

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.Mm Textbooks for graduates and researchers
- 01.30.Pp Textbooks for undergraduates
- 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*)

01.40. –d Education

- 01.40.Di Course design and evaluation
- 01.40.Ej Science in elementary and secondary school
- 01.40.Fk Physics education research (cognition, problem solving, etc.)
- 01.40.Gm Curricula; teaching methods, strategies, theory of testing, evaluation
- 01.40.Jp Teacher training

01.50. –i Educational aids

- 01.50.Fr Audio and visual aids, films
- 01.50.Ht Instructional computer use
- 01.50.Kw Techniques of testing
- 01.50.Lc Laboratory computer use (*see also 01.50.P*)
- 01.50.My Demonstration experiments and apparatus
- 01.50.Pa Laboratory experiments and apparatus (*see also 01.50.L*)
- 01.50.Qb Laboratory course design, organization, and evaluation
- 01.50.Wg Physics of toys

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*)

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

01.80.+b Physics of sports

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.By Logic and foundations
- 02.10.Cz Set theory
- 02.10.Eb Combinatorics
- 02.10.Gd Order, lattices, and ordered algebraic structures
- 02.10.Jf General mathematical systems
- 02.10.Lh Number theory
- 02.10.Nj Algebraic number theory, field theory, and polynomials
- 02.10.Pk Commutative rings and algebras
- 02.10.Rn Algebraic geometry
- 02.10.Sp Linear and multilinear algebra; matrix theory (finite and infinite)
- 02.10.Tq Associative rings and algebras
- 02.10.Vr Nonassociative rings and algebras
- 02.10.Ws Category theory and homological algebra

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

- 02.20.Df Finite groups
- 02.20.Fh Infinite groups
- 02.20.Hj Classical linear algebraic groups
- 02.20.Km Abelian groups
- 02.20.Mp Semigroups
- 02.20.Nq Topological groups, general
- 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

02.30. –f Function theory, analysis

- 02.30.Bi Real functions
- 02.30.Cj Measure and integration
- 02.30.Dk Functions of a complex variable
- 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.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.Px Abstract harmonic analysis
- 02.30.Qy Integral transforms and operational calculus
- 02.30.Rz Integral equations
- 02.30.Sa Functional analysis
- 02.30.Tb Operator theory
- 02.30.Wd Calculus of variations and optimal control

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

- 02.40.Dr Euclidean and projective geometries
- 02.40.Ft Convex sets and geometric inequalities
- 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.Vh Global analysis and analysis on manifolds

02.50. –r Probability theory, stochastic processes, and statistics (*see also 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.Hb Queuing theory
- 02.50.Kd Foundations of statistics; sufficiency
- 02.50.Le Decision theory and game theory
- 02.50.Ng Distribution theory and Monte Carlo studies
- 02.50.Ph Parametric inference
- 02.50.Rj Nonparametric inference
- 02.50.Sk Multivariate analysis
- 02.50.Vn Linear inference
- 02.50.Wp Inference from stochastic processes

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** (for quantum computation, see 03.67.L)
 - 02.70.Bf Finite-difference methods
 - 02.70.Dh Finite-element and Galerkin methods
 - 02.70.Fj Finite-volume methods
 - 02.70.Hm Spectral methods
 - 02.70.Jn Collocation methods
 - 02.70.Lq Monte Carlo and statistical methods
 - 02.70.Ns Molecular dynamics and particle methods
 - 02.70.Pt Boundary-integral methods
- 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 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)
 - 03.50.Kk Other special classical field theories
- 03.65.–w Quantum mechanics** (see also 05.30 Quantum statistical mechanics)
 - 03.65.Bz Foundations, theory of measurement, miscellaneous theories (including Aharonov–Bohm effect, Bell inequalities, Berry’s phase)
 - 03.65.Ca Formalism
 - 03.65.Db Functional analytical methods
 - 03.65.Fd Algebraic methods (see also 02.20 Group theory)
 - 03.65.Ge Solutions of wave equations: bound states
 - 03.65.Nk Nonrelativistic scattering theory
 - 03.65.Pm Relativistic wave equations
 - 03.65.Sq Semiclassical theories and applications
- 03.67.–a Quantum information**
 - 03.67.Dd Quantum cryptography
 - 03.67.Hk Quantum communication
 - 03.67.Lx Quantum computation
- 03.70.+k Theory of quantized fields** (see also 11.10 Field theory)

