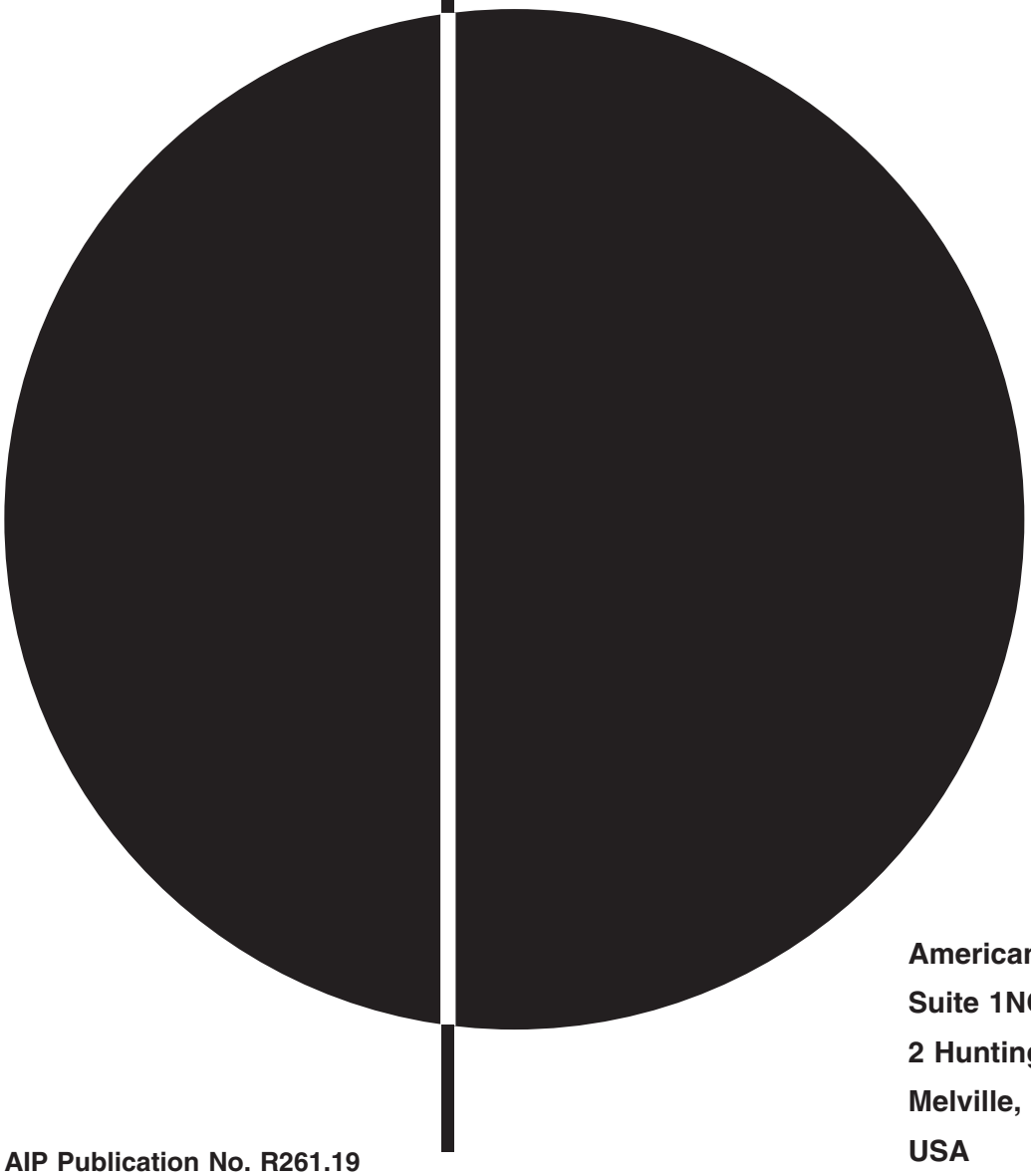
AMERICAN INSTITUTE OF PHYSICS

Physics and Astronomy Classification Scheme® (PACS®) 2008



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Physics and Astronomy Classification Scheme®—2008

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PACS 2008 is freely available for downloading, in multiple formats, from http://www.aip.org/pacs. Feedback from the community is welcome; address all suggestions, comments, and questions to pacs@aip.org.

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Physics and Astronomy Classification Scheme®—2008

(Based on the ICSTI International Classification System for Physics)

The *Physics and Astronomy Classification Scheme®* (PACS®) is prepared by the American Institute of Physics (AIP) in collaboration with certain other members of the International Council on Scientific and Technical Information (ICSTI) having an interest in physics and astronomy classification. The most recent internationally agreed-upon scheme was published by ICSTI in 1991. Revised editions of *PACS* are published biennially, or as necessary, by AIP.

Introduction

The *Physics and Astronomy Classification Scheme®* (*PACS®*) is a hierarchical subject classification scheme designed to classify and categorize the literature of physics and astronomy. *PACS* provides an essential tool for classification and efficient retrieval of literature in physics and astronomy; as such, *PACS* is used by AIP and other international publishers of journals in physics, astronomy, and related fields.

What is *PACS*?

PACS contains ten broad subject categories subdivided into narrower categories. The hierarchy includes mainly four levels of depth, with the narrowest term giving the most detailed characterization. However, beginning with the 2006 edition, a fifth level hierarchy was introduced; subsequently, in this new edition, the fifth level hierarchy is continued in sections that have undergone revision and will also be a part of future editions. *PACS* also includes detailed appendices for acoustics and geophysics, a nanoscale science and technology supplement, and a topical alphabetical index with corresponding *PACS* codes.

Depending on the topic, the most detailed *PACS* code may be found at the third, fourth, or fifth hierarchical levels. At these three levels, each *PACS* code consists of six alphanumeric characters divided into three pairs. The examples, in the table below, illustrate the structure and format of *PACS* codes for all levels of the scheme, using *PACS* codes where the hierarchy terminates at the third, fourth, and fifth levels:

***PACS* Level**	**Hierarchy to 3rd Level**	**Hierarchy to 4th Level**	**Hierarchy to 5th Level**	**Notes**
1st	**00. GENERAL**	**30. ATOMIC AND MOLECULAR PHYSICS**	**90. GEOPHYSICS, ASTRONOMY, AND ASTROPHYSICS**	Broadest category; there are 10 such codes from 00 to 90, in increments of 10
2nd	**04. General relativity and gravitation**	**32. Atomic properties and interactions with photons**	**91. Solid Earth physics**	More specific category; up to 9 such codes under each Level 1 category
3rd	**04.65.+e Supergravity**	**32.10.−f Properties of atoms**	91.25.−r Geomagnetism and paleomagnetism; geoelectricity	Fairly specific category; "−" or "+" as 5th character denotes presence or absence, respectively, of 4th level
4th		32.10.Hq Ionization potentials, electron affinities	91.25.F− Rock and mineral magnetism	Most specific category found in most of *PACS*; "−" or a lowercase letter as the 6th character denotes presence or absence, respectively, of 5th level
5th			*91.25.fd Environmental magnetism*	Most specific category found in *PACS*; the 5th character is the same as for the 4th level code, but lowercase

Note that the use of uppercase and lowercase letters as the fifth character for fourth- and fifth-level codes, respectively, is a means to easily distinguish the level of a given code; the use of italics for the fifth-level serves a similar purpose. However, case and font are not needed to determine uniqueness, i.e., there are no redundant codes.

How to Use *PACS*

In order to classify an article, the main topics presented in that article must be identified. The most specific *PACS* codes that describe the content of an article are then selected using the alphabetical index to *PACS*. The first code is reserved for the main topic of the paper. Select as many codes as are necessary to classify the paper; three to four codes are generally sufficient. For errata or related items, an additional code must be selected from **99.10.−x Errata and other corrections**.

What is New in *PACS 2008*?

New to the printed version of *PACS* is the addition of a collection of terms applicable to nanoscale science and technology, which appears as a supplement at the back of this book. Similar nanoscience supplements have been published previously only as part of the online edition of *PACS*.

There are extensive revisions in the following sections included in *PACS 2008*; these sections have been expanded with many new fourth- and fifth-level codes:

20 Nuclear physics
30 Atomic and molecular physics
42 Optics
60 Condensed matter: structural, mechanical, and thermal properties
87 Biological and medical physics

Minor revisions were done in the following sections:

03.67 Quantum information
04 General relativity and gravitation
41 Electromagnetism; electron and ion optics
47.60 Flow phenomena in quasi-one-dimensional systems
78.47 Spectroscopy of solid state dynamics
89.70 Information and communication theory
96.30 Solar system objects

The minor revisions include additions of *PACS* codes, modifications of the text of *PACS* codes, and some *PACS* code deletions. The *2008 PACS Special Edition* (available at the below URL) contains a full listing of *PACS 2008* with new, modified, and deleted codes highlighted; the *Special Edition* serves as a bridge between *PACS 2006* and *2008*.

Online Availability

PACS is freely accessible online (both the hierarchical scheme and the topical alphabetical index) at **http://www.aip.org/pacs**. It can be downloaded in HTML and ASCII formats.

Availability of Printed *PACS*

Complimentary printed copies of *PACS* may be obtained by contacting **pacs@aip.org** (Scientific Classification Department, American Institute of Physics, Suite 1NO1, 2 Huntington Quadrangle, Melville, NY 11747-4502, USA).

Community Feedback

AIP welcomes feedback from the scientific community. Any comments or suggestions you may have, both on the scheme and on the form of presentation, may be sent to **pacs@aip.org**.

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Members of both AIP's SCIR and the Working Groups formed under their charge serve on a voluntary basis. We express sincere appreciation to these dedicated individuals. Listed below are members of the AIP SCIR, Working Groups, and *PACS 2008* Project Team, along with individual advisors, whose efforts were invaluable in producing this new edition of the *Physics and Astronomy Classification Scheme*:

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Summary of PACS 2008

00. GENERAL

01. Communication, education, history, and philosophy
02. Mathematical methods in physics
03. Quantum mechanics, field theories, and special relativity
04. General relativity and gravitation
05. Statistical physics, thermodynamics, and nonlinear dynamical systems
06. Metrology, measurements, and laboratory procedures
07. Instruments, apparatus, and components common to several branches of physics and astronomy

10. THE PHYSICS OF ELEMENTARY PARTICLES AND FIELDS

11. General theory of fields and particles
12. Specific theories and interaction models; particle systematics
13. Specific reactions and phenomenology
14. Properties of specific particles

20. NUCLEAR PHYSICS

21. Nuclear structure
23. Radioactive decay and in-beam spectroscopy
24. Nuclear reactions: general
25. Nuclear reactions: specific reactions
***26. Nuclear astrophysics**
27. Properties of specific nuclei listed by mass ranges
28. Nuclear engineering and nuclear power studies
29. Experimental methods and instrumentation for elementary-particle and nuclear physics

30. ATOMIC AND MOLECULAR PHYSICS

31. Electronic structure of atoms and molecules: theory
32. Atomic properties and interactions with photons
33. Molecular properties and interactions with photons
34. Atomic and molecular collision processes and interactions
36. Exotic atoms and molecules; macromolecules; clusters
37. Mechanical control of atoms, molecules, and ions

40. ELECTROMAGNETISM, OPTICS, ACOUSTICS, HEAT TRANSFER, CLASSICAL MECHANICS, AND FLUID DYNAMICS

41. Electromagnetism; electron and ion optics
42. Optics
43. Acoustics
44. Heat transfer
***45. Classical mechanics of discrete systems**
46. Continuum mechanics of solids
47. Fluid dynamics

50. PHYSICS OF GASES, PLASMAS, AND ELECTRIC DISCHARGES

51. Physics of gases
52. Physics of plasmas and electric discharges

60. CONDENSED MATTER: STRUCTURAL, MECHANICAL, AND THERMAL PROPERTIES

61. Structure of solids and liquids; crystallography
62. Mechanical and acoustical properties of condensed matter
63. Lattice dynamics
64. Equations of state, phase equilibria, and phase transitions
65. Thermal properties of condensed matter
66. Nonelectronic transport properties of condensed matter
67. Quantum fluids and solids
68. Surfaces and interfaces; thin films and nanosystems (structure and nonelectronic properties)

70. CONDENSED MATTER: ELECTRONIC STRUCTURE, ELECTRICAL, MAGNETIC, AND OPTICAL PROPERTIES

71. Electronic structure of bulk materials
72. Electronic transport in condensed matter
73. Electronic structure and electrical properties of surfaces, interfaces, thin films, and low-dimensional structures
74. Superconductivity
75. Magnetic properties and materials
76. Magnetic resonances and relaxations in condensed matter, Mössbauer effect
77. Dielectrics, piezoelectrics, and ferroelectrics and their properties
78. Optical properties, condensed-matter spectroscopy and other interactions of radiation and particles with condensed matter
79. Electron and ion emission by liquids and solids; impact phenomena

80. INTERDISCIPLINARY PHYSICS AND RELATED AREAS OF SCIENCE AND TECHNOLOGY

81. Materials science
82. Physical chemistry and chemical physics
***83. Rheology**
***84. Electronics; radiowave and microwave technology; direct energy conversion and storage**
***85. Electronic and magnetic devices; microelectronics**
87. Biological and medical physics
***89. Other areas of applied and interdisciplinary physics**

90. GEOPHYSICS, ASTRONOMY, AND ASTROPHYSICS

91. Solid Earth physics
92. Hydrospheric and atmospheric geophysics
93. Geophysical observations, instrumentation, and techniques
94. Physics of the ionosphere and magnetosphere
95. Fundamental astronomy and astrophysics; instrumentation, techniques, and astronomical observations
96. Solar system; planetology
97. Stars
98. Stellar systems; interstellar medium; galactic and extragalactic objects and systems; the Universe

APPENDICES

***43. Acoustics**
***91–94, 96. Geophysics**
Nanoscale Science and Technology Supplement

**These sections are outside the ICSTI International Classification for Physics.*

00. GENERAL

01. Communication, education, history, and philosophy

01.10.−m Announcements, news, and organizational activities

01.10.Cr Announcements, news, and awards
01.10.Fv Conferences, lectures, and institutes
01.10.Hx Physics organizational activities

01.20.+x Communication forms and techniques (written, oral, electronic, etc.)

01.30.−y Physics literature and publications

01.30.Bb Publications of lectures (advanced institutes, summer schools, etc.)
01.30.Cc Conference proceedings
01.30.Ee Monographs and collections
01.30.Kj Handbooks, dictionaries, tables, and data compilations
01.30.L− Physics laboratory manuals
01.30.la Secondary schools
01.30.lb Undergraduate schools
01.30.M− Textbooks
01.30.mm Textbooks for graduates and researchers
01.30.mp Textbooks for undergraduates
01.30.mr Textbooks for students in grades 9–12
01.30.mt Textbooks for students in grades K–8
01.30.Os Books of general interest to physics teachers
01.30.Rr Surveys and tutorial papers; resource letters
01.30.Tt Bibliographies
01.30.Vv Book reviews
01.30.Xx Publications in electronic media *(for the topic of electronic publishing, see 01.20.+x)*

01.40.−d Education

01.40.Di Course design and evaluation
01.40.E− Science in school
01.40.eg Elementary school
01.40.ek Secondary school
01.40.Fk Research in physics education
01.40.G− Curricula and evaluation
01.40.gb Teaching methods and strategies
01.40.gf Theory of testing and techniques
01.40.Ha Learning theory and science teaching
01.40.J− Teacher training
01.40.jc Preservice training
01.40.jh Inservice training

01.50.−i Educational aids

01.50.F− Audio and visual aids
01.50.fd Audio devices
01.50.ff Films; electronic video devices
01.50.fh Posters, cartoons, art, etc.
01.50.H− Computers in education
01.50.ht Instructional computer use
01.50.hv Computer software and software reviews
01.50.Kw Techniques of testing
01.50.Lc Laboratory computer use *(see also 01.50.Pa)*
01.50.My Demonstration experiments and apparatus
01.50.Pa Laboratory experiments and apparatus *(see also 01.50.Lc)*
01.50.Qb Laboratory course design, organization, and evaluation
01.50.Rt Physics tournaments and contests
01.50.Wg Physics of toys
01.50.Zv Errors in physics classroom materials

01.52.+r National and international laboratory facilities

01.55.+b General physics

01.60.+q Biographies, tributes, personal notes, and obituaries

01.65.+g History of science

01.70.+w Philosophy of science

01.75.+m Science and society *(for science and government, see 01.78.+p)*

01.78.+p Science and government (funding, politics, etc.)

01.80.+b Physics of games and sports

01.85.+f Careers in physics and science

01.90.+g Other topics of general interest (restricted to new topics in section 01)

02. Mathematical methods in physics

02.10.−v Logic, set theory, and algebra

02.10.Ab Logic and set theory
02.10.De Algebraic structures and number theory
02.10.Hh Rings and algebras
02.10.Kn Knot theory
02.10.Ox Combinatorics; graph theory
02.10.Ud Linear algebra
02.10.Xm Multilinear algebra
02.10.Yn Matrix theory

02.20.−a Group theory *(for algebraic methods in quantum mechanics, see 03.65.Fd; for symmetries in elementary particle physics, see 11.30.−j)*

02.20.Bb General structures of groups
02.20.Hj Classical groups
02.20.Qs General properties, structure, and representation of Lie groups
02.20.Rt Discrete subgroups of Lie groups
02.20.Sv Lie algebras of Lie groups
02.20.Tw Infinite-dimensional Lie groups
02.20.Uw Quantum groups

02.30.−f Function theory, analysis

02.30.Cj Measure and integration
02.30.Em Potential theory
02.30.Fn Several complex variables and analytic spaces
02.30.Gp Special functions
02.30.Hq Ordinary differential equations
02.30.Ik Integrable systems
02.30.Jr Partial differential equations
02.30.Ks Delay and functional equations
02.30.Lt Sequences, series, and summability
02.30.Mv Approximations and expansions
02.30.Nw Fourier analysis
02.30.Oz Bifurcation theory *(see also 47.20.Ky in fluid dynamics)*
02.30.Px Abstract harmonic analysis
02.30.Rz Integral equations
02.30.Sa Functional analysis
02.30.Tb Operator theory
02.30.Uu Integral transforms
02.30.Vv Operational calculus
02.30.Xx Calculus of variations
02.30.Yy Control theory
02.30.Zz Inverse problems

02.40.−k Geometry, differential geometry, and topology *(see also section 04 Relativity and gravitation)*

02.40.Dr Euclidean and projective geometries
02.40.Ft Convex sets and geometric inequalities
02.40.Gh Noncommutative geometry
02.40.Hw Classical differential geometry
02.40.Ky Riemannian geometries
02.40.Ma Global differential geometry
02.40.Pc General topology
02.40.Re Algebraic topology
02.40.Sf Manifolds and cell complexes
02.40.Tt Complex manifolds
02.40.Vh Global analysis and analysis on manifolds
02.40.Xx Singularity theory *(see also 05.45.−a Nonlinear dynamics and chaos)*
02.40.Yy Geometric mechanics *(see also 45.20.Jj in formalisms in classical mechanics)*

02.50.−r Probability theory, stochastic processes, and statistics *(see also section 05 Statistical physics, thermodynamics, and nonlinear dynamical systems)*

02.50.Cw Probability theory
02.50.Ey Stochastic processes
02.50.Fz Stochastic analysis
02.50.Ga Markov processes
02.50.Le Decision theory and game theory
02.50.Ng Distribution theory and Monte Carlo studies
02.50.Sk Multivariate analysis
02.50.Tt Inference methods

02.60.−x Numerical approximation and analysis
02.60.Cb Numerical simulation; solution of equations
02.60.Dc Numerical linear algebra
02.60.Ed Interpolation; curve fitting
02.60.Gf Algorithms for functional approximation
02.60.Jh Numerical differentiation and integration
02.60.Lj Ordinary and partial differential equations; boundary value problems
02.60.Nm Integral and integrodifferential equations
02.60.Pn Numerical optimization

02.70.−c Computational techniques; simulations *(for quantum computation, see 03.67.Lx; for computational techniques extensively used in subdivisions of physics, see the appropriate section; for example, see 47.11.−j Computational methods in fluid dynamics)*
02.70.Bf Finite-difference methods
02.70.Dh Finite-element and Galerkin methods
02.70.Hm Spectral methods
02.70.Jn Collocation methods
02.70.Ns Molecular dynamics and particle methods
02.70.Pt Boundary-integral methods
02.70.Rr General statistical methods
02.70.Ss Quantum Monte Carlo methods
02.70.Tt Justifications or modifications of Monte Carlo methods
02.70.Uu Applications of Monte Carlo methods *(see also 02.50.Ng in probability theory, stochastic processes, and statistics, and 05.10.Ln in statistical physics)*
02.70.Wz Symbolic computation (computer algebra)

02.90.+p Other topics in mathematical methods in physics (restricted to new topics in section 02)

03. Quantum mechanics, field theories, and special relativity *(see also section 11 General theory of fields and particles)*

03.30.+p Special relativity

03.50.−z Classical field theories
03.50.De Classical electromagnetism, Maxwell equations *(for applied classical electromagnetism, see 41.20.−q)*
03.50.Kk Other special classical field theories

03.65.−w Quantum mechanics *[see also 03.67.−a Quantum information; 05.30.−d Quantum statistical mechanics; 31.30.J− Relativistic and quantum electrodynamics (QED) effects in atoms, molecules, and ions in atomic physics]*
03.65.Ca Formalism
03.65.Db Functional analytical methods
03.65.Fd Algebraic methods *(see also 02.20.−a Group theory)*
03.65.Ge Solutions of wave equations: bound states
03.65.Nk Scattering theory
03.65.Pm Relativistic wave equations
03.65.Sq Semiclassical theories and applications
03.65.Ta Foundations of quantum mechanics; measurement theory *(for optical tests of quantum theory, see 42.50.Xa)*
03.65.Ud Entanglement and quantum nonlocality (e.g. EPR paradox, Bell's inequalities, GHZ states, etc.) *(for entanglement production and manipulation, see 03.67.Bg; for entanglement measures, witnesses etc., see 03.67.Mn; for entanglement in Bose–Einstein condensates, see 03.75.Gg)*
03.65.Vf Phases: geometric; dynamic or topological
03.65.Wj State reconstruction, quantum tomography
03.65.Xp Tunneling, traversal time, quantum Zeno dynamics
03.65.Yz Decoherence; open systems; quantum statistical methods *(see also 03.67.Pp in quantum information; for decoherence in Bose–Einstein condensates, see 03.75.Gg)*

03.67.−a Quantum information *(see also 42.50.Dv Quantum state engineering and measurements; 42.50.Ex Optical implementations of quantum information processing and transfer in quantum optics)*
03.67.Ac Quantum algorithms, protocols, and simulations
03.67.Bg Entanglement production and manipulation *(for entanglement in Bose–Einstein condensates, see 03.75.Gg)*
03.67.Dd Quantum cryptography and communication security
03.67.Hk Quantum communication
03.67.Lx Quantum computation architectures and implementations
03.67.Mn Entanglement measures, witnesses, and other characterizations *(see also 03.65.Ud Entanglement and quantum nonlocality; 42.50.Dv Quantum state engineering and measurements in quantum optics)*
03.67.Pp Quantum error correction and other methods for protection against decoherence *(see also 03.65.Yz Decoherence; open systems; quantum statistical methods; for decoherence in Bose–Einstein condensates, see 03.75.Gg)*

03.70.+k Theory of quantized fields *(see also 11.10.−z Field theory)*

03.75.−b Matter waves *(for atom interferometry, see 37.25.+k; see also 67.85.−d ultracold gases, trapped gases in quantum fluids and solids)*
03.75.Be Atom and neutron optics
03.75.Dg Atom and neutron interferometry
03.75.Gg Entanglement and decoherence in Bose–Einstein condensates
03.75.Hh Static properties of condensates; thermodynamical, statistical, and structural properties
03.75.Kk Dynamic properties of condensates; collective and hydrodynamic excitations, superfluid flow
03.75.Lm Tunneling, Josephson effect, Bose–Einstein condensates in periodic potentials, solitons, vortices, and topological excitations
03.75.Mn Multicomponent condensates; spinor condensates
03.75.Nt Other Bose–Einstein condensation phenomena
03.75.Pp Atom lasers
03.75.Ss Degenerate Fermi gases

04. General relativity and gravitation *(for astrophysical aspects, see 95.30.Sf Relativity and gravitation; for relativistic aspects of cosmology, see 98.80.Jk)*

. . . . *Special relativity, see 03.30.+p*

04.20.−q Classical general relativity *(see also 02.40.−k Geometry, differential geometry, and topology)*
04.20.Cv Fundamental problems and general formalism
04.20.Dw Singularities and cosmic censorship
04.20.Ex Initial value problem, existence and uniqueness of solutions

04.20.Fy Canonical formalism, Lagrangians, and variational principles

04.20.Gz Spacetime topology, causal structure, spinor structure

04.20.Ha Asymptotic structure

04.20.Jb Exact solutions

04.25.−g Approximation methods; equations of motion

04.25.D− Numerical relativity

04.25.dc Numerical studies of critical behavior, singularities, and cosmic censorship

04.25.dg Numerical studies of black holes and black-hole binaries

04.25.dk Numerical studies of other relativistic binaries (see also 97.80.−d Binary and multiple stars in astronomy)

04.25.Nx Post-Newtonian approximation; perturbation theory; related approximations

04.30.−w Gravitational waves *(see also 04.80.Nn Gravitational wave detectors and experiments)*

04.30.Db Wave generation and sources

04.30.Nk Wave propagation and interactions

04.30.Tv Gravitational-wave astrophysics *(see also 95.85.Sz Gravitational radiation, magnetic fields, and other observations in astronomy)*

04.40.−b Self-gravitating systems; continuous media and classical fields in curved spacetime

04.40.Dg Relativistic stars: structure, stability, and oscillations *(see also 97.60.−s Late stages of stellar evolution)*

04.40.Nr Einstein–Maxwell spacetimes, spacetimes with fluids, radiation or classical fields

04.50.−h Higher-dimensional gravity and other theories of gravity *(see also 11.25.Mj Compactification and four-dimensional models, 11.25.Uv D branes)*

04.50.Cd Kaluza–Klein theories

04.50.Gh Higher-dimensional black holes, black strings, and related objects

04.50.Kd Modified theories of gravity

04.60.−m Quantum gravity *(see also 11.25.−w Strings and branes)*

04.60.Bc Phenomenology of quantum gravity

04.60.Cf Gravitational aspects of string theory

04.60.Ds Canonical quantization

04.60.Gw Covariant and sum-over-histories quantization

04.60.Kz Lower dimensional models; minisuperspace models

04.60.Nc Lattice and discrete methods

04.60.Pp Loop quantum gravity, quantum geometry, spin foams

04.62.+v Quantum fields in curved spacetime

04.65.+e Supergravity *(see also 12.60.Jv Supersymmetric models)*

04.70.−s Physics of black holes *(see also 97.60.Lf—in astronomy)*

04.70.Bw Classical black holes

04.70.Dy Quantum aspects of black holes, evaporation, thermodynamics

04.80.−y Experimental studies of gravity

04.80.Cc Experimental tests of gravitational theories

04.80.Nn Gravitational wave detectors and experiments *(see also 95.55.Ym Gravitational radiation detectors; mass spectrometers; and other instrumentation and techniques)*

04.90.+e Other topics in general relativity and gravitation (restricted to new topics in section 04)

05. Statistical physics, thermodynamics, and nonlinear dynamical systems *(see also 02.50.−r Probability theory, stochastic processes, and statistics)*

05.10.−a Computational methods in statistical physics and nonlinear dynamics *(see also 02.70.−c in mathematical methods in physics)*

05.10.Cc Renormalization group methods

05.10.Gg Stochastic analysis methods (Fokker–Planck, Langevin, etc.)

05.10.Ln Monte Carlo methods *(see also 02.70.Tt, Uu in mathematical methods in physics; for Monte Carlo methods extensively used in subdivisions of physics, see the appropriate section; for example, see 52.65.Pp in plasma simulation)*

05.20.−y Classical statistical mechanics

05.20.Dd Kinetic theory *(see also 51.10.+y Kinetic and transport theory of gases)*

05.20.Gg Classical ensemble theory

05.20.Jj Statistical mechanics of classical fluids *(see also 47.10.−g General theory in fluid dynamics)*

05.30.−d Quantum statistical mechanics *(for quantum fluids aspects, see 67.10.Fj)*

05.30.Ch Quantum ensemble theory

05.30.Fk Fermion systems and electron gas *(see also 71.10.−w Theories and models of many-electron systems; see also 67.10.Db Fermion degeneracy in quantum fluids)*

05.30.Jp Boson systems *(for static and dynamic properties of Bose–Einstein condensates, see 03.75.Hh and 03.75.Kk; see also 67.10.Ba Boson degeneracy in quantum fluids)*

05.30.Pr Fractional statistics systems (anyons, etc.)

05.40.−a Fluctuation phenomena, random processes, noise, and Brownian motion *(for fluctuations in superconductivity, see 74.40.+k; for statistical theory and fluctuations in nuclear reactions, see 24.60.−k; for fluctuations in plasma, see 52.25.Gj)*

05.40.Ca Noise

05.40.Fb Random walks and Levy flights

05.40.Jc Brownian motion

05.45.−a Nonlinear dynamics and chaos *(see also section 45 Classical mechanics of discrete systems; for chaos in fluid dynamics, see 47.52.+j)*

05.45.Ac Low-dimensional chaos

05.45.Df Fractals *(see also 47.53.+n Fractals in fluid dynamics; 61.43.Hv Fractals; macroscopic aggregates in structure of solids)*

05.45.Gg Control of chaos, applications of chaos

05.45.Jn High-dimensional chaos

05.45.Mt Quantum chaos; semiclassical methods

05.45.Pq Numerical simulations of chaotic systems

05.45.Ra Coupled map lattices

05.45.Tp Time series analysis

05.45.Vx Communication using chaos

05.45.Xt Synchronization; coupled oscillators

05.45.Yv Solitons *(see 52.35.Sb for solitons in plasma; for solitons in acoustics, see 43.25.Rq—in Acoustics Appendix; see 42.50.Md, 42.65.Tg, 42.81.Dp for solitons in optics; see also 03.75.Lm in matter waves; for solitons in space plasma physics, see 94.05.Fg; for solitary waves in fluid dynamics, see 47.35.Fg)*

05.50.+q Lattice theory and statistics (Ising, Potts, etc.) *(see also 64.60.Cn Order–disorder transformations, and 75.10.Hk Classical spin models)*

05.60.−k Transport processes

05.60.Cd Classical transport

05.60.Gg Quantum transport

05.65.+b Self-organized systems *(see also 45.70.−n in classical mechanics of discrete systems)*

05.70.−a **Thermodynamics** *(see also section 64 Equations of state, phase equilibria, and phase transitions, and section 65 Thermal properties of condensed matter; for chemical thermodynamics, see 82.60.−s; for thermodynamics of plasmas, see 52.25.Kn; for thermodynamic properties of quantum fluids, see section 67)*

. . . . *Thermodynamics of nanoparticles, see 82.60.Qr; 65.80.+n*

. . . . *Thermodynamic processes in astrophysics, see 95.30.Tg*

. . . . *Thermodynamics in volcanology, see 91.40.Pc*

05.70.Ce Thermodynamic functions and equations of state *(see also 51.30.+i Thermodynamic properties, equations of state in physics of gases; for equations of state of specific substances, see 64.30.−t; for equations of state of nuclear matter, and of neutron–star matter, see 21.65.Mn and 26.60.Kp respectively; see also 95.30.Tg in astronomy)*

05.70.Fh Phase transitions: general studies *(see also 64.70.Tg Quantum phase transitions)*

05.70.Jk Critical point phenomena

05.70.Ln Nonequilibrium and irreversible thermodynamics *(see also 82.40.Bj Oscillations, chaos, and bifurcations in physical chemistry and chemical physics)*

05.70.Np Interface and surface thermodynamics *(see also 68.35.Md Surface thermodynamics, surface energies in surfaces and interfaces)*

05.90.+m **Other topics in statistical physics, thermodynamics, and nonlinear dynamical systems (restricted to new topics in section 05)**

06. Metrology, measurements, and laboratory procedures *(for laser applications in metrology, see 42.62.Eh)*

06.20.−f **Metrology**

06.20.Dk Measurement and error theory

06.20.F− Units and standards

06.20.fa Units

06.20.fb Standards and calibration

06.20.Jr Determination of fundamental constants

06.30.−k **Measurements common to several branches of physics and astronomy**

06.30.Bp Spatial dimensions (e.g., position, lengths, volume, angles, and displacements)

06.30.Dr Mass and density

06.30.Ft Time and frequency

06.30.Gv Velocity, acceleration, and rotation

06.30.Ka Basic electromagnetic quantities *(see also 84.37.+q Measurements in electric variables)*

06.60.−c **Laboratory procedures**

06.60.Ei Sample preparation (including design of sample holders)

06.60.Jn High-speed techniques (microsecond to femtosecond)

06.60.Mr Testing and inspecting procedures

06.60.Sx Positioning and alignment; manipulating, remote handling

06.60.Vz Workshop procedures (welding, machining, lubrication, bearings, etc.)

06.60.Wa Laboratory safety procedures

. . . . *National and international laboratory facilities, see 01.52.+r*

06.90.+v **Other topics in metrology, measurements, and laboratory procedures (restricted to new topics in section 06)**

07. Instruments, apparatus, and components common to several branches of physics and astronomy *(see also each subdiscipline for specialized instrumentation and techniques)*

07.05.−t **Computers in experimental physics**

. . . . *Computers in education, see 01.50.H− and 01.50.Lc*

. . . . *Computational techniques, see 02.70.−c*

. . . . *Quantum computation architectures and implementations, see 03.67.Lx*

. . . . *Optical computers, see 42.79.Ta*

07.05.Bx Computer systems: hardware, operating systems, computer languages, and utilities

07.05.Dz Control systems

07.05.Fb Design of experiments

07.05.Hd Data acquisition: hardware and software

07.05.Kf Data analysis: algorithms and implementation; data management (for data analysis in nuclear physics, see 29.85.−c)

07.05.Mh Neural networks, fuzzy logic, artificial intelligence

07.05.Pj Image processing *(see also 42.30.Va in optics; 87.57.−s Medical imaging in biological and medical physics; 95.75.Tv Digitization techniques in astronomy)*

07.05.Rm Data presentation and visualization: algorithms and implementation

07.05.Tp Computer modeling and simulation

07.05.Wr Computer interfaces *(for nuclear physics applications, see 29.50.+v)*

07.07.−a **General equipment**

07.07.Df Sensors (chemical, optical, electrical, movement, gas, etc.); remote sensing

07.07.Hj Display and recording equipment, oscilloscopes, TV cameras, etc.

07.07.Mp Transducers

07.07.Tw Servo and control equipment; robots

07.07.Vx Hygrometers; hygrometry

07.10.−h **Mechanical instruments and equipment**

07.10.Cm Micromechanical devices and systems *(for micro- and nano-electromechanical systems (MEMS/NEMS), see 85.85.+j in electronic and magnetic devices; see also 87.80.Ek Mechanical and micromechanical techniques; 87.85.Ox Biomedical instrumentation and transducers including micro-electro-mechanical systems in biological and medical physics)*

07.10.Fq Vibration isolation

07.10.Lw Balance systems, tensile machines, etc.

07.10.Pz Instruments for strain, force, and torque

07.20.−n **Thermal instruments and apparatus**

07.20.Dt Thermometers

07.20.Fw Calorimeters *(for calorimeters as radiation detectors, see 29.40.Vj)*

07.20.Hy Furnaces; heaters

07.20.Ka High-temperature instrumentation; pyrometers

07.20.Mc Cryogenics; refrigerators, low-temperature detectors, and other low-temperature equipment

07.20.Pe Heat engines; heat pumps; heat pipes

07.30.−t **Vacuum apparatus**

07.30.Bx Degasification, residual gas

07.30.Cy Vacuum pumps

07.30.Dz Vacuum gauges

07.30.Hd Vacuum testing methods; leak detectors

07.30.Kf Vacuum chambers, auxiliary apparatus, and materials

07.35.+k **High-pressure apparatus; shock tubes; diamond anvil cells**

07.50.−e **Electrical and electronic instruments and components**

07.50.Ek Circuits and circuit components

(see also 84.30.−r Electronic circuits and 84.32.−y Passive circuit components)

07.50.Hp Electrical noise and shielding equipment

07.50.Ls Electrometers

07.50.Qx Signal processing electronics *(see also 84.40.Ua in radiowave and microwave technology; 87.85.Ng Biological signal processing in biomedical engineering)*

07.55.−w Magnetic instruments and components

07.55.Db Generation of magnetic fields; magnets *(for superconducting magnets, see 84.71.Ba; for beam focusing magnets, see 41.85.Lc in beam optics)*

07.55.Ge Magnetometers for magnetic field measurements

07.55.Jg Magnetometers for susceptibility, magnetic moment, and magnetization measurements

07.55.Nk Magnetic shielding in instruments

07.57.−c Infrared, submillimeter wave, microwave and radiowave instruments and equipment *(for infrared and radio telescopes, see 95.55.Cs, 95.55.Fw, and 95.55.Jz in astronomy; for biophysical spectroscopic applications, see 87.64.−t)*

07.57.Hm Infrared, submillimeter wave, microwave, and radiowave sources *(see also 42.72.Ai Infrared sources in optics)*

07.57.Kp Bolometers; infrared, submillimeter wave, microwave, and radiowave receivers and detectors *(see also 85.60.Gz Photodetectors in electronic and magnetic devices, and 95.55.Rg Photoconductors and bolometers in astronomy)*

07.57.Pt Submillimeter wave, microwave and radiowave spectrometers; magnetic resonance spectrometers, auxiliary equipment, and techniques

07.57.Ty Infrared spectrometers, auxiliary equipment, and techniques

07.60.−j Optical instruments and equipment *(see also 87.64.M− Optical microscopy in biological and medical physics)*

. . . . *Optical sources, see 42.72.−g*

. . . . *Optical elements, devices, and systems 42.79.−e*

. . . . *Optoelectronic devices 85.60.−q*

. . . . *Optical telescopes, see 95.55.Cs*

. . . . *Photometric, polarimetric, and spectroscopic instrumentation in astronomy, see 95.55.Qf*

07.60.Dq Photometers, radiometers, and colorimeters

07.60.Fs Polarimeters and ellipsometers

07.60.Hv Refractometers and reflectometers

07.60.Ly Interferometers

07.60.Pb Conventional optical microscopes *(for near-field scanning optical microscopes, see 07.79.Fc; for x-ray microscopes, see 07.85.Tt)*

07.60.Rd Visible and ultraviolet spectrometers

07.60.Vg Fiber-optic instruments *(see also 42.81.−i Fiber optics)*

07.64.+z Acoustic instruments and equipment *(see also 43.58.+z—in acoustics)*

07.68.+m Photography, photographic instruments; xerography

07.75.+h Mass spectrometers *(see also 82.80.Ms, 82.80.Nj, and 82.80.Rt in physical chemistry and chemical physics)*

07.77.−n Atomic, molecular, and charged-particle sources and detectors

07.77.Gx Atomic and molecular beam sources and detectors *(see also 37.20.+j Atomic and molecular beam sources and techniques, in atomic and molecular physics)*

07.77.Ka Charged-particle beam sources and detectors *(see also 29.40.−n Radiation detectors in nuclear physics)*

07.78.+s Electron, positron, and ion microscopes; electron diffractometers

07.79.−v Scanning probe microscopes and components *(see also 68.37.−d Microscopy of surfaces, interfaces, and thin films)*

07.79.Cz Scanning tunneling microscopes

07.79.Fc Near-field scanning optical microscopes

07.79.Lh Atomic force microscopes

07.79.Pk Magnetic force microscopes

07.79.Sp Friction force microscopes

07.81.+a Electron and ion spectrometers *(see also 29.30.Dn Electron spectroscopy; 29.30.Ep Charged-particle spectroscopy in nuclear physics)*

07.85.−m X- and γ-ray instruments *(for x- and γ-ray telescopes, see 95.55.Ka in astronomy; see also 41.50.+h X-ray beams and x-ray optics)*

07.85.Fv X- and γ-ray sources, mirrors, gratings, and detectors

07.85.Jy Diffractometers

07.85.Nc X-ray and γ-ray spectrometers

07.85.Qe Synchrotron radiation instrumentation

07.85.Tt X-ray microscopes

07.87.+v Spaceborne and space research instruments, apparatus, and components (satellites, space vehicles, etc.) *(for instrumentation for space plasma physics, ionosphere, and magnetosphere, see 94.80.+g; see also 95.55.−n and 95.40.+s in astronomy)*

07.88.+y Instruments for environmental pollution measurements

07.89.+b Environmental effects on instruments (e.g., radiation and pollution effects) *(for environmental effects on optical elements, devices, and systems, see 42.88.+h)*

07.90.+c Other topics in instruments, apparatus, and components common to several branches of physics and astronomy (restricted to new topics in section 07)

10. THE PHYSICS OF ELEMENTARY PARTICLES AND FIELDS *(for experimental methods and instrumentation for elementary-particle physics, see section 29)*

11. General theory of fields and particles *(see also 03.65.−w Quantum mechanics and 03.70.+k Theory of quantized fields)*

11.10.−z Field theory *(for gauge field theories, see 11.15.−q)*

11.10.Cd Axiomatic approach
11.10.Ef Lagrangian and Hamiltonian approach
11.10.Gh Renormalization
11.10.Hi Renormalization group evolution of parameters
11.10.Jj Asymptotic problems and properties
11.10.Kk Field theories in dimensions other than four *(see also 04.50.−h Higher-dimensional gravity and other theories of gravity; 04.60.Kz Lower dimensional models; minisuperspace models in general relativity and gravitation)*
11.10.Lm Nonlinear or nonlocal theories and models *(see also 11.27.+d Extended classical solutions; cosmic strings, domain walls, texture)*
11.10.Nx Noncommutative field theory
11.10.St Bound and unstable states; Bethe–Salpeter equations
11.10.Wx Finite-temperature field theory
. . . . *Relativistic wave equations, see 03.65.Pm*

11.15.−q Gauge field theories

11.15.Bt General properties of perturbation theory
11.15.Ex Spontaneous breaking of gauge symmetries
11.15.Ha Lattice gauge theory *(see also 12.38.Gc Lattice QCD calculations)*
11.15.Kc Classical and semiclassical techniques
11.15.Me Strong-coupling expansions
11.15.Pg Expansions for large numbers of components (e.g., $1/N_c$ expansions)
11.15.Tk Other nonperturbative techniques

11.25.−w Strings and branes *(for cosmic strings, see 98.80.Cq in cosmology; see also 11.27.+d Extended classical solutions; cosmic strings, domain walls, texture)*

11.25.Db Properties of perturbation theory
11.25.Hf Conformal field theory, algebraic structures
11.25.Mj Compactification and four-dimensional models
11.25.Pm Noncritical string theory
11.25.Sq Nonperturbative techniques; string field theory
11.25.Tq Gauge/string duality
11.25.Uv D branes
11.25.Wx String and brane phenomenology
11.25.Yb M theory

11.27.+d Extended classical solutions; cosmic strings, domain walls, texture *(see also 98.80.Cq in cosmology; 11.25.−w Strings and branes)*

11.30.−j Symmetry and conservation laws *(see also 02.20.−a Group theory)*

11.30.Cp Lorentz and Poincaré invariance
11.30.Er Charge conjugation, parity, time reversal, and other discrete symmetries
11.30.Fs Global symmetries (e.g., baryon number, lepton number)
11.30.Hv Flavor symmetries
11.30.Ly Other internal and higher symmetries
11.30.Na Nonlinear and dynamical symmetries (spectrum-generating symmetries)
11.30.Pb Supersymmetry *(see also 12.60.Jv Supersymmetric models)*
11.30.Qc Spontaneous and radiative symmetry breaking
11.30.Rd Chiral symmetries

11.40.−q Currents and their properties

11.40.Dw General theory of currents
11.40.Ex Formal properties of current algebras *(see also 12.39.Fe Chiral Lagrangians)*
11.40.Ha Partially conserved axial-vector currents

11.55.−m S-matrix theory; analytic structure of amplitudes

11.55.Bq Analytic properties of S matrix
11.55.Ds Exact S matrices
11.55.Fv Dispersion relations
11.55.Hx Sum rules
11.55.Jy Regge formalism *(see also 12.40.Nn in strong interactions)*

11.80.−m Relativistic scattering theory

11.80.Cr Kinematical properties (helicity and invariant amplitudes, kinematic singularities, etc.)
11.80.Et Partial-wave analysis
11.80.Fv Approximations (eikonal approximation, variational principles, etc.)
11.80.Gw Multichannel scattering
11.80.Jy Many-body scattering and Faddeev equation
11.80.La Multiple scattering

11.90.+t Other topics in general theory of fields and particles (restricted to new topics in section 11)

12. Specific theories and interaction models; particle systematics

12.10.−g Unified field theories and models *(see also 04.50.−h Higher-dimensional gravity and other theories of gravity—in general relativity and gravitation, 11.25.Mj Compactification and four-dimensional models)*

12.10.Dm Unified theories and models of strong and electroweak interactions
12.10.Kt Unification of couplings; mass relations

12.15.−y Electroweak interactions

. . . . *Extensions of gauge or Higgs sector, see 12.60.Cn or 12.60.Fr*
12.15.Ff Quark and lepton masses and mixing *(see also 14.60.Pq Neutrino mass and mixing)*
12.15.Hh Determination of Kobayashi–Maskawa matrix elements
12.15.Ji Applications of electroweak models to specific processes
12.15.Lk Electroweak radiative corrections *(see also 13.40.Ks Electromagnetic corrections to strong- and weak-interaction processes)*
12.15.Mm Neutral currents

12.20.−m Quantum electrodynamics

12.20.Ds Specific calculations
12.20.Fv Experimental tests *(for optical tests in quantum electrodynamics, see 42.50.Xa)*

12.38.−t Quantum chromodynamics

. . . . *Quarks, gluons, and QCD in nuclear reactions, see 24.85.+p*
12.38.Aw General properties of QCD (dynamics, confinement, etc.)
12.38.Bx Perturbative calculations
12.38.Cy Summation of perturbation theory
12.38.Gc Lattice QCD calculations *(see also 11.15.Ha Lattice gauge theory)*
12.38.Lg Other nonperturbative calculations
12.38.Mh Quark–gluon plasma *(see also 25.75.Nq Quark deconfinement, quark–gluon plasma production and phase transitions in relativistic heavy ion collisions; see also 21.65.Qr Quark matter)*
12.38.Qk Experimental tests

12.39.−x Phenomenological quark models

12.39.Ba Bag model
12.39.Dc Skyrmions
12.39.Fe Chiral Lagrangians
12.39.Hg Heavy quark effective theory
12.39.Jh Nonrelativistic quark model
12.39.Ki Relativistic quark model

12.39.Mk Glueball and nonstandard multi-quark/gluon states
12.39.Pn Potential models
12.39.St Factorization

12.40.−y Other models for strong interactions
12.40.Ee Statistical models
12.40.Nn Regge theory, duality, absorptive/optical models *(see also 11.55.Jy Regge formalism)*
12.40.Vv Vector-meson dominance
12.40.Yx Hadron mass models and calculations

12.60.−i Models beyond the standard model
. . . . *Unified field theories and models, see 12.10.−g*
12.60.Cn Extensions of electroweak gauge sector
12.60.Fr Extensions of electroweak Higgs sector
12.60.Jv Supersymmetric models *(see also 04.65.+e Supergravity)*
12.60.Nz Technicolor models
12.60.Rc Composite models

12.90.+b Miscellaneous theoretical ideas and models (restricted to new topics in section 12)

13. Specific reactions and phenomenology

13.15.+g Neutrino interactions

13.20.−v Leptonic, semileptonic, and radiative decays of mesons
13.20.Cz Decays of π mesons
13.20.Eb Decays of K mesons
13.20.Fc Decays of charmed mesons
13.20.Gd Decays of J/ψ, Υ, and other quarkonia
13.20.He Decays of bottom mesons
13.20.Jf Decays of other mesons

13.25.−k Hadronic decays of mesons
13.25.Cq Decays of π mesons
13.25.Es Decays of K mesons
13.25.Ft Decays of charmed mesons
13.25.Gv Decays of J/ψ, Υ, and other quarkonia
13.25.Hw Decays of bottom mesons
13.25.Jx Decays of other mesons

13.30.−a Decays of baryons
13.30.Ce Leptonic, semileptonic, and radiative decays
13.30.Eg Hadronic decays

13.35.−r Decays of leptons
13.35.Bv Decays of muons
13.35.Dx Decays of taus
13.35.Hb Decays of heavy neutrinos

13.38.−b Decays of intermediate bosons
13.38.Be Decays of W bosons
13.38.Dg Decays of Z bosons

13.40.−f Electromagnetic processes and properties
13.40.Dk Electromagnetic mass differences
13.40.Em Electric and magnetic moments
13.40.Gp Electromagnetic form factors
13.40.Hq Electromagnetic decays
13.40.Ks Electromagnetic corrections to strong- and weak-interaction processes

13.60.−r Photon and charged-lepton interactions with hadrons *(for neutrino interactions, see 13.15.+g)*
13.60.Fz Elastic and Compton scattering
13.60.Hb Total and inclusive cross sections (including deep-inelastic processes)
13.60.Le Meson production
13.60.Rj Baryon production

13.66.−a Lepton-lepton interactions
13.66.Bc Hadron production in e^-e^+ interactions
13.66.De Lepton production in e^-e^+ interactions
13.66.Fg Gauge and Higgs boson production in e^-e^+ interactions
13.66.Hk Production of non-standard model particles in e^-e^+ interactions
13.66.Jn Precision measurements in e^-e^+ interactions
13.66.Lm Processes in other lepton-lepton interactions

13.75.−n Hadron-induced low- and intermediate-energy reactions and scattering (energy ≤ 10 GeV) *(for higher energies, see 13.85.−t)*
13.75.Cs Nucleon–nucleon interactions (including antinucleons, deuterons, etc.) *(for N–N interactions in nuclei, see 21.30.−x)*
13.75.Ev Hyperon–nucleon interactions
13.75.Gx Pion–baryon interactions
13.75.Jz Kaon–baryon interactions
13.75.Lb Meson–meson interactions

13.85.−t Hadron-induced high- and super-high-energy interactions (energy > 10 GeV) *(for low energies, see 13.75.−n)*
13.85.Dz Elastic scattering
13.85.Fb Inelastic scattering: two-particle final states
13.85.Hd Inelastic scattering: many-particle final states
13.85.Lg Total cross sections
13.85.Ni Inclusive production with identified hadrons
13.85.Qk Inclusive production with identified leptons, photons, or other nonhadronic particles
13.85.Rm Limits on production of particles
13.85.Tp Cosmic-ray interactions *(see also 96.50.S− Cosmic rays in interplanetary physics)*

13.87.−a Jets in large-Q^2 scattering
13.87.Ce Production
13.87.Fh Fragmentation into hadrons

13.88.+e Polarization in interactions and scattering

13.90.+i Other topics in specific reactions and phenomenology of elementary particles (restricted to new topics in section 13)

14. Properties of specific particles

14.20.−c Baryons (including antiparticles)
14.20.Dh Protons and neutrons
14.20.Gk Baryon resonances with $S=0$
14.20.Jn Hyperons
14.20.Lq Charmed baryons
14.20.Mr Bottom baryons
14.20.Pt Dibaryons

14.40.−n Mesons
14.40.Aq π, K, and η mesons
14.40.Cs Other mesons with $S=C=0$, mass < 2.5 GeV
14.40.Ev Other strange mesons
14.40.Gx Mesons with $S=C=B=0$, mass > 2.5 GeV (including quarkonia)
14.40.Lb Charmed mesons
14.40.Nd Bottom mesons

14.60.−z Leptons
14.60.Cd Electrons (including positrons)
14.60.Ef Muons
14.60.Fg Taus
14.60.Hi Other charged heavy leptons
14.60.Lm Ordinary neutrinos (ν_e, ν_μ, ν_τ)
14.60.Pq Neutrino mass and mixing *(see also 12.15.Ff Quark and lepton masses and mixing)*
14.60.St Non-standard-model neutrinos, right-handed neutrinos, etc.