- 03.75.–b Matter waves** (for atom interferometry techniques, see 39.20—in atomic and molecular physics)
 - 03.75.Be Atom and neutron optics
 - 03.75.Dg Atom and neutron interferometry
 - 03.75.Fi Phase coherent atomic ensembles; quantum condensation phenomena

04. General relativity and gravitation (see also 95.30.H in astronomy)

- ... Special relativity, see 03.30
- 04.20.–q Classical general relativity** (see also 02.40 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.Dm Numerical relativity
 - 04.25.Nx Post-Newtonian approximation; perturbation theory; related approximations
- 04.30.–w Gravitational waves: theory**
 - 04.30.Db Wave generation and sources
 - 04.30.Nk Wave propagation and interactions
- 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 Late stages of stellar evolution)
 - 04.40.Nr Einstein–Maxwell spacetimes, spacetimes with fluids, radiation or classical fields
- 04.50.+h Gravity in more than four dimensions, Kaluza–Klein theory, unified field theories; alternative theories of gravity** (see also 11.25.M Compactification and four-dimensional models)
- 04.60.–m Quantum gravity**
 - 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
- 04.62.+v Quantum field theory in curved spacetime**

- 04.65.+e Supergravity** (see also 12.60.J Supersymmetric models)
- 04.70.–s Physics of black holes** (see also 97.60.L—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.Y—in astronomy)
- 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 Probability theory, stochastic processes, and statistics)

- 05.10.–a Computational methods in statistical physics and nonlinear dynamics** (see also 02.70 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
- 05.20.–y Classical statistical mechanics**
 - 05.20.Dd Kinetic theory
 - 05.20.Gg Classical ensemble theory
 - 05.20.Jj Statistical mechanics of classical fluids (see also 47.10 General theory in fluid dynamics)
- 05.30.–d Quantum statistical mechanics**
 - 05.30.Ch Quantum ensemble theory
 - 05.30.Fk Fermion systems and electron gas (see also 71.10 Theories and models of many electron systems)
 - 05.30.Jp Boson systems (for Bose-Einstein condensation, see 03.75.F)
 - 05.30.Pr Fractional statistics systems (anyons, etc.)
- 05.40.–a Fluctuation phenomena, random processes, noise, and Brownian motion**
 - 05.40.Ca Noise
 - 05.40.Fb Random walks and Levy flights
 - 05.40.Jc Brownian motion
- 05.45.–a Nonlinear dynamics and nonlinear dynamical systems** (see also 45 Classical mechanics of discrete systems)
 - 05.45.Ac Low-dimensional chaos
 - 05.45.Df Fractals (see also 47.53 Fractals in Fluid dynamics)

- 05.45.Gg Control of chaos, applications of chaos
- 05.45.Jn High-dimensional chaos
- 05.45.Mt Semiclassical chaos (“quantum chaos”)
- 05.45.Pq Numerical simulations of chaotic models
- 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.S *for solitons in Plasma*; 43.25.R *for solitons in Acoustics*; 42.50.M, 42.65.T, 42.81.D *for solitons in Optics*)
- 05.50.+q Lattice theory and statistics (Ising, Potts, etc.)** (*see also* 64.60.C *Order–disorder transformations and statistical mechanics of model systems* and 75.10.H *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 *in classical mechanics of discrete systems*)
- 05.70.–a Thermodynamics** (*see also* 64 *Equations of state, phase equilibria, and phase transitions, and* 65 *Thermal properties of condensed matter; for chemical thermodynamics, see* 82.60)
- 05.70.Ce Thermodynamic functions and equations of state
- 05.70.Fh Phase transitions: general studies
- 05.70.Jk Critical point phenomena
- 05.70.Ln Nonequilibrium and irreversible thermodynamics (*see also* 82.20.M *Nonequilibrium kinetics, and* 82.40.B *Oscillations, chaos, and bifurcations in homogeneous nonequilibrium reactors*)
- 05.70.Np Interface and surface thermodynamics (*see also* 82.65.D *Thermodynamics of surfaces and interfaces in physical chemistry*)
- 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