14.65.−q Quarks
14.65.Bt Light quarks
14.65.Dw Charmed quarks
14.65.Fy Bottom quarks
14.65.Ha Top quarks

14.70.−e Gauge bosons
14.70.Bh Photons
14.70.Dj Gluons
14.70.Fm W bosons
14.70.Hp Z bosons
14.70.Pw Other gauge bosons

14.80.−j Other particles (including hypothetical)

14.80.Bn Standard-model Higgs bosons

14.80.Cp Non-standard-model Higgs bosons

14.80.Hv Magnetic monopoles

14.80.Ly Supersymmetric partners of known particles

14.80.Mz Axions and other Nambu–Goldstone bosons (Majorons, familons, etc.)

20. NUCLEAR PHYSICS

21. Nuclear structure *(for nucleon structure, see 14.20.Dh Properties of protons and neutrons; 13.40.−f for electromagnetic processes and properties; 13.60.Hb for deep-inelastic structure functions)*

21.10.−k Properties of nuclei; nuclear energy levels *(for properties of specific nuclei listed by mass ranges, see section 27)*

21.10.Dr Binding energies and masses

21.10.Ft Charge distribution

21.10.Gv Nucleon distributions and halo features

21.10.Hw Spin, parity, and isobaric spin

21.10.Jx Spectroscopic factors and asymptotic normalization coefficients

21.10.Ky Electromagnetic moments

21.10.Ma Level density

21.10.Pc Single-particle levels and strength functions

21.10.Re Collective levels

21.10.Sf Coulomb energies, analogue states

21.10.Tg Lifetimes, widths

21.30.−x Nuclear forces *(see also 13.75.Cs Nucleon–nucleon interactions)*

21.30.Cb Nuclear forces in vacuum

21.30.Fe Forces in hadronic systems and effective interactions

21.45.−v Few-body systems

21.45.Bc Two-nucleon system

21.45.Ff Three-nucleon forces

21.60.−n Nuclear structure models and methods

21.60.Cs Shell model

21.60.De *Ab initio* methods

21.60.Ev Collective models

21.60.Fw Models based on group theory

21.60.Gx Cluster models

21.60.Jz Nuclear Density Functional Theory and extensions (includes Hartree–Fock and random-phase approximations)

21.60.Ka Monte Carlo models

21.65.−f Nuclear matter

21.65.Cd Asymmetric matter, neutron matter

21.65.Ef Symmetry energy

21.65.Jk Mesons in nuclear matter

21.65.Mn Equations of state of nuclear matter *(see also 26.60.Kp Equations of state of neutron-star matter)*

21.65.Qr Quark matter *(see also 12.38.Mh Quark–gluon plasma in quantum chromodynamics; 25.75.Nq Quark deconfinement, quark–gluon plasma production and phase transitions in relativistic heavy-ion collisions)*

. . . . *Exotic atoms and molecules, see 36.10.−k*

21.80.+a Hypernuclei

21.85.+d Mesic nuclei

21.90.+f Other topics in nuclear structure (restricted to new topics in section 21)

23. Radioactive decay and in-beam spectroscopy

23.20.−g Electromagnetic transitions

23.20.En Angular distribution and correlation measurements

23.20.Gq Multipole mixing ratios

23.20.Js Multipole matrix elements

23.20.Lv γ transitions and level energies

23.20.Nx Internal conversion and extranuclear effects (including Auger electrons and internal bremsstrahlung)

23.20.Ra Internal pair production

23.35.+g Isomer decay

23.40.−s β decay; double β decay; electron and muon capture

23.40.Bw Weak-interaction and lepton (including neutrino) aspects *(see also 14.60.Pq Neutrino mass and mixing)*

23.40.Hc Relation with nuclear matrix elements and nuclear structure

23.50.+z Decay by proton emission

23.60.+e α decay

23.70.+j Heavy-particle decay

23.90.+w Other topics in radioactive decay and in-beam spectroscopy (restricted to new topics in section 23)

24. Nuclear reactions: general

24.10.−i Nuclear reaction models and methods

24.10.Cn Many-body theory

24.10.Eq Coupled-channel and distorted-wave models

24.10.Ht Optical and diffraction models

24.10.Jv Relativistic models

24.10.Lx Monte Carlo simulations (including hadron and parton cascades and string breaking models)

24.10.Nz Hydrodynamic models

24.10.Pa Thermal and statistical models

24.30.−v Resonance reactions

24.30.Cz Giant resonances

24.30.Gd Other resonances

24.50.+g Direct reactions

24.60.−k Statistical theory and fluctuations

24.60.Dr Statistical compound-nucleus reactions

24.60.Gv Statistical multistep direct reactions

24.60.Ky Fluctuation phenomena

24.60.Lz Chaos in nuclear systems

24.70.+s Polarization phenomena in reactions

24.75.+i General properties of fission

24.80.+y Nuclear tests of fundamental interactions and symmetries

24.85.+p Quarks, gluons, and QCD in nuclear reactions

24.87.+y Surrogate reactions

24.90.+d Other topics in nuclear reactions: general (restricted to new topics in section 24)

25. Nuclear reactions: specific reactions

25.10.+s Nuclear reactions involving few-nucleon systems

25.20.−x Photonuclear reactions

25.20.Dc Photon absorption and scattering

25.20.Lj Photoproduction reactions

25.30.−c Lepton-induced reactions

25.30.Bf Elastic electron scattering

25.30.Dh Inelastic electron scattering to specific states

25.30.Fj Inelastic electron scattering to continuum

25.30.Hm Positron-induced reactions

25.30.Mr Muon-induced reactions (including the EMC effect)

25.30.Pt Neutrino-induced reactions

25.30.Rw Electroproduction reactions

25.40.−h Nucleon-induced reactions *(see also 28.20.−v Neutron physics)*

25.40.Cm Elastic proton scattering

25.40.Dn Elastic neutron scattering

25.40.Ep Inelastic proton scattering

25.40.Fq Inelastic neutron scattering

25.40.Hs Transfer reactions

25.40.Kv Charge-exchange reactions

25.40.Lw Radiative capture

25.40.Ny Resonance reactions

25.40.Qa (p, π) reactions
25.40.Sc Spallation reactions
25.40.Ve Other reactions above meson production thresholds (energies $>$ 400 MeV)

25.43.+t Antiproton-induced reactions

25.45.−z ^{2}H-induced reactions
25.45.De Elastic and inelastic scattering
25.45.Hi Transfer reactions
25.45.Kk Charge-exchange reactions

25.55.−e ^{3}H-, ^{3}He-, and ^{4}He-induced reactions
25.55.Ci Elastic and inelastic scattering
25.55.Hp Transfer reactions
25.55.Kr Charge-exchange reactions

25.60.−t Reactions induced by unstable nuclei
25.60.Bx Elastic scattering
25.60.Dz Interaction and reaction cross sections
25.60.Gc Breakup and momentum distributions
25.60.Je Transfer reactions
25.60.Lg Charge-exchange reactions
25.60.Pj Fusion reactions
25.60.Tv Radiative capture

25.70.−z Low and intermediate energy heavy-ion reactions
25.70.Bc Elastic and quasielastic scattering
25.70.De Coulomb excitation
25.70.Ef Resonances
25.70.Gh Compound nucleus
25.70.Hi Transfer reactions
25.70.Jj Fusion and fusion–fission reactions
25.70.Kk Charge-exchange reactions
25.70.Lm Strongly damped collisions
25.70.Mn Projectile and target fragmentation
25.70.Pq Multifragment emission and correlations

25.75.−q Relativistic heavy-ion collisions *(collisions induced by light ions studied to calibrate relativistic heavy-ion collisions should be classified under both 25.75.−q and sections 13 or 25 appropriate to the light ions)*
25.75.Ag Global features in relativistic heavy ion collisions
25.75.Bh Hard scattering in relativistic heavy ion collisions
25.75.Cj Photon, lepton, and heavy quark production in relativistic heavy ion collisions
25.75.Dw Particle and resonance production
25.75.Gz Particle correlations and fluctuations
25.75.Ld Collective flow
25.75.Nq Quark deconfinement, quark–gluon plasma production, and phase transitions *(see also 12.38.Mh Quark–gluon plasma in quantum chromodynamics; 21.65.Qr Quark matter in nuclear matter)*

25.80.−e Meson- and hyperon-induced reactions
25.80.Dj Pion elastic scattering
25.80.Ek Pion inelastic scattering
25.80.Gn Pion charge-exchange reactions
25.80.Hp Pion-induced reactions
25.80.Ls Pion inclusive scattering and absorption
25.80.Nv Kaon-induced reactions
25.80.Pw Hyperon-induced reactions

25.85.−w Fission reactions
25.85.Ca Spontaneous fission
25.85.Ec Neutron-induced fission
25.85.Ge Charged-particle-induced fission
25.85.Jg Photofission

25.90.+k Other topics in nuclear reactions: specific reactions (restricted to new topics in section 25)

26. Nuclear astrophysics *(see also 95.30.−k Fundamental aspects of astrophysics in astronomy)*

26.20.−f Hydrostatic stellar nucleosynthesis *(see also 97.10.Cv Stellar structure, interiors, evolution, nucleosynthesis, ages in astronomy)*
26.20.Cd Stellar hydrogen burning
26.20.Fj Stellar helium burning
26.20.Kn s-process
26.20.Np Nucleosynthesis in late stellar evolution
26.20.Qr Quasistatistical processes

26.30.−k Nucleosynthesis in novae, supernovae, and other explosive environments
26.30.Ca Explosive burning in accreting binary systems (novae, x-ray bursts)
26.30.Ef Explosive burning in supernovae shock fronts
26.30.Hj r-process
26.30.Jk Weak interaction and neutrino induced processes, galactic radioactivity

26.35.+c Big Bang nucleosynthesis *(see also 98.80.Ft Origin, formation, and abundances of the elements in astronomy)*

26.40.+r Cosmic ray nucleosynthesis

26.50.+x Nuclear physics aspects of novae, supernovae, and other explosive environments

26.60.−c Nuclear matter aspects of neutron stars
26.60.Dd Neutron star core
26.60.Gj Neutron star crust
26.60.Kp Equations of state of neutron-star matter

26.65.+t Solar neutrinos *(see also 96.60.Vg Particle emission, solar wind in solar physics)*

26.90.+n Other topics in nuclear astrophysics (restricted to new topics in section 26)

27. Properties of specific nuclei listed by mass ranges *(an additional heading must be chosen with these entries, where the given mass number limits are, to some degree, arbitrary)*

27.10.+h A ≤ 5

27.20.+n 6 ≤ A ≤ 19

27.30.+t 20 ≤ A ≤ 38

27.40.+z 39 ≤ A ≤ 58

27.50.+e 59 ≤ A ≤ 89

27.60.+j 90 ≤ A ≤ 149

27.70.+q 150 ≤ A ≤ 189

27.80.+w 190 ≤ A ≤ 219

27.90.+b A ≥ 220

28. Nuclear engineering and nuclear power studies

28.20.−v Neutron physics *(see also 25.40.−h Nucleon-induced reactions and 25.85.Ec Neutron-induced fission)*
28.20.Cz Neutron scattering
28.20.Fc Neutron absorption
28.20.Gd Neutron transport: diffusion and moderation
28.20.Ka Thermal neutron cross sections
28.20.Np Neutron capture γ-rays

28.41.−i Fission reactors *(see also 89.30.Gg nuclear fission power in energy resources)*
28.41.Ak Theory, design, and computerized simulation
28.41.Bm Fuel elements, preparation, reloading, and reprocessing
28.41.Fr Reactor coolants, reactor cooling, and heat recovery
28.41.Kw Radioactive wastes, waste disposal
28.41.My Reactor control systems
28.41.Pa Moderators
28.41.Qb Structural and shielding materials
28.41.Rc Instrumentation

28.41.Te Protection systems, safety, radiation monitoring, accidents, and dismantling

28.41.Vx Fuel cycles

28.50.−k Fission reactor types

28.50.Dr Research reactors

28.50.Ft Fast and breeder reactors

28.50.Hw Power and production reactors

28.50.Ky Propulsion reactors

28.50.Ma Auxiliary generators

28.52.−s Fusion reactors *(see also 52.55.−s Magnetic confinement and equilibrium, 52.57.−z Laser inertial confinement, and 52.58.−c Other confinement methods in physics of plasmas; 89.30.Jj Nuclear fusion power in energy resources)*

28.52.Av Theory, design, and computerized simulation

28.52.Cx Fueling, heating and ignition

28.52.Fa Materials

28.52.Lf Components and instrumentation

28.52.Nh Safety *(see also 87.55.N− Radiation monitoring, control, and safety in biological and medical physics)*

28.60.+s Isotope separation and enrichment

28.65.+a Accelerator-driven transmutation of nuclear waste

28.70.+y Nuclear explosions *(see also 47.40.−x Compressible flows; shock waves; for radiation protection from fallout, for dosimetry and exposure assessment, see 87.53.Bn; for nuclear explosion seismology, see 91.30.Rz)*

28.90.+i Other topics in nuclear engineering and nuclear power studies (restricted to new topics in section 28)

29. Experimental methods and instrumentation for elementary-particle and nuclear physics

29.20.−c Accelerators *(for accelerators used in medical applications, see 87.56.bd)*

29.20.Ba Electrostatic accelerators

29.20.D− Cyclic accelerators and storage rings

29.20.db Storage rings and colliders

29.20.df Betatrons

29.20.dg Cyclotrons

29.20.dk Synchrotrons

29.20.Ej Linear accelerators

29.25.−t Particle sources and targets *(see also 52.59.−f Intense particle beams and radiation sources in physics of plasmas; see also 87.56.bg Radioactive sources in medical physics)*

29.25.Bx Electron sources

29.25.Dz Neutron sources

29.25.Lg Ion sources: polarized

29.25.Ni Ion sources: positive and negative

29.25.Pj Polarized and other targets

29.25.Rm Sources of radioactive nuclei

29.27.−a Beams in particle accelerators *(for low energy charged-particle beams, see 41.75.−i and 41.85.−p)*

29.27.Ac Beam injection and extraction

29.27.Bd Beam dynamics; collective effects and instabilities

29.27.Eg Beam handling; beam transport

29.27.Fh Beam characteristics

29.27.Hj Polarized beams

29.30.−h Spectrometers and spectroscopic techniques

29.30.Aj Charged-particle spectrometers: electric and magnetic

29.30.Dn Electron spectroscopy

29.30.Ep Charged-particle spectroscopy

29.30.Hs Neutron spectroscopy

29.30.Kv X- and γ-ray spectroscopy

29.30.Lw Nuclear orientation devices

. . . . *Energy loss and stopping power, see 34.50.Bw and 61.85.+p*

29.38.−c Radioactive beams

29.38.Db Fast radioactive beam techniques

29.38.Gj Reaccelerated radioactive beams

29.40.−n Radiation detectors *(for mass spectrometers, see 07.75.+h; see also 95.55.Vj Neutrino, muon, pion, and other particle detectors; cosmic ray detectors in astronomy)*

29.40.Cs Gas-filled counters: ionization chambers, proportional, and avalanche counters

29.40.Gx Tracking and position-sensitive detectors

29.40.Ka Cherenkov detectors

29.40.Mc Scintillation detectors

29.40.Rg Nuclear emulsions

29.40.Vj Calorimeters

29.40.Wk Solid-state detectors

29.50.+v Computer interfaces

29.85.−c Computer data analysis

29.85.Ca Data acquisition and sorting

29.85.Fj Data analysis

29.87.+g Nuclear data compilation

29.90.+r Other topics in elementary-particle and nuclear physics experimental methods and instrumentation (restricted to new topics in section 29)

30. ATOMIC AND MOLECULAR PHYSICS

31. Electronic structure of atoms and molecules: theory

31.10.+z **Theory of electronic structure, electronic transitions, and chemical binding** *(for theory and mathematical methods applied to electronic structure of biomolecules, see 87.10.−e)*

31.15.−p **Calculations and mathematical techniques in atomic and molecular physics** *(see also 02.70.−c Computational techniques, in mathematical methods in physics)*

31.15.A− *Ab initio* calculations

31.15.ac *High-precision calculations for few-electron (or few-body) atomic systems*

31.15.ae *Electronic structure and bonding characteristics*

31.15.ag *Excitation energies and lifetimes; oscillator strengths*

31.15.aj *Relativistic corrections, spin-orbit effects, fine structure; hyperfine structure*

31.15.am *Relativistic configuration interaction (CI) and many-body perturbation calculations*

31.15.ap *Polarizabilities and other atomic and molecular properties*

31.15.ar *Strongly correlated electron systems: generalized tight-binding method*

31.15.at *Molecule transport characteristics; molecular dynamics; electronic structure of polymers*

31.15.B− Approximate calculations

31.15.bt *Statistical model calculations (including Thomas–Fermi and Thomas–Fermi–Dirac models)*

31.15.bu *Semi-empirical and empirical calculations (differential overlap, Hückel, PPP methods, etc.)*

31.15.bw *Coupled-cluster theory*

31.15.E− Density-functional theory

31.15.ec *Hohenberg-Kohn theorem and formal mathematical properties, completeness theorems*

31.15.ee *Time-dependent density functional theory*

31.15.eg *Exchange-correlation functionals (in current density functional theory)*

31.15.ej *Spin-density functionals*

31.15.em *Corrections for core-spin polarization, surface effects, etc.*

31.15.ep *Variational particle-number approach*

31.15.es *Applications of density-functional theory (e.g., to electronic structure and stability; defect formation; dielectric properties, susceptibilities; viscoelastic coefficients; Rydberg transition frequencies)*

31.15.V− Electron correlation calculations for atoms, ions and molecules

31.15.ve *Electron correlation calculations for atoms and ions: ground state*

31.15.vj *Electron correlation calculations for atoms and ions: excited states*

31.15.vn *Electron correlation calculations for diatomic molecules*

31.15.vq *Electron correlation calculations for polyatomic molecules*

31.15.X− Alternative approaches

31.15.xf *Finite-difference schemes*

31.15.xg *Semiclassical methods*

31.15.xh *Group-theoretical methods (see also 02.20.−a Group theory in mathematical methods in physics)*

31.15.xj *Hyperspherical methods*

31.15.xk *Path-integral methods*

31.15.xm *Quasiparticle methods*

31.15.xp *Perturbation theory*

31.15.xr *Self-consistent-field methods*

31.15.xt *Variational techniques*

31.15.xv *Molecular dynamics and other numerical methods (for simulation techniques for biomolecules, see 87.15.ak, ap)*

31.15.xw *Valence bond calculations*

31.30.−i **Corrections to electronic structure** *(see also 03.30.+p Special relativity; for exotic atoms and molecules, see 36.10.−k; for applications of density-functional theory, see 31.15.es)*

31.30.Gs Hyperfine interactions and isotope effects *(see also 32.10.Fn Fine and hyperfine structure)*

31.30.J− Relativistic and quantum electrodynamic (QED) effects in atoms, molecules, and ions

31.30.jc *Relativistic corrections to atomic structure and properties*

31.30.jd *Relativistic corrections due to negative-energy states or processes*

31.30.jf *QED calculations of level energies, transition frequencies, fine structure intervals (radiative corrections, self-energy, vacuum polarization, etc.)*

31.30.jg *QED corrections to parity nonconserving transition amplitudes and CP violations*

31.30.jh *QED corrections to long-range and weak interactions*

31.30.jn *QED corrections to electric dipole moments and other atomic properties*

31.30.jp *Electron electric dipole moment*

31.30.jr *QED corrections (Lamb shift) in muonic hydrogen and deuterium (see also 36.10.Ee Muonium, muonic atoms and molecules)*

31.30.js *Corrections to bound-electron g factor*

31.30.jx *Nonrelativistic limits of Dirac-Fock calculations*

31.30.jy *Higher-order effective Hamiltonians*

31.30.jz *Decay rates of hydrogen-antihydrogen quasimolecules (for exotic atoms and molecules, see 36.10.−k)*

31.50.−x **Potential energy surfaces** *(for potential energy surfaces for chemical reactions, see 82.20.Kh; for collisions, see 34.20.−b)*

31.50.Bc Potential energy surfaces for ground electronic states

31.50.Df Potential energy surfaces for excited electronic states

31.50.Gh Surface crossings, non-adiabatic couplings

31.70.−f **Effects of atomic and molecular interactions on electronic structure** *(see also section 34 Atomic and molecular collision processes and interactions)*

31.70.Dk Environmental and solvent effects

31.70.Hq Time-dependent phenomena: excitation and relaxation processes, and reaction rates *(for chemical kinetics aspects, see 82.20.Rp)*

31.70.Ks Molecular solids

31.90.+s **Other topics in the theory of the electronic structure of atoms and molecules (restricted to new topics in section 31)**

32. Atomic properties and interactions with photons

(for quantum chaos, see 05.45.Mt; for standards of calibration, see 06.20.fb; for relativistic and quantum electrodynamic effects, see 31.30.J−)

32.10.−f **Properties of atoms** *(for astrophysical applications, see 95.30.Ky)*

32.10.Bi Atomic masses, mass spectra,

abundances, and isotopes *(for mass spectroscopy, see 07.75.+h in instruments, and 82.80.Ms, Nj, Rt in physical chemistry and chemical physics)*

32.10.Dk Electric and magnetic moments, polarizabilities

32.10.Ee Magnetic bound states, magnetic trapping of Rydberg states

32.10.Fn Fine and hyperfine structure *(see also 31.30.Gs Hyperfine interactions and isotope effects)*

32.10.Hq Ionization potentials, electron affinities

32.30.−r Atomic spectra *(see also 78.47.J− Ultrafast pump/probe spectroscopy in condensed matter and 82.53.Kp Coherent spectroscopy of atoms and molecules in physical chemistry and chemical physics)*

32.30.Bv Radio-frequency, microwave, and infrared spectra

32.30.Dx Magnetic resonance spectra

32.30.Jc Visible and ultraviolet spectra

32.30.Rj X-ray spectra

32.50.+d Fluorescence, phosphorescence (including quenching)

32.60.+i Zeeman and Stark effects

32.70.−n Intensities and shapes of atomic spectral lines *(see also 31.15.−p Calculations and mathematical techniques)*

32.70.Cs Oscillator strengths, lifetimes, transition moments

32.70.Fw Absolute and relative intensities

32.70.Jz Line shapes, widths, and shifts

32.80.−t Photoionization and excitation

32.80.Aa Inner-shell excitation and ionization

. . . . *Atomic scattering cross sections, form factors, Compton scattering, see section 34*

32.80.Ee Rydberg states

32.80.Fb Photoionization of atoms and ions *(for fluorescence yield, see 32.50.+d)*

32.80.Gc Photodetachment of atomic negative ions

32.80.Hd Auger effect (including Coster-Krönig transitions)

. . . . *Mechanical effects of light on atoms, molecules, and ions, see 37.10.Vz*

. . . . *Atom cooling methods, traps and guides, see 37.10.De and 37.10.Gh*

. . . . *Atoms in optical lattices, see 37.10.Jk*

32.80.Rm Multiphoton ionization and excitation to highly excited states

32.80.Wr Other multiphoton processes

32.80.Xx Level crossing and optical pumping

32.80.Zb Autoionization

32.90.+a Other topics in atomic properties and interactions of atoms with photons (restricted to new topics in section 32)

33. Molecular properties and interactions with photons

33.15.−e Properties of molecules *(see also section 31, Electronic structure of atoms and molecules: theory; for molecules of interest in astrophysics, see 95.30.Ky; for structure and properties of biomolecules, see 87.15.−v)*

33.15.Bh General molecular conformation and symmetry; stereochemistry

33.15.Dj Interatomic distances and angles

33.15.Fm Bond strengths, dissociation energies

33.15.Hp Barrier heights (internal rotation, inversion, rotational isomerism, conformational dynamics)

33.15.Kr Electric and magnetic moments (and derivatives), polarizability, and magnetic susceptibility

33.15.Mt Rotation, vibration, and vibration–rotation constants

33.15.Pw Fine and hyperfine structure

33.15.Ry Ionization potentials, electron affinities, molecular core binding energy

33.15.Ta Mass spectra

33.15.Vb Correlation times in molecular dynamics

33.20.−t Molecular spectra *(see also 78.47.J− Ultrafast pump/probe spectroscopy in condensed matter and 82.53.Kp Coherent spectroscopy of atoms and molecules; for chemical analytical methods using spectroscopy, see 82.80.Dx, Gk, Ha in physical chemistry; 87.64.−t Spectroscopic and microscopic techniques in biological physics; for spectra of macromolecules and polymer molecules, see 36.20.Kd)*

33.20.Bx Radio-frequency and microwave spectra

33.20.Ea Infrared spectra

33.20.Fb Raman and Rayleigh spectra (including optical scattering)

33.20.Kf Visible spectra

33.20.Lg Ultraviolet spectra

33.20.Ni Vacuum ultraviolet spectra

33.20.Rm X-ray spectra

33.20.Sn Rotational analysis

33.20.Tp Vibrational analysis

33.20.Vq Vibration–rotation analysis

33.20.Wr Vibronic, rovibronic, and rotation–electron–spin interactions

33.20.Xx Spectra induced by strong-field or attosecond laser irradiation *(see also 33.60.+q Photoelectron spectra)*

33.25.+k Nuclear resonance and relaxation *(see also 76.60.−k Nuclear magnetic resonance and relaxation in condensed matter; 82.56.−b Nuclear magnetic resonance in physical chemistry and chemical physics; 87.80.Lg Magnetic and paramagnetic resonance in biological physics)*

33.35.+r Electron resonance and relaxation *(see also 76.30.−v Electron paramagnetic resonance and relaxation in condensed matter)*

33.40.+f Multiple resonances (including double and higher-order resonance processes, such as double nuclear magnetic resonance, electron double resonance, and microwave optical double resonance) *(see also 76.70.−r Magnetic double resonances and cross effects in condensed matter)*

33.45.+x Mössbauer spectra *(see also 76.80.+y Mössbauer effect; other γ-ray spectroscopy in condensed matter; for biophysical applications, see 87.64.Kx; for chemical analysis applications, see 82.80.Ej)*

33.50.−j Fluorescence and phosphorescence; radiationless transitions, quenching (intersystem crossing, internal conversion) *(for energy transfer, see also section 34; for biophysical applications, see 87.64.kv)*

33.50.Dq Fluorescence and phosphorescence spectra

33.50.Hv Radiationless transitions, quenching

33.55.+b Optical activity and dichroism

33.57.+c Magnetooptical and electrooptical spectra and effects

33.60.+q Photoelectron spectra *(for biophysical applications, see 87.64.ks)*

33.70.−w Intensities and shapes of molecular spectral lines and bands

33.70.Ca Oscillator and band strengths, lifetimes, transition moments, and Franck–Condon factors

33.70.Fd Absolute and relative line and band intensities

33.70.Jg Line and band widths, shapes, and shifts

33.80.−b Photon interactions with

molecules *(see also 42.50.−p Quantum optics)*

33.80.Be Level crossing and optical pumping

33.80.Eh Autoionization, photoionization, and photodetachment

33.80.Gj Diffuse spectra; predissociation, photodissociation

. . . . *Slowing, cooling, and trapping of molecules, see 37.10.Mn and 37.10.Pq*

33.80.Rv Multiphoton ionization and excitation to highly excited states (e.g., Rydberg states)

33.80.Wz Other multiphoton processes

33.90.+h Other topics in molecular properties and interactions with photons (restricted to new topics in section 33)

34. Atomic and molecular collision processes and interactions

(for atomic, molecular, and ionic collisions in plasma, see 52.20.Hv; for atoms and molecules of astrophysical interest, see 95.30.Dr, Ft; see also 98.38.Bn and 98.58.Bz in interstellar media in astronomy; 87.15.K− Molecular interactions, membrane-protein interactions in biological physics)

34.10.+x General theories and models of atomic and molecular collisions and interactions (including statistical theories, transition state, stochastic and trajectory models, etc.)

34.20.−b Interatomic and intermolecular potentials and forces, potential energy surfaces for collisions *(see also 82.20.Kh Potential energy surfaces for reactions; for potential energy surfaces in electronic structure calculations, see 31.50.−x)*

34.20.Cf Interatomic potentials and forces

34.20.Gj Intermolecular and atom–molecule potentials and forces

34.35.+a Interactions of atoms and molecules with surfaces

34.50.−s Scattering of atoms and molecules

34.50.Bw Energy loss and stopping power

34.50.Cx Elastic; ultracold collisions

34.50.Ez Rotational and vibrational energy transfer

34.50.Fa Electronic excitation and ionization of atoms (including beam–foil excitation and ionization)

34.50.Gb Electronic excitation and ionization of molecules

34.50.Lf Chemical reactions

34.50.Rk Laser-modified scattering and reactions

34.70.+e Charge transfer *(for charge transfer in biological systems, see 82.39.Jn in physical chemistry)*

34.80.−i Electron and positron scattering

34.80.Bm Elastic scattering

34.80.Dp Atomic excitation and ionization

34.80.Gs Molecular excitation and ionization

34.80.Ht Dissociation and dissociative attachment

34.80.Lx Recombination, attachment, and positronium formation

34.80.Nz Spin dependence of cross sections; polarized beam experiments

34.80.Pa Coherence and correlation

34.80.Qb Laser-modified scattering

34.80.Uv Positron scattering

34.90.+q Other topics in atomic and molecular collision processes and interactions (restricted to new topics in section 34)

36. Exotic atoms and molecules; macromolecules; clusters

36.10.−k Exotic atoms and molecules (containing mesons, antiprotons and other unusual particles)

36.10.Dr Positronium *(see also 82.30.Gg Positronium chemistry)*

36.10.Ee Muonium, muonic atoms and molecules *[see also 31.30.jr QED corrections (Lamb shift) in muonic hydrogen and deuterium]*

36.10.Gv Mesonic, hyperonic and antiprotonic atoms and molecules

36.20.−r Macromolecules and polymer molecules

36.20.Cw Molecular weights, dispersity

36.20.Ey Conformation (statistics and dynamics)

36.20.Fz Constitution (chains and sequences)

36.20.Hb Configuration (bonds, dimensions)

36.20.Kd Electronic structure and spectra

36.20.Ng Vibrational and rotational structure, infrared and Raman spectra

36.40.−c Atomic and molecular clusters *(see also 61.46.−w Nanoscale materials in condensed matter)*

36.40.Cg Electronic and magnetic properties of clusters

36.40.Ei Phase transitions in clusters

36.40.Gk Plasma and collective effects in clusters

36.40.Jn Reactivity of clusters

36.40.Mr Spectroscopy and geometrical structure of clusters

36.40.Qv Stability and fragmentation of clusters

36.40.Sx Diffusion and dynamics of clusters

36.40.Vz Optical properties of clusters

36.40.Wa Charged clusters

36.90.+f Other topics in exotic atoms and molecules; macromolecules; clusters (restricted to new topics in section 36)

37. Mechanical control of atoms, molecules, and ions

(see also 82.37.Gk STM and AFM manipulations of a single molecule in physical chemistry and chemical physics; for atom manipulation in nanofabrication and processing, see 81.16.Ta; see also 03.75.−b Matter waves)

37.10.−x Atom, molecule, and ion cooling methods *(see also 87.80.Cc Optical trapping in biophysical techniques)*

37.10.De Atom cooling methods

37.10.Gh Atom traps and guides

37.10.Jk Atoms in optical lattices

37.10.Mn Slowing and cooling of molecules

37.10.Pq Trapping of molecules

37.10.Rs Ion cooling

37.10.Ty Ion trapping

37.10.Vz Mechanical effects of light on atoms, molecules, and ions

37.20.+j Atomic and molecular beam sources and techniques

37.25.+k Atom interferometry techniques *(see also 03.75.Dg Atom and neutron interferometry in matter waves)*

37.30.+i Atoms, molecules, and ions in cavities *(see also 42.50.Pq Cavity quantum electrodynamics; micromasers)*

37.90.+j Other topics in mechanical control of atoms, molecules, and ions (restricted to new topics in section 37)

40. ELECTROMAGNETISM, OPTICS, ACOUSTICS, HEAT TRANSFER, CLASSICAL MECHANICS, AND FLUID DYNAMICS

41. Electromagnetism; electron and ion optics

41.20.−q Applied classical electromagnetism *(for submillimeter wave, microwave, and radiowave instruments and equipment, see 07.57.−c)*

41.20.Cv Electrostatics; Poisson and Laplace equations, boundary-value problems

41.20.Gz Magnetostatics; magnetic shielding, magnetic induction, boundary-value problems

41.20.Jb Electromagnetic wave propagation; radiowave propagation *(for light propagation, see 42.25.Bs; for electromagnetic waves in plasma, see 52.35.Hr; for atmospheric, ionospheric, and magnetospheric propagation, see 92.60.Ta, 94.20.Bb, and 94.30.Tz, respectively; see also 94.05.Pt Wave/wave, wave/particle interactions, in space plasma physics)*

41.50.+h X-ray beam source magnets and x-ray optics for control of particle beams *(see also 07.85.Fv X- and γ-ray sources, mirrors, gratings, and detectors in instruments)*

41.60.−m Radiation by moving charges

41.60.Ap Synchrotron radiation *(for synchrotron radiation instrumentation, see 07.85.Qe)*

41.60.Bq Cherenkov radiation

41.60.Cr Free-electron lasers *(see also 52.59.Rz Free-electron devices—in plasma physics)*

41.60.Dk Transition radiation

41.75.−i Charged-particle beams

41.75.Ak Positive-ion beams

41.75.Cn Negative-ion beams

41.75.Fr Electron and positron beams

41.75.Ht Relativistic electron and positron beams

41.75.Jv Laser-driven acceleration *(see also 52.38.−r Laser-plasma interactions in plasma physics)*

41.75.Lx Other advanced accelerator concepts

41.85.−p Beam optics *(see also 07.77.Ka Charged-particle beam sources and detectors in instruments; 29.27.−a Beams in particle accelerators)*

41.85.Ar Particle beam extraction, beam injection

41.85.Ct Particle beam shaping, beam splitting

41.85.Ew Particle beam profile, beam intensity

41.85.Gy Chromatic and geometrical aberrations

41.85.Ja Particle beam transport

41.85.Lc Particle beam focusing and bending magnets, wiggler magnets, and quadrupoles *(see also 07.55.Db Generation of magnetic fields; magnets in instruments; for superconducting magnets, see 84.71.Ba)*

41.85.Ne Electrostatic lenses, septa

41.85.Qg Particle beam analyzers, beam monitors, and Faraday cups

41.85.Si Particle beam collimators, monochromators

41.90.+e Other topics in electromagnetism; electron and ion optics (restricted to new topics in section 41)

42. Optics *(for optical properties of gases, see 51.70.+f; for optical properties of bulk materials and thin films, see 78.20.−e; for x-ray optics, see 41.50.+h)*

42.15.−i Geometrical optics

42.15.Dp Wave fronts and ray tracing

42.15.Eq Optical system design

42.15.Fr Aberrations

42.25.−p Wave optics

42.25.Bs Wave propagation, transmission and absorption *[see also 41.20.Jb—in electromagnetism; for propagation in atmosphere, see 42.68.Ay; see also 52.40.Db Electromagnetic (nonlaser) radiation interactions with plasma and 52.38−r Laser-plasma interactions—in plasma physics]*

42.25.Dd Wave propagation in random media

42.25.Fx Diffraction and scattering

42.25.Gy Edge and boundary effects; reflection and refraction

42.25.Hz Interference

42.25.Ja Polarization

42.25.Kb Coherence

42.25.Lc Birefringence

42.30.−d Imaging and optical processing

42.30.Kq Fourier optics

42.30.Lr Modulation and optical transfer functions

42.30.Ms Speckle and moiré patterns

42.30.Rx Phase retrieval

42.30.Sy Pattern recognition

42.30.Tz Computer vision; robotic vision

42.30.Va Image forming and processing

42.30.Wb Image reconstruction; tomography

42.40.−i Holography

42.40.Eq Holographic optical elements; holographic gratings

42.40.Ht Hologram recording and readout methods *(see also 42.70.Ln Holographic recording materials; optical storage media)*

42.40.Jv Computer-generated holograms

42.40.Kw Holographic interferometry; other holographic techniques *(for interferometers, see 07.60.Ly in instruments)*

42.40.Lx Diffraction efficiency, resolution, and other hologram characteristics

42.40.My Applications

42.40.Pa Volume holograms

42.50.−p Quantum optics *(for lasers, see 42.55.−f and 42.60.−v; see also 42.65.−k Nonlinear optics; 03.65.−w Quantum mechanics)*

42.50.Ar Photon statistics and coherence theory

42.50.Ct Quantum description of interaction of light and matter; related experiments

42.50.Dv Quantum state engineering and measurements *(see also 03.65.Ud Entanglement and quantum nonlocality, e.g., EPR paradox, Bells inequalities, GHZ states, etc.)*

42.50.Ex Optical implementations of quantum information processing and transfer

42.50.Gy Effects of atomic coherence on propagation, absorption, and amplification of light; electromagnetically induced transparency and absorption

42.50.Hz Strong-field excitation of optical transitions in quantum systems; multiphoton processes; dynamic Stark shift *(for multiphoton ionization and excitation of atoms and molecules, see 32.80.Rm, and 33.80.Rv, respectively)*

42.50.Lc Quantum fluctuations, quantum noise, and quantum jumps

42.50.Md Optical transient phenomena: quantum beats, photon echo, free-induction decay, dephasings and revivals, optical nutation, and self-induced transparency

. . . . *Dynamics of nonlinear optical systems; optical instabilities, optical chaos, and optical spatio-temporal dynamics, see 42.65.Sf*

. . . . *Optical solitons; nonlinear guided waves, see 42.65.Tg*

42.50.Nn Quantum optical phenomena in absorbing, amplifying, dispersive and conducting media; cooperative phenomena in quantum optical systems

42.50.Pq Cavity quantum electrodynamics; micromasers

42.50.St Nonclassical interferometry, subwavelength lithography

42.50.Tx Optical angular momentum and its quantum aspects *(see also 42.25.Ja Polarization)*

. . . . *Mechanical effects of light on atoms, molecules, and ions, see 37.10.Vz*

42.50.Wk Mechanical effects of light on material media, microstructures and particles *(see also 87.80.Cc Optical trapping in biology and medicine)*

. . . . *Experimental tests in quantum electrodynamics, see 12.20.Fv*

. . . . *Measurements theory in quantum mechanics, see 03.65.Ta*

42.50.Xa Optical tests of quantum theory

42.55.−f Lasers

42.55.Ah General laser theory

42.55.Ks Chemical lasers *(for chemiluminescence, see 78.60.Ps)*

42.55.Lt Gas lasers including excimer and metal-vapor lasers

42.55.Mv Dye lasers

42.55.Px Semiconductor lasers; laser diodes

42.55.Rz Doped-insulator lasers and other solid state lasers

42.55.Sa Microcavity and microdisk lasers

42.55.Tv Photonic crystal lasers and coherent effects

42.55.Vc X- and γ-ray lasers

42.55.Wd Fiber lasers

42.55.Xi Diode-pumped lasers

42.55.Ye Raman lasers *(see also 42.65.Dr Stimulated Raman scattering; CARS)*

. . . . *Free-electron lasers, see 41.60.Cr and 52.59.Rz*

42.55.Zz Random lasers

42.60.−v Laser optical systems: design and operation

42.60.By Design of specific laser systems

42.60.Da Resonators, cavities, amplifiers, arrays, and rings

42.60.Fc Modulation, tuning, and mode locking

42.60.Gd Q-switching

42.60.Jf Beam characteristics: profile, intensity, and power; spatial pattern formation

42.60.Lh Efficiency, stability, gain, and other operational parameters

42.60.Mi Dynamical laser instabilities; noisy laser behavior

42.60.Pk Continuous operation

42.60.Rn Relaxation oscillations and long pulse operation

. . . . *Ultrashort pulse generation, see 42.65.Re*

. . . . *Dynamics of nonlinear optical systems, see 42.65.Sf*

42.62.−b Laser applications

42.62.Be Biological and medical applications *(see also 87.50.W−, 87.63.L−, and 87.80.Cc in biological and medical physics)*

42.62.Cf Industrial applications

42.62.Eh Metrological applications; optical frequency synthesizers for precision spectroscopy *(see also 06.20.−f Metrology in metrology, measurements, and laboratory procedures)*

42.62.Fi Laser spectroscopy

42.65.−k Nonlinear optics

42.65.An Optical susceptibility, hyperpolarizability *[see also 33.15.Kr Electric and magnetic moments (and derivatives), polarizability, and magnetic susceptibility]*

42.65.Dr Stimulated Raman scattering; CARS *(for Raman lasers, see 42.55.Ye)*

42.65.Es Stimulated Brillouin and Rayleigh scattering

42.65.Hw Phase conjugation; photorefractive and Kerr effects

42.65.Jx Beam trapping, self-focusing and defocusing; self-phase modulation

42.65.Ky Frequency conversion; harmonic generation, including higher-order harmonic generation *(see also 42.79.Nv Optical frequency converters)*

42.65.Lm Parametric down conversion and production of entangled photons *(see also 42.50.Dv Quantum state engineering and measurements; for optical parametric oscillators and amplifiers, see 42.65.Yj)*

42.65.Pc Optical bistability, multistability, and switching, including local field effects *(see also 42.60.Gd Q-switching; 42.79.Ta Optical computers, logic elements, interconnects, switches; neural networks)*

42.65.Re Ultrafast processes; optical pulse generation and pulse compression

42.65.Sf Dynamics of nonlinear optical systems; optical instabilities, optical chaos and complexity, and optical spatio–temporal dynamics

42.65.Tg Optical solitons; nonlinear guided waves *(for solitons in fibers, see 42.81.Dp)*

42.65.Wi Nonlinear waveguides

42.65.Yj Optical parametric oscillators and amplifiers *(see also 42.65.Lm Parametric down conversion and production of entangled photons)*

42.66.−p Physiological optics *(see also 87.19.lt Sensory systems: visual, auditory, tactile, taste, and olfaction)*

42.66.Ct Anatomy and optics of eye

42.66.Ew Physiology of eye; optic-nerve structure and function *(see also 87.19.lt Sensory systems: visual, auditory, tactile, taste, and olfaction)*

42.66.Lc Vision: light detection, adaptation, and discrimination

42.66.Ne Color vision: color detection, adaptation, and discrimination

42.66.Qg Scales for light and color detection

42.66.Si Psychophysics of vision, visual perception; binocular vision

42.68.−w Atmospheric and ocean optics

42.68.Ay Propagation, transmission, attenuation, and radiative transfer *(see also 92.60.Ta Electromagnetic wave propagation)*

42.68.Bz Atmospheric turbulence effects *(see also 92.60.hk Convection, turbulence, and diffusion in meteorology)*

42.68.Ca Spectral absorption by atmospheric gases *(see also 92.60.Vb Radiative processes, solar radiation in meteorology)*

42.68.Ge Effects of clouds and water; ice crystal phenomena *(see also 92.60.Jq Water in the atmosphere; 92.60.Nv Cloud physics and chemistry in meteorology)*

42.68.Jg Effects of aerosols *(see also 92.60.Mt Particles and aerosols in meteorology; 92.20.Bk Aerosols in chemical and biological oceanography; 91.40.Dr Atmospheric effects in volcanology)*

42.68.Kh Effects of air pollution *(see also 92.60.Sz Air quality and air pollution in meteorology; 92.10.Xc Ocean fog in oceanography)*

42.68.Mj Scattering, polarization *(see also 92.60.Ta Electromagnetic wave propagation and 92.60.Vb Radiative processes, solar radiation in meteorology)*

42.68.Sq Image transmission and formation

42.68.Wt Remote sensing; LIDAR and adaptive systems

42.68.Xy Ocean optics *(see also 92.05.Hj Physical and chemical properties of sea water in oceanography)*

42.70.−a Optical materials *(see also 81.05.−t Specific materials: fabrication, treatment, testing and analysis)*

42.70.Ce Glasses, quartz

42.70.Df Liquid crystals *(for structure of liquid crystals, see 61.30.−v)*

42.70.Gi Light-sensitive materials

42.70.Hj Laser materials

42.70.Jk Polymers and organics

42.70.Km Infrared transmitting materials

42.70.Ln Holographic recording materials; optical storage media

42.70.Mp Nonlinear optical crystals *(see also 77.84.−s Dielectric, piezoelectric, and ferroelectric materials)*

42.70.Nq Other nonlinear optical materials; photorefractive and semiconductor materials

42.70.Qs Photonic bandgap materials *(for photonic crystal lasers, see 42.55.Tv)*

42.72.−g Optical sources and standards *(for lasers, see 42.55.−f)*

42.72.Ai Infrared sources *(see also 07.57.Hm Infrared, submillimeter wave, microwave, and radiowave sources)*

42.72.Bj Visible and ultraviolet sources

42.79.−e Optical elements, devices, and systems *(for integrated optics, see 42.82.−m; for fiber optics, see 42.81.−i)*

. . . . *Optical instruments, equipment and techniques, see 07.60.−j and 07.57.−c*

. . . . *Optical spectrometers, see 07.57.Ty and 07.60.Rd*

. . . . *Photography, photographic instruments and techniques, see 07.68.+m*

. . . . *Magnetooptical devices, see 85.70.Sq*

42.79.Ag Apertures, collimators

42.79.Bh Lenses, prisms and mirrors

42.79.Ci Filters, zone plates, and polarizers

42.79.Dj Gratings *(for holographic gratings, see 42.40.Eq)*

42.79.Ek Solar collectors and concentrators *(see also 84.60.Jt Photoelectric conversion: solar cells and arrays)*

42.79.Fm Reflectors, beam splitters, and deflectors

42.79.Gn Optical waveguides and couplers *(for fiber waveguides and waveguides in integrated optics, see 42.81.Qb and 42.82.Et, respectively)*

42.79.Hp Optical processors, correlators, and modulators

42.79.Jq Acousto-optical devices *(see also 43.38.Zp-in Acoustics Appendix)*

42.79.Kr Display devices, liquid-crystal devices *(see also 85.60.Pg Display systems)*

42.79.Ls Scanners, image intensifiers, and image converters *(see also 85.60.−q Optoelectronic devices)*

42.79.Mt Schlieren devices

42.79.Nv Optical frequency converters

42.79.Pw Imaging detectors and sensors *(see also 85.60.Gz Photodetectors)*

42.79.Qx Range finders, remote sensing devices; laser Doppler velocimeters, SAR, and LIDAR *(see also 42.68.Wt Remote sensing; LIDAR and adaptive systems)*

42.79.Ry Gradient-index (GRIN) devices *(for fiber GRIN devices, see 42.81.Ht)*

42.79.Sz Optical communication systems, multiplexers, and demultiplexers *(for fiber networks, see 42.81.Uv)*

42.79.Ta Optical computers, logic elements, interconnects, switches; neural networks

42.79.Vb Optical storage systems, optical disks *(see also 42.40.Ht Hologram recording and readout methods)*

42.79.Wc Optical coatings

42.81.−i Fiber optics

. . . . *Fiber-optic instruments, see 07.60.Vg*

42.81.Bm Fabrication, cladding, and splicing

42.81.Cn Fiber testing and measurement of fiber parameters

42.81.Dp Propagation, scattering, and losses; solitons

42.81.Gs Birefringence, polarization

42.81.Ht Gradient-index (GRIN) fiber devices

42.81.Pa Sensors, gyros

42.81.Qb Fiber waveguides, couplers, and arrays

42.81.Uv Fiber networks *(see also 42.79.Sz Optical communication systems, multiplexers, and demultiplexers)*

42.81.Wg Other fiber-optical devices *(for fiber lasers, see 42.55.Wd)*

42.82.−m Integrated optics

42.82.Bq Design and performance testing of integrated-optical systems

42.82.Cr Fabrication techniques; lithography, pattern transfer *(see also 85.40.−e Microelectronics: LSI, VLSI, ULSI; integrated circuit fabrication technology)*

42.82.Ds Interconnects, including holographic interconnects *(see also 42.79.Ta Optical computers, logic elements, interconnects, switches; neural networks)*

42.82.Et Waveguides, couplers, and arrays *(for fiber waveguides, see 42.81.Qb)*

42.82.Fv Hybrid systems

42.82.Gw Other integrated-optical elements and systems

42.86.+b Optical workshop techniques

42.87.−d Optical testing techniques

42.87.Bg Phase shifting interferometry *(for interferometers, see 07.60.Ly in instruments)*

42.88.+h Environmental and radiation effects on optical elements, devices, and systems

42.90.+m Other topics in optics (restricted to new topics in section 42)

43. Acoustics *(for more detailed headings, see Appendix to section 43)*

43.20.+g General linear acoustics

43.25.+y Nonlinear acoustics

43.28.+h Aeroacoustics and atmospheric sound *(see also 92.60.hh Acoustic gravity waves, tides, and compressional waves in meteorology)*

43.30.+m Underwater sound *(see also 92.10.Vz—in physical oceanography)*

43.35.+d Ultrasonics, quantum acoustics, and physical effects of sound

. . . . *Phonons in crystal lattices, see 63.20.−e*

. . . . *Acoustical properties of rocks and minerals, see 91.60.Lj*

. . . . *Sound waves in plasma, see 52.35.Dm*

. . . . *Low-temperature acoustics and sound in liquid helium, see section 67*

. . . . *Acoustical properties and ultrasonic relaxation of solids, see 62.65.+k and 62.80.+f*

. . . . *Acoustic properties of thin films, see 68.60.Bs*

. . . . *Acoustoelectric effects, see 72.50.+b and 73.50.Rb*

. . . . *Magnetoacoustic effects, oscillations, and resonance, see 72.55.+s, 73.50.Rb, and 75.80.+q*

. . . . *Acoustic holography, see 43.60.Sx in Acoustics Appendix;*

. . . . *Sound waves in fluid dynamics, see 47.35.Rs*

. . . . *Acoustooptical effects, see 78.20.Hp*

43.38.+n Transduction; acoustical devices for the generation and reproduction of sound

43.40.+s Structural acoustics and vibration

43.50.+y Noise: its effects and control

43.55.+p Architectural acoustics

43.58.+z Acoustical measurements and instrumentation

43.60.+d Acoustic signal processing

43.64.+r Physiological acoustics

. . . . *Biological effects of sound and ultrasound, see 87.50.Y−*

43.66.+y Psychological acoustics

43.70.+i Speech production

43.71.+m Speech perception

43.72.+q Speech processing and communication systems

43.75.+a Music and musical instruments

43.80.+p Bioacoustics

43.90.+v Other topics in acoustics (restricted to new topics in section 43)

44. Heat transfer

44.05.+e Analytical and numerical techniques

44.10.+i Heat conduction *(see also 66.25.+g and 66.70.−f in nonelectronic transport properties of condensed matter)*

44.15.+a Channel and internal heat flow

44.20.+b Boundary layer heat flow

44.25.+f Natural convection *(see also 47.27.te Turbulent convective heat transfer in fluid dynamics)*

44.27.+g Forced convection

44.30.+v Heat flow in porous media

44.35.+c Heat flow in multiphase systems

44.40.+a Thermal radiation

44.90.+c Other topics in heat transfer (restricted to new topics in section 44)

45. Classical mechanics of discrete systems

45.05.+x General theory of classical mechanics of discrete systems

45.10.−b Computational methods in classical mechanics *(see also 02.70.−c Computational techniques in mathematical methods in physics)*

45.10.Db Variational and optimization methods

45.10.Hj Perturbation and fractional calculus methods

45.10.Na Geometrical and tensorial methods

45.20.−d Formalisms in classical mechanics

45.20.D− Newtonian mechanics

45.20.da Forces and torques

45.20.dc Rotational dynamics

45.20.df Momentum conservation

45.20.dg Mechanical energy, work, and power

45.20.dh Energy conservation

45.20.Jj Lagrangian and Hamiltonian mechanics

45.30.+s General linear dynamical systems *(for nonlinear dynamical systems, see 05.45.−a)*

45.40.−f Dynamics and kinematics of rigid bodies

45.40.Aa Translation kinematics

45.40.Bb Rotational kinematics

45.40.Cc Rigid body and gyroscope motion

45.40.Gj Ballistics (projectiles; rockets)

45.40.Ln Robotics

45.50.−j Dynamics and kinematics of a particle and a system of particles

45.50.Dd General motion

45.50.Jf Few- and many-body systems

45.50.Pk Celestial mechanics *(see also 95.10.Ce in fundamental astronomy)*

45.50.Tn Collisions

45.70.−n Granular systems *(see also 05.65.+b Self-organized systems)*

45.70.Cc Static sandpiles; granular compaction

45.70.Ht Avalanches

45.70.Mg Granular flow: mixing, segregation and stratification

45.70.Qj Pattern formation

45.70.Vn Granular models of complex systems; traffic flow

45.80.+r Control of mechanical systems *(see also 46.80.+j Measurement methods and techniques in continuum mechanics of solids)*

45.90.+t Other topics in classical mechanics of discrete systems (restricted to new topics in section 45)

46. Continuum mechanics of solids

(see also 83.10.Ff in rheology; 91.60.Ba Elasticity, fracture, and flow; 91.45.Ga Dynamics and mechanics of tectonics; 91.55.Ln Kinematics of crustal and mantle deformation in geophysics)

46.05.+b General theory of continuum mechanics of solids

46.15.−x Computational methods in continuum mechanics *(see also 02.70.−c Computational techniques; simulations, in mathematical methods in physics)*

46.15.Cc Variational and optimizational methods

46.15.Ff Perturbation and complex analysis methods

46.25.−y Static elasticity

46.25.Cc Theoretical studies

46.25.Hf Thermoelasticity and electromagnetic elasticity (electroelasticity, magnetoelasticity)

46.32.+x Static buckling and instability

46.35.+z Viscoelasticity, plasticity, viscoplasticity *(see also 83.60.Bc, Df, in rheology; 91.60.Dc Plasticity, diffusion, and creep in physical properties of rocks and minerals)*

46.40.−f Vibrations and mechanical waves *(see also 43.40.+s Structural acoustics and vibration; 62.30.+d Mechanical and elastic waves; vibrations in mechanical properties of solids)*

46.40.Cd Mechanical wave propagation (including diffraction, scattering, and dispersion)

46.40.Ff Resonance, damping, and dynamic stability

46.40.Jj Aeroelasticity and hydroelasticity

46.50.+a Fracture mechanics, fatigue and cracks *(see also 62.20.M− Structural failure of materials in mechanical properties of condensed matter)*

46.55.+d Tribology and mechanical contacts *(see also 81.40.Pq Friction, lubrication and wear in materials science; 62.20.Qp Friction, tribology and hardness in mechanical properties of solids)*

46.65.+g Random phenomena and media *(see also 05.40.−a Fluctuation phenomena, random processes, noise, and Brownian motion)*

46.70.−p Application of continuum mechanics to structures

46.70.De Beams, plates, and shells

46.70.Hg Membranes, rods, and strings

46.70.Lk Other structures

46.80.+j Measurement methods and techniques in continuum mechanics of solids *(for mechanical instruments, equipment, and techniques, see 07.10.−h in instruments)*

46.90.+s Other topics in continuum mechanics of solids (restricted to new topics in section 46)

47. Fluid dynamics *(for fluid dynamics of quantum fluids, see section 67; see also section 83 Rheology; for sound generation by fluid flow, see 43.28.Ra—in Acoustics Appendix)*

47.10.−g General theory in fluid dynamics

47.10.A− Mathematical formulations

47.10.ab Conservation laws and constitutive relations

47.10.ad Navier-Stokes equations

47.10.Df Hamiltonian formulations

47.10.Fg Dynamical systems methods

47.11.−j Computational methods in fluid dynamics

47.11.Bc Finite difference methods

47.11.Df Finite volume methods

47.11.Fg Finite element methods

47.11.Hj Boundary element methods

47.11.Kb Spectral methods

47.11.Mn Molecular dynamics methods

47.11.Qr Lattice gas

47.11.St Multi-scale methods

47.15.−x Laminar flows

47.15.Cb Laminar boundary layers

47.15.Fe Stability of laminar flows

47.15.G− Low-Reynolds-number (creeping) flows

47.15.gm Thin film flows

47.15.gp Hele-Shaw flows

47.15.K− Inviscid laminar flows

47.15.ki Inviscid flows with vorticity

47.15.km Potential flows

47.15.Rq Laminar flows in cavities, channels, ducts, and conduits

47.15.St Free shear layers

47.15.Tr Laminar wakes

47.15.Uv Laminar jets

47.20.−k Flow instabilities *(see also 47.15.Fe Stability of laminar flows)*

47.20.Bp Buoyancy-driven instabilities (e.g., Rayleigh-Benard)

47.20.Cq Inviscid instability

47.20.Dr Surface-tension-driven instability

47.20.Ft Instability of shear flows (e.g., Kelvin-Helmholtz)

47.20.Gv Viscous and viscoelastic instabilities

47.20.Hw Morphological instability; phase changes

47.20.Ib Instability of boundary layers; separation

47.20.Ky Nonlinearity, bifurcation, and symmetry breaking

47.20.Lz Secondary instabilities

47.20.Ma Interfacial instabilities (e.g., Rayleigh-Taylor)

47.20.Pc Flow receptivity

47.20.Qr Centrifugal instabilities (e.g., Taylor-Couette flow)

47.27.−i Turbulent flows

47.27.Ak Fundamentals

47.27.Cn Transition to turbulence

47.27.De Coherent structures

47.27.E− Turbulence simulation and modeling

47.27.eb Statistical theories and models

47.27.ed Dynamical systems approaches

47.27.ef Field-theoretic formulations and renormalization

47.27.ek Direct numerical simulations

47.27.em Eddy-viscosity closures; Reynolds stress modeling

47.27.ep Large-eddy simulations

47.27.er Spectral methods

47.27.Gs Isotropic turbulence; homogeneous turbulence

47.27.Jv High-Reynolds-number turbulence

47.27.N− Wall-bounded shear flow turbulence

47.27.nb Boundary layer turbulence

47.27.nd Channel flow

47.27.nf Flows in pipes and nozzles

47.27.Rc Turbulence control

47.27.Sd Turbulence generated noise

47.27.T− Turbulent transport processes

47.27.tb Turbulent diffusion

47.27.te Turbulent convective heat transfer

47.27.W− Boundary-free shear flow turbulence

47.27.wb Turbulent wakes

47.27.wg Turbulent jets

47.27.wj Turbulent mixing layers

47.32.−y Vortex dynamics; rotating fluids *(for vortices in superfluid helium, see 67.25.dk and 67.30.he)*

47.32.C− Vortex dynamics

47.32.cb Vortex interactions

47.32.cd Vortex stability and breakdown

47.32.cf Vortex reconnection and rings

47.32.ck Vortex streets

47.32.Ef Rotating and swirling flows

47.32.Ff Separated flows

47.35.−i Hydrodynamic waves *(see also 47.65.−d Magnetohydrodynamics and electrohydrodynamics; 52.35.Bj Magnetohydrodynamic waves; 52.35.Dm Sound waves in Physics of plasmas and electric discharges)*

47.35.Bb Gravity waves

47.35.De Shear waves

47.35.Fg Solitary waves

47.35.Jk Wave breaking

47.35.Lf Wave-structure interactions

47.35.Pq Capillary waves

47.35.Rs Sound waves

47.35.Tv Magnetohydrodynamic waves

47.37.+q Hydrodynamic aspects of superfluidity; quantum fluids *(for transport and hydrodynamics of normal and superfluid phase of ^{4}He, see 67.25.bf, and 67.25.dg respectively; for transport and hydrodynamics of normal and superfluid phase of ^{3}He, see 67.30.eh, and 67.30.hb respectively)*

47.40.−x Compressible flows; shock waves *(see also 43.25.Cb Macrosonic propagation, finite amplitude sound; shock waves in Acoustics Appendix; 52.35.Tc Shock waves and discontinuities in Physics of plasmas and electric discharges; 82.40.Fp Shock wave initiated reactions, high-pressure chemistry in Physical chemistry and chemical physics)*

47.40.Dc General subsonic flows

47.40.Hg Transonic flows

47.40.Ki Supersonic and hypersonic flows

47.40.Nm Shock wave interactions and shock effects *(for shock wave initiated chemical reactions, see 82.40.Fp)*

47.40.Rs Detonation waves

47.45.−n Rarefied gas dynamics

47.45.Ab Kinetic theory of gases

47.45.Dt Free molecular flows

47.45.Gx Slip flows and accommodation

47.50.−d Non-Newtonian fluid flows

47.50.Cd Modeling

47.50.Ef Measurements

47.50.Gj Instabilities

47.51.+a Mixing *(see also 64.75.Ef Mixing in Equations of state, phase equilibria, and phase transitions; 82.60.Lf Thermodynamics of solutions in Physical chemistry and chemical physics; 83.50.Xa Mixing and blending in Rheology)*

47.52.+j Chaos in fluid dynamics *(see also 05.45.−a Nonlinear dynamics and chaos in Statistical physics, thermodynamics, and nonlinear dynamical systems)*

47.53.+n Fractals in fluid dynamics *(see also 05.45.Df Fractals in Statistical physics, thermodynamics, and nonlinear dynamical systems)*

47.54.−r Pattern selection; pattern formation *(see also 82.40.Ck Pattern formation in reactions with diffusion, flow and heat transfer in Physical chemistry and chemical physics; 87.18.Hf Spatiotemporal pattern formation in cellular populations in Biological and medical physics)*

47.54.Bd Theoretical aspects
47.54.De Experimental aspects
47.54.Fj Chemical and biological applications
47.54.Jk Materials science applications

47.55.−t Multiphase and stratified flows
47.55.Ca Gas/liquid flows
47.55.D− Drops and bubbles
47.55.db Drop and bubble formation
47.55.dd Bubble dynamics
47.55.df Breakup and coalescence
47.55.dk Surfactant effects
47.55.dm Thermocapillary effects
47.55.dp Cavitation and boiling
47.55.dr Interactions with surfaces
47.55.Hd Stratified flows
. . . . *Rotational flows, see 47.32.−y*
47.55.Iv Core-annular flows
47.55.Kf Particle-laden flows
47.55.Lm Fluidized beds
47.55.N− Interfacial flows
47.55.nb Capillary and thermocapillary flows
47.55.nd Spreading films
47.55.nk Liquid bridges
47.55.nm Curtains/sheets
47.55.np Contact lines
47.55.P− Buoyancy-driven flows; convection
47.55.pb Thermal convection
47.55.pd Multidiffusive convection
47.55.pf Marangoni convection

47.56.+r Flows through porous media

47.57.−s Complex fluids and colloidal systems *(see also 82.70.−y Disperse systems; complex fluids in Physical chemistry and chemical physics; 83.80.Hj Suspensions, dispersions, pastes, slurries, colloids; 83.80.Iz Emulsions and foams in Rheology)*
47.57.Bc Foams and emulsions
47.57.E− Suspensions
47.57.eb Diffusion and aggregation
47.57.ef Sedimentation and migration
47.57.Gc Granular flow
47.57.J− Colloidal systems
47.57.jb Microemulsions
47.57.jd Electrokinetic effects
47.57.Lj Flows of liquid crystals
47.57.Ng Polymers and polymer solutions
47.57.Qk Rheological aspects

47.60.−i Flow phenomena in quasi-one-dimensional systems *(see also 43.28.Py Interaction of fluid motion and sound, Doppler effect and sound in flow ducts in Acoustics Appendix; 47.15.Rq Laminar flows in cavities, channels, ducts and conduits; 47.27.nd Channel flows; 47.27.nf Flows in pipes and nozzles)*
47.60.Dx Flows in ducts and channels
47.60.Kz Flows and jets through nozzles

47.61.−k Micro- and nano- scale flow phenomena
47.61.Cb Non-continuum effects
47.61.Fg Flows in micro-electromechanical systems (MEMS) and nano-electromechanical systems (NEMS)
47.61.Jd Multiphase flows
47.61.Ne Micromixing

47.63.−b Biological fluid dynamics *(see also 87.19.U− Hemodynamics, 87.19.rh Fluid transport and rheology, 87.19.Wx Pneumodynamics, 87.85.gf Fluid mechanics and rheology in biological and medical physics)*
47.63.Cb Blood flow in cardiovascular system
47.63.Ec Pulmonary fluid mechanics
47.63.Gd Swimming microorganisms
47.63.Jd Microcirculation and flow through tissues
47.63.M− Biopropulsion in water and air
47.63.mc High-Reynolds-number motions
47.63.mf Low-Reynolds-number motions
47.63.mh Transport processes and drug delivery

47.65.−d Magnetohydrodynamics and electrohydrodynamics *(see also 47.35.Tv Magnetohydrodynamic waves; 52.30.Cv Magnetohydrodynamics, and 52.65.Kj Magnetohydrodynamics and fluid equation in Physics of plasmas and electric discharges; 83.80.Gv Electro- and magnetorheological fluids in Rheology)*
47.65.Cb Magnetic fluids and ferrofluids
47.65.Gx Electrorheological fluids
47.65.Md Plasma dynamos

47.70.−n Reactive and radiative flows *(see also 82.33.Vx Reactions in flames, combustion and explosion; 82.33.Xj Plasma reactions (including flowing afterglow and electric discharges); 82.33.Ya Chemistry of MOCVD and other vapor deposition methods in Physical chemistry and chemical physics; 92.60.Vb Radiative processes, solar radiation in Hydrospheric and atmospheric geophysics)*
47.70.Fw Chemically reactive flows *(see also 83.80.Jx-in rheology)*
47.70.Mc Radiation gas dynamics
47.70.Nd Nonequilibrium gas dynamics
47.70.Pq Flames; combustion

47.75.+f Relativistic fluid dynamics *(see also 52.27.Ny Relativistic plasmas in Physics of plasmas and electric discharges; 98.80.Jk Mathematical and relativistic aspects of cosmology in Stellar systems; interstellar medium; galactic and extragalactic objects and systems; the Universe)*

47.80.−v Instrumentation and measurement methods in fluid dynamics
47.80.Cb Velocity measurements
47.80.Fg Pressure and temperature measurements
47.80.Jk Flow visualization and imaging

47.85.−g Applied fluid mechanics
47.85.Dh Hydrodynamics, hydraulics, hydrostatics
47.85.Gj Aerodynamics
47.85.Kn Hydraulic and pneumatic machinery
47.85.L− Flow control
47.85.lb Drag reduction
47.85.ld Boundary layer control
47.85.lf Flow noise reduction
47.85.lk Mixing enhancement
47.85.M− Material processing flows; industrial applications
47.85.mb Coating flows
47.85.md Polymer processing flows
47.85.mf Lubrication flows
47.85.Np Fluidics
. . . . *Atmospheric circulation, see 92.60.Bh*
. . . . *Atmospheric boundary layer processes, see 92.60.Fm*
. . . . *Atmospheric turbulence, see 92.60.hk*
. . . . *Storms, see 92.60.Qx*
. . . . *Hydrodynamics of the oceans, see 92.10.−c*
. . . . *Mantle convection, see 91.45.Fj*
. . . . *Lava and magma rheology, see 83.80.Nb, 91.40.Hw, and 91.40.Jk*
. . . . *Groundwater flow, see 92.40.Kf*
. . . . *Role of fluids in structural geology, see 91.55.Tt*
. . . . *Flows in streams and rivers, see 92.40.Qk;*
. . . . *Geothermal fluids, see 91.40.Ge*

47.90.+a Other topics in fluid dynamics (restricted to new topics in section 47)

50. PHYSICS OF GASES, PLASMAS, AND ELECTRIC DISCHARGES

51. Physics of gases

51.10.+y **Kinetic and transport theory of gases** *(see also 05.20.Dd Kinetic theory in classical statistical mechanics; see also 47.70.Mc Radiation gas dynamics)*

51.20.+d **Viscosity, diffusion, and thermal conductivity**

51.30.+i **Thermodynamic properties, equations of state** *(see also 05.70.Ce Thermodynamic functions and equations of state in thermodynamics)*

51.35.+a **Mechanical properties; compressibility**

51.40.+p **Acoustical properties** *(see also 43.28.−g Aeroacoustics and atmospheric sound in Acoustics Appendix; for ultrasonic relaxation in gases, see 43.35.Fj—in Acoustics Appendix)*

51.50.+v **Electrical properties (ionization, breakdown, electron and ion mobility, etc.)** *(see also 52.80.−s Electric discharges in physics of plasmas)*

51.60.+a **Magnetic properties**

51.70.+f **Optical and dielectric properties**

. . . . *Sorption, see 68.43.−h*

. . . . *Gas sensors and detectors, see 07.07.Df*

51.90.+r **Other topics in the physics of gases (restricted to new topics in section 51)**

52. Physics of plasmas and electric discharges *(for space plasma physics, see 94.05.−a; for astrophysical plasmas, see 95.30.Qd; for physics of the ionosphere and magnetosphere, see 94.20.−y and 94.30.−d respectively)*

52.20.−j **Elementary processes in plasmas**

52.20.Dq Particle orbits

52.20.Fs Electron collisions

52.20.Hv Atomic, molecular, ion, and heavy-particle collisions

52.25.−b **Plasma properties** *(for chemical reactions in plasma, see 82.33.Xj)*

52.25.Dg Plasma kinetic equations

52.25.Fi Transport properties

52.25.Gj Fluctuation and chaos phenomena *(for plasma turbulence, see 52.35.Ra; see also 05.45.−a Nonlinear dynamics and chaos)*

52.25.Jm Ionization of plasmas

52.25.Kn Thermodynamics of plasmas

52.25.Mq Dielectric properties

52.25.Os Emission, absorption, and scattering of electromagnetic radiation

52.25.Tx Emission, absorption, and scattering of particles

52.25.Vy Impurities in plasmas

52.25.Xz Magnetized plasmas

52.25.Ya Neutrals in plasmas

52.27.−h **Basic studies of specific kinds of plasmas**

52.27.Aj Single-component, electron-positive-ion plasmas

52.27.Cm Multicomponent and negative-ion plasmas

52.27.Ep Electron-positron plasmas

52.27.Gr Strongly-coupled plasmas

52.27.Jt Nonneutral plasmas

52.27.Lw Dusty or complex plasmas; plasma crystals

52.27.Ny Relativistic plasmas

52.30.−q **Plasma dynamics and flow**

52.30.Cv Magnetohydrodynamics (including electron magnetohydrodynamics) *(see also 47.65.−d Magnetohydrodynamics and electrohydrodynamics in fluid dynamics; for MHD generators, see 52.75.Fk; see also 95.30.Qd Magnetohydrodynamics and plasmas in astrophysics)*

52.30.Ex Two-fluid and multi-fluid plasmas

52.30.Gz Gyrokinetics

52.35.−g **Waves, oscillations, and instabilities in plasmas and intense beams** *(see also 94.20.wf Plasma waves and instabilities in physics of the ionosphere; 94.30.cq MHD waves, plasma waves, and instabilities in physics of the magnetosphere; 96.50.Tf MHD waves, plasma waves, turbulence in interplanetary physics)*

52.35.Bj Magnetohydrodynamic waves (e.g., Alfven waves)

52.35.Dm Sound waves

52.35.Fp Electrostatic waves and oscillations (e.g., ion-acoustic waves)

52.35.Hr Electromagnetic waves (e.g., electron-cyclotron, Whistler, Bernstein, upper hybrid, lower hybrid)

52.35.Kt Drift waves

52.35.Lv Other linear waves

52.35.Mw Nonlinear phenomena: waves, wave propagation, and other interactions (including parametric effects, mode coupling, ponderomotive effects, etc.)

52.35.Py Macroinstabilities (hydromagnetic, e.g., kink, fire-hose, mirror, ballooning, tearing, trapped-particle, flute, Rayleigh-Taylor, etc.)

52.35.Qz Microinstabilities (ion-acoustic, two-stream, loss-cone, beam-plasma, drift, ion- or electron-cyclotron, etc.)

52.35.Ra Plasma turbulence

52.35.Sb Solitons; BGK modes

52.35.Tc Shock waves and discontinuities

52.35.Vd Magnetic reconnection *(see also 94.30.cp in physics of the magnetosphere)*

52.35.We Plasma vorticity

52.38.−r **Laser–plasma interactions** *(for plasma production and heating by laser beams, see 52.50.Jm)*

52.38.Bv Rayleigh scattering; stimulated Brillouin and Raman scattering

52.38.Dx Laser light absorption in plasmas (collisional, parametric, etc.)

52.38.Fz Laser-induced magnetic fields in plasmas

52.38.Hb Self-focussing, channeling, and filamentation in plasmas

52.38.Kd Laser-plasma acceleration of electrons and ions *(see also 41.75.Jv Laser-driven acceleration in electromagnetism; electron and ion optics)*

52.38.Mf Laser ablation *(see also 79.20.Ds, Laser-beam impact phenomena)*

52.38.Ph X-ray, γ-ray, and particle generation

52.40.−w **Plasma interactions (nonlaser)**

52.40.Db Electromagnetic (nonlaser) radiation interactions with plasma *(for electromagnetic wave propagation in the ionosphere and magnetosphere, see 94.20.Bb and 94.30.Tz respectively)*

52.40.Fd Plasma interactions with antennas; plasma-filled waveguides

52.40.Hf Plasma–material interactions; boundary layer effects

52.40.Kh Plasma sheaths *(see also 94.30.cj Magnetosheath)*

52.40.Mj Particle beam interactions in plasmas

52.50.−b **Plasma production and heating** *(see also 52.80.−s Electric discharges)*

52.50.Dg Plasma sources

52.50.Gj Plasma heating by particle beams

52.50.Jm Plasma production and heating by laser beams (laser–foil, laser–cluster, etc.)

52.50.Lp Plasma production and heating by shock waves and compression

52.50.Nr Plasma heating by DC fields; ohmic heating, arcs

52.50.Qt Plasma heating by radio-frequency fields; ICR, ICP, helicons

52.50.Sw Plasma heating by microwaves; ECR, LH, collisional heating

52.55.−s Magnetic confinement and equilibrium *(see also 28.52.−s Fusion reactors)*

52.55.Dy General theory and basic studies of plasma lifetime, particle and heat loss, energy balance, field structure, etc.

52.55.Ez Theta pinch

52.55.Fa Tokamaks, spherical tokamaks

52.55.Hc Stellarators, torsatrons, heliacs, bumpy tori, and other toroidal confinement devices

52.55.Ip Spheromaks

52.55.Jd Magnetic mirrors, gas dynamic traps

52.55.Lf Field-reversed configurations, rotamaks, astrons, ion rings, magnetized target fusion, and cusps

52.55.Pi Fusion products effects (e.g., alpha-particles, etc.), fast particle effects

52.55.Rk Power exhaust; divertors

52.55.Tn Ideal and resistive MHD modes; kinetic modes

52.55.Wq Current drive; helicity injection

52.57.−z Laser inertial confinement

52.57.Bc Target design and fabrication

52.57.Fg Implosion symmetry and hydrodynamic instability (Rayleigh-Taylor, Richtmyer-Meshkov, imprint, etc.)

52.57.Kk Fast ignition of compressed fusion fuels

52.58.−c Other confinement methods

52.58.Ei Light-ion inertial confinement

52.58.Hm Heavy-ion inertial confinement

52.58.Lq Z-pinches, plasma focus, and other pinch devices

52.58.Qv Electrostatic and high-frequency confinement

52.59.−f Intense particle beams and radiation sources *(see also 29.25.−t Particle sources and targets, and 29.27.−a Beams in particle accelerators, in instrumentation for elementary-particle and nuclear physics)*

52.59.Bi Grid- and ion-diode-accelerated beams

52.59.Dk Magneto-plasma accelerated plasmas

52.59.Fn Multistage accelerated heavy-ion beams

52.59.Hq Dense plasma focus

52.59.Mv High-voltage diodes *(for high-current and high-voltage technology, see 84.70.+p)*

52.59.Px Hard X-ray sources

52.59.Qy Wire array Z-pinches

52.59.Rz Free-electron devices *(for free-electron lasers, see 41.60.Cr)*

52.59.Sa Space-charge-dominated beams

52.59.Tb Moderate-intensity beams

52.59.Wd Emittance-dominated beams

52.59.Ye Plasma devices for generation of coherent radiation

52.65.−y Plasma simulation

52.65.Cc Particle orbit and trajectory

52.65.Ff Fokker-Planck and Vlasov equation

52.65.Kj Magnetohydrodynamic and fluid equation

52.65.Pp Monte Carlo methods

52.65.Rr Particle-in-cell method

52.65.Tt Gyrofluid and gyrokinetic simulations

52.65.Vv Perturbative methods

52.65.Ww Hybrid methods

52.65.Yy Molecular dynamics methods

52.70.−m Plasma diagnostic techniques and instrumentation

52.70.Ds Electric and magnetic measurements

52.70.Gw Radio-frequency and microwave measurements

52.70.Kz Optical (ultraviolet, visible, infrared) measurements

52.70.La X-ray and γ-ray measurements

52.70.Nc Particle measurements

52.72.+v Laboratory studies of space- and astrophysical-plasma processes *(see also 94.05.Rx in space plasma physics)*

52.75.−d Plasma devices *(for ion sources, see 29.25.Lg, Ni; for plasma sources, see 52.50.Dg)*

52.75.Di Ion and plasma propulsion

52.75.Fk Magnetohydrodynamic generators and thermionic convertors; plasma diodes *(see also 84.60.Lw, Ny in direct-energy conversion and storage)*

52.75.Hn Plasma torches

52.75.Kq Plasma switches (e.g., spark gaps)

52.75.Xx Thermionic and filament-based sources (e.g., Q machines, double- and triple-plasma devices, etc.)

52.77.−j Plasma applications

52.77.Bn Etching and cleaning *(see also 81.65.Cf Surface cleaning, etching, patterning in surface treatments)*

52.77.Dq Plasma-based ion implantation and deposition *(see also 81.15.Jj Ion and electron beam-assisted deposition)*

52.77.Fv High-pressure, high-current plasmas (plasma spray, arc welding, etc.) *(see also 81.15.Rs Spray coating techniques)*

. . . . *Chemical synthesis; combustion synthesis, see 81.20.Ka*

52.80.−s Electric discharges *(see also 51.50.+v Electrical properties of gases; for plasma reactions including flowing afterglow and electric discharges, see 82.33.Xj in physical chemistry and chemical physics)*

52.80.Dy Low-field and Townsend discharges

52.80.Hc Glow; corona

52.80.Mg Arcs; sparks; lightning; atmospheric electricity *(see also 92.60.Pw Atmospheric electricity, lightning in meteorology)*

52.80.Pi High-frequency and RF discharges

52.80.Qj Explosions; exploding wires

52.80.Sm Magnetoactive discharges (e.g., Penning discharges)

52.80.Tn Other gas discharges

52.80.Vp Discharge in vacuum

52.80.Wq Discharge in liquids and solids *(for electric breakdown in liquids, see 77.22.Jp)*

52.80.Yr Discharges for spectral sources (including inductively coupled plasma)

52.90.+z Other topics in physics of plasmas and electric discharges (restricted to new topics in section 52)

60. CONDENSED MATTER: STRUCTURAL, MECHANICAL, AND THERMAL PROPERTIES

61. Structure of solids and liquids; crystallography *(for surface, interface, and thin film structure, see section 68)*

61.05.−a Techniques for structure determination

. . . . *Microscopy of surfaces, interfaces, and thin films, see 68.37.−d*

61.05.C− X-ray diffraction and scattering *(for x-ray diffractometers, see 07.85.Jy; for x-ray studies of crystal defects, see 61.72.Dd, Ff)*

61.05.cc Theories of x-ray diffraction and scattering

61.05.cf X-ray scattering (including small-angle scattering)

61.05.cj X-ray absorption spectroscopy: EXAFS, NEXAFS, XANES, etc. (for x-ray and EXAFS applications in biological physics, see 87.64.kd)

61.05.cm X-ray reflectometry (surfaces, interfaces, films)

61.05.cp X-ray diffraction

61.05.F− Neutron diffraction and scattering

61.05.fd Theories of neutron diffraction and scattering

61.05.fg Neutron scattering (including small-angle scattering)

61.05.fj Neutron reflectometry

61.05.fm Neutron diffraction

. . . . *Microscopy of surfaces, interfaces, and thin films, see 68.37.−d*

61.05.J− Electron diffraction and scattering *(for electron diffractometers, see 07.78.+s)*

61.05.jd Theories of electron diffraction and scattering

61.05.jh Low-energy electron diffraction (LEED) and reflection high-energy electron diffraction (RHEED)

61.05.jm Convergent-beam electron diffraction, selected-area electron diffraction, nanodiffraction

61.05.jp Electron holography

61.05.js X-ray photoelectron diffraction

61.05.Np Atom, molecule, and ion scattering (for structure determination only)

61.05.Qr Magnetic resonance techniques; Mössbauer spectroscopy (for structure determination only)

61.20.−p Structure of liquids

61.20.Gy Theory and models of liquid structure

61.20.Ja Computer simulation of liquid structure

61.20.Lc Time-dependent properties; relaxation *(for glass transitions, see 64.70.P−)*

61.20.Ne Structure of simple liquids

61.20.Qg Structure of associated liquids: electrolytes, molten salts, etc.

61.25.−f Studies of specific liquid structures

61.25.Bi Liquid noble gases

61.25.Em Molecular liquids

61.25.H− Macromolecular and polymers solutions; polymer melts

61.25.he Polymer solutions

61.25.hk Polymer melts and blends

61.25.hp Polymer swelling, cross linking

61.25.Mv Liquid metals and alloys

61.30.−v Liquid crystals *(for phase transitions in liquid crystals, see 64.70.M-; for liquid crystals as dielectric materials, see 77.84.Nh; for liquid crystals as optical materials, see 42.70.Df; for liquid crystal devices, see 42.79.Kr)*

61.30.Cz Molecular and microscopic models and theories of liquid crystal structure

61.30.Dk Continuum models and theories of liquid crystal structure

61.30.Eb Experimental determinations of smectic, nematic, cholesteric, and other structures

61.30.Gd Orientational order of liquid crystals; electric and magnetic field effects on order

61.30.Hn Surface phenomena: alignment, anchoring, anchoring transitions, surface-induced layering, surface-induced ordering, wetting, prewetting transitions, and wetting transitions

61.30.Jf Defects in liquid crystals

61.30.Mp Blue phases and other defect-phases

61.30.Pq Microconfined liquid crystals: droplets, cylinders, randomly confined liquid crystals, polymer dispersed liquid crystals, and porous systems

61.30.St Lyotropic phases

61.30.Vx Polymer liquid crystals

61.41.+e Polymers, elastomers, and plastics *(see also 81.05.Lg in materials science; for rheology of polymers, see section 83; for polymer reactions and polymerization, see 82.35.−x in physical chemistry and chemical physics)*

61.43.−j Disordered solids *(see also 81.05.Gc Amorphous semiconductors, 81.05.Kf Glasses, and 81.05.Rm Porous materials; granular materials in materials science; for photoluminescence of disordered solids, see 78.55.Mb and 78.55.Qr)*

61.43.Bn Structural modeling: serial-addition models, computer simulation

61.43.Dq Amorphous semiconductors, metals, and alloys

61.43.Er Other amorphous solids

61.43.Fs Glasses

61.43.Gt Powders, porous materials

61.43.Hv Fractals; macroscopic aggregates (including diffusion-limited aggregates)

61.44.−n Semi-periodic solids

61.44.Br Quasicrystals

61.44.Fw Incommensurate crystals

61.46.−w Structure of nanoscale materials *(for thermal properties of nanocrystals and nanotubes, see 65.80.+n; for mechanical properties of nanoscale systems, see 62.25.−g; for electronic transport in nanoscale materials, see 73.63.−b; see also 62.23.−c Structural classes of nanoscale systems; 64.70.Nd Structural transitions in nanoscale materials)*

61.46.Bc Structure of clusters (e.g., metcars; not fragments of crystals; free or loosely aggregated or loosely attached to a substrate) *(see also 61.48.−c for structure of fullerenes)*

61.46.Df Structure of nanocrystals and nanoparticles (″colloidal″ quantum dots but not gate-isolated embedded quantum dots)

61.46.Fg Nanotubes

61.46.Hk Nanocrystals

61.46.Km Structure of nanowires and nanorods (long, free or loosely attached, quantum wires and quantum rods, but not gate-isolated embedded quantum wires)

61.46.Np Structure of nanotubes (hollow nanowires) *(see 61.48.De for carbon nanotubes, boron nanotubes, and closely related graphitelike systems)*

61.48.−c Structure of fullerenes and related hollow molecular clusters *(see also 81.05.Tp Fullerenes and related materials in materials science)*

61.48.De Structure of carbon nanotubes, boron nanotubes, and closely related graphitelike systems *(for structure of hollow nanowires, see 61.46.Np)*

61.50.−f Structure of bulk crystals

61.50.Ah Theory of crystal structure, crystal symmetry; calculations and modeling

. . . . *Crystal growth, see 81.10.−h*

61.50.Ks Crystallographic aspects of phase transformations; pressure effects *(see also 81.30.Hd in materials science)*

61.50.Lt Crystal binding; cohesive energy

61.50.Nw Crystal stoichiometry

61.66.−f Structure of specific crystalline solids *(for surface structure, see 68.35.B−)*

61.66.Bi Elemental solids

61.66.Dk Alloys

61.66.Fn Inorganic compounds

61.66.Hq Organic compounds

. . . . *Quantum crystals, see 67.80.−s*

61.68.+n Crystallographic databases

61.72.−y Defects and impurities in crystals; microstructure *(for radiation induced defects, see 61.80.−x; for defects in surfaces, interfaces, and thin films, see 68.35.Dv and 68.55.Ln; see also 85.40.Ry Impurity doping, diffusion, and ion implantation technology)*

61.72.Bb Theories and models of crystal defects

61.72.Cc Kinetics of defect formation and annealing

61.72.Dd Experimental determination of defects by diffraction and scattering

61.72.Ff Direct observation of dislocations and other defects (etch pits, decoration, electron microscopy, x-ray topography, etc.)

61.72.Hh Indirect evidence of dislocations and other defects (resistivity, slip, creep, strains, internal friction, EPR, NMR, etc.)

61.72.J− Point defects and defect clusters

61.72.jd Vacancies

61.72.jj Interstitials

61.72.jn Color centers

61.72.Lk Linear defects: dislocations, disclinations

61.72.Mm Grain and twin boundaries

61.72.Nn Stacking faults and other planar or extended defects

61.72.Qq Microscopic defects (voids, inclusions, etc.)

61.72.S− Impurities in crystals

61.72.sd Impurity concentration

61.72.sh Impurity distribution

61.72.sm Impurity gradients

61.72.U− Doping and impurity implantation

61.72.uf Ge and Si

61.72.uj III–V and II–VI semiconductors

61.72.up Other materials

61.72.Yx Interaction between different crystal defects; gettering effect

61.80.−x Physical radiation effects, radiation damage *(for photochemical reactions, see 82.50.−m; for effects of ionizing radiation on biological systems, see 87.53.−j)*

. . . . *Radiation treatments, see 81.40.Wx*

61.80.Az Theory and models of radiation effects

61.80.Ba Ultraviolet, visible, and infrared radiation effects (including laser radiation)

61.80.Cb X-ray effects

61.80.Ed γ-ray effects

61.80.Fe Electron and positron radiation effects

61.80.Hg Neutron radiation effects

61.80.Jh Ion radiation effects *(for ion implantation, see 61.72.U−)*

61.80.Lj Atom and molecule irradiation effects

. . . . *Channeling, blocking, and energy loss of particles, see 61.85.+p*

61.82.−d Radiation effects on specific materials

61.82.Bg Metals and alloys

61.82.Fk Semiconductors

61.82.Ms Insulators

61.82.Pv Polymers, organic compounds

61.82.Rx Nanocrystalline materials

61.85.+p Channeling phenomena (blocking, energy loss, etc.)

61.90.+d Other topics in structure of solids and liquids; crystallography (restricted to new topics in section 61)

62. Mechanical and acoustical properties of condensed matter

(for mechanical properties of tissues and organs, see 87.19.R-; for mechanical properties of nanoscale systems, see 62.25.−g; for nonlinear acoustics of solids, see 43.25.Dc—in Acoustics Appendix; for mechanical and acoustical properties of interfaces and thin films, see 68.35.Gy, 68.35.Iv, and 68.60.Bs; for mechanical properties related to treatment conditions, see 81.40.Jj, Lm, Np—in materials science; for mechanical and acoustical properties of superconductors, see 74.25.Ld; for mechanical and acoustical properties of rocks and minerals, see 91.60.Ba, Dc, and Lj)

62.10.+s Mechanical properties of liquids *(for viscosity of liquids, see 66.20.−d)*

62.20.−x Mechanical properties of solids

62.20.D− Elasticity *(for materials treatment effects on elastic properties, see 81.40.Jj)*

62.20.de Elastic moduli

62.20.dj Poisson's ratio

62.20.dq Other elastic constants

62.20.F− Deformation and plasticity *(see also 83.50.−v Deformation and flow in rheology; for materials treatment effects on deformation, see 81.40.Lm)*

62.20.fg Shape-memory effect; yield stress; superelasticity

62.20.fk Ductility, malleability

62.20.fq Plasticity and superplasticity

62.20.Hg Creep

62.20.M− Structural failure of materials *(for materials treatment effects on microstructure, see 81.40.Np)*

62.20.me Fatigue

62.20.mj Brittleness

62.20.mm Fracture

62.20.mq Buckling

62.20.mt Cracks

62.20.Qp Friction, tribology, and hardness *(see also 46.55.+d Tribology and mechanical contacts in continuum mechanics of solids; for materials treatment effects on friction related properties, see 81.40.Pq)*

62.23.−c Structural classes of nanoscale systems *(see also 81.07.−b Nanoscale materials and structures: fabrication and characterization in materials science)*

62.23.Eg Nanodots

62.23.Hj Nanowires

62.23.Kn Nanosheets

62.23.Pq Composites (nanosystems embedded in a larger structure)

62.23.St Complex nanostructures, including patterned or assembled structures

62.25.−g Mechanical properties of nanoscale systems *(for structure of nanoscale systems, see 61.46.−w; for structural transitions in nanoscale materials, see 64.70.Nd; for electronic transport in nanoscale systems, see 73.63.−b)*

62.25.De Low-frequency properties: response coefficients

62.25.Fg High-frequency properties, responses to resonant or transient (time-dependent) fields

62.25.Jk Mechanical modes of vibration

62.25.Mn Fracture/brittleness

62.30.+d Mechanical and elastic waves; vibrations *(see also 43.40.+s Structural acoustics and vibration; 46.40.−f Vibrations and mechanical waves in continuum mechanics of solids)*

62.40.+i Anelasticity, internal friction, stress relaxation, and

mechanical resonances *(for materials treatment effects on anelasticity, see 81.40.Jj in materials science)*

. . . . *Thermomechanical effects, see 65.40.De*

. . . . *Magnetomechanical effects, see 75.80.+q*

. . . . *Piezoelectric effects, see 77.65.−j*

. . . . *Elastooptical effects, see 78.20.Hp*

62.50.−p High-pressure effects in solids and liquids *(for high pressure apparatus and techniques, see 07.35.+k; for high-pressure behavior of rocks and minerals, see 91.60.Gf; for pressure treatments, see 81.40.Vw in materials science)*

62.50.Ef Shock wave effects in solids and liquids *(for shock wave initiated high-pressure chemistry, see 82.40.Fp; see also 47.40.Nm Shock wave interactions and shock effects in fluid dynamics)*

62.60.+v Acoustical properties of liquids *(see also 43.35.+d in acoustics; 87.50.Y− Biological effects of acoustic and ultrasonic energy in biological and medical physics)*

. . . . *Lattice dynamics, phonons, see section 63*

. . . . *Sound waves in fluid dynamics, see 47.35.Rs*

. . . . *Second sound in quantum fluids, see 67.25.dt*

62.65.+k Acoustical properties of solids

. . . . *Magnetoacoustic effects, see 72.55.+s and 73.50.Rb*

. . . . *Acoustoelectric effects, see 72.50.+b, 73.50.Rb, and 77.65.Dq*

. . . . *Acoustooptical effects, see 78.20.Hp*

62.80.+f Ultrasonic relaxation *(see also 43.35.Fj Ultrasonic relaxation processes in liquids and solids—in Acoustics Appendix; for ultrasonic attenuation in superconductors, see 74.25.Ld)*

62.90.+k Other topics in mechanical and acoustical properties of condensed matter (restricted to new topics in section 62)

63. Lattice dynamics *(see also 78.30.−j Infrared and Raman spectra; for surface and interface vibrations, see 68.35.Ja; for adsorbate vibrations, see 68.43.Pq; for lattice dynamics of quantum solids, see 67.80.de)*

63.10.+a General theory

63.20.−e Phonons in crystal lattices *(for phonons in superconductors, see 74.25.Kc; see also 43.35.Gk Phonons in crystal lattice, quantum acoustics—in Acoustics Appendix)*

63.20.D− Phonon states and bands, normal modes, and phonon dispersion

63.20.dd Measurements

63.20.dh Fitted theory

63.20.dk First-principles theory

63.20.K− Phonon interactions

63.20.kd Phonon–electron interactions

63.20.kg Phonon–phonon interactions

63.20.kk Phonon interactions with other quasiparticles

63.20.kp Phonon–defect interactions

63.20.Pw Localized modes

63.20.Ry Anharmonic lattice modes

63.22.−m Phonons or vibrational states in low-dimensional structures and nanoscale materials

63.22.Dc Free films

63.22.Gh Nanotubes and nanowires

63.22.Kn Clusters and nanocrystals

63.22.Np Layered systems

63.50.−x Vibrational states in disordered systems

63.50.Gh Disordered crystalline alloys

63.50.Lm Glasses and amorphous solids

63.70.+h Statistical mechanics of lattice vibrations and displacive phase transitions

63.90.+t Other topics in lattice dynamics (restricted to new topics in section 63)

64. Equations of state, phase equilibria, and phase transitions *(see also 82.60.−s Chemical thermodynamics)*

64.10.+h General theory of equations of state and phase equilibria *(see also 05.70.Ce Thermodynamic functions and equations of state)*

64.30.−t Equations of state of specific substances

64.30.Ef Equations of state of pure metals and alloys

64.30.Jk Equations of state of nonmetals

64.60.−i General studies of phase transitions *(see also 63.70.+h Statistical mechanics of lattice vibrations and displacive phase transitions; for critical phenomena in solid surfaces and interfaces, and in magnetism, see 68.35.Rh, and 75.40.−s, respectively)*

64.60.A− Specific approaches applied to studies of phase transitions

64.60.ae Renormalization-group theory

64.60.ah Percolation

64.60.al Fractal and multifractal systems (see also 61.43.Hv Fractals; macroscopic aggregates)

64.60.an Finite-size systems

64.60.aq Networks

64.60.at Convolution

64.60.av Cracks, sandpiles, avalanches, and earthquakes (for general studies of sandpiles and avalanches, see 45.70.Cc, Ht in classical mechanics of discrete systems; see also 91.30.Px Earthquakes in geophysics)

64.60.Bd General theory of phase transitions

64.60.Cn Order–disorder transformations *(see also 81.30.Hd Constant-composition solid-solid phase transformations: polymorphic, massive, and order-disorder in materials science)*

64.60.De Statistical mechanics of model systems (Ising model, Potts model, field-theory models, Monte Carlo techniques, etc)

64.60.Ej Studies/theory of phase transitions of specific substances

64.60.F− Equilibrium properties near critical points, critical exponents

64.60.fd General theory of critical region behavior

64.60.fh Studies of specific substances in the critical region

. . . . *Properties of quantum fluids, see section 67*

64.60.Ht Dynamic critical phenomena

64.60.Kw Multicritical points

64.60.My Metastable phases

64.60.Q− Nucleation *(see also 82.60.Nh Thermodynamics of nucleation in physical chemistry and chemical physics)*

64.60.qe General theory and computer simulations of nucleation

64.60.qj Studies of nucleation in specific substances

64.70.−p Specific phase transitions

64.70.D− Solid–liquid transitions

64.70.dg Crystallization of specific substances

64.70.dj Melting of specific substances

64.70.dm General theory of the solid-liquid transition

64.70.F− Liquid–vapor transitions

64.70.fh Boiling and bubble dynamics (for bubble formation, bubble dynamics, boiling and cavitation, see section 47.55.D−; for acoustic cavitation, see 43.35.Ei see Acoustic Appendix

64.70.fm Thermodynamics studies of

evaporation and condensation (for evaporation and condensation on surfaces, see 68.03.Fg)

64.70.Hz Solid–vapor transitions

64.70.Ja Liquid–liquid transitions

64.70.K− Solid–solid transitions *(see also 61.50.Ks Crystallographic aspects of phase transformations; pressure effects; 75.30.Kz and 77.80.Bh for magnetic and ferroelectric transitions, respectively; for materials science aspects, see 81.30.−t)*

64.70.kd Metals and alloys

64.70.kg Semiconductors

64.70.kj Glasses

64.70.km Polymers

64.70.kp Ionic crystals

64.70.kt Molecular crystals

64.70.M− Transitions in liquid crystals

64.70.mf Theory and modeling of specific liquid crystal transitions, including computer simulation

64.70.mj Experimental studies of liquid crystal transitions

64.70.Nd Structural transitions in nanoscale materials

64.70.P− Glass transitions of specific systems

64.70.pe Metallic glasses

64.70.ph Nonmetallic glasses (silicates, oxides, selenides, etc)

64.70.pj Polymers

64.70.pm Liquids

64.70.pp Liquid crystals (see also 64.70.M− Transitions in liquid crystals)

64.70.ps Granules

64.70.pv Colloids

64.70.Q− Theory and modeling of the glass transition

64.70.qd Thermodynamics and statistical mechanics

64.70.qj Dynamics and criticality

64.70.Rh Commensurate–incommensurate transitions

64.70.Tg Quantum phase transitions *(for quantum Hall effects aspects, see 73.43.Nq in electronic structure of surfaces, interfaces, thin films, and low dimensional structures)*

64.75.−g Phase equilibria *(see also 82.60.Lf Thermodynamics of solutions; 47.51.+a Mixing in fluid dynamics; for properties of solutions of biomolecules, see 87.15.N− in biological physics)*

64.75.Bc Solubility

64.75.Cd Phase equilibria of fluid mixtures, including gases, hydrates, etc.