- 06.20.–f Metrology**
- 06.20.Dk Measurement and error theory
- 06.20.Fn Units and standards
- 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, displacements, including nanometer-scale displacements)
- 06.30.Dr Mass and density
- 06.30.Ft Time and frequency
- 06.30.Gv Velocity, acceleration, and rotation
- 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
- 06.90.+v Other topics in metrology, measurements, and laboratory procedures** (*restricted to new topics in section 06*)

07. Instruments, apparatus, components, and techniques 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 physics education, see* 01.50.H *and* 01.50.L
- *Computational techniques, see* 02.70—*in mathematical methods in physics*
- *Quantum computation, see* 03.67.L *in quantum mechanics*
- 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
- 07.05.Mh Neural networks, fuzzy logic, artificial intelligence
- 07.05.Pj Image processing (*see also* 42.30.V *in optics*; 87.57 *Medical imaging: general—in biological and medical physics*)
- 07.05.Rm Data presentation and visualization: algorithms and implementation
- 07.05.Tp Computer modeling and simulation
- 07.05.Wr Computer interfaces
- 07.07.–a General equipment and techniques**
- 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
- 07.10.–h Mechanical instruments, equipment, and techniques**
- 07.10.Cm Micromechanical devices and systems
- 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, apparatus, and techniques**
- 07.20.Dt Thermometry
- 07.20.Fw Calorimetry
- 07.20.Hy Furnaces; heaters
- 07.20.Ka High-temperature techniques and instrumentation; pyrometry
- 07.20.Mc Cryogenics, refrigerators; low-temperature techniques
- 07.20.Pe Heat engines; heat pumps
- 07.30.–t Vacuum apparatus and techniques**
- 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 and techniques; shock tubes; diamond anvil cells**
- 07.50.–e Electrical and electronic components, instruments, and techniques**
- 07.50.Ek Circuits and circuit components (*see also* 84.30 *Electronic circuits and* 84.32 *Passive circuit components*)
- 07.50.Hp Electrical noise and shielding, interference
- 07.50.Ls Electrometers
- 07.50.Qx Signal processing electronics (*see also* 84.40.U—*in radiowave and microwave technology*)
- 07.55.–w Magnetic components, instruments and techniques**

- 07.55.Db Generation of magnetic fields; magnets
- 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, equipment and techniques** (*for infrared and radio telescopes, see 95.55*)
- 07.57.Hm Infrared, submillimeter wave, microwave, and radiowave sources
- 07.57.Kp Bolometers; infrared, submillimeter wave, microwave, and radiowave receivers and detectors (*see also 85.60.G Photodetectors in electronic and magnetic devices, and 95.55.R 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, equipment, and techniques**
- · · · · *Optical sources, see 42.72*
- · · · · *Optical elements, devices, and systems 42.79*
- · · · · *Optoelectric devices 85.60*
- · · · · *Optical telescopes, see 95.55*
- 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.F; for x-ray microscopes, see 07.85.T*)
- 07.60.Rd Visible and ultraviolet spectrometers
- 07.60.Vg Fiber-optic instruments (*see also 42.81 Fiber optics-in optics*)
- 07.64.+z Acoustic instruments, equipment, and techniques** (*see also 43.58—in acoustics appendix*)
- 07.68.+m Photography, photographic instruments and techniques; xerography**
- 07.75.+h Mass spectrometers and related techniques**
- 07.77.-n Atomic, molecular, and charged-particle sources and detectors**
- 07.77.Gx Atomic and molecular beam sources and detectors
- 07.77.Ka Charged-particle beam sources and detectors
- 07.78.+s Electron, positron, and ion microscopes, electron diffractometers, and related techniques**
- 07.79.-v Scanning probe microscopes, components, and techniques** (*for x-ray microscopes, see 07.85.T*)
- 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, ion spectrometers, and related techniques**
- 07.85.-m X- and γ -ray instruments and techniques** (*for x- and γ -ray telescopes, see 95.55.K*)
- 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 aeronomy and magnetospheric instrumentation, see 94.80; see also 95.55 Astronomical and space-research instrumentation*)
- 07.88.+y Instruments for environmental pollution measurements**
- 07.89.+b Environmental effects on instruments (e.g., radiation and pollution effects)**
- 07.90.+c Other topics in instruments, apparatus, components, and techniques common to several branches of physics and astronomy (restricted to new topics in section 07)**