64.75.Ef Mixing

64.75.Gh Phase separation and segregation in model systems (hard spheres, Lennard-Jones, etc.)

64.75.Jk Phase separation and segregation in nanoscale systems *(for general nanoscale materials studies, see 81.07.−b in materials science)*

64.75.Lm Phase separation and segregation in oxidation *(for general surface oxidation studies in surface treatments, see 81.65.Mq)*

64.75.Nx Phase separation and segregation in solid solutions

64.75.Op Phase separation and segregation in alloying

64.75.Qr Phase separation and segregation in semiconductors

64.75.St Phase separation and segregation in thin films

64.75.Va Phase separation and segregation in polymer blends/polymeric solutions

64.75.Xc Phase separation and segregation in colloidal systems

64.75.Yz Self-assembly

64.90.+b Other topics in equations of state, phase equilibria, and phase transitions (restricted to new topics in section 64)

65. Thermal properties of condensed matter *(see also section 44 Heat transfer; for thermodynamic properties of quantum fluids and solids, see section 67; for thermal properties of thin films, see 68.60.Dv; for nonelectronic thermal conduction, see 66.25.+g and 66.70.−f; for thermal properties of rocks and minerals, see 91.60.Ki; for thermodynamic properties of superconductors, see 74.25.Bt; see also 87.19.Pp Biothermics and thermal processes in biological physics)*

65.20.−w Thermal properties of liquids

65.20.De General theory of thermodynamic properties of liquids, including computer simulation

65.20.Jk Studies of thermodynamic properties of specific liquids

65.40.−b Thermal properties of crystalline solids *(for specific heat of superconductors, see 74.25.Bt; for specific heat of magnetic systems, see 75.40.Cx)*

65.40.Ba Heat capacity

65.40.De Thermal expansion; thermomechanical effects

65.40.G− Other thermodynamical quantities *(for magnetocaloric effect, see 75.30.Sg; for properties of dielectrics, ferroelectrics, and piezoelectrics, see section 77)*

65.40.gd Entropy

65.40.gh Work functions

65.40.gk Electrochemical properties (for general electrochemistry, see 82.45.−h)

65.40.gp Surface energy (see also 68.35.Md Surface thermodynamics, surface energies in surfaces and interfaces)

65.60.+a Thermal properties of amorphous solids and glasses: heat capacity, thermal expansion, etc.

65.80.+n Thermal properties of small particles, nanocrystals, and nanotubes *(see also 82.60.Qr Thermodynamics of nanoparticles in physical chemistry and chemical physics)*

65.90.+i Other topics in thermal properties of condensed matter (restricted to new topics in section 65)

66. Nonelectronic transport properties of condensed matter

66.10.−x Diffusion and ionic conduction in liquids

66.10.C− Diffusion and thermal diffusion *(for osmosis in biological systems, see 82.39.Wj in physical chemistry; for cellular transport, see 87.16.dp and 87.16.Uv in biological physics)*

66.10.cd Thermal diffusion and diffusive energy transport

66.10.cg Mass diffusion, including self-diffusion, mutual diffusion, tracer diffusion, etc.

66.10.Ed Ionic conduction

66.20.−d Viscosity of liquids; diffusive momentum transport

66.20.Cy Theory and modeling of viscosity and rheological properties, including computer simulation

66.20.Ej Studies of viscosity and rheological properties of specific liquids

66.20.Gd Diffusive momentum transport

66.25.+g Thermal conduction in nonmetallic liquids *(for thermal conduction in liquid metals, see 72.15.Cz)*

66.30.−h Diffusion in solids *(for surface and interface diffusion, see 68.35.Fx)*

66.30.Dn Theory of diffusion and ionic conduction in solids

66.30.Fq Self-diffusion in metals, semimetals, and alloys

66.30.H− Self-diffusion and ionic conduction in nonmetals

66.30.hd Ionic crystals

66.30.hh Glasses

66.30.hk Polymers

66.30.hp Molecular crystals

66.30.J− Diffusion of impurities *(for surface diffusion, hopping, sorption, etc., see 68.35.Fx; see section 72 for carrier diffusion and electron-hole diffusion)*

66.30.je Diffusion of gases

66.30.jj Diffusion of water

66.30.jp Proton diffusion

66.30.Lw Diffusion of other defects

66.30.Ma Diffusion in quantum solids (supersolidity) *(see also 67.80.dj Defects, impurities, and diffusion in quantum fluids and solids)*

66.30.Ny Chemical interdiffusion; diffusion barriers

66.30.Pa Diffusion in nanoscale solids

66.30.Qa Electromigration

66.30.Xj Thermal diffusivity

66.35.+a Quantum tunneling of defects

66.70.−f Nonelectronic thermal conduction and heat-pulse propagation in solids; thermal waves *(for electronic thermal conduction in metals and alloys, see 72.15.Cz and 72.15.Eb)*

66.70.Df Metals, alloys, and semiconductors

66.70.Hk Glasses and polymers

66.70.Lm Other systems such as ionic crystals, molecular crystals, nanotubes, etc.

66.90.+r Other topics in nonelectronic transport properties of condensed matter (restricted to new topics in section 66)

67. Quantum fluids and solids *(see also 05.30.−d Quantum statistical mechanics; for cryogenics, refrigerators, low-temperature detectors, and other low temperature equipment, see 07.20.Mc; see also 47.37.+q Hydrodynamic aspects of superfluidity; quantum fluids—in fluid dynamics)*

67.10.−j Quantum fluids: general properties

67.10.Ba Boson degeneracy *(for ultracold, trapped gases, see 67.85.−d)*

67.10.Db Fermion degeneracy

67.10.Fj Quantum statistical theory

67.10.Hk Quantum effects on the structure and dynamics of non-degenerate fluids

67.10.Jn Transport properties and hydrodynamics

67.25.−k ^{4}He

67.25.B− Normal phase of ^{4}He

67.25.bd Thermodynamic properties

67.25.bf Transport, hydrodynamics

67.25.bh Films and restricted geometries

67.25.D− Superfluid phase

67.25.de Thermodynamic properties

67.25.dg Transport, hydrodynamics, and superflow

67.25.dj Superfluid transition and critical phenomena

67.25.dk Vortices and turbulence

67.25.dm Two-fluid model; phenomenology

67.25.dp Films

67.25.dr Restricted geometries

67.25.dt Sound and excitations

67.25.du Relaxation phenomena

67.25.dw Superfluidity in small clusters

67.30.−n ^{3}He

67.30.E− Normal phase of ^{3}He

67.30.ef Thermodynamics

67.30.eh Transport and hydrodynamics

67.30.ej Films and restricted geometries

67.30.em Excitations

67.30.ep Spin polarized ^{3}He

67.30.er Magnetic properties, NMR

67.30.H− Superfluid phase of ^{3}He

67.30.hb Transport, hydrodynamics, and superflow

67.30.he Textures and vortices

67.30.hj Spin dynamics

67.30.hm Impurities

67.30.hp Interfaces

67.30.hr Films

67.30.ht Restricted geometries

67.60.−g Mixtures of ^{3}He and ^{4}He

67.60.Bc Boson mixtures

67.60.Fp Bose-Fermi mixtures

67.60.G− Solutions of ^{3}He in liquid ^{4}He

67.60.gc Spin polarized solutions

67.60.gf Films

67.60.gj Restricted geometries

67.63.−r Hydrogen and isotopes

67.63.Cd Molecular hydrogen and isotopes

67.63.Gh Atomic hydrogen and isotopes

67.80.−s Quantum solids

67.80.B− Solid ^{4}He

67.80.bd Superfluidity in solid ^{4}He, supersolid ^{4}He

67.80.bf Liquid-solid interfaces; growth kinetics

67.80.D− Solid ^{3}He

67.80.de Structure, lattice dynamics and sound

67.80.dj Defects, impurities, and diffusion

67.80.dk Magnetic properties, phases, and NMR

67.80.dm Films

67.80.F− Solids of hydrogen and isotopes

67.80.ff Molecular hydrogen and isotopes

67.80.fh Atomic hydrogen and isotopes

67.80.K− Other supersolids

67.80.kb Supersolid phases on lattices

67.85.−d Ultracold gases, trapped gases *(see also 03.75.−b Matter waves in quantum mechanics)*

67.85.Bc Static properties of condensates

67.85.De Dynamic properties of condensates; excitations, and superfluid flow

67.85.Fg Multicomponent condensates; spinor condensates

67.85.Hj Bose–Einstein condensates in optical potentials

67.85.Jk Other Bose–Einstein condensation phenomena

67.85.Lm Degenerate Fermi gases

67.85.Pq Mixtures of Bose and Fermi gases

67.90.+z Other topics in quantum fluids and solids (restricted to new topics in section 67)

68. Surfaces and interfaces; thin films and nanosystems (structure and nonelectronic properties) *(for surface and interface chemistry, see 82.65.+r, for surface magnetism, see 75.70.Rf*

68.03.−g Gas-liquid and vacuum-liquid interfaces

68.03.Cd Surface tension and related phenomena

68.03.Fg Evaporation and condensation of liquids

68.03.Hj Liquid surface structure: measurements and simulations

68.03.Kn Dynamics (capillary waves)

68.05.−n Liquid-liquid interfaces

68.05.Cf Liquid-liquid interface structure: measurements and simulations

68.05.Gh Interfacial properties of microemulsions

68.08.−p Liquid-solid interfaces

68.08.Bc Wetting

68.08.De Liquid-solid interface structure: measurements and simulations *(for crystal growth from solutions and melts, see 81.10.Dn, Fq in materials science)*

68.15.+e Liquid thin films

68.18.−g Langmuir-Blodgett films on liquids *(for L-B films on solids, see 68.47.Pe)*

68.18.Fg Liquid thin film structure: measurements and simulations

68.18.Jk Phase transitions in liquid thin films

68.35.−p Solid surfaces and solid–solid interfaces: structure and energetics

68.35.Af Atomic scale friction

68.35.B− Structure of clean surfaces (and surface reconstruction)

68.35.bd Metals and alloys

268.35.bg *Semiconductors*

68.35.bj *Amorphous semiconductors, glasses*

68.35.bm *Polymers, organics*

68.35.bp *Fullerenes*

68.35.bt *Other materials*

68.35.Ct Interface structure and roughness

68.35.Dv Composition, segregation; defects and impurities

68.35.Fx Diffusion; interface formation *(see also 66.30.−h Diffusion in solids, for diffusion of adsorbates, see 68.43.Jk)*

68.35.Gy Mechanical properties; surface strains

68.35.Iv Acoustical properties

68.35.Ja Surface and interface dynamics and vibrations

. . . . *Solid-solid interfaces: transport and optical properties, see 73.40.−c and 78.20.−e respectively*

68.35.Md Surface thermodynamics, surface energies *(see also 05.70.Np Interface and surface thermodynamics in statistical physics, thermodynamics and nonlinear dynamical systems; 65.40.gp Surface energy in thermal properties of condensed matter)*

68.35.Np Adhesion *(for polymer adhesion, see 82.35.Gh: for cell adhesion, see 87.17.Rt in biological physics)*

68.35.Rh Phase transitions and critical phenomena

68.37.−d Microscopy of surfaces, interfaces, and thin films

68.37.Ef Scanning tunneling microscopy (including chemistry induced with STM)

68.37.Hk Scanning electron microscopy (SEM) (including EBIC)

68.37.Lp Transmission electron microscopy (TEM)

68.37.Ma Scanning transmission electron microscopy (STEM)

68.37.Nq Low energy electron microscopy (LEEM)

68.37.Og High-resolution transmission electron microscopy (HRTEM)

68.37.Ps Atomic force microscopy (AFM)

68.37.Rt Magnetic force microscopy (MFM)

68.37.Tj Acoustic force microscopy

68.37.Uv Near-field scanning microscopy and spectroscopy

68.37.Vj Field emission and field-ion microscopy

68.37.Xy Scanning Auger microscopy, photoelectron microscopy

68.37.Yz X-ray microscopy

68.43.−h Chemisorption/physisorption: adsorbates on surfaces

68.43.Bc *Ab initio* calculations of adsorbate structure and reactions *(for electronic structure of adsorbates, see 73.20.Hb; for adsorbate reactions, see also 82.65.+r Surface and interface chemistry; heterogeneous catalysis at surfaces)*

68.43.De Statistical mechanics of adsorbates

68.43.Fg Adsorbate structure (binding sites, geometry)

68.43.Hn Structure of assemblies of adsorbates (two- and three-dimensional clustering)

68.43.Jk Diffusion of adsorbates, kinetics of coarsening and aggregation

68.43.Mn Adsorption kinetics

68.43.Nr Desorption kinetics

68.43.Pq Adsorbate vibrations

68.43.Rs Electron stimulated desorption

68.43.Tj Photon stimulated desorption

68.43.Vx Thermal desorption

68.47.−b Solid–gas/vacuum interfaces: types of surfaces

68.47.De Metallic surfaces

68.47.Fg Semiconductor surfaces

68.47.Gh Oxide surfaces

68.47.Jn Clusters on oxide surfaces

68.47.Mn Polymer surfaces

68.47.Pe Langmuir–Blodgett films on solids; polymers on surfaces; biological molecules on surfaces

68.49.−h Surface characterization by particle–surface scattering *(see also 34.35.+a Interactions of atoms and molecules with surfaces)*

68.49.Bc Atom scattering from surfaces (diffraction and energy transfer)

68.49.Df Molecule scattering from surfaces (energy transfer, resonances, trapping)

68.49.Jk Electron scattering from surfaces

68.49.Sf Ion scattering from surfaces (charge transfer, sputtering, SIMS)

68.49.Uv X-ray standing waves

. . . . *Surface and interface electron states, see 73.20.−r*

. . . . *Vibrational spectroscopy (IR, Raman, ATR), see 78.30.−j*

. . . . *Electron spectroscopy (EELS, Auger, metastable quenching spectroscopy) see 79.20.−m*

. . . . *Photoelectron spectroscopy (XPS and UPS), see 79.60.−i*

. . . . *Nonlinear spectroscopy (second harmonic, sum frequency generation, etc.), see 42.65.Ky*

. . . . *Electron diffraction and scattering, see 61.05.J−*

. . . . *Surface enhanced spectroscopy, plasmons, see 73.20.Mf*

. . . . *Near-field scanning microscopy and spectroscopy, see 68.37.Uv*

68.55.−a Thin film structure and morphology *(for methods of thin film deposition, film growth and epitaxy, see 81.15.−z)*

68.55.A− Nucleation and growth

68.55.ag *Semiconductors*

68.55.aj *Insulators*

68.55.am *Polymers and organics*

68.55.ap *Fullerenes*

68.55.at *Other materials*

68.55.J− Morphology of films

68.55.jd *Thickness*

68.55.jm *Texture*

68.55.Ln Defects and impurities: doping, implantation, distribution, concentration, etc. *(for diffusion of impurities, see 66.30.J−)*

68.55.Nq Composition and phase identification

68.60.−p Physical properties of thin films, nonelectronic

68.60.Bs Mechanical and acoustical properties

68.60.Dv Thermal stability; thermal effects

68.60.Wm Other nonelectronic physical properties

68.65.−k Low-dimensional, mesoscopic, and nanoscale systems: structure and nonelectronic properties *(for structure of nanoscale materials, see 61.46.−w; for magnetic properties of interfaces, see 75.70.Cn; for superconducting properties, see 74.78.−w; for optical properties, see 78.67.−n; for transport properties, see 73.63.−b; for thermal properties of nanocrystals and nanotubes, see 65.80.+n; for mechanical properties of nanoscale systems, see 62.25.−g)*

. . . . *Growth of low-dimensional structures, see 81.16.−c*

68.65.Ac Multilayers

68.65.Cd Superlattices

68.65.Fg Quantum wells

68.65.Hb Quantum dots (patterned in quantum wells)

68.65.La Quantum wires (patterned in quantum wells)

68.70.+w Whiskers and dendrites (growth, structure, and nonelectronic properties)

68.90.+g Other topics in structure, and nonelectronic properties of surfaces and interfaces; thin films and low-dimensional structures (restricted to new topics in section 68)

70. CONDENSED MATTER: ELECTRONIC STRUCTURE, ELECTRICAL, MAGNETIC, AND OPTICAL PROPERTIES

71. Electronic structure of bulk materials *(see section 73 for electronic structure of surfaces, interfaces, low-dimensional structures, and nanomaterials; for electronic structure of superconductors, see 74.25.Jb)*

71.10.−w Theories and models of many-electron systems

71.10.Ay Fermi-liquid theory and other phenomenological models

71.10.Ca Electron gas, Fermi gas

71.10.Fd Lattice fermion models (Hubbard model, etc.)

71.10.Hf Non-Fermi-liquid ground states, electron phase diagrams and phase transitions in model systems

71.10.Li Excited states and pairing interactions in model systems

71.10.Pm Fermions in reduced dimensions (anyons, composite fermions, Luttinger liquid, etc.) *(for anyon mechanism in superconductors, see 74.20.Mn)*

71.15.−m Methods of electronic structure calculations *(see also 31.15.−p Calculations and mathematical techniques in atomic and molecular physics)*

71.15.Ap Basis sets (LCAO, plane-wave, APW, etc.) and related methodology (scattering methods, ASA, linearized methods, etc.)

71.15.Dx Computational methodology (Brillouin zone sampling, iterative diagonalization, pseudopotential construction)

71.15.Mb Density functional theory, local density approximation, gradient and other corrections

71.15.Nc Total energy and cohesive energy calculations

71.15.Pd Molecular dynamics calculations (Car–Parrinello) and other numerical simulations

71.15.Qe Excited states: methodology *(see also 71.10.Li Excited states and pairing interactions in model systems)*

71.15.Rf Relativistic effects *[see also 31.30.J− Relativistic and quantum electrodynamic (QED) effects in atoms, molecules, and ions]*

71.18.+y Fermi surface: calculations and measurements; effective mass, g factor

71.20.−b Electron density of states and band structure of crystalline solids

71.20.Be Transition metals and alloys

71.20.Dg Alkali and alkaline earth metals

71.20.Eh Rare earth metals and alloys

71.20.Gj Other metals and alloys

71.20.Lp Intermetallic compounds

71.20.Mq Elemental semiconductors

71.20.Nr Semiconductor compounds

71.20.Ps Other inorganic compounds

71.20.Rv Polymers and organic compounds

71.20.Tx Fullerenes and related materials; intercalation compounds

. . . . *Photonic band-gap materials, see 42.70.Qs*

71.22.+i Electronic structure of liquid metals and semiconductors and their alloys

71.23.−k Electronic structure of disordered solids

71.23.An Theories and models; localized states

71.23.Cq Amorphous semiconductors, metallic glasses, glasses

71.23.Ft Quasicrystals

71.27.+a Strongly correlated electron systems; heavy fermions

71.28.+d Narrow-band systems; intermediate-valence solids *(for magnetic aspects, see 75.20.Hr and 75.30.Mb in magnetic properties and materials)*

71.30.+h Metal–insulator transitions and other electronic transitions

71.35.−y Excitons and related phenomena

71.35.Aa Frenkel excitons and self-trapped excitons

71.35.Cc Intrinsic properties of excitons; optical absorption spectra

71.35.Ee Electron-hole drops and electron-hole plasma

71.35.Gg Exciton-mediated interactions

71.35.Ji Excitons in magnetic fields; magnetoexcitons

71.35.Lk Collective effects (Bose effects, phase space filling, and excitonic phase transitions)

71.35.Pq Charged excitons (trions)

71.36.+c Polaritons (including photon–phonon and photon–magnon interactions)

71.38.−k Polarons and electron-phonon interactions *(see also 63.20.K− Phonon interactions in lattice dynamics)*

71.38.Cn Mass renormalization in metals

71.38.Fp Large or Fröhlich polarons

71.38.Ht Self-trapped or small polarons

71.38.Mx Bipolarons

71.45.−d Collective effects

71.45.Gm Exchange, correlation, dielectric and magnetic response functions, plasmons

71.45.Lr Charge-density-wave systems *(see also 75.30.Fv Spin-density waves)*

71.55.−i Impurity and defect levels

71.55.Ak Metals, semimetals, and alloys

71.55.Cn Elemental semiconductors

71.55.Eq III–V semiconductors

71.55.Gs II–VI semiconductors

71.55.Ht Other nonmetals

71.55.Jv Disordered structures; amorphous and glassy solids

71.60.+z Positron states *(for positron annihilation, see 78.70.Bj)*

71.70.−d Level splitting and interactions *(see also 73.20.−r Surface and interface electron states; 75.30.Et Exchange and superexchange interactions)*

71.70.Ch Crystal and ligand fields

71.70.Di Landau levels

71.70.Ej Spin–orbit coupling, Zeeman and Stark splitting, Jahn–Teller effect

71.70.Fk Strain-induced splitting

71.70.Gm Exchange interactions

71.70.Jp Nuclear states and interactions

71.90.+q Other topics in electronic structure (restricted to new topics in section 71)

72. Electronic transport in condensed matter *(for electronic transport in surfaces, interfaces, and thin films, see section 73; for electrical properties related to treatment conditions, see 81.40.Rs; for transport properties of superconductors, see 74.25.Fy; for electrical properties of tissues and organs, see 87.19.R− in biological physics)*

72.10.−d Theory of electronic transport; scattering mechanisms

72.10.Bg General formulation of transport theory

72.10.Di Scattering by phonons, magnons, and other nonlocalized excitations *(see also 71.45.−d Collective effects in electronic structure of bulk materials)*

72.10.Fk Scattering by point defects, dislocations, surfaces, and other imperfections (including Kondo effect)

72.15.−v Electronic conduction in metals and alloys

72.15.Cz Electrical and thermal conduction in amorphous and liquid metals and alloys

72.15.Eb Electrical and thermal conduction in crystalline metals and alloys

72.15.Gd Galvanomagnetic and other magnetotransport effects *(see also 75.47.−m Magnetotransport phenomena; materials for magnetotransport)*

72.15.Jf Thermoelectric and thermomagnetic effects

72.15.Lh Relaxation times and mean free paths

72.15.Nj Collective modes (e.g., in one-dimensional conductors)

72.15.Qm Scattering mechanisms and Kondo effect *(see also 75.20.Hr Local moments in compounds and alloys; Kondo effect, valence fluctuations, heavy fermions in magnetic properties and materials)*

72.15.Rn Localization effects (Anderson or weak localization)

72.20.−i Conductivity phenomena in semiconductors and insulators *(see also 66.70.−f Nonelectronic thermal conduction and heat-pulse propagation in solids; thermal waves)*

72.20.Dp General theory, scattering mechanisms

72.20.Ee Mobility edges; hopping transport

72.20.Fr Low-field transport and mobility; piezoresistance

72.20.Ht High-field and nonlinear effects

72.20.Jv Charge carriers: generation, recombination, lifetime, and trapping

72.20.My Galvanomagnetic and other magnetotransport effects

72.20.Pa Thermoelectric and thermomagnetic effects

72.25.−b Spin polarized transport *(for ballistic magnetoresistance, see 75.47.Jn; for spin polarized transport devices, see 85.75.−d)*

72.25.Ba Spin polarized transport in metals

72.25.Dc Spin polarized transport in semiconductors

72.25.Fe Optical creation of spin polarized carriers

72.25.Hg Electrical injection of spin polarized carriers

72.25.Mk Spin transport through interfaces

72.25.Pn Current-driven spin pumping

72.25.Rb Spin relaxation and scattering

72.30.+q High-frequency effects; plasma effects

72.40.+w Photoconduction and photovoltaic effects

72.50.+b Acoustoelectric effects

72.55.+s Magnetoacoustic effects *(see also 75.80.+q Magnetomechanical and magnetoelectric effects, magnetostriction)*

72.60.+g Mixed conductivity and conductivity transitions

72.70.+m Noise processes and phenomena

72.80.−r Conductivity of specific materials *(for conductivity of metals and alloys, see 72.15.−v)*

72.80.Cw Elemental semiconductors

72.80.Ey III–V and II–VI semiconductors

72.80.Ga Transition-metal compounds

72.80.Jc Other crystalline inorganic semiconductors

72.80.Le Polymers; organic compounds (including organic semiconductors)

72.80.Ng Disordered solids

72.80.Ph Liquid semiconductors

72.80.Rj Fullerenes and related materials

72.80.Sk Insulators

72.80.Tm Composite materials

72.90.+y Other topics in electronic transport in condensed matter (restricted to new topics in section 72)

73. Electronic structure and electrical properties of surfaces, interfaces, thin films, and low-dimensional structures *(for electronic structure and electrical properties of superconducting films and low-dimensional structures, see 74.78.−w; for computational methodology for electronic structure calculations in condensed matter, see 71.15.−m)*

73.20.−r Electron states at surfaces and interfaces

73.20.At Surface states, band structure, electron density of states

73.20.Fz Weak or Anderson localization

73.20.Hb Impurity and defect levels; energy states of adsorbed species

73.20.Jc Delocalization processes

73.20.Mf Collective excitations (including excitons, polarons, plasmons and other charge-density excitations) *(for collective excitations in quantum Hall effects, see 73.43.Lp)*

73.20.Qt Electron solids

73.21.−b Electron states and collective excitations in multilayers, quantum wells, mesoscopic, and nanoscale systems *(for electron states in nanoscale materials, see 73.22.−f)*

73.21.Ac Multilayers

73.21.Cd Superlattices

73.21.Fg Quantum wells

73.21.Hb Quantum wires

73.21.La Quantum dots

73.22.−f Electronic structure of nanoscale materials: clusters, nanoparticles, nanotubes, and nanocrystals

73.22.Dj Single particle states

73.22.Gk Broken symmetry phases

73.22.Lp Collective excitations

73.23.−b Electronic transport in mesoscopic systems

73.23.Ad Ballistic transport *(see also 75.47.Jn Ballistic magnetoresistance in magnetic properties and materials)*

73.23.Hk Coulomb blockade; single-electron tunneling

73.23.Ra Persistent currents

73.25.+i Surface conductivity and carrier phenomena

73.30.+y Surface double layers, Schottky barriers, and work functions *(see also 82.45.Mp Thin layers, films, monolayers, membranes in electrochemistry; see also 87.16.D− Membranes, bilayers, and vesicles in biological physics)*

73.40.−c Electronic transport in interface structures

73.40.Cg Contact resistance, contact potential

73.40.Ei Rectification

73.40.Gk Tunneling *(for tunneling in quantum Hall effects, see 73.43.Jn)*

73.40.Jn Metal-to-metal contacts

73.40.Kp III–V semiconductor-to-semiconductor contacts, *p–n* junctions, and heterojunctions

73.40.Lq Other semiconductor-to-semiconductor contacts, *p–n* junctions, and heterojunctions

73.40.Mr Semiconductor–electrolyte contacts

73.40.Ns Metal–nonmetal contacts

73.40.Qv Metal–insulator–semiconductor structures (including semiconductor-to-insulator)

73.40.Rw Metal–insulator–metal structures

73.40.Sx Metal–semiconductor–metal structures

73.40.Ty Semiconductor–insulator–semiconductor structures

73.40.Vz Semiconductor–metal–semiconductor structures

73.43.−f Quantum Hall effects

73.43.Cd Theory and modeling

73.43.Fj Novel experimental methods; measurements

73.43.Jn Tunneling

73.43.Lp Collective excitations

73.43.Nq Quantum phase transitions *(see also 64.70.Tg Quantum phase transitions in equations of state, phase equilibria and phase transitions)*

73.43.Qt Magnetoresistance *(see also 75.47.−m Magnetotransport phenomena; materials for magnetotransport in magnetic properties and materials)*

. . . . *Optical properties, see 78.66.−w*

73.50.−h Electronic transport phenomena in thin films *(for electronic transport in mesoscopic systems, see 73.23.−b; see also 73.40.−c Electronic transport in interface structures; for electronic transport in nanoscale materials and structures, see 73.63.−b)*

73.50.Bk General theory, scattering mechanisms

73.50.Dn Low-field transport and mobility; piezoresistance

73.50.Fq High-field and nonlinear effects

73.50.Gr Charge carriers: generation, recombination, lifetime, trapping, mean free paths

73.50.Jt Galvanomagnetic and other magnetotransport effects (including thermomagnetic effects)

73.50.Lw Thermoelectric effects

73.50.Mx High-frequency effects; plasma effects

73.50.Pz Photoconduction and photovoltaic effects

73.50.Rb Acoustoelectric and magnetoacoustic effects

73.50.Td Noise processes and phenomena

73.61.−r Electrical properties of specific thin films *(for optical properties of thin films, see 78.20.−e and 78.66.−w; for magnetic properties of thin films, see 75.70.−i)*

73.61.At Metal and metallic alloys

73.61.Cw Elemental semiconductors

73.61.Ey III–V semiconductors

73.61.Ga II–VI semiconductors

73.61.Jc Amorphous semiconductors; glasses

73.61.Le Other inorganic semiconductors

73.61.Ng Insulators

73.61.Ph Polymers; organic compounds

73.61.Wp Fullerenes and related materials

73.63.−b Electronic transport in nanoscale materials and structures *(see also 73.23.−b Electronic transport in mesoscopic systems)*

73.63.Bd Nanocrystalline materials

73.63.Fg Nanotubes

73.63.Hs Quantum wells

73.63.Kv Quantum dots

73.63.Nm Quantum wires

73.63.Rt Nanoscale contacts

73.90.+f Other topics in electronic structure and electrical properties of surfaces, interfaces, thin films, and low-dimensional structures (Restricted to new topics in section 73)

74. Superconductivity *(for superconducting devices, see 85.25.−j)*

74.10.+v Occurrence, potential candidates

74.20.−z Theories and models of superconducting state

74.20.De Phenomenological theories (two-fluid, Ginzburg–Landau, etc.)

74.20.Fg BCS theory and its development

74.20.Mn Nonconventional mechanisms (spin fluctuations, polarons and bipolarons, resonating valence bond model, anyon mechanism, marginal Fermi liquid, Luttinger liquid, etc.)

74.20.Rp Pairing symmetries (other than s-wave)

74.25.−q Properties of type I and type II superconductors

74.25.Bt Thermodynamic properties

74.25.Dw Superconductivity phase diagrams

74.25.Fy Transport properties (electric and thermal conductivity, thermoelectric effects, etc.)

74.25.Gz Optical properties

74.25.Ha Magnetic properties

74.25.Jb Electronic structure

74.25.Kc Phonons

74.25.Ld Mechanical and acoustical properties, elasticity, and ultrasonic attenuation

74.25.Nf Response to electromagnetic fields (nuclear magnetic resonance, surface impedance, etc.)

74.25.Op Mixed states, critical fields, and surface sheaths

74.25.Qt Vortex lattices, flux pinning, flux creep

74.25.Sv Critical currents

74.40.+k Fluctuations (noise, chaos, nonequilibrium superconductivity, localization, etc.)

74.45.+c Proximity effects; Andreev effect; SN and SNS junctions

74.50.+r Tunneling phenomena; point contacts, weak links, Josephson effects *(for SQUIDs, see 85.25.Dq; for Josephson devices, see 85.25.Cp; for Josephson junction arrays, see 74.81.Fa)*

74.62.−c Transition temperature variations

74.62.Bf Effects of material synthesis, crystal structure, and chemical composition

74.62.Dh Effects of crystal defects, doping and substitution

74.62.Fj Pressure effects

74.62.Yb Other effects

74.70.−b Superconducting materials *(for cuprates, see 74.72.−h)*

74.70.Ad Metals; alloys and binary compounds (including A15, MgB_2, etc.)

74.70.Dd Ternary, quaternary, and multinary compounds (including Chevrel phases, borocarbides, etc.)

74.70.Kn Organic superconductors

74.70.Pq Ruthenates

74.70.Tx Heavy-fermion superconductors

74.70.Wz Fullerenes and related materials

74.72.−h Cuprate superconductors (high-T_c and insulating parent compounds)

74.72.Bk Y-based cuprates

74.72.Dn La-based cuprates

74.72.Hs Bi-based cuprates

74.72.Jt Other cuprates, including Tl and Hg-based cuprates

74.78.−w Superconducting films and low-dimensional structures

74.78.Bz High-T_c films

74.78.Db Low-T_c films

74.78.Fk Multilayers, superlattices, heterostructures

74.78.Na Mesoscopic and nanoscale systems

74.81.−g Inhomogeneous superconductors and superconducting systems

74.81.Bd Granular, melt-textured, amorphous, and composite superconductors

74.81.Fa Josephson junction arrays and wire networks

74.90.+n Other topics in superconductivity (restricted to new topics in section 74)

75. Magnetic properties and materials *(for magnetic properties of quantum solids, see 67.80.dk; for magnetic properties related to treatment conditions, see 81.40.Rs;*

for magnetic properties of superconductors, see 74.25.Ha; for magnetic properties of rocks and minerals, see 91.60.Pn)

75.10.−b General theory and models of magnetic ordering *(see also 05.50.+q Lattice theory and statistics)*

75.10.Dg Crystal-field theory and spin Hamiltonians

75.10.Hk Classical spin models

75.10.Jm Quantized spin models

75.10.Lp Band and itinerant models

75.10.Nr Spin-glass and other random models

75.10.Pq Spin chain models

75.20.−g Diamagnetism, paramagnetism, and superparamagnetism

75.20.Ck Nonmetals

75.20.En Metals and alloys

75.20.Hr Local moment in compounds and alloys; Kondo effect, valence fluctuations, heavy fermions *(see also 72.15.Qm Scattering mechanisms and Kondo effect)*

75.25.+z Spin arrangements in magnetically ordered materials (including neutron and spin-polarized electron studies, synchrotron-source X-ray scattering, etc.) *(for devices exploiting spin polarized transport, see 85.75.−d)*

75.30.−m Intrinsic properties of magnetically ordered materials *(for critical point effects, see 75.40.−s)*

75.30.Cr Saturation moments and magnetic susceptibilities

75.30.Ds Spin waves *(for spin-wave resonance, see 76.50.+g)*

75.30.Et Exchange and superexchange interactions *(see also 71.70.−d Level splitting and interactions)*

75.30.Fv Spin-density waves

75.30.Gw Magnetic anisotropy

75.30.Hx Magnetic impurity interactions

75.30.Kz Magnetic phase boundaries (including magnetic transitions, metamagnetism, etc.)

75.30.Mb Valence fluctuation, Kondo lattice, and heavy-fermion phenomena *(see also 71.27.+a Strongly correlated electron systems, heavy fermions)*

75.30.Sg Magnetocaloric effect, magnetic cooling

75.30.Wx Spin crossover

75.40.−s Critical-point effects, specific heats, short-range order *(see also 65.40.Ba Heat capacity)*

75.40.Cx Static properties (order parameter, static susceptibility, heat capacities, critical exponents, etc.)

75.40.Gb Dynamic properties (dynamic susceptibility, spin waves, spin diffusion, dynamic scaling, etc.)

75.40.Mg Numerical simulation studies

75.45.+j Macroscopic quantum phenomena in magnetic systems

75.47.−m Magnetotransport phenomena; materials for magnetotransport *(for spintronics, see 85.75.−d; see also 72.15.Gd, 73.50.Jt, 73.43.Qt, and 72.25.−b in transport phenomena)*

75.47.De Giant magnetoresistance

75.47.Gk Colossal magnetoresistance

75.47.Jn Ballistic magnetoresistance

75.47.Lx Manganites

75.47.Np Metals and alloys

75.47.Pq Other materials

75.50.−y Studies of specific magnetic materials

75.50.Bb Fe and its alloys

75.50.Cc Other ferromagnetic metals and alloys

75.50.Dd Nonmetallic ferromagnetic materials

75.50.Ee Antiferromagnetics

75.50.Gg Ferrimagnetics

75.50.Kj Amorphous and quasicrystalline magnetic materials

75.50.Lk Spin glasses and other random magnets

75.50.Mm Magnetic liquids

75.50.Pp Magnetic semiconductors

75.50.Ss Magnetic recording materials *(see also 85.70.−w Magnetic devices)*

75.50.Tt Fine-particle systems; nanocrystalline materials

75.50.Vv High coercivity materials

75.50.Ww Permanent magnets

75.50.Xx Molecular magnets

75.60.−d Domain effects, magnetization curves, and hysteresis

75.60.Ch Domain walls and domain structure *(for magnetic bubbles, see 75.70.Kw)*

75.60.Ej Magnetization curves, hysteresis, Barkhausen and related effects

75.60.Jk Magnetization reversal mechanisms

75.60.Lr Magnetic aftereffects

75.60.Nt Magnetic annealing and temperature–hysteresis effects

75.70.−i Magnetic properties of thin films, surfaces, and interfaces *(for magnetic properties of nanostructures, see 75.75.+a)*

75.70.Ak Magnetic properties of monolayers and thin films

75.70.Cn Magnetic properties of interfaces (multilayers, superlattices, heterostructures)

75.70.Kw Domain structure (including magnetic bubbles)

75.70.Rf Surface magnetism

75.75.+a Magnetic properties of nanostructures

75.80.+q Magnetomechanical and magnetoelectric effects, magnetostriction

. . . . *Galvanomagnetic effects, see 72.15.Gd and 72.20.My*

. . . . *Magnetooptical effects, see 78.20.Ls*

75.90.+w Other topics in magnetic properties and materials (restricted to new topics in section 75)

76. Magnetic resonances and relaxations in condensed matter, Mössbauer effect

76.20.+q General theory of resonances and relaxations

76.30.−v Electron paramagnetic resonance and relaxation *(see also 33.35.+r Electron resonance and relaxation in atomic and molecular physics; 87.80.Lg Magnetic and paramagnetic resonance in biological physics)*

76.30.Da Ions and impurities: general

76.30.Fc Iron group (3*d*) ions and impurities (Ti–Cu)

76.30.He Platinum and palladium group (4*d* and 5*d*) ions and impurities (Zr–Ag and Hf–Au)

76.30.Kg Rare-earth ions and impurities

76.30.Lh Other ions and impurities

76.30.Mi Color centers and other defects

76.30.Pk Conduction electrons

76.30.Rn Free radicals

76.40.+b Diamagnetic and cyclotron resonances

76.50.+g Ferromagnetic, antiferromagnetic, and ferrimagnetic resonances; spin-wave resonance *(see also 75.30.Ds Spin waves)*

76.60.−k Nuclear magnetic resonance and relaxation *(see also 33.25.+k Nuclear resonance and relaxation in atomic and molecular physics and 82.56.−b Nuclear magnetic resonance in physical chemistry and chemical physics; for structure determination using magnetic resonance techniques, see 61.05.Qr; for biophysical applications, see 87.80.Lg)*

76.60.Cq Chemical and Knight shifts

76.60.Es Relaxation effects

76.60.Gv Quadrupole resonance

76.60.Jx Effects of internal magnetic fields

76.60.Lz Spin echoes

76.60.Pc NMR imaging *(for medical NMR imaging, see 87.61.−c)*

76.70.−r Magnetic double resonances and cross effects *(see also 33.40.+f Multiple resonances in atomic and molecular physics)*

76.70.Dx Electron–nuclear double resonance (ENDOR), electron double resonance (ELDOR)

76.70.Fz Double nuclear magnetic resonance (DNMR), dynamical nuclear polarization

76.70.Hb Optically detected magnetic resonance (ODMR)

76.75.+i Muon spin rotation and relaxation

76.80.+y Mössbauer effect; other γ-ray spectroscopy *(see also 33.45.+x Mössbauer spectra—in atomic and molecular physics; for biophysical applications, see 87.64.kx; for chemical analysis applications, see 82.80.Ej)*

. . . . *Magnetic resonance spectrometers, 07.57.Pt*

76.90.+d Other topics in magnetic resonances and relaxations (restricted to new topics in section 76)

77. Dielectrics, piezoelectrics, and ferroelectrics and their properties *(for conductivity phenomena, see 72.20.−i and 72.80.−r; for dielectric properties related to treatment conditions, see 81.40.Tv)*

77.22.−d Dielectric properties of solids and liquids *(for dielectric properties of tissues and organs, see 87.19.rf)*

77.22.Ch Permittivity (dielectric function)

77.22.Ej Polarization and depolarization

77.22.Gm Dielectric loss and relaxation

77.22.Jp Dielectric breakdown and space-charge effects

77.55.+f Dielectric thin films

77.65.−j Piezoelectricity and electromechanical effects

77.65.Bn Piezoelectric and electrostrictive constants

77.65.Dq Acoustoelectric effects and surface acoustic waves (SAW) in piezoelectrics *(see also 43.35.Pt Surface waves in solids and liquids—in Acoustics Appendix; for surface acoustic wave transducers, see 43.38.Rh—in Acoustics Appendix)*

77.65.Fs Electromechanical resonance; quartz resonators

77.65.Ly Strain-induced piezoelectric fields

77.70.+a Pyroelectric and electrocaloric effects

77.80.−e Ferroelectricity and antiferroelectricity

77.80.Bh Phase transitions and Curie point

77.80.Dj Domain structure; hysteresis

77.80.Fm Switching phenomena

77.84.−s Dielectric, piezoelectric, ferroelectric, and antiferroelectric materials *(for nonlinear optical materials, see 42.70.Mp; for dielectric materials in electrochemistry, see 82.45.Un)*

77.84.Bw Elements, oxides, nitrides, borides, carbides, chalcogenides, etc.

77.84.Dy Niobates, titanates, tantalates, PZT ceramics, etc.