10. THE PHYSICS OF ELEMENTARY PARTICLES AND FIELDS *(for cosmic rays, see 96.40; for experimental methods and instrumentation for elementary-particle physics, see 29)*

- 11. General theory of fields and particles** *(see also 03.65 Quantum mechanics, 03.70 Theory of quantized fields)*
- 11.10.–z Field theory** *(for gauge field theories, see 11.15)*
- 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 Gravity in more than four dimensions; 04.60.K Lower dimensional models in quantum gravity)*
- 11.10.Lm Nonlinear or nonlocal theories and models *(see also 11.27 Extended classical solutions; cosmic strings, domain walls, texture)*
- 11.10.St Bound and unstable states; Bethe–Salpeter equations
- 11.10.Wx Finite-temperature field theory
- ... **Relativistic wave equations, see 03.65.P**
- 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.G 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 Theory of fundamental strings**
- 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
- 11.27.+d Extended classical solutions; cosmic strings, domain walls, texture** *(see also 98.80.C in cosmology)*
- 11.30.–j Symmetry and conservation laws** *(see also 02.20 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.J 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.F 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.N 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—in general relativity and gravitation, 11.25.M 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**
- ... *for extensions of gauge or Higgs sector, see 12.60.C or 12.60.F*
- 12.15.Ff Quark and lepton masses and mixing *(see also 14.60.P 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.K 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
- 12.38.–t Quantum chromodynamics**
- ... *see also 24.85 Quarks, gluons, and QCD in nuclei and nuclear processes*
- 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.H Lattice gauge theory)*
- 12.38.Lg Other nonperturbative calculations
- 12.38.Mh Quark–gluon plasma
- 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
- 12.40.–y Other models for strong interactions**
- 12.40.Ee Statistical models
- 12.40.Nn Regge theory, duality, absorptive/optical models *(see also 11.55.J Regge formalism)*
- 12.40.Vv Vector-meson dominance
- 12.40.Yx Hadron mass models and calculations

- 12.60.-i Models beyond the standard model**
 *see also 12.10 Unified field theories and models*
- 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 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

- 13.10.+q Weak and electromagnetic interactions of leptons** (*see also 13.35 Decays of leptons*)
- 13.15.+g Neutrino interactions** (*for neutrino-lepton interactions, see 13.10*)
- 13.20.-v Leptonic and semileptonic 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 , Y , 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 , Y , 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 and semileptonic 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** (*see also 13.10 Weak and electromagnetic interactions of leptons*)
- 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*)
- 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
- 13.65.+i Hadron production by electron-positron collisions**
- 13.75.-n Hadron-induced low- and intermediate-energy reactions and scattering (energy ≤ 10 GeV)** (*for higher energies, see 13.85*)
- 13.75.Cs Nucleon-nucleon interactions (including antinucleons, deuterons, etc.) (*for N - N interactions in nuclei, see 21.30*)
- 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*)
- 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 96.40 Cosmic rays*)
- 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.F 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.D Properties of protons and neutrons; 14.20.G for nucleon resonances; 13.40 for electromagnetic processes and properties; 13.60.H for deep-inelastic structure functions*)

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

21.10.Dr Binding energies and masses
 21.10.Ft Charge distribution
 21.10.Gv Mass and neutron distributions
 21.10.Hw Spin, parity, and isobaric spin
 21.10.Jx Spectroscopic factors
 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
 21.10.Tg Lifetimes

21.30.–x Nuclear forces (*see also 13.75.C 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

21.60.–n Nuclear-structure models and methods

21.60.Cs Shell model
 21.60.Ev Collective models
 21.60.Fw Models based on group theory
 21.60.Gx Cluster models
 21.60.Jz Hartree–Fock and random-phase approximations
 21.60.Ka Monte Carlo models

21.65.+f Nuclear matter

· · · · *Exotic atoms and molecules, see 36.10*

21.80.+a Hypernuclei

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

23. Radioactive decay and in-beam spectroscopy (*see also 82.55 Radiochemistry*)

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 Gamma transitions and level energies

23.20.Nx Internal conversion and extranuclear effects

23.20.Ra Internal pair production

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.P 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 nuclei and nuclear processes

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 scattering

25.30.Mr Muon scattering (including the EMC effect)

25.30.Pt Neutrino scattering

25.30.Rw Electroproduction reactions

25.40.–h Nucleon-induced reactions (*see also 28.20 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 ^2H -induced reactions