77.84.Fa KDP- and TGS-type crystals

77.84.Jd Polymers; organic compounds

77.84.Lf Composite materials

77.84.Nh Liquids, emulsions, and suspensions; liquid crystals *(for structure of liquid crystals, see 61.30.−v)*

77.90.+k Other topics in dielectrics, piezoelectrics, and ferroelectrics and their properties (restricted to new topics in section 77)

78. Optical properties, condensed-matter spectroscopy and other interactions of radiation and particles with condensed matter

78.20.−e Optical properties of bulk materials and thin films *(for optical properties related to materials treatment, see 81.40.Tv; for optical materials, see 42.70−a; for optical properties of superconductors, see 74.25.Gz; for optical properties of rocks and minerals, see 91.60.Mk; for optical/infrared radiation effects on biological systems, see 87.50.W−)*

78.20.Bh Theory, models, and numerical simulation

78.20.Ci Optical constants (including refractive index, complex dielectric constant, absorption, reflection and transmission coefficients, emissivity)

78.20.Ek Optical activity

78.20.Fm Birefringence

78.20.Hp Piezo-, elasto-, and acoustooptical effects; photoacoustic effects

78.20.Jq Electrooptical effects

78.20.Ls Magnetooptical effects

78.20.Nv Thermooptical and photothermal effects

. . . . *Nonlinear optical properties, see 42.65.−k*

78.30.−j Infrared and Raman spectra *(for vibrational states in crystals and disordered systems, see 63.20.−e and 63.50.−x respectively)*

78.30.Am Elemental semiconductors and insulators

78.30.Cp Liquids

78.30.Er Solid metals and alloys

78.30.Fs III–V and II–VI semiconductors

78.30.Hv Other nonmetallic inorganics

78.30.Jw Organic compounds, polymers

78.30.Ly Disordered solids

78.30.Na Fullerenes and related materials

78.35.+c Brillouin and Rayleigh scattering; other light scattering *(for Raman scattering, see 78.30.−j)*

78.40.−q Absorption and reflection spectra: visible and ultraviolet *(for infrared spectra, see 78.30.−j)*

78.40.Dw Liquids

78.40.Fy Semiconductors

78.40.Ha Other nonmetallic inorganics

78.40.Kc Metals, semimetals, and alloys

78.40.Me Organic compounds and polymers

78.40.Pg Disordered solids

78.40.Ri Fullerenes and related materials

78.45.+h Stimulated emission *(see also 42.55.−f Lasers)*

78.47.−p Spectroscopy of solid state dynamics *(see also 42.65.−k Nonlinear optics; 42.50.−p Quantum optics)*

78.47.Cd Time resolved luminescence

78.47.Fg Coherent nonlinear optical spectroscopy

78.47.J− Ultrafast pump/probe spectroscopy ($<$ 1 psec) *(see also 82.53.Eb Pump probe studies of photodissociation; 82.53.Hn Pump probe experiments with bound states in femtochemistry; for ultrafast processes in nonlinear optics, see 42.65.Re)*

78.47.jc Time resolved spectroscopy ($>$ 1 psec)

78.47.jf Photon echoes

78.47.jj Transient grating spectroscopy

78.47.jm Quantum beats

78.47.jp Optical nutation

78.47.js Free polarization decay

78.47.N− High resolution nonlinear optical spectroscopy

78.47.nd Hole burning spectroscopy

78.47.nj Four-wave mixing spectroscopy

78.55.−m Photoluminescence, properties and materials

78.55.Ap Elemental semiconductors

78.55.Bq Liquids

78.55.Cr III–V semiconductors

78.55.Et II–VI semiconductors

78.55.Fv Solid alkali halides

78.55.Hx Other solid inorganic materials

78.55.Kz Solid organic materials

78.55.Mb Porous materials

78.55.Qr Amorphous materials; glasses and other disordered solids

78.60.−b Other luminescence and radiative recombination

78.60.Fi Electroluminescence

78.60.Hk Cathodoluminescence, ionoluminescence

78.60.Kn Thermoluminescence

78.60.Mq Sonoluminescence, triboluminescence

78.60.Ps Chemiluminescence *(see also 42.55.Ks Chemical lasers)*

78.66.−w Optical properties of specific thin films *(for optical properties of low-dimensional, mesoscopic, and nanoscale materials, see 78.67.−n; for optical properties of surfaces, see 78.68.+m)*

78.66.Bz Metals and metallic alloys

78.66.Db Elemental semiconductors and insulators

78.66.Fd III–V semiconductors

78.66.Hf II–VI semiconductors

78.66.Jg Amorphous semiconductors; glasses

78.66.Li Other semiconductors

78.66.Nk Insulators

78.66.Qn Polymers; organic compounds

78.66.Sq Composite materials

78.66.Tr Fullerenes and related materials

78.66.Vs Fine-particle systems

78.67.−n Optical properties of low-dimensional, mesoscopic, and nanoscale materials and structures

78.67.Bf Nanocrystals and nanoparticles

78.67.Ch Nanotubes

78.67.De Quantum wells

78.67.Hc Quantum dots

78.67.Lt Quantum wires

78.67.Pt Multilayers; superlattices

78.68.+m Optical properties of surfaces

78.70.−g Interactions of particles and radiation with matter

78.70.Bj Positron annihilation *(for positron states, see 71.60.+z in electronic structure of bulk materials; for positronium chemistry, see 82.30.Gg in physical chemistry and chemical physics)*

78.70.Ck X-ray scattering

78.70.Dm X-ray absorption spectra

78.70.En X-ray emission spectra and fluorescence

78.70.Gq Microwave and radio-frequency interactions

78.70.Nx Neutron inelastic scattering

78.90.+t Other topics in optical properties, condensed matter spectroscopy and other interactions of particles and radiation with condensed matter (restricted to new topics in section 78)

79. Electron and ion emission by liquids and solids; impact phenomena

79.20.−m Impact phenomena (including electron spectra and sputtering)

79.20.Ap Theory of impact phenomena; numerical simulation

79.20.Ds Laser-beam impact phenomena

79.20.Fv Electron impact: Auger emission

79.20.Hx Electron impact: secondary emission

79.20.Kz Other electron-impact emission phenomena

79.20.La Photon- and electron-stimulated desorption

79.20.Mb Positron emission

79.20.Rf Atomic, molecular, and ion beam impact and interactions with surfaces

. . . . *Channeling, blocking, energy loss of particles, see 61.85.+p*

79.20.Uv Electron energy loss spectroscopy *(see also 82.80.Pv Electron spectroscopy in physical chemistry and chemical physics; 34.80.−i Electron and positron scattering in atomic and molecular physics)*

79.40.+z Thermionic emission

79.60.−i Photoemission and photoelectron spectra

79.60.Bm Clean metal, semiconductor, and insulator surfaces

79.60.Dp Adsorbed layers and thin films

79.60.Fr Polymers; organic compounds

79.60.Ht Disordered structures

79.60.Jv Interfaces; heterostructures; nanostructures

79.70.+q Field emission, ionization, evaporation, and desorption

79.75.+g Exoelectron emission

79.90.+b Other topics in electron and ion emission by liquids and solids and impact phenomena (restricted to new topics in section 79)

80. INTERDISCIPLINARY PHYSICS AND RELATED AREAS OF SCIENCE AND TECHNOLOGY

81. Materials science

81.05.−t Specific materials: fabrication, treatment, testing, and analysis

. . . . *Superconducting materials, see 74.70.−b and 74.72.−h*

. . . . *Magnetic materials, see 75.50.−y*

. . . . *Optical materials, see 42.70.−a*

. . . . *Dielectric, piezoelectric, and ferroelectric materials, see 77.84.−s*

. . . . *Colloids, gels, and emulsions, see 82.70.Dd, Gg, Kj*

. . . . *Biomaterials, see 87.85.J−*

. . . . *Molecular sieves, zeolites, and other complex materials, see 82.75.−z*

81.05.Bx Metals, semimetals, and alloys

81.05.Cy Elemental semiconductors *(for semiconductors in electrochemistry, see 82.45.Vp)*

81.05.Dz II–VI semiconductors

81.05.Ea III–V semiconductors

81.05.Gc Amorphous semiconductors

81.05.Hd Other semiconductors

81.05.Je Ceramics and refractories (including borides, carbides, hydrides, nitrides, oxides, and silicides) *(for ceramics in electrochemistry, see 82.45.Yz)*

81.05.Kf Glasses (including metallic glasses)

81.05.Lg Polymers and plastics; rubber; synthetic and natural fibers; organometallic and organic materials *(for polymers and organic materials in electrochemistry, see 82.45.Wx)*

81.05.Mh Cermets, ceramic and refractory composites

81.05.Ni Dispersion-, fiber-, and platelet-reinforced metal-based composites

81.05.Pj Glass-based composites, vitroceramics

81.05.Qk Reinforced polymers and polymer-based composites

81.05.Rm Porous materials; granular materials *(for granular superconductors, see 74.81.Bd)*

81.05.Tp Fullerenes and related materials

81.05.Uw Carbon, diamond, graphite

81.05.Zx New materials: theory, design, and fabrication

81.07.−b Nanoscale materials and structures: fabrication and characterization *(for structure of nanoscale materials, see 61.46.−w; for nanostructured materials in electrochemistry, see 82.45.Yz; for nanoparticles in polymers, see 82.35.Np in physical chemistry and chemical physics; see also 62.23.−c Structural classes of nanoscale systems in mechanical properties of condensed matter)*

81.07.Bc Nanocrystalline materials

81.07.De Nanotubes

81.07.Lk Nanocontacts

81.07.Nb Molecular nanostructures

81.07.Pr Organic-inorganic hybrid nanostructures

81.07.St Quantum wells

81.07.Ta Quantum dots

81.07.Vb Quantum wires

81.07.Wx Nanopowders

81.10.−h Methods of crystal growth; physics of crystal growth *(for crystal structure, see section 61)*

81.10.Aj Theory and models of crystal growth; physics of crystal growth, crystal morphology, and orientation

81.10.Bk Growth from vapor

81.10.Dn Growth from solutions

81.10.Fq Growth from melts; zone melting and refining

81.10.Jt Growth from solid phases (including multiphase diffusion and recrystallization)

81.10.Mx Growth in microgravity environments

81.15.−z Methods of deposition of films and coatings; film growth and epitaxy *(for structure of thin films, see 68.55.−a; see also 85.40.Sz Deposition technology in microelectronics)*

81.15.Aa Theory and models of film growth

81.15.Cd Deposition by sputtering

81.15.Ef Vacuum deposition

81.15.Fg Laser deposition

81.15.Gh Chemical vapor deposition (including plasma-enhanced CVD, MOCVD, etc.) *(for chemistry of MOCVD, see 82.33.Ya in physical chemistry and chemical physics)*

81.15.Hi Molecular, atomic, ion, and chemical beam epitaxy

81.15.Jj Ion and electron beam-assisted deposition; ion plating *(see also 52.77.Dq Plasma-based ion implantation and deposition in physics of plasmas)*

81.15.Kk Vapor phase epitaxy; growth from vapor phase

81.15.Lm Liquid phase epitaxy; deposition from liquid phases (melts, solutions, and surface layers on liquids)

81.15.Np Solid phase epitaxy; growth from solid phases

81.15.Pq Electrodeposition, electroplating

81.15.Rs Spray coating techniques

81.16.−c Methods of nanofabrication and processing *(for femtosecond probing of semiconductor nanostructures, see 82.53.Mj in physical chemistry and chemical physics)*

81.16.Be Chemical synthesis methods

81.16.Dn Self-assembly

81.16.Fg Supramolecular and biochemical assembly

81.16.Hc Catalytic methods

81.16.Mk Laser-assisted deposition

81.16.Nd Nanolithography

81.16.Pr Nanooxidation *(see also 82.37.Np Single molecule reaction kinetics in physical chemistry and chemical physics)*

81.16.Rf Nanoscale pattern formation

81.16.Ta Atom manipulation *(see also 82.37.Gk STM and AFM manipulation of a single-molecule in physical chemistry; 37.10.Gh Atom traps and guides; 37.10.Pq Trapping of molecules; 87.80.Nj Single-molecule techniques in biological physics; 82.37.Rs Single-molecule manipulation of proteins and other biological molecules in physical chemistry)*

81.20.−n Methods of materials synthesis and materials processing *(for ion implantation and doping, see 61.72.U−)*

. . . . *Crystal growth, see 81.10.−h*

. . . . *Film deposition, film growth, and epitaxy, see 81.15.−z*

81.20.Ev Powder processing: powder metallurgy, compaction, sintering, mechanical alloying, and granulation

81.20.Fw Sol–gel processing, precipitation

81.20.Hy Forming; molding, extrusion etc.

81.20.Ka Chemical synthesis; combustion synthesis *(for electrochemical synthesis, see 82.45.Aa)*

. . . . *Chemical vapor deposition, see 81.15.Gh*

81.20.Rg Aerosols in materials synthesis and processing

81.20.Vj Joining; welding

81.20.Wk Machining, milling

81.20.Ym Purification

81.30.−t Phase diagrams and microstructures developed by solidification and solid–solid phase transformations *(see also 64.70.K− Solid–solid transitions)*

81.30.Bx Phase diagrams of metals and alloys

81.30.Dz Phase diagrams of other materials *(for phase diagrams of superconductors, see 74.25.Dw)*

81.30.Fb Solidification

81.30.Hd Constant-composition solid–solid phase transformations: polymorphic, massive, and order–disorder

81.30.Kf Martensitic transformations

81.30.Mh Solid-phase precipitation *(see also 64.75.−g Phase equilibria)*

81.40.−z Treatment of materials and its effects on microstructure and properties

81.40.Cd Solid solution hardening, precipitation hardening, and dispersion hardening; aging *(see also 64.75.Nx Phase separation and segregation in solid solutions)*

81.40.Ef Cold working, work hardening; annealing, post-deformation annealing, quenching, tempering recovery, and crystallization

81.40.Gh Other heat and thermomechanical treatments

81.40.Jj Elasticity and anelasticity, stress-strain relations

81.40.Lm Deformation, plasticity, and creep *(see also 83.50.−v Deformation and flow in rheology)*

81.40.Np Fatigue, corrosion fatigue, embrittlement, cracking, fracture, and failure *(see also 62.20.M− Structural failure of materials)*

81.40.Pq Friction, lubrication, and wear

81.40.Rs Electrical and magnetic properties (related to treatment conditions)

81.40.Tv Optical and dielectric properties (related to treatment conditions)

81.40.Vw Pressure treatment *(see also 62.50.−p High-pressure effects in solids and liquids)*

81.40.Wx Radiation treatment (particle and electromagnetic) *(see also 61.80.−x Physical radiation effects, radiation damage)*

. . . . *Etching, corrosion, oxidation, and other surface treatments, see 81.65.−b*

81.65.−b Surface treatments *(see also 85.40.−e Microelectronics: LSI, VLSI, ULSI; integrated circuit fabrication technology)*

81.65.Cf Surface cleaning, etching, patterning *(see also 52.77.Bn Etching and cleaning in physics of plasmas)*

81.65.Kn Corrosion protection *(see also 82.45.Bb Corrosion and passivation in electrochemistry)*

81.65.Lp Surface hardening: nitridation, carburization, carbonitridation

81.65.Mq Oxidation

81.65.Ps Polishing, grinding, surface finishing

81.65.Rv Passivation *(see also 82.45.Bb Corrosion and passivation in electrochemistry)*

81.65.Tx Gettering

81.70.−q Methods of materials testing and analysis *(for specific chemical analysis methods, see 82.80.−d)*

81.70.Bt Mechanical testing, impact tests, static and dynamic loads

81.70.Cv Nondestructive testing: ultrasonic testing, photoacoustic testing

81.70.Ex Nondestructive testing: electromagnetic testing, eddy-current testing

81.70.Fy Nondestructive testing: optical methods

81.70.Ha Testing in microgravity environments

81.70.Jb Chemical composition analysis, chemical depth and dopant profiling

81.70.Pg Thermal analysis, differential thermal analysis (DTA), differential thermogravimetric analysis

81.70.Tx Computed tomography

81.90.+c Other topics in materials science (restricted to new topics in section 81)

82. Physical chemistry and chemical physics

. . . . *Electronic structure theory of atoms and molecules, see 33.15.−p*

. . . . *Electronic structure theory of condensed matter, see section 71*

. . . . *Electronic structure theory for biomolecules, see 87.10.−e*

. . . . *Electronic structure of macromolecules and polymer molecules, see 36.20.Kd*

. . . . *Geochemistry, see 91.67.−y*

. . . . *Chemistry of the ocean, see 92.20.Cm*

. . . . *Chemistry of fresh water, see 92.40.Bc*

. . . . *Ion chemistry of the atmosphere, see 92.60.Ls*

. . . . *Chemical reactions in scattering of atoms and molecules, see 34.50.Lf*

82.20.−w Chemical kinetics and dynamics

82.20.Bc State selected dynamics and product distribution

82.20.Db Transition state theory and statistical theories of rate constants

82.20.Ej Quantum theory of reaction cross section

82.20.Fd Collision theories; trajectory models

82.20.Gk Electronically non-adiabatic reactions

82.20.Hf Product distribution *(for state selected dynamics and product distribution, see 82.20.Bc)*

82.20.Kh Potential energy surfaces for chemical reactions *(for potential energy surfaces for collisions, see 34.20.−b in atomic and molecular collisions and interactions)*

82.20.Ln Semiclassical theory of reactions and/or energy transfer

82.20.Nk Classical theories of reactions and/or energy transfer

82.20.Pm Rate constants, reaction cross sections, and activation energies

82.20.Rp State to state energy transfer *(see also 31.70.Hq Time-dependent phenomena—in atomic and molecular physics)*

82.20.Sb Correlation function theory of rate constants and its applications

82.20.Tr Kinetic isotope effects including muonium

82.20.Uv Stochastic theories of rate constants

82.20.Wt Computational modeling; simulation

82.20.Xr Quantum effects in rate constants (tunneling, resonances, etc.)

82.20.Yn Solvent effects on reactivity

82.30.−b Specific chemical reactions; reaction mechanisms

82.30.Cf Atom and radical reactions; chain reactions; molecule-molecule reactions

82.30.Fi Ion–molecule, ion–ion, and charge-transfer reactions *(see also 34.70.+e Charge transfer in atomic and molecular collisions)*

. . . . *Charge transfer in enzymes, see 82.39.Jn and 87.15.R−*

82.30.Gg Positronium chemistry *(see also 36.10.Dr Positronium in atomic and molecular physics; 78.70.Bj Positron annihilation in interactions of particles and radiation with matter)*

82.30.Hk Chemical exchanges (substitution, atom transfer, abstraction, disproportionation, and group exchange)

82.30.Lp Decomposition reactions (pyrolysis, dissociation, and fragmentation)

82.30.Nr Association, addition, insertion, cluster formation

82.30.Qt Isomerization and rearrangement

82.30.Rs Hydrogen bonding, hydrophilic effects

82.30.Vy Homogeneous catalysis in solution,

polymers and zeolites *(for heterogeneous catalysis in zeolites, see 82.75.Qt)*

. . . . *Enzyme kinetics, see 82.39.Fk and 87.15.R−*

. . . . *Protein folding dynamics, see 87.15.Hm*

82.33.−z Reactions in various media

82.33.De Reactions in supercritical fluids

82.33.Fg Reactions in clusters *(see also 36.40.Jn Reactivity of clusters in atomic and molecular physics)*

82.33.Hk Reactions on clusters

82.33.Jx Reactions in zeolites

82.33.Ln Reactions in sol gels, aerogels, porous media

82.33.Nq Reactions in micells

82.33.Pt Solid state chemistry

. . . . *Reactions in complex biological systems, see 82.39.Rt and 87.15R−*

82.33.Tb Atmospheric chemistry *(see also 92.60.H− in geophysics)*

82.33.Vx Reactions in flames, combustion, and explosions

82.33.Xj Plasma reactions (including flowing afterglow and electric discharges)

82.33.Ya Chemistry of MOCVD and other vapor deposition methods *(for methods of vapor deposition of films and coatings, see 81.15.Gh, Kk in materials science)*

82.35.−x Polymers: properties; reactions; polymerization *(for polymers in electrochemistry, see 82.45.Wx)*

82.35.Cd Conducting polymers

82.35.Ej Nonlinear optics with polymers *(see also 42.65.−k in nonlinear optics)*

82.35.Gh Polymers on surfaces; adhesion *(see also 68.35.Np Adhesion in surfaces and interfaces)*

82.35.Jk Copolymers, phase transitions, structure

82.35.Lr Physical properties of polymers

82.35.Np Nanoparticles in polymers *(see also 81.07.−b Nanoscale materials and structures: fabrication and characterization)*

82.35.Pq Biopolymers, biopolymerization *(see also 87.15.rp Polymerization in biological and medical physics)*

82.35.Rs Polyelectrolytes

. . . . *Protein properties, folding, see 87.15.Cc and 87.15.hm*

. . . . *Enzymes, see 82.39.Fk and 87.14.ej*

. . . . *DNA/RNA, see 82.39.Pj and 87.14.gk, gn*

82.37.−j Single molecule kinetics

82.37.Gk STM and AFM manipulations of a single molecule *(for atom manipulation see 37.10.Gh, Pq in atomic and molecular physics; see also 81.16.Ta Atom manipulation in methods of nanofabrication and processing; 87.80.Nj Single-molecule techniques in biological physics)*

82.37.Np Single molecule reaction kinetics, dissociation, etc.

82.37.Rs Single molecule manipulation of proteins and other biological molecules

82.37.Vb Single molecule photochemistry

82.39.−k Chemical kinetics in biological systems *(see also 87.15.R− Reactions and kinetics in biological and medical physics, and 82.45.Tv Bioelectrochemistry)*

82.39.Fk Enzyme kinetics *(see also 87.14.ej Enzymes in biological physics)*

82.39.Jn Charge (electron, proton) transfer in biological systems

. . . . *Protein folding, see 87.15.Cc and 87.15.hm*

82.39.Pj Nucleic acids, DNA and RNA bases

82.39.Rt Reactions in complex biological systems *(see also 87.18.−h Biological complexity)*

82.39.Wj Ion exchange, dialysis, osmosis, electro-osmosis, membrane processes

82.40.−g Chemical kinetics and reactions: special regimes and techniques

. . . . *Chemically reactive flows, see 47.70.Fw*

82.40.Bj Oscillations, chaos, and bifurcations

82.40.Ck Pattern formation in reactions with diffusion, flow and heat transfer *(see also 47.54.−r Pattern selection; pattern formation and 47.32.C− Vortex dynamics in fluid dynamics)*

82.40.Fp Shock wave initiated reactions, high-pressure chemistry *(see also 47.40.Nm Shock wave interactions and shock effects in fluid dynamics, and 62.50.Ef Shock wave effects in solids and liquids)*

82.40.Np Temporal and spatial patterns in surface reactions

82.40.Qt Complex chemical systems *(for complex biological systems, see 82.39.Rt in physical chemistry; 87.18.−h in biological physics)*

. . . . *Stochastic theories of chemical kinetics, see 82.20.Uv*

82.45.−h Electrochemistry and electrophoresis

82.45.Aa Electrochemical synthesis *(see also 81.16.Be Chemical synthesis methods in nanofabrication and 81.20.Ka Chemical synthesis; combustion synthesis in materials science)*

82.45.Bb Corrosion and passivation *(see also 81.65.Kn Corrosion protection and 81.65.Rv Passivation in surface treatments)*

82.45.Cc Anodic films

82.45.Fk Electrodes

82.45.Gj Electrolytes *(for polyelectrolytes, see 82.35.Rs and 82.45.Wx; see also 66.30.H− Self-diffusion and ionic conduction in nonmetals)*

82.45.Hk Electrolysis

82.45.Jn Surface structure, reactivity and catalysis *(see also 82.65.+r Surface and interface chemistry; heterogeneous catalysis at surfaces)*

82.45.Mp Thin layers, films, monolayers, membranes *(for anodic films, see 82.45.Cc; for surface double layers, see 73.30.+y in electronic structure of surfaces)*

82.45.Qr Electrodeposition and electrodissolution *(see also 81.15.Pq Electrodeposition, electroplating in materials science)*

82.45.Rr Electroanalytical chemistry *(see also 82.80.Fk Electrochemical methods in chemical analysis and related physical methods of analysis)*

82.45.Tv Bioelectrochemistry *(see also 82.39.−k Chemical kinetics in biological systems; 87.15.Tt Electrophoresis in biological physics)*

82.45.Un Dielectric materials in electrochemistry *(see also 77.84.−s Dielectric, piezoelectric, ferroelectric, and antiferroelectric materials)*

82.45.Vp Semiconductor materials in electrochemistry *(see also 81.05.Cy, Dz, Ea, Gc, Hd in specific materials)*

82.45.Wx Polymers and organic materials in electrochemistry *(see also 82.35.−x Polymers: properties; reactions; polymerization)*

82.45.Xy Ceramics in electrochemistry *(see also 81.05.Je, Mh in specific materials)*

82.45.Yz Nanostructured materials in electrochemistry *(for nanofabrication, see 81.16.−c in materials science)*

82.47.−a Applied electrochemistry

82.47.Aa Lithium-ion batteries

82.47.Cb Lead-acid, nickel-metal hydride and other batteries *(for lithium-ion batteries, see 82.47.Aa)*

82.47.Ed Solid-oxide fuel cells (SOFC)

82.47.Gh Proton exchange membrane (PEM) fuel cells

82.47.Jk Photoelectrochemical cells, photoelectrochromic and other hybrid electrochemical energy storage devices *(see also 84.60.Jt Photoelectric conversion, solar cells and arrays)*

82.47.Lh Molten-carbonate fuel cells (MCFC)

82.47.Nj Polymer-electrolyte fuel cells (PEFC)

82.47.Pm Phosphoric-acid fuel cells (PAFC); other fuel cells

82.47.Rs Electrochemical sensors

82.47.Tp Electrochemical displays

82.47.Uv Electrochemical capacitors; supercapacitors

82.47.Wx Electrochemical engineering

82.50.−m Photochemistry *(for single molecule photochemistry, see 82.37.Vb)*

. . . . *Optical spectroscopy in atomic and molecular physics, see 32.30.−r and 33.20.−t*

. . . . *Optical spectroscopy in condensed matter, see 78.35.+c, 78.40.−q, and 78.47.+p*

82.50.Bc Processes caused by infrared radiation

82.50.Hp Processes caused by visible and UV light

82.50.Kx Processes caused by X-rays or γ-rays

82.50.Nd Control of photochemical reactions

82.50.Pt Multiphoton processes

. . . . *Potential energy surfaces for excited electronic states, see 31.50.Df*

. . . . *Surface crossings, non-adiabatic couplings, see 31.50.Gh*

82.53.−k Femtochemistry *[see also 78.47.J− Ultrafast pump/probe spectroscopy (<1 psec) in condensed matter; 42.65.Re Ultrafast processes; optical generation and pulse compression in nonlinear optics]*

82.53.Eb Pump probe studies of photodissociation

82.53.Hn Pump probe experiments with bound states

82.53.Kp Coherent spectroscopy of atoms and molecules

82.53.Mj Femtosecond probing of semiconductor nanostructures *(see also 81.16.−c Methods of nanofabrication and processing)*

82.53.Ps Femtosecond probing of biological molecules

82.53.St Femtochemistry of adsorbed molecules *(for adsorbate structure, see 68.43.Bc, Fg in chemisorption/physisorption: adsorbates on surfaces)*

82.53.Uv Femtosecond probes of molecules in liquids

82.53.Xa Femtosecond probes of molecules in solids and of molecular solids

82.56.−b Nuclear magnetic resonance *(see also 33.25.+k Nuclear resonance and relaxation in atomic and molecular physics; 76.60.−k Nuclear magnetic resonance and relaxation; 76.70.−r Magnetic double resonances and cross effects in condensed matter)*

82.56.Dj High resolution NMR

82.56.Fk Multidimensional NMR

82.56.Hg Multinuclear NMR

82.56.Jn Pulse sequences in NMR

82.56.Lz Diffusion

82.56.Na Relaxation

82.56.Pp NMR of biomolecules

82.56.Ub Structure determination with NMR

. . . . *ENDOR, see 76.70.Dx and 33.40.+f*

. . . . *NMR imaging, see 76.60.Pc and 87.61.−c*

82.60.−s Chemical thermodynamics

82.60.Cx Enthalpies of combustion, reaction, and formation

82.60.Fa Heat capacities and heats of phase transitions

82.60.Hc Chemical equilibria and equilibrium constants

82.60.Lf Thermodynamics of solutions

82.60.Nh Thermodynamics of nucleation *(see also 64.60.Q− Nucleation—in equations of state, phase equilibria and phase transitions)*

82.60.Qr Thermodynamics of nanoparticles

. . . . *Irreversible thermodynamics, nonequilibrium thermodynamics, see 05.70.Ln*

82.65.+r Surface and interface chemistry; heterogeneous catalysis at surfaces *(for temporal and spatial patterns in surface reactions, see 82.40.Np; see also 82.45.Jn Surface structure, reactivity and catalysis in electrochemistry)*

. . . . *Chemisorption/physisorption: adsorbates on surfaces, see 68.43.−h*

82.70.−y Disperse systems; complex fluids *(see also 82.33.−z reactions in various media; for quantum optical phenomena in dispersive media, see 42.50.Nn)*

82.70.Dd Colloids

82.70.Gg Gels and sols

82.70.Kj Emulsions and suspensions

82.70.Rr Aerosols and foams

82.70.Uv Surfactants, micellar solutions, vesicles, lamellae, amphiphilic systems, (hydrophilic and hydrophobic interactions) *(see also 82.30.Rs Hydrogen bonding, hydrophilic effects in specific chemical reactions)*

. . . . *Nanoscale materials and structures, see 81.07.−b and 61.46.−w*

. . . . *Preparation and assembly of nanostructures, see 81.16.−c*

. . . . *Structural transitions in nanoscale materials, see 64.70.Nd*

. . . . *Spectroscopy of nanostructures, see 78.67.−n*

82.75.−z Molecular sieves, zeolites, clathrates, and other complex solids

82.75.Fq Synthesis, structure determination, structure modeling

82.75.Jn Measurements and modeling of molecule migration in zeolites

82.75.Mj Measurements and simulation of properties (optical, structural) of molecules in zeolites

82.75.Qt Mechanism and kinetics of catalysis in zeolites (measurements or simulations)

82.75.Vx Clusters in zeolites

82.80.−d Chemical analysis and related physical methods of analysis *(for related instrumentation, see section 07; for spectroscopic techniques in biological physics, see 87.64.−t)*

82.80.Bg Chromatography

82.80.Dx Analytical methods involving electronic spectroscopy

82.80.Ej X-ray, Mössbauer, and other γ-ray spectroscopic analysis methods

82.80.Fk Electrochemical methods *(see also 82.45.Rr Electroanalytical chemistry; for electrochemical sensors, see 82.47.Rs)*

82.80.Gk Analytical methods involving vibrational spectroscopy

82.80.Ha Analytical methods involving rotational spectroscopy

82.80.Jp Activation analysis and other radiochemical methods

82.80.Kq Energy-conversion spectro-analytical methods (e.g., photoacoustic, photothermal, and optogalvanic spectroscopic methods)

82.80.Ms Mass spectrometry (including SIMS, multiphoton ionization and resonance ionization mass spectrometry, MALDI)

82.80.Nj Fourier transform mass spectrometry

82.80.Pv Electron spectroscopy (X-ray photoelectron (XPS), Auger electron spectroscopy (AES), etc.)

82.80.Qx Ion cyclotron resonance mass spectrometry

82.80.Rt Time of flight mass spectrometry

82.80.Yc Rutherford backscattering (RBS), and other methods of chemical analysis

82.90.+j Other topics in physical chemistry and chemical physics (restricted to new topics in section 82)

83. Rheology *(see also section 47 Fluid dynamics; for rheology of the Earth, see 91.32.−m; see also 87.19.rh Fluid transport and rheology in biological physics)*

83.10.−y Fundamentals and theoretical

83.10.Bb Kinematics of deformation and flow

. . . . *Non-Newtonian fluid flows, see 47.50.−d*

83.10.Ff Continuum mechanics *(see also section 46 Continuum mechanics of solids)*

83.10.Gr Constitutive relations

83.10.Kn Reptation and tube theories

83.10.Mj Molecular dynamics, Brownian dynamics

83.10.Pp Particle dynamics

83.10.Rs Computer simulation of molecular and particle dynamics

83.10.Tv Structural and phase changes

83.50.−v Deformation and flow

83.50.Ax Steady shear flows, viscometric flow

83.50.Ha Flow in channels *(see also 47.60.Dx Flows in ducts and channels in fluid dynamics)*

83.50.Jf Extensional flow and combined shear and extension

83.50.Lh Slip boundary effects (interfacial and free surface flows) *(see also 47.45.Gx Slip flows and accommodation in fluid dynamics)*

83.50.Rp Wall slip and apparent slip

83.50.Uv Material processing (extension, molding, etc.)

83.50.Xa Mixing and blending

83.60.−a Material behavior

83.60.Bc Linear viscoelasticity

83.60.Df Nonlinear viscoelasticity

83.60.Fg Shear rate dependent viscosity

83.60.Hc Normal stress differences and their effects (e.g. rod climbing)

83.60.Jk Extrudate swell

83.60.La Viscoplasticity; yield stress

83.60.Np Effects of electric and magnetic fields

83.60.Pq Time-dependent structure (thixotropy, rheopexy)

83.60.Rs Shear rate-dependent structure (shear thinning and shear thickening)

83.60.St Non-isothermal rheology

83.60.Uv Wave propagation, fracture, and crack healing

83.60.Wc Flow instabilities

83.60.Yz Drag reduction

83.80.−k Material type *(see also 82.70.−y Disperse systems; complex fluids and 82.35.−x Polymers: properties; reactions; polymerization in physical chemistry and chemical physics)*

83.80.Ab Solids: e.g., composites, glasses, semicrystalline polymers

83.80.Fg Granular solids

83.80.Gv Electro- and magnetorheological fluids

83.80.Hj Suspensions, dispersions, pastes, slurries, colloids

83.80.Iz Emulsions and foams

83.80.Jx Reacting systems: thermosetting polymers, chemorheology, rheokinetics

83.80.Kn Physical gels and microgels

83.80.Lz Physiological materials (e.g. blood, collagen, etc.)

83.80.Mc Other natural materials (e.g. wood and other vegetable materials)

83.80.Nb Geological materials: Earth, magma, ice, rocks, etc.

83.80.Qr Surfactant and micellar systems, associated polymers

83.80.Rs Polymer solutions

83.80.Sg Polymer melts

83.80.Tc Polymer blends

83.80.Uv Block copolymers

83.80.Va Elastomeric polymers

83.80.Wx Filled elastomers

83.80.Xz Liquid crystals: nematic, cholesteric, smectic, discotic, etc.

83.80.Ya Processed food

83.85.−c Techniques and apparatus

83.85.Cg Rheological measurements—rheometry

83.85.Ei Optical methods; rheo-optics

83.85.Fg NMR/magnetic resonance imaging *(see also 76.60.Pc NMR imaging in condensed matter)*

83.85.Hf X-ray and neutron scattering

83.85.Jn Viscosity measurements

83.85.Lq Normal stress difference measurements

83.85.Ns Data analysis (interconversion of data computation of relaxation and retardation spectra; time-temperature superposition, etc.)

. . . . *Computational fluid dynamics, see 47.11.−j*

83.85.Rx Extensional flow measurement

83.85.St Stress relaxation

83.85.Tz Creep and/or creep recoil

83.85.Vb Small amplitude oscillatory shear (dynamic mechanical analysis)

83.90.+s Other topics in rheology (restricted to new topics in section 83)

84. Electronics; radiowave and microwave technology; direct energy conversion and storage

84.30.−r Electronic circuits *(for integrated circuits, see 85.40.−e, for microwave circuits, see 84.40.Dc)*

84.30.Bv Circuit theory

84.30.Jc Power electronics; power supply circuits *(see also 84.70.+p High-current and high-voltage technology; for superconducting high-power technology, see 84.71.−b)*

84.30.Le Amplifiers

84.30.Ng Oscillators, pulse generators, and function generators

84.30.Qi Modulators and demodulators; discriminators, comparators, mixers, limiters, and compressors

84.30.Sk Pulse and digital circuits

84.30.Vn Filters

84.32.−y Passive circuit components *(see also 07.50.−e Electrical and electronic instruments, and components)*

84.32.Dd Connectors, relays, and switches

84.32.Ff Conductors, resistors (including thermistors, varistors, and photoresistors)

84.32.Hh Inductors and coils; wiring

84.32.Tt Capacitors *(for electrochemical capacitors and supercapacitors, see 82.47.Uv)*

84.32.Vv Fuses

84.35.+i Neural networks *(for optical neural networks, see 42.79.Ta; see also 07.05.Mh Neural networks, fuzzy logic, artificial intelligence in computers in experimental physics; 87.18.Sn in biological complexity)*

84.37.+q Measurements in electric variables (including voltage, current, resistance, capacitance, inductance, impedance, and admittance, etc.)

84.40.−x Radiowave and microwave (including millimeter wave) technology

. . . . *Microwave, submillimeter wave, and radiowave receivers and detectors, see 07.57.Kp*

. . . . *Microwave and radiowave spectrometers, see 07.57.Pt*

. . . . *Electromagnetic wave propagation, see 41.20.Jb*

84.40.Az Waveguides, transmission lines, striplines

84.40.Ba Antennas: theory, components and accessories *(for plasma interactions with antennas, see 52.40.Fd in plasma physics)*

84.40.Dc Microwave circuits

84.40.Fe Microwave tubes (e.g., klystrons, magnetrons, traveling-wave, backward-wave tubes, etc.)

84.40.Ik Masers; gyrotrons (cyclotron-resonance masers)

84.40.Lj Microwave integrated electronics

84.40.Ua Telecommunications: signal transmission and processing; communication satellites *(for optical communications, see 42.79.Sz in optics)*

84.40.Xb Telemetry: remote control, remote sensing; radar

84.47.+w Vacuum tubes *(see also 85.45.−w Vacuum microelectronics)*

. . . . *Phototubes, see 85.60.Ha*

. . . . *Microwave tubes, see 84.40.Fe*

84.50.+d Electric motors

84.60.−h Direct energy conversion and storage *(see also 89.30.−g Energy resources; for electrochemical conversion, see 82.47.−a; for Ocean energy extraction, see 92.05.Jn)*

84.60.Bk Performance characteristics of energy conversion systems; figure of merit

84.60.Jt Photoelectric conversion: solar cells and arrays *(for solar collectors and concentrators, see 42.79.Ek in optics)*

84.60.Lw Magnetohydrodynamic conversion *(for MHD generators, see 52.75.Fk−in plasma physics)*

84.60.Ny Thermionic conversion *(for thermionic generators, see 52.75.Fk−in plasma physics)*

84.60.Rb Thermoelectric, electrogasdynamic and other direct energy conversion

84.60.Ve Energy storage systems, including capacitor banks

84.70.+p High-current and high-voltage technology: power systems; power transmission lines and cables *(for superconducting cables, see 84.71.Fk)*

84.71.−b Superconducting high-power technology *(see also 84.30.Jc Power electronics; power supply circuits)*

84.71.Ba Superconducting magnets; magnetic levitation devices

84.71.Fk Superconducting cables

84.71.Mn Superconducting wires, fibers, and tapes

84.90.+a Other topics in electronics, radiowave and microwave technology, and direct energy conversion and storage (restricted to new topics in section 84)

85. Electronic and magnetic devices; microelectronics

. . . . *Vacuum tubes, see 84.47.+w*

. . . . *Microwave tubes, see 84.40.Fe*

. . . . *Phototubes, see 85.60.Ha*

. . . . *Conductors, resistors, and inductors, see 84.32.Ff, Hh*

85.25.−j Superconducting devices

85.25.Am Superconducting device characterization, design, and modeling

85.25.Cp Josephson devices

85.25.Dq Superconducting quantum interference devices (SQUIDs)

85.25.Hv Superconducting logic elements and memory devices; microelectronic circuits

85.25.Oj Superconducting optical, X-ray, and γ-ray detectors (SIS, NIS, transition edge)

85.25.Pb Superconducting infrared, submillimeter and millimeter wave detectors

. . . . *High power superconducting devices, see 84.71.−b*

85.25.Qc Superconducting surface acoustic wave devices and other superconducting devices

85.30.−z Semiconductor devices *(for photodiodes, phototransistors, and photoresistors, see 85.60.Dw; for laser diodes, see 42.55.Px)*

85.30.De Semiconductor-device characterization, design, and modeling

85.30.Fg Bulk semiconductor and conductivity oscillation devices (including Hall effect devices, space-charge-limited devices, and Gunn effect devices)

85.30.Hi Surface barrier, boundary, and point contact devices

85.30.Kk Junction diodes

85.30.Mn Junction breakdown and tunneling devices (including resonance tunneling devices)

85.30.Pq Bipolar transistors

85.30.Rs Thyristors

85.30.Tv Field effect devices

85.35.−p Nanoelectronic devices

85.35.Be Quantum well devices (quantum dots, quantum wires, etc.)

85.35.Ds Quantum interference devices

85.35.Gv Single electron devices

85.35.Kt Nanotube devices

85.40.−e Microelectronics: LSI, VLSI, ULSI; integrated circuit fabrication technology *(see also 85.45.−w Vacuum microelectronics)*

. . . . *Microwave integrated electronics, see 84.40.Lj*

. . . . *Integrated optics, see 42.82.−m*

. . . . *Superconducting logic elements and memory devices; microelectronic circuits, see 85.25.Hv*

85.40.Bh Computer-aided design of microcircuits; layout and modeling

85.40.Hp Lithography, masks and pattern transfer

. . . . *Micro- and nano-electromechanical systems (MEMS/NEMS) and devices, see 85.85.+j*

85.40.Ls Metallization, contacts, interconnects; device isolation

85.40.Qx Microcircuit quality, noise, performance, and failure analysis

85.40.Ry Impurity doping, diffusion and ion implantation technology

85.40.Sz Deposition technology *(for plasma applications in deposition technology, see 52.77.Dq)*

. . . . *Bipolar integrated circuits, see 85.30.Pq*

. . . . *Field effect integrated circuits, see 85.30.Tv*

85.40.Xx Hybrid microelectronics; thick films

85.45.−w Vacuum microelectronics

. . . . *Microwave vacuum microelectronic devices, see 84.40.−x*

85.45.Bz Vacuum microelectronic device characterization, design, and modeling

85.45.Db Field emitters and arrays, cold electron emitters

85.45.Fd Field emission displays (FEDs)

. . . . *Capacitors, see 84.32.Tt*

85.50.−n Dielectric, ferroelectric, and piezoelectric devices

85.50.Gk Non-volatile ferroelectric memories

85.60.−q Optoelectronic devices *(see also 42.79.−e Optical elements, devices and systems)*

85.60.Bt Optoelectronic device characterization, design, and modeling

85.60.Dw Photodiodes; phototransistors; photoresistors

85.60.Gz Photodetectors (including infrared

and CCD detectors) *(for superconducting infrared detectors, see 85.25.Pb; for superconducting optical, x-ray and γ-ray detectors, see 85.25.Oj; see also 07.57.Kp in instruments)*

85.60.Ha Photomultipliers; phototubes and photocathodes

85.60.Jb Light-emitting devices

85.60.Pg Display systems *(for field emission display, see 85.45.Fd, for optical display devices, see 42.79.Kr; for electrochemical displays, see 82.47.Tp; see also 07.07.Hj Display and recording equipment, oscilloscopes, TV cameras, etc.)*

85.65.+h Molecular electronic devices

85.70.−w Magnetic devices

. . . . *Molecular magnets, see 75.50.Xx*

. . . . *Magnets, see 07.55.Db*

. . . . *Superconducting magnets and magnetic levitation devices, see 84.71.Ba*

. . . . *Beam bending magnets, see 41.85.Lc*

85.70.Ay Magnetic device characterization, design, and modeling

85.70.Ec Magnetostrictive, magnetoacoustic, and magnetostatic devices *(for magnetostrictive transducers, see 43.38.Ct—in Acoustics Appendix)*

. . . . *Magnetic recording materials, see 75.50.Ss*

85.70.Ge Ferrite and garnet devices

85.70.Kh Magnetic thin film devices: magnetic heads (magnetoresistive, inductive, etc.); domain-motion devices, etc.

85.70.Li Other magnetic recording and storage devices (including tapes, disks, and drums)

85.70.Rp Magnetic levitation, propulsion and control devices *(for superconducting magnetic levitation devices, see 84.71.Ba)*

85.70.Sq Magnetooptical devices

85.75.−d Magnetoelectronics; spintronics: devices exploiting spin polarized transport or integrated magnetic fields

85.75.Bb Magnetic memory using giant magnetoresistance

85.75.Dd Magnetic memory using magnetic tunnel junctions

85.75.Ff Reprogrammable magnetic logic

85.75.Hh Spin polarized field effect transistors

85.75.Mm Spin polarized resonant tunnel junctions

85.75.Nn Hybrid Hall devices

85.75.Ss Magnetic field sensors using spin polarized transport

85.80.−b Thermoelectromagnetic and other devices *(for acoustoelectric devices, see 43.38.−p in Acoustics Appendix; for electrochemical devices, see 82.47.−a)*

85.80.Fi Thermoelectric devices

85.80.Jm Magnetoelectric devices

85.80.Lp Magnetothermal devices

85.85.+j Micro- and nano-electromechanical systems (MEMS/NEMS) and devices

85.90.+h Other topics in electronic and magnetic devices and microelectronics (restricted to new topics in section 85)

87. Biological and medical physics

87.10.−e General theory and mathematical aspects

87.10.Ca Analytical theories

87.10.Ed Ordinary differential equations (ODE), partial differential equations (PDE), integrodifferential models

87.10.Hk Lattice models

87.10.Kn Finite element calculations

87.10.Mn Stochastic modeling

87.10.Pq Elasticity theory

87.10.Rt Monte Carlo simulations

87.10.Tf Molecular dynamics simulation

87.10.Vg Biological information

87.14.−g Biomolecules: types

87.14.Cc Lipids

87.14.Df Carbohydrates

87.14.E− Proteins

87.14.ef Peptides

87.14.ej Enzymes

87.14.em Fibrils (amyloids, collagen, etc.)

87.14.ep Membrane proteins

87.14.et Generic models (lattice, HP, etc.)

87.14.G− Nucleic acids

87.14.gf Nucleotides

87.14.gk DNA

87.14.gn RNA

87.14.Lk Hormones

87.14.Pq Vitamins

87.15.−v Biomolecules: structure and physical properties

87.15.A− Theory, modeling, and computer simulation

87.15.ad Analytical theories

87.15.ag Quantum calculations

87.15.ak Monte Carlo simulations

87.15.ap Molecular dynamics simulation

87.15.B− Structure of biomolecules

87.15.bd Secondary structure

87.15.bg Tertiary structure

87.15.bk Structure of aggregates

87.15.Cc Folding: thermodynamics, statistical mechanics, models, and pathways *(see also 87.15.hm Folding dynamics)*

87.15.Fh Bonding; mechanisms of bond breakage

87.15.H− Dynamics of biomolecules

87.15.hg Dynamics of intermolecular interactions

87.15.hj Transport dynamics

87.15.hm Folding dynamics

87.15.hp Conformational changes

87.15.ht Ultrafast dynamics; charge transfer

87.15.K− Molecular interactions; membrane-protein interactions

87.15.kj Protein-polynucleotide interactions

87.15.km Protein-protein interactions

87.15.kp Protein-ligand interactions

87.15.kr Protein-solvent interactions

87.15.kt Protein-membrane interactions

87.15.La Mechanical properties

87.15.M− Spectra of biomolecules

87.15.mk Photodissociation

87.15.mn Photoionization

87.15.mq Luminescence

87.15.N− Properties of solutions of macromolecules

87.15.np Dissolution

87.15.nr Aggregation

87.15.nt Crystallization

87.15.Pc Electronic and electrical properties

87.15.Qt Sequence analysis

87.15.R− Reactions and kinetics *(see also 82.39.−k Chemical kinetics in biological systems in physical chemistry)*

87.15.rp Polymerization (see also 82.35.Pq Biopolymers, biopolymerization in physical chemistry)

87.15.rs Dissociation

87.15.Tt Electrophoresis *(see also 82.45.−h Electrochemistry and electrophoresis)*

87.15.Vv Diffusion

87.15.Ya Fluctuations

87.15.Zg Phase transitions

87.16.−b Subcellular structure and processes

87.16.A− Theory, modeling, and simulations

87.16.ad Analytical theories

87.16.af Monte Carlo calculations

87.16.aj Lattice models

87.16.D− Membranes, bilayers, and vesicles

87.16.dj Dynamics and fluctuations

87.16.dm Mechanical properties and rheology

87.16.dp Transport, including channels, pores, and lateral diffusion

87.16.dr Assembly and interactions

87.16.dt Structure, static correlations, domains, and rafts

87.16.Gj Cell walls

87.16.Ka Filaments, microtubules, their networks, and supramolecular assemblies
87.16.Ln Cytoskeleton
87.16.Mq Morphology of nerve cells
87.16.Nn Motor proteins (myosin, kinesin dynein)
87.16.Qp Pseudopods, lamellipods, cilia, and flagella
87.16.Sr Chromosomes, histones
87.16.Tb Mitochondria and other organelles
87.16.Uv Active transport processes
87.16.Vy Ion channels
87.16.Wd Intracellular trafficking
87.16.Xa Signal transduction and intracellular signaling
87.16.Yc Regulatory genetic and chemical networks
87.16.Zg Nuclear morphology

87.17.−d Cell processes

87.17.Aa Modeling, computer simulation of cell processes
87.17.Ee Growth and division
87.17.Jj Cell locomotion, chemotaxis
87.17.Pq Morphogenesis
87.17.Rt Cell adhesion and cell mechanics
87.17.Uv Biotechnology of cell processes

87.18.−h Biological complexity *(see also 82.39.Rt Reactions in complex biological systems in physical chemistry)*

87.18.Cf Genetic switches and networks
87.18.Ed Cell aggregation
87.18.Fx Multicellular phenomena, biofilms
87.18.Gh Cell-cell communication; collective behavior of motile cells
87.18.Hf Spatiotemporal pattern formation in cellular populations
87.18.Mp Signal transduction networks
87.18.Nq Large-scale biological processes and integrative biophysics
87.18.Sn Neural networks and synaptic communication
87.18.Tt Noise in biological systems
87.18.Vf Systems biology
87.18.Wd Genomics
87.18.Xr Proteomics
87.18.Yt Circadian rhythms

87.19.−j Properties of higher organisms

87.19.Ff Muscles
87.19.Hh Cardiac dynamics
87.19.L− Neuroscience
87.19.lb Action potential propagation and axons
87.19.lc Noise in the nervous system
87.19.ld Electrodynamics in the nervous system
87.19.le EEG and MEG
87.19.lf MRI: anatomic, functional, spectral, diffusion
87.19.lg Synapses: chemical and electrical (gap junctions)
87.19.lh Optical imaging of neuronal activity
87.19.lj Neuronal network dynamics
87.19.lk Glia
87.19.ll Models of single neurons and networks
87.19.lm Synchronization in the nervous system
87.19.ln Oscillations and resonance
87.19.lo Information theory
87.19.lp Pattern formation: activity and anatomic
87.19.lq Neuronal wave propagation
87.19.lr Control theory and feedback
87.19.ls Encoding, decoding, and transformation
87.19.lt Sensory systems: visual, auditory, tactile, taste, and olfaction (for Neurophysiology of speech perception, see 43.71.Qr and 43.72.Qr Auditory synthesis and recognition in Acoustics Appendix; 42.66.−p Physiological optics)
87.19.lu Motor systems: Locomotion, flight, vocalization
87.19.lv Learning and memory
87.19.lw Plasticity
87.19.lx Development and growth
87.19.ly Energetics
87.19.Pp Biothermics and thermal processes in biology
87.19.R− Mechanical and electrical properties of tissues and organs
87.19.rd Elastic properties
87.19.rf Dielectric properties
87.19.rh Fluid transport and rheology
87.19.rj Contraction
87.19.rm Structure
87.19.rp Impulse propagation
87.19.rs Movement
87.19.ru Locomotion
87.19.U− Hemodynamics
87.19.ug Heart and lung dynamics
87.19.uj Peripheral vascular dynamics
87.19.um Blood-brain barrier
87.19.Wx Pneumodyamics, respiration
87.19.X− Diseases
87.19.xb Bacterial diseases
87.19.xd Viral diseases
87.19.xe Parasitic diseases
87.19.xg Fungal diseases
87.19.xh Prion diseases
87.19.xj Cancer
87.19.xk Genetic diseases
87.19.xm Epilepsy
87.19.xn Musculoskeletal
87.19.xp Motor system disease (Parkinson's, etc.)
87.19.xq Stroke
87.19.xr Degenerative diseases (Alzheimer's, ALS, etc)
87.19.xt Developmental diseases
87.19.xu Gastrointestinal diseases
87.19.xv Endocrine diseases
87.19.xw Immune system diseases

87.23.−n Ecology and evolution

87.23.Cc Population dynamics and ecological pattern formation
87.23.Ge Dynamics of social systems
87.23.Kg Dynamics of evolution

87.50.−a Effects of electromagnetic and acoustic fields on biological systems

87.50.C− Static and low-frequency electric and magnetic fields effects
87.50.cf Biophysical mechanisms of interaction
87.50.ch Electrophoresis/dielectrophoresis and other mechanical effects (see also 87.15.Tt Electrophoresis)
87.50.cj Electroporation/membrane effects
87.50.cm Dosimetry/exposure assessment
87.50.ct Therapeutic applications
87.50.S− Radiofrequency/microwave fields effects
87.50.sg Biophysical mechanisms of interaction
87.50.sj Dosimetry/exposure assessment
87.50.st Therapeutic applications
87.50.U− Millimeter/terahertz fields effects
87.50.uj Biophysical mechanisms of interaction
87.50.up Dosimetry/exposure assessment
87.50.ux Therapeutic applications
87.50.W− Optical/infrared radiation effects
87.50.wf Biophysical mechanisms of interaction
87.50.wj Dosimetry/exposure assessment
87.50.wp Therapeutic applications
87.50.Y− Biological effects of acoustic and ultrasonic energy
87.50.yg Biophysical mechanisms of interaction
87.50.yk Dosimetry/exposure assessment
87.50.yt Therapeutic applications