25.45.De Elastic and inelastic scattering
 25.45.Hi Transfer reactions
 25.45.Kk Charge-exchange reactions

25.55.–e ^3H -, ^3He -, and ^4He -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

25.70.–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 and the 13 or 25 category appropriate to the light ions)

25.75.Dw Particle and resonance production
 25.75.Gz Particle correlations
 25.75.Ld Collective flow

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 Fundamental aspects of astrophysics)*

26.20.+f Hydrostatic stellar nucleosynthesis
(see also 97.10.C Stellar structure, interiors, evolution, nucleosynthesis, ages)

26.30.+k Nucleosynthesis in novae, supernovae and other explosive environments

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

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

26.65.+t Solar neutrinos

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 $A \leq 5$

27.20.+n $6 \leq A \leq 19$

27.30.+t $20 \leq A \leq 38$

27.40.+z $39 \leq A \leq 58$

27.50.+e $59 \leq A \leq 89$

27.60.+j $90 \leq A \leq 149$

27.70.+q $150 \leq A \leq 189$

27.80.+w $190 \leq A \leq 219$

27.90.+b $220 \leq A$

28. Nuclear engineering and nuclear power studies

28.20.–v Neutron physics *(see also 25.40 Nucleon-induced reactions and 25.85.E Neutron-induced fission)*

28.20.Cz Neutron scattering

28.20.Fc Neutron absorption

28.20.Gd Neutron transport: diffusion and moderation

28.41.–i Fission reactors

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

28.50.–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 *(for fusion reactor types, see 52.55)*

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

28.60.+s Isotope separation and enrichment

28.70.+y Nuclear explosions *(see also 47.40 Compressional flows; shock and detonation phenomena; for radiation protection from fallout, see 87.52 in biological and medical physics)*

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

29.17.+w Electrostatic, collective, and linear accelerators

29.20.–c Cyclic accelerators and storage rings

29.20.Dh Storage rings

29.20.Fj Betatrons

29.20.Hm Cyclotrons

29.20.Lq Synchrotrons

29.25.–t Particle sources and targets

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)

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.B and 61.80.M*

29.40.–n Radiation detectors *(for mass spectrometers, see 07.75)*

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** (*for special purpose electronic circuits, see 07.50.E*)

29.85.+c **Computer data analysis**

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 (for physical chemistry, see 82)

31. Electronic structure of atoms, molecules and their ions: theory

- 31.10.+z Theory of electronic structure, electronic transitions, and chemical binding**
- 31.15.–p Calculations and mathematical techniques in atomic and molecular physics (excluding electron correlation calculations)** (see also 02.70 computational techniques, in mathematical methods in physics)
- 31.15.Ar Ab initio calculations
- 31.15.Bs Statistical model calculations (including Thomas–Fermi and Thomas–Fermi–Dirac models)
- 31.15.Ct Semi-empirical and empirical calculations (differential overlap, Hückel, PPP methods, etc.)
- 31.15.Dv Coupled cluster theory
- 31.15.Ew Density-functional theory
- 31.15.Fx Finite-difference schemes
- 31.15.Gy Semiclassical methods
- 31.15.Hz Group theory
- 31.15.Ja Hyperspherical methods
- 31.15.Kb Path-integral methods
- 31.15.Lc Quasiparticle methods
- 31.15.Md Perturbation theory
- 31.15.Ne Self-consistent-field methods
- 31.15.Pf Variational techniques
- 31.15.Qg Molecular dynamics and other numerical methods
- 31.15.Rh Valence bond calculations
- 31.25.–v Electron correlation calculations for atoms and molecules**
- 31.25.Eb Electron-correlation calculations for atoms and ions: ground state
- 31.25.Jf Electron-correlation calculations for atoms and ions: excited states
- 31.25.Nj Electron-correlation calculations for diatomic molecules
- 31.25.Qm Electron-correlation calculations for polyatomic molecules
- 31.30.–i Corrections to electronic structure**
- 31.30.Gs Hyperfine interactions and isotope effects, Jahn-Teller effect
- 31.30.Jv Relativistic and quantum electrodynamic effects in atoms and molecules
- 31.50.+w Excited states**
- 31.70.–f Effects of atomic and molecular interactions on electronic structure** (see also 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.R)
- 31.70.Ks Molecular solids
- 31.90.+s Other topics in the theory of the electronic structure of atoms, molecules, and their ions (restricted to new topics in section 31)**