87.53.−j Effects of ionizing radiation on biological systems

87.53.Ay Biophysical mechanisms of interaction
87.53.Bn Dosimetry/exposure assessment
87.53.Jw Therapeutic applications, including brachytherapy
87.53.Kn Conformal radiation treatment
87.53.Ly Stereotactic radiosurgery

87.55.−x Treatment strategy

87.55.D− Treatment planning
87.55.de Optimization
87.55.dh Tissue response

87.55.dk *Dose-volume analysis*
87.55.Gh Simulation
87.55.K− Monte Carlo methods
87.55.kd *Algorithms*
87.55.kh *Applications*
87.55.km *Verification*
87.55.N− Radiation monitoring, control, and safety
87.55.ne *Therapeutic applications*
87.55.Qr Quality assurance in radiotherapy
87.55.T− Record and verify systems and applications
87.55.tg *Design*
87.55.tm *Applications*

87.56.−v Radiation therapy equipment
87.56.B− Radiation sources
87.56.bd *Accelerators*
87.56.bg *Radioactive sources*
87.56.Da Ancillary equipment
87.56.Fc Quality assurance equipment
87.56.J− Collimation
87.56.jf *Field size*
87.56.jk *Field shaping*
87.56.N− Beam intensity modifications
87.56.ng *Wedges and compensators*
87.56.nk *Collimators*

87.57.−s Medical imaging
87.57.C− Image quality
87.57.cf *Spatial resolution*
87.57.cj *Contrast*
87.57.cm *Noise*
87.57.cp *Artifacts and distortion*
87.57.N− Image analysis
87.57.nf *Reconstruction*
87.57.nj *Registration*
87.57.nm *Segmentation*
87.57.np *Smoothing*
87.57.nt *Edge enhancement*
87.57.Q− Computed tomography
87.57.qh *Single-slice*
87.57.qp *Multislice*
87.57.R− Computer-aided diagnosis
87.57.rh *Mammography*
87.57.U− Nuclear medicine imaging
87.57.ue *Conventional nuclear medicine imaging*
87.57.uh *Single photon emission computed tomography (SPECT)*
87.57.uk *Positron emission tomography (PET)*
87.57.un *Radiopharmaceuticals*
87.57.uq *Dosimetry*

87.59.−e X-ray imaging
87.59.B− Radiography
87.59.bd *Computed radiography*
87.59.bf *Digital radiography*
87.59.C− Fluoroscopy
87.59.cf *Digital fluoroscopy*
87.59.Dj Angiography
87.59.E− Mammography
87.59.eg *Film mammography*
87.59.ej *Digital mammography*

87.61.−c Magnetic resonance imaging
87.61.Bj Theory and principles
87.61.Ff Instrumentation
87.61.Hk Pulse sequences
87.61.Jc Anatomic imaging
87.61.Np Flow imaging
87.61.Qr Functional imaging
87.61.Tg Clinical applications

87.63.−d Non-ionizing radiation equipment and techniques
87.63.D− Ultrasonography
87.63.dh *Ultrasonographic imaging*
87.63.dk *Doppler*
87.63.Hg Thermography
87.63.L− Visual imaging
87.63.lg *Principles of visualization*
87.63.lj *Image perception*
87.63.lm *Image enhancement*
87.63.lp *Transillumination*
87.63.lt *Laser imaging*
87.63.Pn Electrical impedance tomography (EIT)
87.63.St Bone densitometry

87.64.−t Spectroscopic and microscopic techniques in biophysics and medical physics
87.64.Aa Computer simulation
87.64.Bx Electron, neutron and x-ray diffraction and scattering
87.64.Cc Scattering of visible, uv, and infrared radiation
87.64.Dz Scanning tunneling and atomic force microscopy
87.64.Ee Electron microscopy
87.64.K− Spectroscopy
87.64.kd *X-ray and EXAFS*
87.64.kh *EPR*
87.64.kj *NMR*
87.64.km *Infrared*
87.64.kp *Raman*
87.64.ks *Electron and photoelectron*
87.64.ku *Magnetic circular dichroism*
87.64.kv *Fluorescence*
87.64.kx *Mössbauer*
87.64.M− Optical microscopy
87.64.mc *Bright field*
87.64.mf *Dark field*
87.64.mh *Phase contrast and DIC*
87.64.mk *Confocal*
87.64.mn *Multiphoton*
87.64.mt *Near-field scanning*

87.80.−y Biophysical techniques (research methods)
87.80.Cc Optical trapping *(see also 42.50.Wk Mechanical effects of light on material media, microstructure and particles in optics; 37.10.−x Atom, molecule, and ion cooling methods)*
87.80.Dj Spectroscopies
87.80.Ek Mechanical and micromechanical techniques
87.80.Fe Micromanipulation of biological structures
87.80.Jg Patch clamping and other physiological measurements
87.80.Kc Electrochemical techniques
87.80.Lg Magnetic and paramagnetic resonance
87.80.Nj Single-molecule techniques *(see also 82.37.Rs Single molecule manipulation of proteins and other biological molecules in physical chemistry)*
87.80.Qk Biochemical separation processes
87.80.St Genomic techniques
87.80.Un Proteomic techniques

87.85.−d Biomedical engineering
87.85.D− Applied neuroscience
87.85.dd *Brain-machine interfaces*
87.85.dh *Cells on a chip*
87.85.dm *Physical models of neurophysiological processes*
87.85.dq *Neural networks*
87.85.E− Neural prosthetics
87.85.eg *Electrode stimulation*
87.85.ej *Safe limits of charge injection*
87.85.em *Tissue damage*
87.85.F− Smart prosthetics
87.85.ff *Feedback*
87.85.fh *Feedforward*
87.85.fk *Biosensors*
87.85.fp *Bidirectional communication*
87.85.G− Biomechanics
87.85.gf *Fluid mechanics and rheology*
87.85.gj *Movement and locomotion*
87.85.gp *Mechanical systems*
87.85.J− Biomaterials
87.85.jc *Electrical, thermal, and mechanical properties of biological matter*
87.85.jf *Bio-based materials*
87.85.jj *Biocompatibility*
87.85.Lf Tissue engineering
87.85.M− Biotechnology *(for biotechnology of cell processes, see 87.17.Uv)*
87.85.md *Genetic engineering*
87.85.mg *Genomics*
87.85.mk *Proteomics*
87.85.Ng Biological signal processing
87.85.Ox Biomedical instrumentation and transducers, including micro-electro-mechanical systems (MEMS)
87.85.Pq Biomedical imaging

87.85.Qr Nanotechnologies-design
87.85.Rs Nanotechnologies-applications
87.85.St Robotics
87.85.Tu Modeling biomedical systems
87.85.Uv Micromanipulators
87.85.Va Micromachining
87.85.Wc Neural engineering *(for neural prosthetics, see 87.85.E−)*
87.85.Xd Dynamical, regulatory, and integrative biology

87.90.+y Other topics in biological and medical physics (restricted to new topics in section 87)

89. Other areas of applied and interdisciplinary physics

89.20.−a Interdisciplinary applications of physics
89.20.Bb Industrial and technological research and development
89.20.Dd Military technology and weapons systems; arms control
89.20.Ff Computer science and technology
89.20.Hh World Wide Web, Internet
89.20.Kk Engineering *(for electrochemical engineering, see 82.47.Wx; for biomedical engineering, see 87.80.−y)*
89.20.Mn Forensic science

89.30.−g Energy resources *(see also 84.60.−h Direct energy conversion and storage)*
89.30.Aa Fossil fuels
89.30.Cc Solar power
89.30.Ee Hydroelectric, hydrothermal, geothermal and wind power
89.30.Gg Nuclear fission power *(for fission reactors, see 28.41.−i and 28.50.−k in nuclear physics)*
89.30.Jj Nuclear fusion power *(for fusion reactors, see 28.52.−s in nuclear physics)*

89.40.−a Transportation
89.40.Bb Land transportation
89.40.Cc Water transportation
89.40.Dd Air transporation

89.60.−k Environmental studies *(for ecology, see 87.23.−n)*
. . . . *Air quality and air pollution, see 92.60.Sz*
. . . . *Erosion sedimentation; sediment transport, see 92.40.Gc*
. . . . *Water quality, see 92.40.kc and in Geophysics Appendix, see 92.40.qc*
89.60.Ec Environmental safety
89.60.Fe Environmental regulations
89.60.Gg Impact of natural and man-made disasters

89.65.−s Social and economic systems
89.65.Cd Demographic studies
89.65.Ef Social organizations; anthropology
89.65.Gh Economics; econophysics, financial markets, business and management
89.65.Lm Urban planning and construction

89.70.−a Information and communication theory *(for telecommunications, see 84.40.Ua; for optical communications, see 42.79.Sz; for quantum information, see 03.67.−a; for applications to neuroscience, see 87.19.lo)*
89.70.Cf Entropy and other measures of information
89.70.Eg Computational complexity
89.70.Hj Communication complexity
89.70.Kn Channel capacity and error-correcting codes

89.75.−k Complex systems
89.75.Da Systems obeying scaling laws
89.75.Fb Structures and organization in complex systems
89.75.Hc Networks and genealogical trees
89.75.Kd Patterns

89.90.+n Other topics in areas of applied and interdisciplinary physics (restricted to new topics in section 89)

90. GEOPHYSICS, ASTRONOMY, AND ASTROPHYSICS *(for more detailed headings, see the Geophysics Appendix)*

91. Solid Earth physics

91.10.−v Geodesy and gravity *(see also 91.50.Kx Gravity and isostasy—in Marine geology and geophysics; 91.45.gh—in Geophysics Appendix)*

91.10.By Mathematical geodesy; general theory

91.10.Da Cartography

91.10.Fc Space and satellite geodesy; applications of global positioning systems

91.10.Jf Topography; geometric observations

91.10.Kg Crustal movements and deformation

91.10.Lh Photogrammetry

91.10.Nj Rotational variations; polar wobble *(see also 92.10.Iv Ocean influence of Earth's rotation)*

91.10.Op Gravity anomalies; time variable gravity

91.10.Pp Geodetic techniques; gravimetric measurements and instruments

91.10.Qm Harmonics of the gravity potential field; geopotential theory and determination

. . . . *Rheology of lithosphere and mantle, see 91.32.De, 91.32.Gh*

91.10.Sp Satellite orbits

91.10.Tq Earth tides

91.10.Vr Ocean/Earth/atmosphere/hydrosphere/cryosphere interactions; mass balance

91.10.Ws Reference systems

91.10.Xa Global change from geodesy

91.25.−r Geomagnetism and paleomagnetism; geoelectricity *(see also 91.50.Iv Marine magnetics and electromagnetics)*

91.25.Cw Origins and models of the magnetic field; dynamo theories

91.25.Dx Archeomagnetism

91.25.Ey Interactions between exterior sources and interior properties

91.25.F− Rock and mineral magnetism *(see also 91.60.Pn Magnetic and electrical properties—in Physical properties of rocks and minerals)*

91.25.fa Biogenic magnetic minerals

91.25.fd Environmental magnetism

91.25.G− Spatial variations in geomagnetism

91.25.ga Harmonics and anomalies

91.25.gj Attributed to seafloor spreading

91.25.Le Time variations in geomagnetism

91.25.Mf Magnetic field reversals: process and timescale

91.25.Ng Paleomagnetism

91.25.Ph Magnetostratigraphy

91.25.Qi Geoelectricity, electromagnetic induction, and telluric currents

91.25.Rt Magnetic anomalies; modeling and interpretations

91.25.St Magnetic fabrics and anisotropy

91.25.Th Reference fields: regional; global

91.25.Ux Remagnetization

91.25.Wb Geomagnetic induction

91.25.Xg Geomagnetic excursion

91.25.Za Core processes

91.30.−f Seismology

91.30.Ab Theory and modeling, computational seismology

91.30.Bi Seismic sources (mechanisms, magnitude, moment frequency spectrum)

91.30.Cd Body wave propagation

91.30.Dk Seismicity *(see also 91.45.gd—in Geophysics Appendix)*

91.30.Fn Surface waves and free oscillations

91.30.Ga Subduction zones *(see also 91.40.Rs—in Volcanology; 91.45.Hc—in Tectonophysics; 91.50.Wy—in Marine geology and geophysics; 91.67.fc—in Geophysics Appendix)*

91.30.Hc Mid-ocean ridges *(see also 91.40.St—in Volcanology; 91.50.Rt—in Marine geology and geophysics; 91.67.ff—in Geophysics Appendix)*

91.30.Iv Transform faults

91.30.Jk Tomography in seismology *(see also 91.35.Pn Tomography of the Earth's interior)*

91.30.Mv Strong motions and shock waves

91.30.Nw Tsunamis *(see also 92.10.hl—in Geophysics Appendix)*

91.30.Px Earthquakes

91.30.Rz Nuclear explosion seismology

91.30.Tb Volcano seismology

91.30.Uv Core and mantle seismology

91.30.Vc Continental crust seismology

91.30.Wx Lithosphere seismology *(see also 91.45.gf—in Geophysics Appendix)*

91.30.Ye Oceanic crust seismology

91.30.Za Paleoseismology

91.32.−m Rheology of the Earth

91.32.Ac General aspects

91.32.De Crust and lithosphere

91.32.Gh Mantle

91.32.Jk Friction of fault zones

91.35.−x Earth's interior structure and properties

91.35.Cb Models of interior structure

91.35.Dc Heat flow; geothermy *(see also 91.50.Ln Heat flow (benthic)—in Marine geology and geophysics)*

91.35.Ed Structure of the Earth's interior below the upper mantle

91.35.Gf Structure of the crust and upper mantle

91.35.Lj Composition and state of the Earth's interior *(see also 91.67.gb—in Geophysics Appendix)*

. . . . *Geochronology, see 91.80.+d; 91.80.−d (in Geophysics Appendix)*

91.35.Pn Tomography of the Earth's interior *(see also 91.30.Jk Tomography in seismology)*

91.40.−k Volcanology *(see also 91.30.Tb Volcano seismology)*

91.40.Ac Geochemical modeling

91.40.Bp Tephrochronology; ash deposits

91.40.Dr Atmospheric effects *(see also 92.60.Mt Particles and aerosols—in Meteorology)*

91.40.Ft Eruption mechanisms

91.40.Ge Hydrothermal systems *(see also 91.67.Jk—in Geochemistry; 92.05.Lf—in oceanography)*

91.40.Hw Lava rheology and morphology

91.40.Jk Magma migration

91.40.La Physics and chemistry of magma bodies

91.40.Pc Thermodynamics in volcanology

91.40.Qa Reactions and phase equilibria *(see also 91.67.De—in Geochemistry)*

91.40.Rs Subduction zone processes *(see also 91.30.Ga—in Seismology; 91.45.Hc—in Tectonophysics; 91.50.Wy—in Marine geology; 91.67.fc—in Geophysics Appendix)*

91.40.St Mid-oceanic ridge processes *(see also 91.30.Hc—in Seismology; 91.50.Rt—in Marine geology; 91.67.ff—in Geophysics Appendix)*

91.40.Ta Intra-plate processes *(see also 91.50.Tb—in Marine geology; 91.67.fh—in Geophysics Appendix)*

91.40.Uc Volcanoclastic deposits

91.40.Vg Volcanic gases

91.40.Wx Calderas

91.40.Yt Remote sensing of volcanoes *(see also 93.85.Pq)*

91.40.Zz Volcano monitoring; volcanic hazards and risks

. . . . *Planetary volcanism, see 96.12.Xy*

91.45.−c Tectonophysics

91.45.Bg Planetary interiors *(see also 96.12.Pc—in Planetology of solid surface planets; 96.15.Nd—in Planetology of fluid planets)*

91.45.Cg Continental tectonics

91.45.Dh Plate tectonics

. . . . *Neotectonics, see 91.45.ch—in Geophysics Appendix*

91.45.Fj Convection currents and mantle plumes

91.45.Ga Dynamics and mechanics of tectonics

91.45.Hc Subduction and obduction zone processes *(see also 91.30.Ga—in Seismology; 91.40.Rs—in Volcanology)*

91.45.Jg Hot spots, large igneous provinces, and flood basalt volcanism

91.45.Kn Core processes

91.45.Nc Evolution of the Earth

91.45.Qv Tomography of plate tectonics *(see also 91.30.Jk—in Seismology)*

91.45.Rg Heat generation and transport

. . . . *Folds and folding, see 91.55.Hj*

. . . . *Fractures and faults, see 91.55.Jk*

91.45.Wa Volcanic arcs

91.45.Xz Stresses in tectonophysics

. . . . *Hydrothermal systems, see 91.40.Ge*

. . . . *Planetary tectonics, see 96.12.Xy*

. . . . *Pluton emplacement, see 91.55.Sn*

. . . . *Rheology of the Earth, see 91.32.−m*

91.50.−r Marine geology and geophysics

91.50.Ac Back-arc basin processes

91.50.Bd Continental shelf and slope processes

91.50.Cw Beach and coastal processes

91.50.Ey Seafloor morphology, geology, and geophysics *(see also 92.10.Oc Benthic boundary layers, ocean bottom processes—in oceanography)*

91.50.Ga Bathymetry, seafloor topology

91.50.Hc Gas and hydrate systems *(see also 92.20.Uv—in oceanography)*

91.50.Iv Marine magnetics and electromagnetics

91.50.Jc Marine sediments, turbidity currents—processes and transport *(see also 91.65.Ti—in petrology; 91.67.Ty—in Geochemistry; 92.10.Wa and 92.20.Vn—in oceanography; 92.40.Gc—in hydrology; 91.80.Wx—in Geophysics Appendix)*

91.50.Kx Gravity and isostasy

91.50.Ln Heat flow (benthic)

91.50.Nc Littoral processes

91.50.Ps Marine hydrogeology

91.50.Qr Micropaleontology

91.50.Rt Mid-ocean ridge processes *(see also 91.30.Hc—in Seismology; 91.40.St—in Volcanology; 91.67.ff—in Geophysics Appendix)*

91.50.Sn Ocean drilling *(see also 93.85.Tf Oil prospecting, pipelines, and conduits)*

91.50.Tb Oceanic hotspots and intra-plate volcanism *(see also 91.40.Ta—in Volcanology; 91.67.fh—in Geophysics Appendix)*

91.50.Uv Oceanic plateaus and fracture zone processes

91.50.Vx Ophiolites

91.50.Wy Subduction zone processes

91.50.Xz Submarine landslides

91.50.Yf Submergence instruments, ROV, AUV, Submersibles, and ocean observatories

91.55.−y Structural geology

91.55.Ax Mechanics, theory and modeling

91.55.Bc Continental neotectonics

91.55.De Diapir and diapirism

91.55.Fg Dynamics and mechanics of faulting *(see also 91.32.Jk Friction of fault zones, rheology of)*

91.55.Hj Folds and folding

91.55.Jk Fractures and faults *(see also 91.50.Uv Oceanic plateaus and fracture zone processes)*

91.55.Ln Kinematics of crustal and mantle deformation

91.55.Mb High strain deformation zones

91.55.Nc Local crustal structure; regional crustal structure

91.55.Pq Melanges

91.55.Qr Mesoscopic fabrics

91.55.Sn Pluton emplacement

91.55.Tt Role of fluids

91.55.Uv Remote sensing in structural geology

. . . . *Rheology of the Earth, see 91.32.−m*

91.60.−x Physical properties of rocks and minerals *(for rheological properties of geological materials, see 83.80.Nb)*

91.60.Ba Elasticity, fracture, and flow

91.60.Dc Plasticity, diffusion, and creep

91.60.Ed Crystal structure and defects, microstructure

91.60.Fe Equations of state

91.60.Gf High-pressure behavior

91.60.Hg Phase changes

91.60.Ki Thermal properties

91.60.Lj Acoustic properties

91.60.Mk Optical properties

91.60.Np Permeability and porosity

91.60.Pn Magnetic and electrical properties *(see also 91.25.F− Rock and mineral magnetism)*

. . . . *Environmental magnetism, see 91.25.fd*

91.60.Qr Wave attenuation

91.60.Tn Transport properties

91.62.+g Biogeosciences *(see also 91.67.Uv Organic and biogenic geochemistry; 92.20.Jt Biology of the ocean; 91.80.Kc—in Geophysics Appendix)*

91.65.−n Mineralogy and petrology

91.65.An Mineral and crystal chemistry

. . . . *Geochemical cycles, see 91.67.Nc*

91.65.Cq Igneous petrology

91.65.Dt Isotopic composition *(see also 91.67.Qr Radiogenic isotope geochemistry; 91.67.Rx Stable isotope geochemistry)*

91.65.Ej Extrusive structures and rocks

. . . . *Low temperature geochemistry, see 91.67.Vf*

91.65.Gk Intrusive structures and rocks

. . . . *Organic geochemistry, see 91.67.Uv*

91.65.Jn Layered magma chambers

91.65.Kf Metamorphic petrology

91.65.Lc Pressure-temperature-time paths

91.65.My Fluid flow

. . . . *Trace elements, see 91.67.Pq*

91.65.Pj Ultra-high pressure metamorphism

91.65.Qr Ultra-high temperature metamorphism

91.65.Rg Mineral occurrences and deposits

91.65.Sn Meteorite mineralogy and petrology

91.65.Ti Sedimentary petrology *(see also 91.50.Jc—in marine geology; 91.67.Ty—in Geochemistry; 92.10.Wa and 92.20.Vn—in oceanography; 92.40.Gc—in hydrology; 91.80.Wx—in Geophysics Appendix)*

. . . . *Major element composition, see 91.67.Pq*

91.67.−y Geochemistry *(see also 92.20.Cm Chemistry of the ocean; 92.40.Bc Chemistry of fresh water; 92.60.Ls Ion chemistry of the atmosphere; 91.62.Kt, 91.80.Kc, and 92.20.C− in Geophysics Appendix)*

91.67.Bc Geochemical modeling

91.67.De Reactions and phase equilibria *(see also 91.40.Qa—in Volcanology)*

91.67.Fx Geochemical processes

91.67.Gy Chemical composition

91.67.Jk Geochemistry of hydrothermal systems *(see also 91.40.Ge—in Volcanology; 92.05.Lf—in oceanography)*

. . . . *Physics and chemistry of magma bodies, see 91.40.La*

91.67.Nc Geochemical cycles *(see also 92.20.Sg Biogeochemical cycles—in oceanography; 92.60.hn—in meteorology; 92.30.Gh—in Geophysics Appendix)*

91.67.Pq Major and trace element geochemistry *(see also 92.20.Wx Trace elements—in chemical and biological oceanography)*

91.67.Qr Radiogenic isotope geochemistry *(see also 91.65.Dt Isotopic composition—in Mineralogy and petrology; 92.20.Td Radioactivity and radioisotopes—in oceanography)*

91.67.Rx Stable isotope geochemistry *(see also 91.65.Dt Isotopic composition—in Mineralogy and petrology)*

91.67.St Fluid and melt inclusion geochemistry

91.67.Ty Sedimentary geochemistry *(see also 91.50.Jc—in marine geology; 91.65.Ti—in Mineralogy and petrology; 92.10.Wa and 92.20.Vn—in oceanography; 92.40.Gc—in hydrology; 91.80.Wx—in Geophysics Appendix)*

91.67.Uv Organic and biogenic geochemistry

91.67.Vf Low-temperature geochemistry

91.70.−c Information related to geologic time

91.70.Bf Cenozoic

91.70.Dh Mesozoic

91.70.Fj Paleozoic

91.70.Hm Precambrian

91.80.+d Geochronology *(see also 92.30.Hj—in Geophysics Appendix)*

91.90.+p Other topics in solid Earth physics (restricted to new topics in section 91)

92. Hydrospheric and atmospheric geophysics

92.05.−x General aspects of oceanography

92.05.Bc Analytical modeling and laboratory experiments

92.05.Df Climate and inter-annual variability *(see also 92.60.Ry Climatology, climate change and variability—in meteorology; 92.70.Gt Climate dynamics—in Global change)*

92.05.Ek Long term variability; Heinrich events

92.05.Fg Diurnal, seasonal and annual cycles

92.05.Hj Physical and chemical properties of seawater (salinity, density, temperature)

92.05.Jn Ocean energy extraction

92.05.Lf Hydrothermal systems *(see also 91.40.Ge—in Volcanology; 91.67.Jk—in Geochemistry)*

92.10.−c Physical oceanography

92.10.A− Circulation and currents

92.10.ab General circulation

92.10.ad Deep water formation and circulation

92.10.af Thermohaline convection

92.10.ah Ocean currents; Eastern boundary currents, Western boundary currents

92.10.ak Eddies and mesoscale processes

92.10.am El Nino Southern Oscillation (see also 92.30.La—in Paleoceanography)

. . . . *Physical properties of seawater, see 92.05.Hj*

. . . . *Capillary waves, see 92.10.hd—in Geophysics Appendix*

92.10.Dh Deep ocean processes

92.10.Ei Coriolis effects

92.10.Fj Upper ocean and mixed layer processes

92.10.Hm Ocean waves and oscillations

92.10.Iv Ocean influence of Earth's rotation

. . . . *Seiches, see 92.10.hk—in Geophysics Appendix*

92.10.Kp Sea–air energy exchange processes *(see also 92.60.Cc—in meteorology)*

92.10.Lq Turbulence, diffusion, and mixing processes in oceanography

92.10.Ns Fine structure and microstructure in oceanography

92.10.Oc Benthic boundary layers, ocean bottom processes *(see also 91.50.Ey Sea floor, morphology, geology, and geophysics—in marine geology)*

92.10.Rw Sea ice (mechanics and air/sea/ice exchange processes)

92.10.Sx Coastal, estuarine, and near shore processes *(see also 91.50.Cw Beach and coastal processes—in marine geology)*

92.10.Ty Fronts and jets

92.10.Ua Overflows

92.10.Vz Underwater sound *(see also 43.30.+m in acoustics; 43.30.−k in Acoustics Appendix)*

92.10.Wa Sediment transport *(see also 91.50.Jc—in marine geology; 91.65.Ti—in Mineralogy and petrology; 91.67.Ty—in Geochemistry; 92.20.Vn—in chemical oceanography; 92.40.Gc—in Hydrology; 91.80.Wx—in Geophysics Appendix)*

92.10.Xc Ocean fog

92.10.Yb Hydrography *(for ocean parameter estimation by acoustical methods, see 43.30.Pc—in Acoustics Appendix)*

92.10.Zf Upwelling and convergences *(see also 92.30.Vn—in Geophysics Appendix)*

. . . . *Marine geology and geophysics, see 91.50.−r*

92.20.−h Chemical and biological oceanography

92.20.Bk Aerosols *(see also 92.60.Mt—in meteorology; 91.67.gp and 92.30.Ef—in Geophysics Appendix)*

92.20.Cm Chemistry of the ocean

. . . . *Photochemistry; photosynthesis, see 92.20.ch—in Geophysics Appendix*

. . . . *Ocean energy extraction, see 92.05.Jn*

92.20.Hs Anoxic environments *(see also 91.62.+g Biogeosciences; 91.62.De—in Geophysics Appendix)*

92.20.Iv Benthic processes, sea-bottom processes *(see also 91.50.Ey—in marine geology; 92.10.Oc—in oceanography; 92.40.Gc—in hydrology)*

92.20.Jt Biology of the ocean *(see also 91.62.+g Biogeosciences; 92.40.vu Cryobiology—in Geophysics Appendix)*

92.20.Ny Marine pollution

92.20.Ox Hypoxic environment *(see also 91.62.De—in Geophysics Appendix)*

. . . . *Bacteria, see 92.20.jb—in Geophysics Appendix*

. . . . *Plankton, see 92.20.jf and 92.20.jh—in Geophysics Appendix*

92.20.Sg Biogeochemical cycles *(see also 91.67.Nc—in Geochemistry; 92.60.hn—in meteorology; 92.30.Gh—in Geophysics Appendix)*

92.20.Td Radioactivity and radioisotopes *(see also 91.65.Dt Isotopic composition—in Mineralogy and petrology; 91.67.Qr Radiogenic isotope geochemistry)*

92.20.Uv Gases in chemical oceanography *(see also 91.50.Hc Gas and hydrate systems—in marine geology)*

92.20.Vn Sedimentation *(see also 91.50.Jc—in marine geology; 91.65.Ti—in petrology; 91.67.Ty—in Geochemistry; 92.10.Wa—in oceanography; 92.40.Gc—in hydrology; 91.80.Wx—in Geophysics Appendix)*

92.20.Wx Trace elements *(see also 91.67.Pq Major and trace element geochemistry)*

92.20.Xy Carbon cycling *(see also 91.62.La—in Geophysics Appendix)*

92.30.+m Paleoceanography

92.40.−t Hydrology and glaciology; cryosphere *(see also 92.70.Ha—in Global change)*

92.40.Aa Anthropogenic effects *(see also 92.30.De—in Geophysics Appendix)*

92.40.Bc Chemistry of fresh water

92.40.Cy Modeling; general theory

92.40.De Drought

92.40.Ea Precipitation *(see also 92.60.jf—in Geophysics Appendix)*

. . . . *Rivers, runoff, and stream flow, see 92.40.qh and 92.40.qp—in Geophysics Appendix*

92.40.Gc Erosion and sedimentation; sediment transport *(see also 91.50.Jc—in marine geology; 91.65.Ti—in Mineralogy and petrology; 91.67.Ty—in Geochemistry; 92.10.Wa and 92.20.Vn—in oceanography; 91.80.Wx—in Geophysics Appendix)*

92.40.Ha Debris flow and landslides

92.40.Iv Desertification

92.40.Je Evapotranspiration *(see also 92.60.jc Evaporation—in Geophysics Appendix)*

92.40.Kf Groundwater

92.40.Lg Soil moisture and temperature

. . . . *Limnology, see 92.40.qj—in Geophysics Appendix*

92.40.Oj Eco-hydrology; plant ecology

92.40.Pb Geomorphology

92.40.Qk Surface water, water resources

. . . . *Water quality, see 92.40.kc and 92.40.qc—in Geophysics Appendix*

. . . . *Snow, see 92.40.ed—in Geophysics Appendix*

92.40.Vq Glaciology *(see also 92.30.Mc—in Geophysics Appendix)*

. . . . *Ice, see 92.40.vx—in Geophysics Appendix*

92.40.We Hydrologic cycles and budgets

92.40.Xx Irrigation; dams

92.40.Yy Wetlands

92.40.Zg Hydrometeorology, hydroclimatology

92.60.−e Properties and dynamics of the atmosphere; meteorology *(see also 92.40.Zg Hydrometeorology, hydroclimatology)*

92.60.Aa Modeling and model calibration *(see also 92.70.Np Global climate modeling)*

92.60.Bh General circulation

92.60.Cc Ocean/atmosphere interactions, air/sea constituent fluxes *(see also 92.10.Kp—in oceanography)*

92.60.Fm Boundary layer structure and processes

92.60.Gn Winds and their effects

92.60.H− Atmospheric composition, structure, and properties

92.60.ha Exospheric composition and chemistry

92.60.hb Thermospheric composition and chemistry, energy deposition

92.60.hc Mesospheric composition, energy deposition, constituent transport and chemistry

92.60.hd Stratospheric composition and chemistry

92.60.hf Tropospheric composition and chemistry, constituent transport and chemistry

92.60.hg Constituent sources and sinks

92.60.hh Acoustic gravity waves, tides, and compressional waves

92.60.hk Convection, turbulence, and diffusion (see also 92.30.Ef—in Geophysics Appendix)

92.60.hn Geochemical cycles (see also 91.67.Nc—in Geochemistry; 92.20.Sg—in oceanography; 92.30.Gh—in Geophysics Appendix)

92.60.hv Pressure, density, and temperature

92.60.hw Airglow and aurorae (see also 94.20.Ac Auroral ionosphere; 94.30.Aa Auroral phenomena in magnetosphere)

92.60.hx Other upper atmospheric phenomena: red sprites; blue jets; atmospheric gamma ray and intense VHF emissions

92.60.Iv Paleoclimatology *(see also 92.70.Gt Climate dynamics—in Global change)*

92.60.Jq Water in the atmosphere

92.60.Kc Land/atmosphere interactions

92.60.Ls Ion chemistry of the atmosphere

92.60.Mt Particles and aerosols *(see also 92.20.Bk—in oceanography; 91.67.gp and 92.30.Ef—in Geophysics Appendix)*

92.60.Nv Cloud physics and chemistry

92.60.Ox Tropical meteorology

92.60.Pw Atmospheric electricity, lightning

92.60.Qx Storms

92.60.Ry Climatology, climate change and variability *(see also 92.70.Gt and 92.70.Kb—in Global change; 92.30.Bc—in Geophysics Appendix)*

92.60.Sz Air quality and air pollution *(see also 07.88.+y Instruments for environmental pollution measurements)*

92.60.Ta Electromagnetic wave propagation

92.60.Uy Polar meteorology

92.60.Vb Radiative processes, solar radiation

92.60.Wc Weather analysis and prediction

92.60.Xg Stratosphere/troposphere interactions

92.60.Zc Volcanic effects

92.70.−j Global change

92.70.Aa Abrupt/rapid climate change

92.70.Bc Land/atmosphere interactions

92.70.Cp Atmosphere

92.70.Er Biogeochemical processes

92.70.Gt Climate dynamics *(see also 92.60.Ry—in meteorology; 92.30.Bc—in Geophysics Appendix)*

92.70.Ha Cryospheric change

92.70.Iv Geomorphology and weathering *(see also 92.40.Gc Erosion and sedimentation; sediment transport; 92.40.Pb—in hydrology; 92.40.P− in Geophysics Appendix)*

92.70.Jw Oceans, sea level change *(see also 92.10.hp—in Geophysics Appendix)*

92.70.Kb Regional climate change *(see also 92.60.Ry—in meteorology; 92.30.Bc—in Geophysics Appendix)*

92.70.Ly Water cycles

92.70.Mn Impacts of global change; global warming *(see also 92.30.Np—in Geophysics Appendix)*

92.70.Np Global climate modeling

92.70.Pq Earth system modeling

92.70.Qr Solar variability impact

92.70.St Land cover change

92.90.+x Other topics in hydrospheric and atmospheric geophysics (restricted to new topics in section 92)

93. Geophysical observations, instrumentation, and techniques

93.30.−w Information related to geographical regions

93.30.Bz Africa

93.30.Ca Antarctica

93.30.Db Asia

93.30.Fd Australia

93.30.Ge Europe

93.30.Hf North America

93.30.Jg South America

93.30.Kh Large islands (e.g., Greenland)

93.30.Li Arctic Ocean

93.30.Mj Atlantic Ocean

93.30.Nk Indian Ocean

93.30.Pm Pacific Ocean

93.30.Qn Southern Ocean

93.30.Rp Regional seas

93.30.Sq Polar regions

93.30.Tr Temperate regions

93.30.Vs Tropical regions

93.55.+z International organizations, national and international programs

. . . . *Data acquisition and storage, see 93.85.Bc*

93.85.−q Instruments and techniques for geophysical research: Exploration geophysics *(see also 91.50.Ga Bathymetry, seafloor topology; 91.50.Yf Submergence instruments, ROV, AUV, submersibles, and ocean observatories—in marine geology; 92.10.Yb Hydrography—in oceanography)*

93.85.Bc Computational methods and data processing, data acquisition and storage

93.85.De Exploration of continental structures

93.85.Fg Downhole methods

93.85.Hj Gravity methods

93.85.Jk Magnetic and electrical methods

93.85.Ly Exploration of oceanic structures

93.85.Np Radioactivity methods

93.85.Pq Remote sensing in exploration geophysics *(see also 91.40.Yt—in Volcanology; 91.55.Uv—in Structural geology)*

93.85.Rt Seismic methods

93.85.Tf Oil prospecting, pipelines, and

conduits *(see also 91.50.Sn Ocean drilling)*

93.90.+y Other topics in geophysical observations, instrumentation, and techniques (restricted to new topics in section 93)

94. Physics of the ionosphere and magnetosphere

94.05.−a Space plasma physics *(see also 96.50.−e Interplanetary physics)*

94.05.Bf Plasma interactions with dust and aerosols

94.05.Dd Radiation processes

94.05.Fg Solitons and solitary waves

94.05.Hk Spacecraft/atmosphere interactions

94.05.Jq Spacecraft sheaths, wakes, and charging

94.05.Lk Turbulence

94.05.Pt Wave/wave, wave/particle interactions

94.05.Rx Experimental techniques and laboratory studies *(see also 52.72.+v—in physics of plasmas)*

94.05.Sd Space weather

. . . . *Convection, diffusion, and turbulence, see 92.60.Hk*

. . . . *Physics of the neutral atmosphere, see 92.60.−e*

. . . . *Absorption and scattering of radiation, see 92.60.Ta and 92.60.Vb*

. . . . *Acoustic gravity waves, tides, and compressional waves, see 92.60.hh*

. . . . *Winds and their effects, see 92.60.Gn*

. . . . *Cosmic dust, see 96.50.Dj and 98.38.Cp*

94.20.−y Physics of the ionosphere *(for ionospheres of the planets, see 96.12.ji and 96.15.hk; for radiowave propagation, see 41.20.Jb—in electromagnetism)*

94.20.Ac Auroral ionosphere *(see also 92.60.hw Airglow and aurorae—in meteorology; 94.30.Aa Auroral phenomena in magnetosphere)*

94.20.Bb Wave propagation *(see also 94.30.Tz—in Physics of the magnetosphere)*

94.20.Cf Ionospheric modeling and forecasting

94.20.D− Ionospheric structure, composition

94.20.de D region

94.20.dg E region

94.20.dj F region

94.20.dk Polar cap ionosphere

94.20.dl Topside region

94.20.dm Mid-latitude ionosphere

94.20.dt Equatorial ionosphere

94.20.dv Ion chemistry and composition; ionization mechanisms

94.20.Fg Plasma temperature and density

. . . . *Plasmasphere, see 94.30.cv*

94.20.Qq Particle precipitation *(see also 94.30.Ny—in Physics of the magnetosphere)*

. . . . *Interactions between waves and particles, see 94.20.W−*

94.20.Ss Electric fields; current system

94.20.Tt Ionospheric soundings; active experiments

94.20.Vv Ionospheric disturbances, irregularities, and storms

94.20.W− Ionospheric dynamics and interactions

94.20.wc Plasma motion; plasma convection; particle acceleration

94.20.wf Plasma waves and instabilities

94.20.wg Ionosphere/atmospheric interactions

94.20.wh Ionosphere/magnetosphere interactions

94.20.wj Wave/particle interactions

94.20.wl Plasma interactions with dust and aerosols

94.20.wq Solar radiation and cosmic ray effects

94.20.ws Electromagnetic wave propagation

94.20.Xa Meteor-trail physics

94.30.−d Physics of the magnetosphere

94.30.Aa Auroral phenomena in magnetosphere *(see also 94.20.Ac Auroral ionosphere)*

94.30.Bg Magnetospheric modeling and forecasting

94.30.C− Magnetospheric configuration and dynamics

94.30.cb Inner magnetosphere

94.30.cf Outer magnetosphere

94.30.cg Magnetospheric cusp

94.30.ch Magnetopause

94.30.cj Magnetosheath

94.30.cl Magnetotail

94.30.cp Magnetic reconnection

94.30.cq MHD waves, plasma waves, and instabilities

94.30.cs Plasma motion; plasma convection

94.30.ct Plasma sheet

94.30.cv Plasmasphere

94.30.cx Polar cap phenomena

94.30.Hn Energetic trapped particles

94.30.Kq Electric fields, field-aligned currents and current systems, and ring currents

94.30.Lr Magnetic storms, substorms

94.30.Ms Magnetic pulsations

94.30.Ny Energetic particle precipitation *(see also 94.20.Qq—in Physics of the ionosphere)*

94.30.Tz Electromagnetic wave propagation *(see also 94.20.Bb—in Physics of the ionosphere)*

94.30.Va Magnetosphere interactions

94.30.Xy Radiation belts

94.80.+g Instrumentation for space plasma physics, ionosphere, and magnetosphere

94.90.+m Other topics in space plasma physics, physics of the ionosphere and magnetosphere (restricted to new topics in section 94)

95. Fundamental astronomy and astrophysics; instrumentation, techniques, and astronomical observations

95.10.−a Fundamental astronomy

95.10.Ce Celestial mechanics (including *n*-body problems) *(see also 45.50.Pk—in Classical mechanics of discrete systems)*

. . . . *Dynamics and kinematics of stellar systems, see 98.10.+z*

95.10.Eg Orbit determination and improvement

95.10.Fh Chaotic dynamics *(see also 05.45.−a Nonlinear dynamics and chaos)*

95.10.Gi Eclipses, transits, and occultations

95.10.Jk Astrometry and reference systems

95.10.Km Ephemerides, almanacs, and calendars

95.30.−k Fundamental aspects of astrophysics *(see also section 26 Nuclear astrophysics)*

95.30.Cq Elementary particle processes

95.30.Dr Atomic processes and interactions

95.30.Ft Molecular and chemical processes and interactions

95.30.Gv Radiation mechanisms; polarization

95.30.Jx Radiative transfer; scattering

95.30.Ky Atomic and molecular data, spectra, and spectral parameters (opacities, rotation constants, line identification, oscillator strengths, *gf* values, transition probabilities, etc.)

95.30.Lz Hydrodynamics

95.30.Qd Magnetohydrodynamics and plasmas *(see also 52.30.Cv and 52.72.+v—in physics of plasmas)*

95.30.Sf Relativity and gravitation *(see also section 04 General relativity and gravitation; 98.80.Jk Mathematical and relativistic aspects of cosmology)*

95.30.Tg Thermodynamic processes, conduction, convection, equations of state

95.30.Wi Dust processes (condensation, evaporation, sputtering, mantle growth, etc.)

95.35.+d Dark matter (stellar, interstellar, galactic, and cosmological) *(see also 95.30.Cq Elementary particle processes; for brown dwarfs, see 97.20.Vs; for galactic halos, see 98.35.Gi or 98.62.Gq; for models of the early Universe, see 98.80.Cq)*

95.36.+x Dark energy *(see also 98.80.−k Cosmology)*

95.40.+s Artificial Earth satellites *(for lunar and planetary probes, see 95.55.Pe)*

95.45.+i Observatories and site testing

95.55.−n Astronomical and space-research instrumentation *(see also 94.80.+g Instrumentation for space plasma physics, ionosphere, and magnetosphere)*

95.55.Aq Charge-coupled devices, image detectors, and IR detector arrays *(see also 85.60.Gz Photodetectors)*

95.55.Br Astrometric and interferometric instruments

95.55.Cs Ground-based ultraviolet, optical and infrared telescopes

95.55.Ev Solar instruments

95.55.Fw Space-based ultraviolet, optical, and infrared telescopes

95.55.Jz Radio telescopes and instrumentation; heterodyne receivers

95.55.Ka X- and γ-ray telescopes and instrumentation

95.55.Pe Lunar, planetary, and deep-space probes

95.55.Qf Photometric, polarimetric, and spectroscopic instrumentation

95.55.Rg Photoconductors and bolometers

95.55.Sh Auxiliary and recording instruments; clocks and frequency standards

95.55.Vj Neutrino, muon, pion, and other elementary particle detectors; cosmic ray detectors *(see also 29.40.−n Radiation detectors—in Nuclear physics)*

95.55.Ym Gravitational radiation detectors; mass spectrometers; and other instrumentation and techniques *(see also 04.80.Nn Gravitational wave detectors and experiments in—General relativity and gravitation)*

95.75.−z Observation and data reduction techniques; computer modeling and simulation

95.75.De Photography and photometry (including microlensing techniques)

95.75.Fg Spectroscopy and spectrophotometry

95.75.Hi Polarimetry

95.75.Kk Interferometry

95.75.Mn Image processing (including source extraction)

95.75.Pq Mathematical procedures and computer techniques

95.75.Qr Adaptive and segmented optics *(see also 42.68.Wt Remote sensing; LIDAR and adaptive systems—in atmospheric optics)*

95.75.Rs Remote observing techniques

95.75.Tv Digitization techniques

95.75.Wx Time series analysis, time variability

95.80.+p Astronomical catalogs, atlases, sky surveys, databases, retrieval systems, archives, etc.

95.85.−e Astronomical observations (additional primary heading(s) must be chosen with these entries to represent the astronomical objects and/or properties studied)

95.85.Bh Radio, microwave (>1 mm)

95.85.Fm Submillimeter (300 μm–1 mm)

95.85.Gn Far infrared (10–300 μm)

95.85.Hp Infrared (3–10 μm)

95.85.Jq Near infrared (0.75–3 μm)

95.85.Kr Visible (390–750 nm)

95.85.Ls Near ultraviolet (300–390 nm)

95.85.Mt Ultraviolet (10–300 nm)

95.85.Nv X-ray

95.85.Pw γ-ray

95.85.Ry Neutrino, muon, pion, and other elementary particles; cosmic rays

95.85.Sz Gravitational radiation, magnetic fields, and other observations

95.90.+v Historical astronomy and archaeoastronomy; and other topics in fundamental astronomy and astrophysics; instrumentation, techniques, and astronomical observations

96. Solar system; planetology

96.10.+i General; solar nebula; cosmogony

96.12.−a Planetology of solid surface planets *(see also 96.15.−g Planetology of fluid planets; 96.30.Bc Comparative planetology)*

96.12.Bc Origin and evolution

96.12.De Orbital and rotational dynamics

96.12.Fe Gravitational fields

96.12.Hg Magnetic field and magnetism

96.12.Jt Atmospheres

96.12.Kz Surfaces

96.12.Ma Composition

96.12.Pc Interiors

96.12.Qr Polar regions

96.12.St Heat flow

96.12.Uv Rings and dust

96.12.Wx Interactions with particles and fields

96.12.Xy Tectonics, volcanism

96.15.−g Planetology of fluid planets *(see also 96.12.−a Planetology of solid surface planets; 96.30.Bc Comparative planetology)*

96.15.Bc Origin and evolution

96.15.De Orbital and rotational dynamics

96.15.Ef Gravitational fields

96.15.Gh Magnetic field and magnetism

96.15.Hy Atmospheres

96.15.Kc Composition

96.15.Lb Surfaces

96.15.Nd Interiors

96.15.Pf Physical properties of materials

96.15.Qr Impact phenomena

96.15.St Tori and exospheres

96.15.Uv Rings and dust

96.15.Vx Interactions with particles and fields

96.15.Wx Tidal forces

96.15.Xy Polar regions

96.20.−n Moon

96.20.Br Origin and evolution

96.20.Dt Features, landmarks, mineralogy, and petrology

96.20.Jz Gravitational field, selenodesy, and magnetic fields

96.20.Ka Impacts, cratering

96.25.−f Planetology of comets and small bodies

96.25.Bd Origin and evolution

96.25.De Orbital and rotational dynamics

96.25.Fx Atmospheres

96.25.Hs Composition

96.25.Jz Ionospheres

96.25.Ln Magnetic fields and magnetism

96.25.Nc Gravitational fields

96.25.Pq Impact phenomena

96.25.Qr Interactions with solar wind plasma and fields

96.25.St Plasma and MHD instabilities

96.25.Tg Radiation and spectra

96.25.Vt Satellites

96.25.Xz Volcanism

96.30.−t Solar system objects

96.30.Bc Comparative planetology *(see also 96.12.−a Planetology of solid surface planets; 96.15.−g Planetology of fluid planets)*

96.30.Cw Comets *(see also 96.25.−f Planetology of comets and small bodies)*

96.30.Dz Mercury

96.30.Ea Venus

96.30.Gc Mars

96.30.Hf Martian satellites

96.30.Iz Dwarf Planets

96.30.Ja Dwarf planet satellites

96.30.Kf Jupiter

96.30.L− Jovian satellites
96.30.lb Io
96.30.ld Europa
96.30.lf Ganymede
96.30.lh Callisto
96.30.Mh Saturn
96.30.N− Saturnian satellites
96.30.nd Titan
96.30.Pj Uranus
96.30.Qk Uranian satellites
96.30.Rm Neptune
96.30.Sn Pluto
96.30.Td Neptunian satellites
96.30.Up Plutonian satellites
96.30.Vb Dust, extraterrestrial materials
96.30.Wr Planetary rings
96.30.Xa Kuiper belt, trans-Neptunian objects
96.30.Ys Asteroids, meteoroids
96.30.Za Meteors, meteorites and tektites *(see also 91.65.Sn Meteorite mineralogy and petrology; 94.20.Xa Meteor-trail physics; 91.67.gn—in Geophysics Appendix)*
· · · · *Planetary, asteroid, cometary, and satellite characteristics and properties, see 96.12.−a, 96.15.−g, and 96.25.−f*
· · · · *Cosmic rays, see 96.50.S−*

96.50.−e Interplanetary physics *(see also 94.05.−a Space plasma physics)*
96.50.Bh Interplanetary magnetic fields
96.50.Ci Solar wind plasma; sources of solar wind
96.50.Dj Interplanetary dust and gas
96.50.Ek Heliopause and solar wind termination
96.50.Fm Planetary bow shocks; interplanetary shocks
· · · · *Comets, see 96.30.Cw; 96.30C− in (Geophysics Appendix)*
96.50.Hp Oort cloud
· · · · *Kuiper belt, see 96.30.Xa*
· · · · *Meteors, meteoroids, and meteor streams, see 96.30.Za*
· · · · *Meteorites, micrometeorites, and tektites, see 96.30.Za*
96.50.Pw Particle acceleration
96.50.Qx Corotating streams
96.50.Ry Discontinuities
96.50.S− Cosmic rays *(see also 94.20.wq Solar radiation and cosmic ray effects)*
96.50.sb Composition, energy spectra and interactions
96.50.sd Extensive air showers
96.50.sf Interactions with terrestrial matter
96.50.sh Interplanetary propagation and effects
96.50.Tf MHD waves; plasma waves, turbulence
96.50.Uv Ejecta, driver gases, and magnetic clouds
96.50.Vg Energetic particles
96.50.Wx Solar cycle variations
96.50.Xy Heliosphere/interstellar medium interactions
96.50.Ya Pickup ions
96.50.Zc Neutral particles

96.55.+z Astrobiology and astrochemistry of the Solar system and interplanetary space *(see also 91.62.Fc—in Geophysics Appendix)*

96.60.−j Solar physics
96.60.Bn Diameter, rotation, and mass
96.60.Fs Composition
96.60.Hv Electric and magnetic fields, solar magnetism
96.60.Iv Magnetic reconnection
96.60.Jw Solar interior
96.60.Ly Helioseismology, pulsations, and shock waves
96.60.Mz Photosphere
96.60.Na Chromosphere
96.60.P− Corona
96.60.pc Coronal holes
96.60.pf Coronal loops, streamers
96.60.ph Coronal mass ejection
96.60.Q− Solar activity *(see also 92.70.Qr—in Global change)*
96.60.qd Sun spots, solar cycles
96.60.qe Flares
96.60.qf Prominence eruptions
96.60.Tf Solar electromagnetic emission
96.60.Ub Solar irradiance
96.60.Vg Particle emission, solar wind *(see also 94.30.vf—in Geophysics Appendix; 26.65.+t Solar neutrinos in nuclear astrophysics)*
96.60.Xy Transition region

96.90.+c Other topics on the Solar system and planetology (restricted to new topics in section 96)

97. Stars *(for relativistic stars, see 04.40.Dg in general relativity and gravitation)*

97.10.−q Stellar characteristics and properties *(see also section 26 Nuclear astrophysics)*
97.10.Bt Star formation
97.10.Cv Stellar structure, interiors, evolution, nucleosynthesis, ages
97.10.Ex Stellar atmospheres (photospheres, chromospheres, coronae, magnetospheres); radiative transfer; opacity and line formation
97.10.Fy Circumstellar shells, clouds, and expanding envelopes; circumstellar masers *(for interstellar masers, see 98.38.Er or 98.58.Ec)*
97.10.Gz Accretion and accretion disks
97.10.Jb Stellar activity
97.10.Kc Stellar rotation
97.10.Ld Magnetic and electric fields; polarization of starlight
97.10.Me Mass loss and stellar winds
97.10.Nf Masses
97.10.Pg Radii
97.10.Qh Surface features (including starspots)
97.10.Ri Luminosities; magnitudes; effective temperatures, colors, and spectral classification
97.10.Sj Pulsations, oscillations, and stellar seismology
97.10.Tk Abundances, chemical composition
97.10.Vm Distances, parallaxes
97.10.Wn Proper motions and radial velocities (line-of-sight velocities); space motions *(see also 95.10.Jk Astrometry and reference systems)*
97.10.Xq Luminosity and mass functions
97.10.Yp Star counts, distribution, and statistics
97.10.Zr Hertzsprung-Russell, color-magnitude, and color-color diagrams

97.20.−w Normal stars (by class): general or individual
97.20.Ec Main-sequence: early-type stars (O and B)
97.20.Ge Main-sequence: intermediate-type stars (A and F)
97.20.Jg Main-sequence: late-type stars (G, K, and M)
97.20.Li Giant and subgiant stars
97.20.Pm Supergiant stars
97.20.Rp Faint blue stars (including blue stragglers), white dwarfs, degenerate stars, nuclei of planetary nebulae *(for planetary nebulae, see 98.38.Ly or 98.58.Li)*
97.20.Tr Population II stars (horizontal branch, metal poor, etc.)
97.20.Vs Low luminosity stars, subdwarfs, and brown dwarfs
97.20.Wt Population III stars

97.21.+a Pre-main sequence objects, young stellar objects (YSO's) and protostars (T Tauri stars, Orion population, Herbig–Haro objects, Bok globules, bipolar outflows, cometary nebulae, etc.) *(see also 98.38.Fs and 98.58.Fd Jets, outflows and bipolar flows—in the Milky Way and external galaxies respectively)*

97.30.−b Variable and peculiar stars (including novae)

97.30.Dg Low-amplitude blue variables (alpha Cygni, beta Cephei, delta Scuti, delta Delphini, delta Canis Majoris, SX Phoenicius, etc.)

97.30.Eh Emission-line stars (Of, Be, Luminous Blue Variables, Wolf–Rayet, etc.)

97.30.Fi Chemically peculiar stars (Ap, Am, etc.)

97.30.Gj Cepheids (delta Cephei, W Virginis)

97.30.Hk Carbon stars, S stars, and related types (C, S, R, and N)

97.30.Jm Long-period variables (Miras) and semiregulars

97.30.Kn RR Lyrae stars; RV Tauri and PV Telescopii variables

97.30.Nr Flare stars (UV Ceti, RS Canum Venaticorum, FU Orionis, R Coronae Borealis variables, etc.)

97.30.Qt Novae, dwarf novae, recurrent novae, and other cataclysmic (eruptive) variables *(see also 97.80.Gm, Jp Cataclysmic binaries and X-ray binaries)*

97.30.Sw Unusual and peculiar variables

97.60.−s Late stages of stellar evolution (including black holes)

97.60.Bw Supernovae *(see also 26.30.−k Nucleosynthesis in novae, supernovae, and other explosive stars; for nuclear physics aspects of supernovae evolution, see 26.50.+x)*

97.60.Gb Pulsars

97.60.Jd Neutron stars *(see also 26.60.−c Nuclear matter aspects of neutron stars in— Nuclear physics)*

97.60.Lf Black holes *(see also 04.70.−s Physics of black holes in—General relativity and gravitation; for galactic black holes, see 98.35.Jk and 98.62.Js)*

97.80.−d Binary and multiple stars

97.80.Af Astrometric and interferometric binaries

97.80.Di Visual binaries

97.80.Fk Spectroscopic binaries; close binaries

97.80.Gm Cataclysmic binaries (novae, dwarf novae, recurrent novae, and nova-like objects); symbiotic stars *(see also 97.30.Qt Novae)*

97.80.Hn Eclipsing binaries

97.80.Jp X-ray binaries *(see also 98.70.Qy X-ray sources and 97.60.Gb Pulsars)*

97.80.Kq Multiple stars

97.82.−j Extrasolar planetary systems

97.82.Cp Photometric and spectroscopic detection; coronographic detection; interferometric detection

97.82.Fs Substellar companions; planets

97.82.Jw Infrared excess; debris disks; protoplanetary disks; exo-zodiacal dust

97.90.+j Other topics on stars (restricted to new topics in section 97)

98. Stellar systems; interstellar medium; galactic and extragalactic objects and systems; the Universe

98.10.+z Stellar dynamics and kinematics

98.20.−d Stellar clusters and associations

98.20.Af Associations of stars (OB, T, R) in the Milky Way

98.20.Bg Associations of stars (OB, T, R) in external galaxies

98.20.Di Open clusters in the Milky Way

98.20.Fk Open clusters in external galaxies

98.20.Gm Globular clusters in the Milky Way

98.20.Jp Globular clusters in external galaxies

98.35.−a Characteristics and properties of the Milky Way galaxy

98.35.Ac Origin, formation, evolution, age, and star formation

98.35.Bd Chemical composition and chemical evolution

98.35.Ce Mass and mass distribution

98.35.Df Kinematics, dynamics, and rotation

98.35.Eg Electric and magnetic fields

98.35.Gi Galactic halo

98.35.Hj Spiral arms and galactic disk

98.35.Jk Galactic center, bar, circumnuclear matter, and bulge (including black hole and distance measurements)

98.35.Ln Stellar content and populations; morphology and overall structure

98.35.Mp Infall and accretion

98.35.Nq Galactic winds and fountains

98.35.Pr Solar neighborhood

98.38.−j Interstellar medium (ISM) and nebulae in Milky Way

98.38.Am Physical properties (abundances, electron density, magnetic fields, scintillation, scattering, kinematics, dynamics, turbulence, etc.)

98.38.Bn Atomic, molecular, chemical, and grain processes

98.38.Cp Interstellar dust grains; diffuse emission; infrared cirrus

98.38.Dq Molecular clouds, H_2 clouds, dense clouds, and dark clouds

98.38.Er Interstellar masers *(for circumstellar masers, see 97.10.Fy)*

98.38.Fs Jets, outflows, and bipolar flows *(for pre-main sequence objects, see 97.21.+a)*

98.38.Gt H I regions and 21-cm lines; diffuse, translucent, and high-velocity clouds

98.38.Hv H II regions; emission and reflection nebulae

98.38.Jw Infrared emission

98.38.Kx Intercloud medium (ICM); hot and highly ionized gas; bubbles

98.38.Ly Planetary nebulae *(for nuclei of planetary nebulae, see also 97.20.Rp)*

98.38.Mz Supernova remnants

98.52.−b Normal galaxies; extragalactic objects and systems (by type)

98.52.Cf Classification and classification systems

98.52.Eh Elliptical galaxies

98.52.Lp Lenticular (S0) galaxies

98.52.Nr Spiral galaxies

98.52.Sw Irregular and morphologically peculiar galaxies

98.52.Wz Dwarf galaxies (elliptical, irregular, and spheroidal)

98.54.−h Quasars; active or peculiar galaxies, objects, and systems

98.54.Aj Quasars *(for quasar absorption and emission-line systems; Lyman forest, see 98.62.Ra)*

98.54.Cm Active and peculiar galaxies and related systems (including BL Lacertae objects, blazars, Seyfert galaxies, Markarian galaxies, and active galactic nuclei)

98.54.Ep Starburst galaxies and infrared excess galaxies

98.54.Gr Radio galaxies

98.54.Kt Protogalaxies; primordial galaxies

98.56.−p Local group; Magellanic Clouds

98.56.Ew Elliptical galaxies

98.56.Ne Spiral galaxies (M31 and M33)

98.56.Si Magellanic Clouds and other irregular galaxies

98.56.Tj Magellanic stream

98.56.Wm Dwarf galaxies (elliptical, irregular, and spheroidal)

98.58.−w Interstellar medium (ISM) and nebulae in external galaxies

98.58.Ay Physical properties (abundances, electron density, magnetic fields, scintillation, scattering, kinematics, dynamics, turbulence, etc.)

98.58.Bz Atomic, molecular, chemical, and grain processes

98.58.Ca Interstellar dust grains; diffuse emission; infrared cirrus

98.58.Db Molecular clouds, H_2 clouds, dense clouds, and dark clouds

98.58.Ec Interstellar masers *(for circumstellar masers, see 97.10.Fy)*

98.58.Fd Jets, outflows and bipolar flows *(for pre-main sequence objects, see 97.21.+a)*

98.58.Ge H I regions and 21-cm lines; diffuse, translucent, and high-velocity clouds

98.58.Hf H II regions; emission and reflection nebulae

98.58.Jg Infrared emission

98.58.Kh Intercloud medium (ICM); hot and highly ionized gas; bubbles

98.58.Li Planetary nebulae *(for nuclei of planetary nebulae, see also 97.20.Rp)*

98.58.Mj Supernova remnants

98.58.Nk Tidal tails; H I shells

98.62.−g Characteristics and properties of external galaxies and extragalactic objects *(for the Milky Way, see 98.35.−a)*

98.62.Ai Origin, formation, evolution, age, and star formation

98.62.Bj Chemical composition and chemical evolution

98.62.Ck Masses and mass distribution

98.62.Dm Kinematics, dynamics, and rotation

98.62.En Electric and magnetic fields

98.62.Gq Galactic halos

98.62.Hr Spiral arms and bars; galactic disks

98.62.Js Galactic nuclei (including black holes), circumnuclear matter, and bulges

98.62.Lv Stellar content and populations; radii; morphology and overall structure

98.62.Mw Infall, accretion, and accretion disks

98.62.Nx Jets and bursts; galactic winds and fountains

98.62.Py Distances, redshifts, radial velocities; spatial distribution of galaxies *(for observational cosmology, see 98.80.Es)*

98.62.Qz Magnitudes and colors; luminosities

98.62.Ra Intergalactic matter; quasar absorption and emission-line systems; Lyman forest *(for quasars, see 98.54.Aj; for intracluster matter, see 98.65.Hb)*

98.62.Sb Gravitational lenses and luminous arcs *(see also 95.30.Sf Relativity and gravitation—in fundamental aspects of astrophysics and section 04 General relativity and gravitation)*

98.62.Tc Astrometry; identification

98.62.Ve Statistical and correlative studies of properties (luminosity and mass functions; mass-to-light ratio; Tully-Fisher relation, etc.)

98.65.−r Galaxy groups, clusters, and superclusters; large scale structure of the Universe

98.65.At Interacting galaxies; galaxy pairs, and triples

98.65.Bv Small and compact galaxy groups

98.65.Cw Galaxy clusters

98.65.Dx Superclusters; large-scale structure of the Universe (including voids, pancakes, great wall, etc.)

98.65.Fz Galaxy mergers, collisions, and tidal interactions

98.65.Hb Intracluster matter; cooling flows

98.70.−f Unidentified sources of radiation outside the Solar System

98.70.Dk Radio sources

. . . . *Quasars, see 98.54.Aj*

98.70.Lt IR sources *(for IR sources in interstellar medium, see 98.38.Jw and/or 98.58.Jg)*

98.70.Qy X-ray sources; X-ray bursts *(see also 97.30.Qt Novae, dwarf novae, recurrent novae, and other cataclysmic (eruptive) variables; 97.80.Jp X-ray binaries)*

98.70.Rz γ-ray sources; γ-ray bursts

98.70.Sa Cosmic rays (including sources, origin, acceleration, and interactions) *(see also 26.40.+r Cosmic ray nucleosynthesis—in Nuclear astrophysics)*

98.70.Vc Background radiations

98.80.−k Cosmology *(see also section 04 General relativity and gravitation; for origin and evolution of galaxies, see 98.62.Ai; for elementary particle and nuclear processes, see 95.30.Cq; for dark matter, see 95.35.+d; for dark energy, see 95.36.+x; for superclusters and large-scale structure of the Universe, see 98.65.Dx)*

98.80.Bp Origin and formation of the Universe

98.80.Cq Particle-theory and field-theory models of the early Universe (including cosmic pancakes, cosmic strings, chaotic phenomena, inflationary universe, etc.)

98.80.Es Observational cosmology (including Hubble constant, distance scale, cosmological constant, early Universe, etc)

98.80.Ft Origin, formation, and abundances of the elements *(see also 26.35.+c Big Bang nucleosynthesis—in Nuclear astrophysics)*

98.80.Jk Mathematical and relativistic aspects of cosmology

98.80.Qc Quantum cosmology *(see also 04.60.−m Quantum gravity—in General relativity and gravitation)*

98.90.+s Other topics on stellar systems; interstellar medium; galactic and extragalactic objects and systems; the Universe (restricted to new topics in section 98)

99.10.−x Errata and other corrections

99.10.Cd Errata

99.10.Fg Publisher's note

99.10.Jk Corrected article

99.10.Ln Retraction

99.10.Np Editorial note

99.10.Qr Addenda

APPENDIX TO 43: ACOUSTICS *The detailed headings of this Appendix correspond to the scheme used by the Journal of the Acoustical Society of America.*

43.05.−k Acoustical Society of America *(in PACS, see also 01.10.Hx)*

43.05.Bp Constitution and bylaws

43.05.Dr History

43.05.Ft Honorary members

43.05.Gv Publications, ARLO, Echoes, ASA Web page, electronic archives and references

43.05.Hw Meetings

43.05.Ky Members and membership lists, personal notes, fellows

43.05.Ma Administrative committee activities

43.05.Nb Technical committee activities; Technical Council

43.05.Pc Prizes, medals, and other awards

43.05.Re Regional chapters

43.05.Sf Obituaries

43.10.−a General

43.10.Ce Conferences, lectures, and announcements (not of the Acoustical Society of America) *(in PACS, see also 01.10.Cr and 01.10.Fv)*

43.10.Df Other acoustical societies and their publications, online journals, and other electronic publications

43.10.Eg Biographical, historical, and personal notes (not of the Acoustical Society of America) *(in PACS, see also 01.60.+q)*

43.10.Gi Editorials, Forum

43.10.Hj Books and book reviews *(in PACS, see also 01.30.Vv)*

43.10.Jk Bibliographies *(in PACS, see also 01.30.Tt)*

43.10.Km Patents

43.10.Ln Surveys and tutorial papers relating to acoustics research; tutorial papers on applied acoustics

43.10.Mq Tutorial papers of historical and philosophical nature

43.10.Nq News with relevance to acoustics, nonacoustical theories of interest to acoustics

43.10.Pr Information technology, internet, nonacoustical devices of interest to acoustics

43.10.Qs Notes relating to acoustics as a profession

43.10.Sv Education in acoustics, tutorial papers of interest to acoustics educators *(in PACS, see also 01.40.−d and 01.50.−i)*

43.10.Vx Errata

43.15.+s Standards *(in PACS, see also 06.20.fb)*

43.20.−f General linear acoustics

43.20.Bi Mathematical theory of wave propagation *(see also 43.40.At)*

43.20.Dk Ray acoustics

43.20.El Reflection, refraction, diffraction of acoustic waves *(see also 43.30.Es)*

43.20.Fn Scattering of acoustic waves *(see also 43.30.Ft, Gv, Hw)*

43.20.Gp Reflection, refraction, diffraction, interference, and scattering of elastic and poroelastic waves

43.20.Hq Velocity and attenuation of acoustic waves *(see also 43.30.Bp, Cq, Es and 43.35.Ae, Bf, Cg)*

43.20.Jr Velocity and attenuation of elastic and poroelastic waves

43.20.Ks Standing waves, resonance, normal modes *(see also 43.25.Gf, 43.40.At, and 43.55.Br)*

43.20.Mv Waveguides, wave propagation in tubes and ducts

43.20.Px Transient radiation and scattering

43.20.Rz Steady-state radiation from sources, impedance, radiation patterns, boundary element methods

43.20.Tb Interaction of vibrating structures with surrounding medium *(see also 43.40.Rj)*

43.20.Wd Analogies

43.20.Ye Measurement methods and instrumentation *(see also 43.58.−e)*

43.25.−x Nonlinear acoustics

43.25.Ba Parameters of nonlinearity of the medium

43.25.Cb Macrosonic propagation, finite amplitude sound; shock waves *(see also 43.28.Mw and 43.30.Lz)*

43.25.Dc Nonlinear acoustics of solids

43.25.Ed Effect of nonlinearity on velocity and attenuation

43.25.Fe Effect of nonlinearity on acoustic surface waves

43.25.Gf Standing waves; resonance *(see also 43.20.Ks)*

43.25.Hg Interaction of intense sound waves with noise

43.25.Jh Reflection, refraction, interference, scattering, and diffraction of intense sound waves *(see also 43.30.Lz and 43.20.Fn)*

43.25.Lj Parametric arrays, interaction of sound with sound, virtual sources *(see also 43.30.Lz)*

43.25.Nm Acoustic streaming

43.25.Qp Radiation pressure *(see also 43.58.Pw)*

43.25.Rq Solitons, chaos

43.25.Ts Nonlinear acoustical and dynamical systems

43.25.Uv Acoustic levitation

43.25.Vt Intense sound sources

43.25.Yw Nonlinear acoustics of bubbly liquids

43.25.Zx Measurement methods and instrumentation for nonlinear acoustics *(see also 43.58.−e)*

43.28.−g Aeroacoustics and atmospheric sound

43.28.Bj Mechanisms affecting sound propagation in air, sound speed in the air

43.28.Dm Infrasound and acoustic-gravity waves

43.28.En Interaction of sound with ground surfaces, ground cover and topography, acoustic impedance of outdoor surfaces

43.28.Fp Outdoor sound propagation through a stationary atmosphere, meteorological factors *(see also 43.50.Vt)*

43.28.Gq Outdoor sound propagation and scattering in a turbulent atmosphere, and in non-uniform flow fields

43.28.Hr Outdoor sound sources *(see also 43.50.Lj, Nm, Sr)*

43.28.Js Numerical models for outdoor propagation

43.28.Kt Aerothermoacoustics and combustion acoustics

43.28.Lv Statistical characteristics of sound fields and propagation parameters *(see also 43.50.Rq, 43.60.Cg)*

43.28.Mw Shock and blast waves, sonic boom *(see also 43.25.Cb and 43.50.Pn)*

43.28.Py Interaction of fluid motion and sound, Doppler effect, and sound in flow ducts

43.28.Ra Generation of sound by fluid flow, aerodynamic sound and turbulence

43.28.Tc Sound-in-air measurements, methods and instrumentation for location, navigation, altimetry, and sound ranging *(see also 43.30.Vh and 43.58.−e)*

43.28.Vd Measurement methods and instrumentation to determine or evaluate atmospheric parameters, winds, turbulence, temperatures, and pollutants in air *(see also 43.58.−e)*

43.28.We Measurement methods and instrumentation for remote sensing

and for inverse problems *(see also 43.58.−e)*

43.30.−k Underwater sound

43.30.Bp Normal mode propagation of sound in water

43.30.Cq Ray propagation of sound in water

43.30.Dr Hybrid and asymptotic propagation theories, related experiments

43.30.Es Velocity, attenuation, refraction, and diffraction in water, Doppler effect

43.30.Ft Volume scattering

43.30.Gv Backscattering, echoes, and reverberation in water due to combinations of boundaries

43.30.Hw Rough interface scattering

43.30.Jx Radiation from objects vibrating under water, acoustic and mechanical impedance *(see also 43.58.Bh)*

43.30.Ky Structures and materials for absorbing sound in water; propagation in fluid-filled permeable material

43.30.Lz Underwater applications of nonlinear acoustics; explosions *(see also 43.25.Cb, Lj)*

43.30.Ma Acoustics of sediments; ice covers, viscoelastic media; seismic underwater acoustics

43.30.Nb Noise in water; generation mechanisms and characteristics of the field *(see also 43.50.Nm and 43.28.Ra)*

43.30.Pc Ocean parameter estimation by acoustical methods; remote sensing; imaging, inversion, acoustic tomography

43.30.Qd Global scale acoustics; ocean basin thermometry, transbasin acoustics

43.30.Re Signal coherence or fluctuation due to sound propagation/ scattering in the ocean

43.30.Sf Acoustical detection of marine life; passive and active

43.30.Tg Navigational instruments using underwater sound

43.30.Vh Active sonar systems

43.30.Wi Passive sonar systems and algorithms, matched field processing in underwater acoustics *(see also 43.60.Kx)*

43.30.Xm Underwater measurement and calibration instrumentation and procedures *(see also 43.58.−e)*

43.30.Yj Transducers and transducer arrays for underwater sound; transducer calibration *(see also 43.58.Vb)*

43.30.Zk Experimental modeling

43.35.−c Ultrasonics, quantum acoustics, and physical effects of sound

43.35.Ae Ultrasonic velocity, dispersion, scattering, diffraction, and attenuation in gases

43.35.Bf Ultrasonic velocity, dispersion, scattering, diffraction, and attenuation in liquids, liquid crystals, suspensions, and emulsions *(see also 43.30.Es, Ft, Gv, Hw)*

43.35.Cg Ultrasonic velocity, dispersion, scattering, diffraction, and attenuation in solids; elastic constants *(see also 43.20.Gp, Jr)*

43.35.Dh Pretersonics (sound of frequency above 10 GHz); Brillouin scattering

43.35.Ei Acoustic cavitation in liquids *(see also 43.30.Nb)*

43.35.Fj Ultrasonic relaxation processes in gases, liquids, and solids

43.35.Gk Phonons in crystal lattices, quantum acoustics *(in PACS, see also 63.20.−e)*

43.35.Hl Sonoluminescence

43.35.Kp Plasma acoustics *(in PACS, see also 52.35.Dm)*

43.35.Lq Low-temperature acoustics, sound in liquid helium *(in PACS, see also 67.25.dt)*

43.35.Mr Acoustics of viscoelastic materials

43.35.Ns Acoustical properties of thin films *(in PACS, see also 68.60.Bs)*

43.35.Pt Surface waves in solids and liquids *(in PACS, see also 68.35.Iv and 62.60.+v)*

43.35.Rw Magnetoacoustic effect; oscillations and resonance *(in PACS, see also 75.80.+q and 72.55.+s)*

43.35.Sx Acoustooptical effects, optoacoustics, acoustical visualization, acoustical microscopy, and acoustical holography *(see also 43.60.Gk, Sx; in PACS, see also 78.20.Hp)*

43.35.Ty Other physical effects of sound

43.35.Ud Thermoacoustics, high temperature acoustics, photoacoustic effect

43.35.Vz Chemical effects of ultrasound

43.35.Wa Biological effects of ultrasound, ultrasonic tomography *(see also 43.40.Ng and 43.80.Gx, Jz, Sh)*

43.35.Xd Nuclear acoustical resonance, acoustical magnetic resonance

43.35.Yb Ultrasonic instrumentation and measurement techniques *(see also 43.58.−e)*

43.35.Zc Use of ultrasonics in nondestructive testing, industrial processes, and industrial products

43.38.−p Transduction; acoustical devices for the generation and reproduction of sound

43.38.Ar Transducing principles, materials, and structures: general *(see also 43.30.Yj and 43.40.Yq)*

43.38.Bs Electrostatic transducers

43.38.Ct Magnetostrictive transducers

43.38.Dv Electromagnetic and electrodynamic transducers

43.38.Ew Feedback transducers

43.38.Fx Piezoelectric and ferroelectric transducers

43.38.Gy Semiconductor transducers

43.38.Hz Transducer arrays, acoustic interaction effects in arrays *(see also 43.30.Yj)*

43.38.Ja Loudspeakers and horns, practical sound sources *(see also 43.20.Rz and 43.38.Tj)*

43.38.Kb Microphones and their calibration *(see also 43.30.Yj and 43.40.Yq)*

43.38.Lc Amplifiers, attenuators, and audio controls

43.38.Md Sound recording and reproducing systems, general concepts

43.38.Ne Mechanical, optical, and photographic recording and reproducing systems

43.38.Pf Hydroacoustic and hydraulic transducers

43.38.Qg Magnetic and electrostatic recording and reproducing systems

43.38.Rh Surface acoustic wave transducers *(see also 43.25.Fe and 43.35.Pt)*

43.38.Si Telephones, earphones, sound power telephones, and intercommunication systems

43.38.Tj Public address systems, sound-reinforcement systems *(see also 43.55.Jz)*

43.38.Vk Stereophonic reproduction

43.38.Wl Broadcasting (radio and television)

43.38.Yn Impulse transducers

43.38.Zp Acoustooptic and photoacoustic transducers *(see also 43.35.Sx)*

43.40.−r Structural acoustics and vibration

43.40.At Experimental and theoretical studies of vibrating systems *(see also 43.20.Bi, Ks, Rz)*

43.40.Cw Vibrations of strings, rods, and beams

43.40.Dx Vibrations of membranes and plates

43.40.Ey Vibrations of shells

43.40.Fz Acoustic scattering by elastic structures

43.40.Ga Nonlinear vibration

43.40.Hb Random vibration

43.40.Jc Shock and shock reduction and absorption

43.40.Kd Impact and impact reduction, mechanical transients

43.40.Le Techniques for nondestructive evaluation and monitoring, acoustic emission *(see also 43.35.Zc)*

43.40.Ng Effects of vibration and shock on biological systems, including

man *(see also 43.35.Wa, 43.50.Qp, and 43.80.−n)*

43.40.Ph Seismology and geophysical prospecting; seismographs

43.40.Qi Effect of sound on structures, fatigue; spatial statistics of structural vibration

43.40.Rj Radiation from vibrating structures into fluid media

43.40.Sk Inverse problems in structural acoustics and vibration

43.40.Tm Vibration isolators, attenuators, and dampers *(see also 43.55.Vj)*

43.40.Vn Active vibration control

43.40.Yq Instrumentation and techniques for tests and measurement relating to shock and vibration, including vibration pickups, indicators, and generators, mechanical impedance

43.50.−x Noise: its effects and control

43.50.Ba Noisiness: rating methods and criteria

43.50.Cb Noise spectra, determination of sound power

43.50.Ed Noise generation *(see also 43.28.Ra)*

43.50.Fe Noise masking systems

43.50.Gf Noise control at source: redesign, application of absorptive materials and reactive elements, mufflers, noise silencers, noise barriers, and attenuators, etc. *(see also 43.55.Dt)*

43.50.Hg Noise control at the ear *(see also 43.66.Vt)*

43.50.Jh Noise in buildings and general machinery noise *(see also 43.55.Ev, Fw, Rg)*

43.50.Ki Active noise control

43.50.Lj Transportation noise sources: air, road, rail, and marine vehicles

43.50.Nm Aerodynamic and jet noise *(see also 43.28.Ra)*

43.50.Pn Impulse noise and noise due to impact *(see also 43.40.Kd)*

43.50.Qp Effects of noise on man and society *(see also 43.66.Ed, and 43.80.Nd)*

43.50.Rq Environmental noise, measurement, analysis, statistical characteristics

43.50.Sr Community noise, noise zoning, by-laws, and legislation

43.50.Vt Topographical and meteorological factors in noise propagation

43.50.Yw Instrumentation and techniques for noise measurement and analysis *(see also 43.58.−e)*

43.55.−n Architectural acoustics

43.55.Br Room acoustics: theory and experiment; reverberation, normal modes, diffusion, transient and steady-state response *(see also 43.20.Fn ,Ks)*

43.55.Cs Stationary response of rooms to noise; spatial statistics of room response; random testing

43.55.Dt Sound absorption in enclosures: theory and measurement; use of absorption in offices, commercial and domestic spaces *(see also 43.50.Jh)*

43.55.Ev Sound absorption properties of materials: theory and measurement of sound absorption coefficients; acoustic impedance and admittance

43.55.Fw Auditorium and enclosure design *(see also 43.50.Gf, Jh)*

43.55.Gx Studies of existing auditoria and enclosures

43.55.Hy Subjective effects in room acoustics, speech in rooms

43.55.Jz Sound-reinforcement systems for rooms and enclosures *(see also 43.38.Tj)*

43.55.Ka Computer simulation of acoustics in enclosures, modeling *(see also 43.58.Ta)*

43.55.Lb Electrical simulation of reverberation

43.55.Mc Room acoustics measuring instruments, computer measurement of room properties *(see also 43.58.Fm)*

43.55.Nd Reverberation room design: theory, applications to measurements of sound absorption, transmission loss, sound power

43.55.Pe Anechoic chamber design, wedges

43.55.Rg Sound transmission through walls and through ducts: theory and measurement

43.55.Ti Sound-isolating structures, values of transmission coefficients *(see also 43.50.Jh)*

43.55.Vj Vibration-isolating supports in building acoustics *(see also 43.40.Tm; in PACS, see 07.10.Fq)*

43.55.Wk Damping of panels

43.58.−e Acoustical measurements and instrumentation *(see also specific sections for specialized instrumentation)*

43.58.Bh Acoustic impedance measurement *(see also 43.30.Jx, 43.20.Rz, and 43.40.Yq)*

43.58.Dj Sound velocity

43.58.Fm Sound level meters, level recorders, sound pressure, particle velocity, and sound intensity measurements, meters, and controllers *(see also 43.55.Mc)*

43.58.Gn Acoustic impulse analyzers and measurements

43.58.Hp Tuning forks, frequency standards; frequency measuring and recording instruments; time standards and chronographs

43.58.Jq Wave and tone synthesizers

43.58.Kr Spectrum and frequency analyzers and filters; acoustical and electrical oscillographs; photoacoustic spectrometers; acoustical delay lines and resonators *(see also 43.40.Sk)*

43.58.Ls Acoustical lenses and microscopes *(see also 43.35.Sx)*

43.58.Mt Phase meters

43.58.Pw Rayleigh disks *(see also 43.25.Qp)*

43.58.Ry Distortion: frequency, nonlinear, phase, and transient; measurement of distortion

43.58.Ta Computers and computer programs in acoustics *(see also 43.75.Wx, 43.55.Ka, 43.60.Gk, and 43.70.Jt)*

43.58.Vb Calibration of acoustical devices and systems

43.58.Wc Electrical and mechanical oscillators

43.60.−c Acoustic signal processing

43.60.Ac Theory of acoustic signal processing

43.60.Bf Acoustic signal detection and classification, applications to control systems

43.60.Cg Statistical properties of signals and noise

43.60.Dh Signal processing for communications: telephony and telemetry, sound pickup and reproduction, multimedia

43.60.Ek Acoustic signal coding, morphology, and transformation

43.60.Fg Acoustic array systems and processing, beam-forming

43.60.Gk Space–time signal processing, other than matched field processing *(see also 43.35.Sx)*

43.60.Hj Time–frequency signal processing, wavelets

43.60.Jn Source localization and parameter estimation

43.60.Kx Matched field processing *(see also 43.30.Wi)*

43.60.Lq Acoustic imaging, displays, pattern recognition, feature extraction

43.60.Mn Adaptive processing

43.60.Np Acoustic signal processing techniques for neural nets and learning systems

43.60.Pt Signal processing techniques for acoustic inverse problems

43.60.Qv Signal processing instrumentation, integrated systems, smart transducers, devices and architectures, displays and interfaces

for acoustic systems *(see also 43.58.−e)*

43.60.Rw Remote sensing methods, acoustic tomography

43.60.Sx Acoustic holography

43.60.Tj Wave front reconstruction, acoustic time-reversal, and phase conjugation

43.60.Uv Model-based signal processing

43.60.Vx Acoustic sensing and acquisition

43.60.Wy Non-stationary signal analysis, non-linear systems, and higher order statistics

43.64.−q Physiological acoustics

43.64.Bt Models and theories of the auditory system

43.64.Dw Anatomy of the cochlea and auditory nerve

43.64.Fy Anatomy of the auditory central nervous system

43.64.Gz Biochemistry and pharmacology of the auditory system

43.64.Ha Acoustical properties of the outer ear; middle-ear mechanics and reflex

43.64.Jb Otoacoustic emissions

43.64.Kc Cochlear mechanics

43.64.Ld Physiology of hair cells

43.64.Me Effects of electrical stimulation, cochlear implant

43.64.Nf Cochlear electrophysiology

43.64.Pg Electrophysiology of the auditory nerve

43.64.Qh Electrophysiology of the auditory central nervous system

43.64.Ri Evoked responses to sounds

43.64.Sj Neural responses to speech

43.64.Tk Physiology of sound generation and detection by animals

43.64.Vm Physiology of the somatosensory system

43.64.Wn Effects of noise and trauma on the auditory system

43.64.Yp Instruments and methods *(see also 43.58.−e)*

43.66.−x Psychological acoustics

43.66.Ba Models and theories of auditory processes

43.66.Cb Loudness, absolute threshold

43.66.Dc Masking

43.66.Ed Auditory fatigue, temporary threshold shift

43.66.Fe Discrimination: intensity and frequency

43.66.Gf Detection and discrimination of sound by animals

43.66.Hg Pitch

43.66.Jh Timbre, timbre in musical acoustics

43.66.Ki Subjective tones

43.66.Lj Perceptual effects of sound *(see also 43.71.−k)*

43.66.Mk Temporal and sequential aspects of hearing; auditory grouping in relation to music

43.66.Nm Phase effects

43.66.Pn Binaural hearing

43.66.Qp Localization of sound sources

43.66.Rq Dichotic listening

43.66.Sr Deafness, audiometry, aging effects

43.66.Ts Auditory prostheses, hearing aids

43.66.Vt Hearing protection *(see also 43.50.Hg)*

43.66.Wv Vibration and tactile senses

43.66.Yw Instruments and methods related to hearing and its measurement *(see also 43.58.−e)*

43.70.−h Speech production

43.70.Aj Anatomy and physiology of the vocal tract, speech aerodynamics, auditory kinetics

43.70.Bk Models and theories of speech production

43.70.Dn Disordered speech

43.70.Ep Development of speech production

43.70.Fq Acoustical correlates of phonetic segments and suprasegmental properties: stress, timing, and intonation

43.70.Gr Larynx anatomy and function; voice production characteristics

43.70.Jt Instrumentation and methodology for speech production research

43.70.Kv Cross-linguistic speech production and acoustics

43.70.Mn Relations between speech production and perception

43.71.−k Speech perception

43.71.An Models and theories of speech perception *(see also 43.66.Ba)*

43.71.Bp Perception of voice and talker characteristics

43.71.Es Vowel and consonant perception; perception of words, sentences, and fluent speech *(see also 43.66.Lj)*

43.71.Ft Development of speech perception

43.71.Gv Measures of speech perception (intelligibility and quality)

43.71.Hw Cross-language perception of speech

43.71.Ky Speech perception by the hearing impaired *(see also 43.66.Ts)*

43.71.Lz Speech perception by the aging

43.71.Qr Neurophysiology of speech perception

43.71.Rt Sensory mechanisms in speech perception

43.71.Sy Spoken language processing by humans

43.72.−p Speech processing and communication systems

43.72.Ar Speech analysis and analysis techniques; parametric representation of speech

43.72.Bs Neural networks for speech recognition

43.72.Ct Acoustical methods for determining vocal tract shapes

43.72.Dv Speech–noise interaction

43.72.Fx Talker identification and adaptation algorithms

43.72.Gy Narrow, medium, and wideband speech coding

43.72.Ja Speech synthesis and synthesis techniques

43.72.Kb Speech communication systems and dialogue systems

43.72.Lc Time and frequency alignment procedures for speech

43.72.Ne Automatic speech recognition systems

43.72.Pf Automatic talker recognition systems

43.72.Qr Auditory synthesis and recognition

43.75.−z Music and musical instruments

43.75.Bc Scales, intonation, vibrato, composition

43.75.Cd Music perception and cognition

43.75.De Bowed stringed instruments

43.75.Ef Woodwinds

43.75.Fg Brass instruments and other lip-vibrated instruments

43.75.Gh Plucked string instruments

43.75.Hi Drums

43.75.Kk Bells, gongs, cymbals, mallet percussion, and similar instruments

43.75.Lm Free reed instruments

43.75.Mn Pianos and other struck string instruments

43.75.Np Pipe organs

43.75.Pq Reed woodwind instruments

43.75.Qr Flutes and similar wind instruments

43.75.Rs Singing

43.75.St Musical performance, training, and analysis

43.75.Tv Electro-acoustic and electronic instruments

43.75.Wx Electronic and computer music

43.75.Xz Automatic music recognition, classification, and information retrieval

43.75.Yy Instrumentation and measurement methods for musical acoustics

43.75.Zz Analysis, synthesis, and processing of musical sounds

43.80.−n Bioacoustics

43.80.Cs Acoustical characteristics of biological media: molecular species, cellular level tissues

43.80.Ev Acoustical measurement methods in biological systems and media

43.80.Gx Mechanisms of action of acoustic energy on biological systems: physical processes, sites of action *(in PACS, see also 87.50.Y−)*

43.80.Jz Use of acoustic energy (with or without other forms) in studies of structure and function of biological systems *(in PACS, see also 87.50.Y−)*

43.80.Ka Sound production by animals: mechanisms, characteristics, populations, biosonar *(see also 43.30.Nb and 43.64.Tk)*

43.80.Lb Sound reception by animals: anatomy, physiology, auditory capacities, processing *(see also 43.64.Tk, 43.66.Gf)*

43.80.Nd Effects of noise on animals and associated behavior, protective mechanisms *(see also 43.50.Qp, 43.64.Tk)*

43.80.Pe Agroacoustics

43.80.Qf Medical diagnosis with acoustics *(in PACS, see also 87.63.D−)*

43.80.Sh Medical use of ultrasonics for tissue modification (permanent and temporary) *(in PACS, see also 87.50.Y−)*

43.80.Vj Acoustical medical instrumentation and measurement techniques *(see also 43.66.Ts and 43.58.−e)*

APPENDIX TO 91–94, 96: GEOPHYSICS

91. Solid Earth physics

91.10.−v Geodesy and gravity *(see also 91.50.Kx Gravity and isostasy—in Marine geology and geophysics; 91.45.gh—in Geophysics Appendix)*

91.10.By Mathematical geodesy; general theory

91.10.Da Cartography

91.10.Fc Space and satellite geodesy; applications of global positioning systems

91.10.Jf Topography; geometric observations

91.10.Kg Crustal movements and deformation

91.10.Lh Photogrammetry

91.10.Nj Rotational variations; polar wobble *(see also 92.10.Iv Ocean influence of Earth's rotation)*

91.10.Op Gravity anomalies; time variable gravity

91.10.P− Geodetic techniques; gravimetric measurements and instruments

91.10.pa Atmospheric monitoring with geodetic techniques

91.10.pc Ocean monitoring with geodetic techniques

91.10.Qm Harmonics of the gravity potential field; geopotential theory and determination

. . . . *Rheology of lithosphere and mantle, see 91.32.De, 91.32.Gh*

91.10.Sp Satellite orbits

91.10.Tq Earth tides

91.10.Vr Ocean/Earth/atmosphere/hydrosphere/cryosphere interactions; mass balance

91.10.Ws Reference systems

91.10.Xa Global change from geodesy

91.25.−r Geomagnetism and paleomagnetism; geoelectricity *(see also 91.50.Iv Marine magnetics and electromagnetics)*

91.25.Cw Origins and models of the magnetic field; dynamo theories

91.25.Dx Archeomagnetism

91.25.Ey Interactions between exterior sources and interior properties

91.25.F− Rock and mineral magnetism *(see also 91.60.Pn Magnetic and electrical properties—in Physical properties of rocks and minerals)*

91.25.fa Biogenic magnetic minerals

91.25.fd Environmental magnetism

91.25.G− Spatial variations in geomagnetism

91.25.ga Harmonics and anomalies

91.25.gj Attributed to seafloor spreading

91.25.L− Time variations in geomagnetism

91.25.lc Rapid time variations

91.25.lf Diurnal to decadal

91.25.lj Secular and longer

91.25.Mf Magnetic field reversals: process and timescale

91.25.N− Paleomagnetism

91.25.nc Paleointensity

91.25.nf Applied to tectonics: regional; global

91.25.nj Applied to geologic processes

91.25.nn Paleomagnetic secular variation

91.25.Ph Magnetostratigraphy

91.25.Qi Geoelectricity, electromagnetic induction, and telluric currents

91.25.Rt Magnetic anomalies; modeling and interpretations

91.25.St Magnetic fabrics and anisotropy

91.25.Th Reference fields: regional; global

91.25.Ux Remagnetization

91.25.Wb Geomagnetic induction

91.25.Xg Geomagnetic excursion

91.25.Za Core processes

91.30.−f Seismology

91.30.Ab Theory and modeling, computational seismology

91.30.Bi Seismic sources (mechanisms, magnitude, moment frequency spectrum)

91.30.Cd Body wave propagation

91.30.Dk Seismicity *(see also 91.45.gd—in Geophysics Appendix)*

91.30.Fn Surface waves and free oscillations

91.30.Ga Subduction zones *(see also 91.40.Rs—in Volcanology; 91.45.Hc—in Tectonophysics; 91.50.Wy—in Marine geology and geophysics; 91.67.fc—in Geophysics Appendix)*

91.30.Hc Mid-ocean ridges *(see also 91.40.St—in Volcanology; 91.50.Rt—in Marine geology and geophysics; 91.67.ff—in Geophysics Appendix)*

91.30.Iv Transform faults

91.30.Jk Tomography in seismology *(see also 91.35.Pn Tomography of the Earth's interior)*

91.30.Mv Strong motions and shock waves

91.30.Nw Tsunamis *(see also 92.10.hl—in Geophysics Appendix)*

91.30.P− Earthquakes

91.30.pa Dynamics and mechanics

91.30.pb Ground motions and engineering seismology

91.30.pc Magnitudes and parameters

91.30.pd Hazard assessment, forecasting, and prediction

91.30.Rz Nuclear explosion seismology

91.30.Tb Volcano seismology

91.30.Uv Core and mantle seismology

91.30.Vc Continental crust seismology

91.30.Wx Lithosphere seismology *(see also 91.45.gf—in Geophysics Appendix)*

91.30.Ye Oceanic crust seismology

91.30.Za Paleoseismology

91.32.−m Rheology of the Earth

91.32.Ac General aspects

91.32.De Crust and lithosphere

91.32.Gh Mantle

91.32.Jk Friction of fault zones

91.35.−x Earth's interior structure and properties

91.35.Cb Models of interior structure

91.35.Dc Heat flow; geothermy *(see also 91.50.Ln Heat flow (benthic)—in Marine geology and geophysics)*

91.35.Ed Structure of the Earth's interior below the upper mantle

91.35.Gf Structure of the crust and upper mantle

91.35.Lj Composition and state of the Earth's interior *(see also 91.67.gb—in Geophysics Appendix)*

. . . . *Geochronology, see 91.80.+d; and in Geophysics Appendix, see 91.80.−d)*

91.35.Pn Tomography of the Earth's interior *(see also 91.30.Jk Tomography in seismology)*

91.40.−k Volcanology *(see also 91.30.Tb Volcano seismology)*

91.40.Ac Geochemical modeling

91.40.Bp Tephrochronology; ash deposits

91.40.Dr Atmospheric effects *(see also 92.60.Mt Particles and aerosols—in Meteorology)*

91.40.Ft Eruption mechanisms

91.40.Ge Hydrothermal systems *(see also 91.67.Jk—in Geochemistry; 92.05.Lf—in oceanography)*

91.40.Hw Lava rheology and morphology

91.40.Jk Magma migration

91.40.La Physics and chemistry of magma bodies

91.40.Pc Thermodynamics in volcanology

91.40.Qa Reactions and phase equilibria *(see also 91.67.De—in Geochemistry)*

91.40.Rs Subduction zone processes *(see also 91.30.Ga—in Seismology; 91.45.Hc—in Tectonophysics; 91.50.Wy—in Marine geology; 91.67.fc—in Geophysics Appendix)*

91.40.St Mid-oceanic ridge processes *(see also 91.30.Hc—in Seismology; 91.50.Rt—in Marine geology; 91.67.ff—in Geophysics Appendix)*

91.40.Ta Intra-plate processes *(see also 91.50.Tb—in Marine geology; 91.67.fh—in Geophysics Appendix)*

91.40.Uc Volcanoclastic deposits

91.40.Vg Volcanic gases

91.40.Wx Calderas

91.40.Yt Remote sensing of volcanoes *(see also 93.85.Pq)*

91.40.Zz Volcano monitoring; volcanic hazards and risks

. . . . *Planetary volcanism, see 96.12.Xy*

91.45.−c Tectonophysics

91.45.Bg Planetary interiors *(see also 96.12.Pc—in Planetology of solid surface planets; 96.15.Nd—in Planetology of fluid planets)*

91.45.C− Continental tectonics

91.45.ca General aspects

91.45.cc Orogenic belts

91.45.cf Continental margins and continental cratons

91.45.ch Continental neotectonics

91.45.cj Extensional, tectonics (rift basins)

91.45.cn Strike-slip tectonics

91.45.D− Plate tectonics

91.45.dc Plate boundaries: general aspects

91.45.df Plate motions: general aspects

91.45.dg Plate motions: past

91.45.dk Plate motions: present and recent

91.45.Fj Convection currents and mantle plumes

91.45.G− Dynamics and mechanics of tectonics

91.45.gd Seismotectonics (see also 91.30.Dk Seismicity)

91.45.gf Lithospheric dynamics; flexure (see also 91.30.Wx Lithosphere seismology; 91.32.De Crust and lithosphere, rheology of)

91.45.gh Gravity and tectonics

91.45.Hc Subduction and obduction zone processes *(see also 91.30.Ga—in Seismology; 91.40.Rs—in Volcanology)*

91.45.Jg Hot spots, large igneous provinces, and flood basalt volcanism

91.45.Kn Core processes

91.45.Nc Evolution of the Earth

91.45.Qv Tomography of plate tectonics *(see also 91.30.Jk—in Seismology)*

91.45.Rg Heat generation and transport

. . . . *Folds and folding, see 91.55.Hj*

. . . . *Fractures and faults, see 91.55.Jk*

91.45.Wa Volcanic arcs

91.45.X− Stresses in tectonophysics

91.45.xa General aspects

91.45.xc Crust and lithosphere (see also 91.30.Wx Lithosphere seismology)

91.45.xf Deep-seated stresses

. . . . *Hydrothermal systems, see 91.40.Ge*

. . . . *Planetary tectonics, see 96.12.Xy*

. . . . *Pluton emplacement, see 91.55.Sn*

. . . . *Rheology of the Earth, see 91.32.−m*

91.50.−r Marine geology and geophysics

91.50.Ac Back-arc basin processes

91.50.Bd Continental shelf and slope processes

91.50.Cw Beach and coastal processes

91.50.Ey Seafloor morphology, geology, and geophysics *(see also 92.10.Oc Benthic boundary layers, ocean bottom processes—in oceanography)*

91.50.Ga Bathymetry, seafloor topology

91.50.Hc Gas and hydrate systems *(see also 92.20.Uv—in oceanography)*

91.50.Iv Marine magnetics and electromagnetics

91.50.Jc Marine sediments, turbidity currents—processes and transport *(see also 91.65.Ti—in petrology; 91.67.Ty—in Geochemistry; 92.10.Wa and 92.20.Vn—in oceanography; 92.40.Gc—in hydrology; 91.80.Wx—in Geophysics Appendix)*

91.50.Kx Gravity and isostasy

91.50.Ln Heat flow (benthic)

91.50.Nc Littoral processes

91.50.Ps Marine hydrogeology

91.50.Qr Micropaleontology

91.50.Rt Mid-ocean ridge processes *(see also 91.30.Hc—in Seismology; 91.40.St—in Volcanology; 91.67.ff—in Geophysics Appendix)*

91.50.Sn Ocean drilling *(see also 93.85.Tf Oil prospecting, pipelines, and conduits)*

91.50.Tb Oceanic hotspots and intra-plate volcanism *(see also 91.40.Ta—in Volcanology; 91.67.fh—in Geophysics Appendix)*

91.50.Uv Oceanic plateaus and fracture zone processes

91.50.Vx Ophiolites

91.50.Wy Subduction zone processes

91.50.Xz Submarine landslides

91.50.Yf Submergence instruments, ROV, AUV, Submersibles, and ocean observatories

91.55.−y Structural geology

91.55.Ax Mechanics, theory and modeling

91.55.Bc Continental neotectonics

91.55.De Diapir and diapirism

91.55.Fg Dynamics and mechanics of faulting *(see also 91.32.Jk Friction of fault zones, rheology of)*

91.55.Hj Folds and folding

91.55.Jk Fractures and faults *(see also 91.50.Uv Oceanic plateaus and fracture zone processes)*

91.55.Ln Kinematics of crustal and mantle deformation

91.55.Mb High strain deformation zones

91.55.Nc Local crustal structure; regional crustal structure

91.55.Pq Melanges

91.55.Qr Mesoscopic fabrics

91.55.Sn Pluton emplacement

91.55.Tt Role of fluids

91.55.Uv Remote sensing in structural geology

. . . . *Rheology of the Earth, see 91.32.−m*

91.60.−x Physical properties of rocks and minerals *(for rheological properties of geological materials, see 83.80.Nb)*

91.60.Ba Elasticity, fracture, and flow

91.60.Dc Plasticity, diffusion, and creep

91.60.Ed Crystal structure and defects, microstructure

91.60.Fe Equations of state

91.60.Gf High-pressure behavior

91.60.Hg Phase changes

91.60.Ki Thermal properties

91.60.Lj Acoustic properties

91.60.Mk Optical properties

91.60.Np Permeability and porosity

91.60.Pn Magnetic and electrical properties *(see also 91.25.F− Rock and mineral magnetism)*

. . . . *Environmental magnetism, see 91.25.fd*

91.60.Qr Wave attenuation

91.60.Tn Transport properties

91.62.−g Biogeosciences *(see also 91.67.Uv Organic and biogenic geochemistry; 91.80.Kc Chemical and biological geochronology; 92.20.J− Biology of the ocean)*

91.62.Bf Agricultural systems

91.62.De Anoxic and hypoxic environments *(see also 92.20.Hs and 92.20.Ox—in Chemical and biological oceanography)*

91.62.Fc Astrobiology and extraterrestrial materials *(see also 96.55.+z Astrobiology and astrochemistry of the Solar system and interplanetary space)*

91.62.Gk Biodiversity

91.62.Jf Bioremediation

91.62.Kt Biogeochemical kinetics

91.62.La Carbon cycling, nitrogen cycling *(see also 92.20.Xy—in Oceanography)*

91.62.Mn Ecosystems, structure and dynamics, plant ecology

91.62.Np Evolutionary geobiology
91.62.Pq Geomicrobiology
91.62.Qs Nutrients and nutrient cycling
91.62.Rt Land pollution, soil pollution
91.62.Ty Natural hazards
91.62.Uv Life in extreme environments
91.62.Xy Biosphere/atmosphere interactions

91.65.−n Mineralogy and petrology

91.65.An Mineral and crystal chemistry
. . . . *Geochemical cycles, see 91.67.Nc*
91.65.Cq Igneous petrology
91.65.Dt Isotopic composition *(see also 91.67.Qr Radiogenic isotope geochemistry; 91.67.Rx Stable isotope geochemistry)*
91.65.Ej Extrusive structures and rocks
. . . . *Low temperature geochemistry, see 91.67.Vf*
91.65.Gk Intrusive structures and rocks
. . . . *Organic geochemistry, see 91.67.Uv*
91.65.Jn Layered magma chambers
91.65.Kf Metamorphic petrology
91.65.Lc Pressure-temperature-time paths
91.65.My Fluid flow
. . . . *Trace elements, see 91.67.Pq*
91.65.Pj Ultra-high pressure metamorphism
91.65.Qr Ultra-high temperature metamorphism
91.65.Rg Mineral occurrences and deposits
91.65.Sn Meteorite mineralogy and petrology
91.65.Ti Sedimentary petrology *(see also 91.50.Jc—in marine geology; 91.67.Ty—in Geochemistry; 92.10.Wa and 92.20.Vn—in oceanography; 92.40.Gc—in hydrology; 91.80.Wx—in Geophysics Appendix)*
. . . . *Major element composition, see 91.67.Pq*

91.67.−y Geochemistry *(see also 92.20.Cm Chemistry of the ocean; 92.40.Bc Chemistry of fresh water; 92.60.Ls Ion chemistry of the atmosphere; 91.62.Kt, 91.80.Kc, and 92.20.C− in Geophysics Appendix)*

91.67.Bc Geochemical modeling
91.67.De Reactions and phase equilibria *(see also 91.40.Qa—in Volcanology)*
91.67.F− Geochemical processes
91.67.fc Subduction zone (see also 91.30.Ga—in Seismology; 91.45.Hc—in Tectonophysics; 91.50.Wy—in Marine geology)
91.67.ff Mid-oceanic ridge (see also 91.30.Hc—in Seismology; 91.40.St—in Volcanology; 91.50.Rt—in Marine geology)
91.67.fh Intra-plate (see also 91.40.Ta—in Volcanology; 91.50.Tb—in Marine geology)
91.67.fk Alteration and weathering
91.67.fm Mantle
91.67.G− Chemical composition
91.67.gb Earth's core (see also 91.35.Lj)
91.67.gd Continental crust
91.67.gf Oceanic crust
91.67.gh Hydrosphere
91.67.gj Biosphere
91.67.gl Mantle
91.67.gn Meteorites
91.67.gp Aerosols and particles (see also 92.20.Bk—in oceanography; 92.30.Ef—in Paleoceanography; 92.60.Mt—in meteorology)
91.67.Jk Geochemistry of hydrothermal systems *(see also 91.40.Ge—in Volcanology; 92.05.Lf—in oceanography)*
. . . . *Physics and chemistry of magma bodies, see 91.40.La*
91.67.Nc Geochemical cycles *(see also 92.20.Sg Biogeochemical cycles—in oceanography; 92.60.hn—in meteorology; 92.30.Gh—in Geophysics Appendix)*
91.67.Pq Major and trace element geochemistry *(see also 92.20.Wx Trace elements—in chemical and biological oceanography)*
91.67.Qr Radiogenic isotope geochemistry *(see also 91.65.Dt Isotopic composition—in Mineralogy and petrology; 92.20.Td Radioactivity and radioisotopes—in oceanography)*
91.67.Rx Stable isotope geochemistry *(see also 91.65.Dt Isotopic composition—in Mineralogy and petrology)*
91.67.St Fluid and melt inclusion geochemistry
91.67.Ty Sedimentary geochemistry *(see also 91.50.Jc—in marine geology; 91.65.Ti—in Mineralogy and petrology; 92.10.Wa and 92.20.Vn—in oceanography; 92.40.Gc—in hydrology; 91.80.Wx—in Geophysics Appendix)*
91.67.Uv Organic and biogenic geochemistry
91.67.Vf Low-temperature geochemistry

91.70.−c Information related to geologic time

91.70.B− Cenozoic
91.70.bc Neogene
91.70.bg Paleogene
91.70.D− Mesozoic
91.70.db Cretaceous
91.70.de Jurassic
91.70.dg Triassic
91.70.F− Paleozoic
91.70.fb Permian
91.70.fd Carboniferous
91.70.ff Devonian
91.70.fh Silurian
91.70.fk Ordovician
91.70.fn Cambrian
91.70.H− Precambrian
91.70.hc Proterozoic
91.70.hf Archean

91.80.−d Geochronology *(see also 92.30.Hj Dendrochronology—in Paleoceanography)*

91.80.Cb Quarternary geochronology
91.80.Ef Sidereal geochronology
91.80.Hj Radioisotope geochronology, isotopic disequilibrium dating
91.80.Kc Chemical and biological geochronology
91.80.Mn Geomorphological geochronology
91.80.Pq Correlative geochronology
91.80.Rx Thermochronology
91.80.St Tephrochronology *(see also 91.40.Bp Tephrochronology; ash deposits—in Volcanology)*
91.80.Uv Cosmogenic-nuclide exposure dating
91.80.Vw Extinct radionuclide geochronology
91.80.Wx Sedimentary geochronology *(see also 91.50.Jc—in Marine geology; 91.65.Ti—in Mineralogy and petrology; 91.67.Ty—in Geochemistry; 92.10.Wa and 92.20.Vn—in oceanography; 92.40.Gc—in Hydrology)*

91.90.+p Other topics in solid Earth physics (restricted to new topics in section 91)

92. Hydrospheric and atmospheric geophysics

92.05.−x General aspects of oceanography

92.05.Bc Analytical modeling and laboratory experiments
92.05.Df Climate and inter-annual variability *(see also 92.60.Ry Climatology, climate change and variability—in meteorology; 92.70.Gt Climate dynamics—in Global change)*
92.05.Ek Long term variability; Heinrich events
92.05.Fg Diurnal, seasonal and annual cycles
92.05.Hj Physical and chemical properties of seawater (salinity, density, temperature)
92.05.Jn Ocean energy extraction
92.05.Lf Hydrothermal systems *(see also 91.40.Ge—in Volcanology; 91.67.Jk—in Geochemistry)*

92.10.−c Physical oceanography

92.10.A− Circulation and currents
92.10.ab General circulation
92.10.ad Deep water formation and circulation
92.10.af Thermohaline convection

92.10.ah *Ocean currents; Eastern boundary currents, Western boundary currents*

92.10.ak *Eddies and mesoscale processes*

92.10.am *El Nino Southern Oscillation (see also 92.30.La—in Paleoceanography)*

. . . . *Physical properties of seawater, see 92.05.Hj*

. . . . *Capillary waves, see 92.10.hd—in Geophysics Appendix*

92.10.Dh Deep ocean processes

92.10.Ei Coriolis effects

92.10.Fj Upper ocean and mixed layer processes

92.10.H− Ocean waves and oscillations

92.10.hb *Surface waves and tides*

92.10.hd *Capillary waves*

92.10.hf *Planetary waves, Rossby waves*

92.10.hh *Kelvin waves*

92.10.hj *Internal and inertial waves*

92.10.hk *Seiches*

92.10.hl *Tsunamis (see also 91.30.Nw—in Seismology)*

92.10.hp *Sea level variations (see also 92.70.Jw Oceans, sea level change—in Global change)*

92.10.Iv Ocean influence of Earth's rotation

. . . . *Seiches, see 92.10.hk—in Geophysics Appendix*

92.10.Kp Sea–air energy exchange processes *(see also 92.60.Cc—in meteorology)*

92.10.Lq Turbulence, diffusion, and mixing processes in oceanography

92.10.Ns Fine structure and microstructure in oceanography

92.10.Oc Benthic boundary layers, ocean bottom processes *(see also 91.50.Ey Sea floor, morphology, geology, and geophysics—in marine geology)*

92.10.Rw Sea ice (mechanics and air/sea/ice exchange processes)

92.10.Sx Coastal, estuarine, and near shore processes *(see also 91.50.Cw Beach and coastal processes—in marine geology)*

92.10.Ty Fronts and jets

92.10.Ua Overflows

92.10.Vz Underwater sound *(see also 43.30.+m in acoustics; 43.30.−k in Acoustics Appendix)*

92.10.Wa Sediment transport *(see also 91.50.Jc—in marine geology; 91.65.Ti—in Mineralogy and petrology; 91.67.Ty—in Geochemistry; 92.20.Vn—in chemical oceanography; 92.40.Gc—in Hydrology; 91.80.Wx—in Geophysics Appendix)*

92.10.Xc Ocean fog

92.10.Yb Hydrography *(for ocean parameter estimation by acoustical methods, see 43.30.Pc—in Acoustics Appendix)*

92.10.Zf Upwelling and convergences *(see also 92.30.Vn—in Geophysics Appendix)*

. . . . *Marine geology and geophysics, see 91.50.−r*

92.20.−h Chemical and biological oceanography

92.20.Bk Aerosols *(see also 92.60.Mt—in meteorology; 91.67.gp and 92.30.Ef—in Geophysics Appendix)*

92.20.C− Chemistry of the ocean

92.20.cb *Chemical speciation and complexation, chemosynthesis*

92.20.cd *Chemical tracers*

92.20.cf *Marine organic chemistry*

92.20.cg *Marine inorganic chemistry*

92.20.ch *Photochemistry, photosynthesis*

92.20.cj *Oxidation and reduction reactions*

92.20.cn *Analytical chemistry*

92.20.cp *Natural products chemistry*

. . . . *Ocean energy extraction, see 92.05.Jn*

92.20.Hs Anoxic environments *(see also 91.62.+g Biogeosciences; 91.62.De—in Geophysics Appendix)*

92.20.Iv Benthic processes, sea-bottom processes *(see also 91.50.Ey—in marine geology; 92.10.Oc—in oceanography; 92.40.Gc—in hydrology)*

92.20.J− Biology of the ocean *(see also 91.62.−g Biogeosciences; 92.40.vu Cryobiology (in Geophysics Appendix)*

92.20.jb *Bacteria, microbiology and microbial ecology (see also 91.62.Kt geomicrobiology)*

92.20.jd *Symbiosis*

92.20.jf *Phytoplankton*

92.20.jh *Zooplankton*

92.20.jj *Sorptive scavenging*

92.20.jm *Population dynamics and ecology*

92.20.jp *Ecosysystems, structure, dynamics and modeling*

92.20.jq *Foodwebs: structure and dynamics*

92.20.ju *Nutrients and nutrient cycling*

92.20.Ny Marine pollution

92.20.Ox Hypoxic environment *(see also 91.62.De—in Geophysics Appendix)*

. . . . *Bacteria, see 92.20.jb—in Geophysics Appendix*

. . . . *Plankton, see 92.20.jf and 92.20.jh—in Geophysics Appendix*

92.20.Sg Biogeochemical cycles *(see also 91.67.Nc—in Geochemistry; 92.60.hn—in meteorology; 92.30.Gh—in Geophysics Appendix)*

92.20.Td Radioactivity and radioisotopes *(see also 91.65.Dt Isotopic composition—in Mineralogy and petrology; 91.67.Qr Radiogenic isotope geochemistry)*

92.20.Uv Gases in chemical oceanography *(see also 91.50.Hc Gas and hydrate systems—in marine geology)*

92.20.Vn Sedimentation *(see also 91.50.Jc—in marine geology; 91.65.Ti—in petrology; 91.67.Ty—in Geochemistry; 92.10.Wa—in oceanography; 92.40.Gc—in hydrology; 91.80.Wx—in Geophysics Appendix)*

92.20.Wx Trace elements *(see also 91.67.Pq Major and trace element geochemistry)*

92.20.Xy Carbon cycling *(see also 91.62.La—in Geophysics Appendix)*

92.30.−m Paleoceanography

92.30.Bc Abrupt climate change, stadial-interstadial transitions *(see also 92.60.Ry—in meteorology; 92.70.Gt and 92.70.Kb—in Global change)*

92.30.De Anthropogenic effects *(see also 92.40.Aa —in Hydrology)*

92.30.Ef Atmospheric transport and circulation, aerosols *(see also 91.67.gp—in Geochemistry; 92.20.Bk—in oceanography; 92.30.Ef—in Paleoceanography; 92.60.hk and 92.60.Mt—in meteorology)*

92.30.Gh Biogeochemical cycles *(see also 91.67.Nc—in Geochemistry; 92.20.Sg—in oceanography; 92.60.hn—in meteorology)*

92.30.Hj Corals

92.30.Iv Continental climate records

92.30.Jh Dendrochronology

92.30.La El Nino Southern Oscillation *(see also 92.10.am—in oceanography)*

92.30.Mc Glacial and interglacial oceanography, ice cores *(see also 92.40.vv in Geophysics Appendix)*

92.30.Np Greenhouse gases *(see also 92.70.Mn Impacts of global change; global warming)*

92.30.Pq Insolation forcing

92.30.Qr Micropaleontology

92.30.Rx Paleoecology

92.30.St Paleocene/Eocene thermal maximum

92.30.Tq Sea surface temperature

92.30.Uv Thermohaline convection

92.30.Vn Upwelling *(see also 92.10.Zf—in oceanography)*

92.30.Wx Palynology, pollen, spores and other palynomorphs, living or fossil

92.30.Xy Speleothems, stalagmites, stalactites

92.40.−t Hydrology and glaciology;

cryosphere *(see also 92.70.Ha—in Global change)*

92.40.Aa Anthropogenic effects *(see also 92.30.De—in Geophysics Appendix)*

92.40.Bc Chemistry of fresh water

92.40.Cy Modeling; general theory

92.40.De Drought

92.40.E− Precipitation *(see also 92.60.jf—in meteorology)*

92.40.ed Snow

92.40.eg Rain, hail

92.40.Gc Erosion and sedimentation; sediment transport *(see also 91.50.Jc—in marine geology; 91.65.Ti—in Mineralogy and petrology; 91.67.Ty—in Geochemistry; 92.10.Wa and 92.20.Vn—in oceanography; 91.80.Wx—in Geophysics Appendix)*

92.40.Ha Debris flow and landslides

92.40.Iv Desertification

92.40.Je Evapotranspiration *(see also 92.60.jc Evaporation—in Geophysics Appendix)*

92.40.K− Ground water

92.40.kc Ground water quality

92.40.ke Ground water transport

92.40.kh Aquifers

92.40.kj Groundwater/surface water interactions

92.40.km Groundwater hydrology

92.40.kp Groundwater hydraulics

92.40.Lg Soil moisture and temperature

. . . . *Limnology, see 92.40.qj—in Geophysics Appendix*

92.40.Oj Eco-hydrology; plant ecology

92.40.P− Geomorphology

92.40.pg Fluvial

92.40.pj Hillslope

92.40.Q− Surface water, water resources

92.40.qc Surface water quality

92.40.qf Water supply, reservoirs

92.40.qh Rivers

92.40.qj Lakes, limnology

92.40.qn Ponds

92.40.qp Floods, runoff, and stream flow

92.40.V− Glaciology *(see also 92.30.Mc—in Paleoceanography)*

92.40.vk Glaciers

92.40.vr Icebergs

92.40.vs Permafrost, frozen ground

92.40.vt Tundra

92.40.vu Cryobiology

92.40.vv Ice cores, ice sheets, ice shelves

92.40.vw Snow melt, avalanches

92.40.vx Sea ice

92.40.We Hydrologic cycles and budgets

92.40.Xx Irrigation; dams

92.40.Yy Wetlands

92.40.Zg Hydrometeorology, hydroclimatology

92.60.−e Properties and dynamics of the atmosphere; meteorology *(see also 92.40.Zg Hydrometeorology, hydroclimatology)*

92.60.Aa Modeling and model calibration *(see also 92.70.Np Global climate modeling)*

92.60.Bh General circulation

92.60.Cc Ocean/atmosphere interactions, air/sea constituent fluxes *(see also 92.10.Kp—in oceanography)*

92.60.Fm Boundary layer structure and processes

92.60.Gn Winds and their effects

92.60.H− Atmospheric composition, structure, and properties

92.60.ha Exospheric composition and chemistry

92.60.hb Thermospheric composition and chemistry, energy deposition

92.60.hc Mesospheric composition, energy deposition, constituent transport and chemistry

92.60.hd Stratospheric composition and chemistry

92.60.hf Tropospheric composition and chemistry, constituent transport and chemistry

92.60.hg Constituent sources and sinks

92.60.hh Acoustic gravity waves, tides, and compressional waves

92.60.hk Convection, turbulence, and diffusion (see also 92.30.Ef—in Geophysics Appendix)

92.60.hn Geochemical cycles (see also 91.67.Nc—in Geochemistry; 92.20.Sg—in oceanography; 92.30.Gh—in Geophysics Appendix)

92.60.hv Pressure, density, and temperature

92.60.hw Airglow and aurorae (see also 94.20.Ac Auroral ionosphere; 94.30.Aa Auroral phenomena in magnetosphere)

92.60.hx Other upper atmospheric phenomena: red sprites; blue jets; atmospheric gamma ray and intense VHF emissions

92.60.Iv Paleoclimatology *(see also 92.70.Gt Climate dynamics—in Global change)*

92.60.J− Water in the atmosphere

92.60.jc Evaporation (see also 92.40.Je Evapotranspiration—in Hydrology)

92.60.jf Precipitation (see also 92.40.E− in Hydrology)

92.60.jk Humidity

92.60.Kc Land/atmosphere interactions

92.60.Ls Ion chemistry of the atmosphere

92.60.Mt Particles and aerosols *(see also 92.20.Bk—in oceanography; 91.67.gp and 92.30.Ef—in Geophysics Appendix)*

92.60.N− Cloud physics and chemistry

92.60.nc Cloud optics

92.60.nf Cloud/radiation interaction

92.60.Ox Tropical meteorology

92.60.Pw Atmospheric electricity, lightning

92.60.Qx Storms

92.60.Ry Climatology, climate change and variability *(see also 92.70.Gt and 92.70.Kb—in Global change; 92.30.Bc—in Geophysics Appendix)*

92.60.Sz Air quality and air pollution *(see also 07.88.+y Instruments for environmental pollution measurements)*

92.60.Ta Electromagnetic wave propagation

92.60.Uy Polar meteorology

92.60.Vb Radiative processes, solar radiation

92.60.Wc Weather analysis and prediction

92.60.Xg Stratosphere/troposphere interactions

92.60.Zc Volcanic effects

92.70.−j Global change

92.70.Aa Abrupt/rapid climate change

92.70.Bc Land/atmosphere interactions

92.70.Cp Atmosphere

92.70.Er Biogeochemical processes

92.70.Gt Climate dynamics *(see also 92.60.Ry—in meteorology; 92.30.Bc—in Geophysics Appendix)*

92.70.Ha Cryospheric change

92.70.Iv Geomorphology and weathering *(see also 92.40.Gc Erosion and sedimentation; sediment transport; 92.40.Pb—in hydrology; 92.40.P− in Geophysics Appendix)*

92.70.Jw Oceans, sea level change *(see also 92.10.hp—in Geophysics Appendix)*

92.70.Kb Regional climate change *(see also 92.60.Ry—in meteorology; 92.30.Bc—in Geophysics Appendix)*

92.70.Ly Water cycles

92.70.Mn Impacts of global change; global warming *(see also 92.30.Np—in Geophysics Appendix)*

92.70.Np Global climate modeling

92.70.Pq Earth system modeling

92.70.Qr Solar variability impact

92.70.St Land cover change

92.90.+x Other topics in hydrospheric and atmospheric geophysics (restricted to new topics in section 92)

93. Geophysical observations, instrumentation, and techniques

93.30.−w Information related to geographical regions

93.30.Bz Africa
93.30.Ca Antarctica
93.30.Db Asia
93.30.Fd Australia
93.30.Ge Europe
93.30.Hf North America
93.30.Jg South America
93.30.Kh Large islands (e.g., Greenland)
93.30.Li Arctic Ocean
93.30.Mj Atlantic Ocean
93.30.Nk Indian Ocean
93.30.Pm Pacific Ocean
93.30.Qn Southern Ocean
93.30.Rp Regional seas
93.30.Sq Polar regions
93.30.Tr Temperate regions
93.30.Vs Tropical regions

93.55.+z International organizations, national and international programs

. . . . *Data acquisition and storage, see 93.85.Bc*

93.85.−q Instruments and techniques for geophysical research: Exploration geophysics *(see also 91.50.Ga Bathymetry, seafloor topology; 91.50.Yf Submergence instruments, ROV, AUV, submersibles, and ocean observatories—in marine geology; 92.10.Yb Hydrography—in oceanography)*

93.85.Bc Computational methods and data processing, data acquisition and storage
93.85.De Exploration of continental structures
93.85.Fg Downhole methods
93.85.Hj Gravity methods
93.85.Jk Magnetic and electrical methods
93.85.Ly Exploration of oceanic structures
93.85.Np Radioactivity methods
93.85.Pq Remote sensing in exploration geophysics *(see also 91.40.Yt—in Volcanology; 91.55.Uv—in Structural geology)*
93.85.Rt Seismic methods
93.85.Tf Oil prospecting, pipelines, and conduits *(see also 91.50.Sn Ocean drilling)*

93.90.+y Other topics in geophysical observations, instrumentation, and techniques (restricted to new topics in section 93)

94. Physics of the ionosphere and magnetosphere

94.05.−a Space plasma physics *(see also 96.50.−e Interplanetary physics)*

94.05.Bf Plasma interactions with dust and aerosols
94.05.Dd Radiation processes
94.05.Fg Solitons and solitary waves
94.05.Hk Spacecraft/atmosphere interactions
94.05.Jq Spacecraft sheaths, wakes, and charging
94.05.Lk Turbulence
94.05.Pt Wave/wave, wave/particle interactions
94.05.Rx Experimental techniques and laboratory studies *(see also 52.72.+v—in physics of plasmas)*
94.05.S− Space weather
94.05.sj Space radiation environment
94.05.sk Impacts on humans
94.05.sp Solar effects
94.05.sq Engineering for hazard mitigation
94.05.st Satellite drag
94.05.sx Forecasting
. . . . *Physics of the neutral atmosphere, see 92.60.−e*
94.05.sy Impacts on technological systems

94.20.−y Physics of the ionosphere *(for ionospheres of the planets, see 96.12.ji and 96.15.hk; for radiowave propagation, see 41.20.Jb—in electromagnetism)*

94.20.Ac Auroral ionosphere *(see also 92.60.hw Airglow and aurorae—in meteorology; 94.30.Aa Auroral phenomena in magnetosphere)*
94.20.Bb Wave propagation *(see also 94.30.Tz—in Physics of the magnetosphere)*
94.20.Cf Ionospheric modeling and forecasting
94.20.D− Ionospheric structure, composition
94.20.de D region
94.20.dg E region
94.20.dj F region
94.20.dk Polar cap ionosphere
94.20.dl Topside region
94.20.dm Mid-latitude ionosphere
94.20.dt Equatorial ionosphere
94.20.dv Ion chemistry and composition; ionization mechanisms
94.20.Fg Plasma temperature and density
. . . . *Plasmasphere, see 94.30.cv*
94.20.Qq Particle precipitation *(see also 94.30.Ny—in Physics of the magnetosphere)*
. . . . *Interactions between waves and particles, see 94.20.W−*
94.20.Ss Electric fields; current system
94.20.Tt Ionospheric soundings; active experiments
94.20.Vv Ionospheric disturbances, irregularities, and storms
94.20.W− Ionospheric dynamics and interactions
94.20.wc Plasma motion; plasma convection; particle acceleration
94.20.wf Plasma waves and instabilities
94.20.wg Ionosphere/atmospheric interactions
94.20.wh Ionosphere/magnetosphere interactions
94.20.wj Wave/particle interactions
94.20.wl Plasma interactions with dust and aerosols
94.20.wq Solar radiation and cosmic ray effects
94.20.ws Electromagnetic wave propagation
94.20.Xa Meteor-trail physics

94.30.−d Physics of the magnetosphere

94.30.Aa Auroral phenomena in magnetosphere *(see also 94.20.Ac Auroral ionosphere)*
94.30.Bg Magnetospheric modeling and forecasting
94.30.C− Magnetospheric configuration and dynamics
94.30.cb Inner magnetosphere
94.30.cf Outer magnetosphere
94.30.cg Magnetospheric cusp
94.30.ch Magnetopause
94.30.cj Magnetosheath
94.30.cl Magnetotail
94.30.cp Magnetic reconnection
94.30.cq MHD waves, plasma waves, and instabilities
94.30.cs Plasma motion; plasma convection
94.30.ct Plasma sheet
94.30.cv Plasmasphere
94.30.cx Polar cap phenomena
94.30.Hn Energetic trapped particles
94.30.Kq Electric fields, field-aligned currents and current systems, and ring currents
94.30.Lr Magnetic storms, substorms
94.30.Ms Magnetic pulsations
94.30.Ny Energetic particle precipitation *(see also 94.20.Qq—in Physics of the ionosphere)*
94.30.Tz Electromagnetic wave propagation *(see also 94.20.Bb—in Physics of the ionosphere)*
94.30.V− Magnetosphere interactions
94.30.vb Magnetosphere/ionosphere interactions (see also 94.20.wj—in Physics of the ionosphere)
94.30.vd Magnetosphere interactions with satellites and rings
94.30.vf Solar wind/magnetosphere interactions
94.30.vh Interactions with interplanetary space
94.30.Xy Radiation belts

94.80.+g **Instrumentation for space plasma physics, ionosphere, and magnetosphere**

94.90.+m **Other topics in space plasma physics, physics of the ionosphere and magnetosphere (restricted to new topics in section 94)**

96. Solar system; planetology

96.10.+i **General; solar nebula; cosmogony**

96.12.−a **Planetology of solid surface planets** *(see also 96.15.−g Planetology of fluid planets; 96.30.Bc Comparative planetology)*

96.12.Bc Origin and evolution
96.12.De Orbital and rotational dynamics
96.12.Fe Gravitational fields
96.12.Hg Magnetic field and magnetism
96.12.J− Atmospheres
96.12.ja Aurorae and airglow
96.12.jc Composition and chemistry
96.12.je Evolution
96.12.jg Structure and dynamics
96.12.ji Ionospheres
96.12.jk Magnetospheres
96.12.jm Meteorology
96.12.K− Surfaces
96.12.ka Hydrology and fluvial processes
96.12.kc Surface materials and properties
96.12.ke Impact phenomena, cratering
96.12.kg Erosion, weathering
96.12.ki Glaciation
96.12.Ma Composition
96.12.Pc Interiors
96.12.Qr Polar regions
96.12.St Heat flow
96.12.Uv Rings and dust
96.12.Wx Interactions with particles and fields
96.12.Xy Tectonics, volcanism

96.15.−g **Planetology of fluid planets** *(see also 96.12.−a Planetology of solid surface planets; 96.30.Bc Comparative planetology)*

96.15.Bc Origin and evolution
96.15.De Orbital and rotational dynamics
96.15.Ef Gravitational fields
96.15.Gh Magnetic field and magnetism
96.15.H− Atmospheres
96.15.hb Aurorae
96.15.he Composition and chemistry
96.15.hg Evolution
96.15.hj Structure and dynamics
96.15.hk Ionospheres
96.15.hm Magnetospheres
96.15.hp Meteorology
96.15.Kc Composition
96.15.Lb Surfaces
96.15.Nd Interiors
96.15.Pf Physical properties of materials
96.15.Qr Impact phenomena
96.15.St Tori and exospheres
96.15.Uv Rings and dust
96.15.Vx Interactions with particles and fields
96.15.Wx Tidal forces
96.15.Xy Polar regions

96.20.−n **Moon**

96.20.Br Origin and evolution
96.20.Dt Features, landmarks, mineralogy, and petrology
96.20.Jz Gravitational field, selenodesy, and magnetic fields
96.20.Ka Impacts, cratering

96.25.−f **Planetology of comets and small bodies**

96.25.Bd Origin and evolution
96.25.De Orbital and rotational dynamics
96.25.F− Atmospheres
96.25.fa Aurorae, airglow and x-ray emission
96.25.fc Composition and chemistry
96.25.ff Evolution
96.25.fh Structure and dynamics
96.25.H− Composition
96.25.hc Dust, erosion, and weathering
96.25.hf Ice
96.25.hj Surfaces and interiors
96.25.hn Physical and chemical properties of materials
96.25.J− Ionospheres
96.25.jf Composition and chemistry
96.25.jh Evolution
96.25.jk Structure and dynamics
96.25.Ln Magnetic fields and magnetism
96.25.Nc Gravitational fields
96.25.Pq Impact phenomena
96.25.Qr Interactions with solar wind plasma and fields
96.25.St Plasma and MHD instabilities
96.25.Tg Radiation and spectra
96.25.Vt Satellites
96.25.Xz Volcanism

96.30.−t **Solar system objects**

96.30.Bc Comparative planetology *(see also 96.12.−a Planetology of solid surface planets; 96.15.−g Planetology of fluid planets)*
96.30.C− Comets *(see also 96.25.−f Planetology of comets and small bodies)*
96.30.cb Dust tails and trails
96.30.cd Interiors
96.30.Dz Mercury
96.30.Ea Venus
96.30.Gc Mars
96.30.Hf Martian satellites
96.30.Kf Jupiter
96.30.L− Jovian satellites
96.30.lb Io
96.30.ld Europa
96.30.lf Ganymede
96.30.lh Callisto
96.30.Mh Saturn
96.30.N− Saturnian satellites
96.30.nd Titan
96.30.Pj Uranus
96.30.Qk Uranian satellites
96.30.Rm Neptune
96.30.Sn Pluto
96.30.Td Neptunian satellites
96.30.Up Plutonian satellites
96.30.V− Dust, extraterrestrial materials
96.30.vx Interplanetary material
96.30.vy Interstellar material
96.30.Wr Planetary rings
96.30.Xa Kuiper belt, trans-Neptunian objects
96.30.Ys Asteroids, meteoroids
96.30.Za Meteors, meteorites and tektites *(see also 91.65.Sn Meteorite mineralogy and petrology; 94.20.Xa Meteor-trail physics; 91.67.gn—in Geophysics Appendix)*
. . . . *Planetary, asteroid, cometary, and satellite characteristics and properties, see 96.12.−a, 96.15.−g, and 96.25.−f*
. . . . *Cosmic rays, see 96.50.S−*

96.50.−e **Interplanetary physics** *(see also 94.05.−a Space plasma physics)*

96.50.Bh Interplanetary magnetic fields
96.50.Ci Solar wind plasma; sources of solar wind
96.50.Dj Interplanetary dust and gas
96.50.Ek Heliopause and solar wind termination
96.50.Fm Planetary bow shocks; interplanetary shocks
. . . . *Comets, see 96.30.Cw; 96.30C− (in Geophysics Appendix)*
96.50.Hp Oort cloud
. . . . *Kuiper belt, see 96.30.Xa*
. . . . *Meteors, meteoroids, and meteor streams, see 96.30.Za*
. . . . *Meteorites, micrometeorites, and tektites, see 96.30.Za*
96.50.Pw Particle acceleration
96.50.Qx Corotating streams
96.50.Ry Discontinuities
96.50.S− Cosmic rays *(see also 94.20.wq Solar radiation and cosmic ray effects)*
96.50.sb Composition, energy spectra and interactions
96.50.sd Extensive air showers
96.50.sf Interactions with terrestrial matter

96.50.sh *Interplanetary propagation and effects*

96.50.Tf MHD waves; plasma waves, turbulence

96.50.Uv Ejecta, driver gases, and magnetic clouds

96.50.Vg Energetic particles

96.50.Wx Solar cycle variations

96.50.Xy Heliosphere/interstellar medium interactions

96.50.Ya Pickup ions

96.50.Zc Neutral particles

96.55.+z **Astrobiology and astrochemistry of the Solar system and interplanetary space** *(see also 91.62.Fc—in Geophysics Appendix)*

96.60.−j **Solar physics**

96.60.Bn Diameter, rotation, and mass

96.60.Fs Composition

96.60.Hv Electric and magnetic fields, solar magnetism

96.60.Iv Magnetic reconnection

96.60.Jw Solar interior

96.60.Ly Helioseismology, pulsations, and shock waves

96.60.Mz Photosphere

96.60.Na Chromosphere

96.60.P− Corona

96.60.pc *Coronal holes*

96.60.pf *Coronal loops, streamers*

96.60.ph *Coronal mass ejection*

96.60.Q− Solar activity *(see also 92.70.Qr—in Global change)*

96.60.qd *Sun spots, solar cycles*

96.60.qe *Flares*

96.60.qf *Prominence eruptions*

96.60.T− Solar electromagnetic emission

96.60.tg *Radio emission*

96.60.th *Visible emission*

96.60.tj *Ultraviolet emission*

96.60.tk *X-ray and gamma-ray emission*

96.60.Ub Solar irradiance

96.60.Vg Particle emission, solar wind *(see also 94.30.vf—in Geophysics Appendix; 26.65.+t Solar neutrinos in nuclear astrophysics)*

96.60.Xy Transition region

96.90.+c **Other topics on the Solar system and planetology (restricted to new topics in section 96)**

NANOSCALE SCIENCE AND TECHNOLOGY SUPPLEMENT
Collection of Applicable Terms from PACS 2008

In the list below, black type indicates terms chosen for the Nanoscale Science and Technology Supplement. Terms in gray type show the placement of the chosen terms within the overall scheme

00. GENERAL

03. Quantum mechanics, field theories, and special relativity

03.67.−a Quantum information

03.67.Ac Quantum algorithms, protocols, and simulations

03.67.Bg Entanglement production and manipulation

03.67.Dd Quantum cryptography and communication security

03.67.Hk Quantum communication

03.67.Lx Quantum computation architectures and implementations

03.67.Mn Entanglement measures, witnesses, and other characterizations

03.67.Pp Quantum error correction and other methods for protection against decoherence

07. Instruments, apparatus, and components common to several branches of physics and astronomy

07.10.−h Mechanical instruments and equipment

07.10.Cm Micromechanical devices and systems

07.79.−v Scanning probe microscopes and components

07.79.Cz Scanning tunneling microscopes

07.79.Fc Near-field scanning optical microscopes

07.79.Lh Atomic force microscopes

07.79.Pk Magnetic force microscopes

07.79.Sp Friction force microscopes

30. ATOMIC AND MOLECULAR PHYSICS

37. Mechanical control of atoms, molecules, and ions

37.25.+k Atom interferometry techniques

40. ELECTROMAGNETISM, OPTICS, ACOUSTICS, HEAT TRANSFER, CLASSICAL MECHANICS, AND FLUID DYNAMICS

42. Optics

42.50.−p Quantum optics

42.50.Ex Optical implementations of quantum information processing and transfer

42.50.Wk Mechanical effects of light on material media, microstructures and particles

42.70.−a Optical materials

42.70.Qs Photonic bandgap materials

47. Fluid dynamics

47.61.−k Micro- and nano- scale flow phenomena

47.61.Cb Non-continuum effects

47.61.Fg Flows in micro-electromechanical systems (MEMS) and nano-electromechanical systems (NEMS)

47.61.Jd Multiphase flows

47.61.Ne Micromixing

60. CONDENSED MATTER: STRUCTURAL, MECHANICAL, AND THERMAL PROPERTIES

61. Structure of solids and liquids; crystallography

61.46.−w Structure of nanoscale materials

61.46.Bc Structure of clusters (e.g., metcars; not fragments of crystals; free or loosely aggregated or loosely attached to a substrate)

61.46.Df Structure of nanocrystals and nanoparticles (″colloidal″ quantum dots but not gate-isolated embedded quantum dots)

61.46.Fg Nanotubes

61.46.Hk Nanocrystals

61.46.Km Structure of nanowires and nanorods (long, free or loosely attached, quantum wires and quantum rods, but not gate-isolated embedded quantum wires)

61.46.Np Structure of nanotubes (hollow nanowires)

61.48.−c Structure of fullerenes and related hollow molecular clusters

61.48.De Structure of carbon nanotubes, boron nanotubes, and closely related graphitelike systems

62. Mechanical and acoustical properties of condensed matter

62.23.−c Structural classes of nanoscale systems

62.23.Eg Nanodots

62.23.Hj Nanowires

62.23.Kn Nanosheets

62.23.Pq Composites (nanosystems embedded in a larger structure)

62.23.St Complex nanostructures, including patterned or assembled structures

62.25.−g Mechanical properties of nanoscale systems

62.25.De Low-frequency properties: response coefficients

62.25.Fg High-frequency properties, responses to resonant or transient (time-dependent) fields

62.25.Jk Mechanical modes of vibration

62.25.Mn Fracture/brittleness

63. Lattice dynamics

63.22.−m Phonons or vibrational states in low-dimensional structures and nanoscale materials

63.22.Dc Free films

63.22.Gh Nanotubes and nanowires

63.22.Kn Clusters and nanocrystals

63.22.Np Layered systems

64. Equations of state, phase equilibria, and phase transitions

64.70.−p Specific phase transitions

64.70.Nd Structural transitions in nanoscale materials

64.75.−g Phase equilibria

64.75.Jk Phase separation and segregation in nanoscale systems

66. Nonelectronic transport properties of condensed matter

66.30.−h Diffusion in solids

66.30.Pa Diffusion in nanoscale solids

68. Surfaces and interfaces; thin films and nanosystems (structure and nonelectronic properties)

68.35.−p Solid surfaces and solid–solid interfaces: structure and energetics

68.35.B− Structure of clean surfaces (and surface reconstruction)

68.35.bp *Fullerenes*

68.37.−d Microscopy of surfaces, interfaces, and thin films

68.37.Ef Scanning tunneling microscopy (including chemistry induced with STM)

68.37.Hk Scanning electron microscopy (SEM) (including EBIC)

68.37.Lp Transmission electron microscopy (TEM)

68.37.Ma Scanning transmission electron microscopy (STEM)

68.37.Nq Low energy electron microscopy (LEEM)

68.37.Og High-resolution transmission electron microscopy (HRTEM)

68.37.Ps Atomic force microscopy (AFM)

68.37.Rt Magnetic force microscopy (MFM)

68.37.Tj Acoustic force microscopy

68.37.Uv Near-field scanning microscopy and spectroscopy

68.37.Vj Field emission and field-ion microscopy

68.37.Xy Scanning Auger microscopy, photoelectron microscopy

68.37.Yz X-ray microscopy

68.55.−a Thin film structure and morphology

68.55.A− Nucleation and growth

68.55.ap *Fullerenes*

68.65.−k Low-dimensional, mesoscopic, and nanoscale systems: structure and nonelectronic properties

68.65.Fg Quantum wells

68.65.Hb Quantum dots (patterned in quantum wells)

68.65.La Quantum wires (patterned in quantum wells)

70. CONDENSED MATTER: ELECTRONIC STRUCTURE, ELECTRICAL, MAGNETIC, AND OPTICAL PROPERTIES

71. Electronic structure of bulk materials

71.20.−b Electron density of states and band structure of crystalline solids

71.20.Tx Fullerenes and related materials; intercalation compounds

72. Electronic transport in condensed matter

72.25.−b Spin polarized transport

72.25.Ba Spin polarized transport in metals

72.25.Dc Spin polarized transport in semiconductors

72.25.Fe Optical creation of spin polarized carriers

72.25.Hg Electrical injection of spin polarized carriers

72.25.Mk Spin transport through interfaces

72.25.Pn Current-driven spin pumping

72.25.Rb Spin relaxation and scattering

72.80.−r Conductivity of specific materials

72.80.Rj Fullerenes and related materials

73. Electronic structure and electrical properties of surfaces, interfaces, thin films, and low-dimensional structures

73.21.−b Electron states and collective excitations in multilayers, quantum wells, mesoscopic, and nanoscale systems

73.21.Fg Quantum wells

73.21.Hb Quantum wires

73.21.La Quantum dots

73.22.−f Electronic structure of nanoscale materials: clusters, nanoparticles, nanotubes, and nanocrystals

73.22.Dj Single particle states

73.22.Gk Broken symmetry phases

73.22.Lp Collective excitations

73.61.−r Electrical properties of specific thin films

73.61.Wp Fullerenes and related materials

73.63.−b Electronic transport in nanoscale materials and structures

73.63.Bd Nanocrystalline materials

73.63.Fg Nanotubes

73.63.Hs Quantum wells

73.63.Kv Quantum dots

73.63.Nm Quantum wires

73.63.Rt Nanoscale contacts

74. Superconductivity

74.70.−b Superconducting materials

74.70.Wz Fullerenes and related materials

74.78.−w Superconducting films and low-dimensional structures

74.78.Na Mesoscopic and nanoscale systems

75. Magnetic properties and materials

75.50.−y Studies of specific magnetic materials

75.50.Tt Fine-particle systems; nanocrystalline materials

75.50.Xx Molecular magnets

75.70.−i Magnetic properties of thin films, surfaces, and interfaces

75.75.+a Magnetic properties of nanostructures

78. Optical properties, condensed-matter spectroscopy and other interactions of radiation and particles with condensed matter

78.30.−j Infrared and Raman spectra

78.30.Na Fullerenes and related materials

78.40.−q Absorption and reflection spectra: visible and ultraviolet

78.40.Ri Fullerenes and related materials

78.66.−w Optical properties of specific thin films

78.66.Tr Fullerenes and related materials

78.67.−n Optical properties of low-dimensional, mesoscopic, and nanoscale materials and structures

78.67.Bf Nanocrystals and nanoparticles

78.67.Ch Nanotubes

78.67.De Quantum wells

78.67.Hc Quantum dots

78.67.Lt Quantum wires

79. Electron and ion emission by liquids and solids; impact phenomena

79.60.−i Photoemission and photoelectron spectra

79.60.Jv Interfaces; heterostructures; nanostructures

80. INTERDISCIPLINARY PHYSICS AND RELATED AREAS OF SCIENCE AND TECHNOLOGY

81. Materials science

81.05.−t Specific materials: fabrication, treatment, testing, and analysis

81.05.Tp Fullerenes and related materials

81.07.−b Nanoscale materials and structures: fabrication and characterization

81.07.Bc Nanocrystalline materials

81.07.De Nanotubes

81.07.Lk Nanocontacts

81.07.Nb Molecular nanostructures

81.07.Pr Organic-inorganic hybrid nanostructures

81.07.St Quantum wells

81.07.Ta Quantum dots

81.07.Vb Quantum wires

81.07.Wx Nanopowders

81.16.−c Methods of nanofabrication and processing

81.16.Be Chemical synthesis methods
81.16.Dn Self-assembly
81.16.Fg Supramolecular and biochemical assembly
81.16.Hc Catalytic methods
81.16.Mk Laser-assisted deposition
81.16.Nd Nanolithography
81.16.Pr Nanooxidation
81.16.Rf Nanoscale pattern formation
81.16.Ta Atom manipulation

82. Physical chemistry and chemical physics

82.35.−x Polymers: properties; reactions; polymerization
82.35.Np Nanoparticles in polymers

82.37.−j Single molecule kinetics
82.37.Gk STM and AFM manipulations of a single molecule
82.37.Rs Single molecule manipulation of proteins and other biological molecules

82.45.−h Electrochemistry and electrophoresis
82.45.Yz Nanostructured materials in electrochemistry

82.60.−s Chemical thermodynamics
82.60.Qr Thermodynamics of nanoparticles

82.70.−y Disperse systems; complex fluids
82.70.Dd Colloids

85. Electronic and magnetic devices; microelectronics

85.35.−p Nanoelectronic devices
85.35.Be Quantum well devices (quantum dots, quantum wires, etc.)
85.35.Ds Quantum interference devices
85.35.Gv Single electron devices
85.35.Kt Nanotube devices

85.65.+h Molecular electronic devices

85.75.−d Magnetoelectronics; spintronics: devices exploiting spin polarized transport or integrated magnetic fields
85.75.Bb Magnetic memory using giant magnetoresistance
85.75.Dd Magnetic memory using magnetic tunnel junctions
85.75.Ff Reprogrammable magnetic logic
85.75.Hh Spin polarized field effect transistors
85.75.Mm Spin polarized resonant tunnel junctions
85.75.Nn Hybrid Hall devices
85.75.Ss Magnetic field sensors using spin polarized transport

85.85.+j Micro- and nano-electromechanical systems (MEMS/NEMS) and devices

87. Biological and medical physics

87.64.−t Spectroscopic and microscopic techniques in biophysics and medical physics
87.64.Dz Scanning tunneling and atomic force microscopy
87.64.Ee Electron microscopy

87.80.−y Biophysical techniques (research methods)
87.80.Ek Mechanical and micromechanical techniques
87.80.Fe Micromanipulation of biological structures
87.80.Nj Single-molecule techniques

87.85.−d Biomedical engineering
87.85.D− Applied neuroscience
87.85.dh Cells on a chip
87.85.J− Biomaterials
87.85.jf Bio-based materials
87.85.Ox Biomedical instrumentation and transducers, including micro-electro-mechanical systems (MEMS)
87.85.Qr Nanotechnologies-design
87.85.Rs Nanotechnologies-applications
87.85.Uv Micromanipulators
87.85.Va Micromachining

ALPHABETICAL INDEX

PACS codes from Acoustics Appendix and Geophysics Appendix are indicated by an asterisk ().

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