32. Atomic properties and interactions with photons

- 32.10.–f Properties of atoms and atomic ions**
- 32.10.Bi Atomic masses, mass spectra, abundances, and isotopes (for mass spectroscopy, see 07.75 and 82.80.M)
- 32.10.Dk Electric and magnetic moments, polarizability
- 32.10.Fn Fine and hyperfine structure
- 32.10.Hq Ionization potentials, electron affinities
- 32.30.–r Atomic spectra**
- 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**
- 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 Photon interactions with atoms** (see also 42.50 Quantum optics)
- 32.80.Bx Level crossing and optical pumping
- 32.80.Cy Atomic scattering, cross sections, and form factors; Compton scattering
- 32.80.Dz Autoionization
- 32.80.Fb Photoionization of atoms and ions
- 32.80.Gc Photodetachment of atomic negative ions
- 32.80.Hd Auger effect and inner-shell excitation or ionization
- 32.80.Lg Mechanical effects of light on atoms, molecules, and ions
- 32.80.Pj Optical cooling of atoms; trapping
- 32.80.Qk Coherent control of atomic interactions with photons

- 32.80.Rm Multiphoton ionization and excitation to highly excited states (e.g., Rydberg states)
- 32.80.Wr Other multiphoton processes
- 32.80.Ys Weak-interaction effects in atoms
- 32.90.+a Other topics in atomic properties and interactions of atoms and ions with photons (restricted to new topics in section 32)**

33. Molecular properties and interactions with photons

- 33.15.–e Properties of molecules and molecular ions**
- 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**
- 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
- 33.25.+k Nuclear resonance and relaxation** (see also 76.60 Nuclear magnetic resonance and relaxation in condensed matter)
- 33.35.+r Electron resonance and relaxation** (see also 76.30 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 Magnetic double resonances and cross effects in condensed matter)**
- 33.45.+x Mössbauer spectra (see also 76.80 Mössbauer effect; other x-ray spectroscopy)**
- 33.50.–j Fluorescence and phosphorescence; radiationless transitions, quenching (intersystem crossing, internal conversion) (for energy transfer, see also 34)**
- 33.50.Dq Fluorescence and phosphorescence spectra
- 33.50.Hv Radiationless transitions, quenching
- 33.55.–b Optical activity and dichroism; magneto-optical and electro-optical spectra**
- 33.55.Ad Optical activity, optical rotation; circular dichroism
- 33.55.Be Zeeman and Stark effects
- 33.55.Fi Other magneto-optical and electro-optical effects
- 33.60.–q Photoelectron spectra**
- 33.60.Cv Ultraviolet and vacuum ultraviolet photoelectron spectra
- 33.60.Fy X-ray photoelectron spectra
- 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 Quantum optics)**
- 33.80.Be Level crossing and optical pumping
- 33.80.Eh Autoionization, photoionization, and photodetachment
- 33.80.Gj Diffuse spectra; predissociation, photodissociation
- 33.80.Ps Optical cooling of molecules; trapping
- 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 52.50.H)**
- 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**
- 34.20.Cf Interatomic potentials and forces
- 34.20.Gj Intermolecular and atom–molecule potentials and forces
- 34.20.Mq Potential energy surfaces for collisions (see also 82.20.K Potential energy surfaces for chemical reactions)
- 34.30.+h Intramolecular energy transfer; intramolecular dynamics; dynamics of van der Waals molecules**
- 34.50.–s Scattering of atoms, molecules, and ions**
- 34.50.Bw Energy loss and stopping power
- 34.50.Dy Interactions of atoms, molecules, and their ions with surfaces; photon and electron emission; neutralization of ions
- 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; intermediate molecular states (including lifetimes, state mixing, etc.)
- 34.50.Lf Chemical reactions, energy disposal, and angular distribution, as studied by atomic and molecular beams (for atomic and molecular beam reactions, see 82.40.D)
- 34.50.Pi State-to-state scattering analyses
- 34.50.Rk Laser-modified scattering and reactions
- 34.60.+z Scattering in highly excited states (e.g. Rydberg states)**
- 34.70.+e Charge transfer (for charge transfer reactions, see 82.30.F)**
- 34.80.–i Electron scattering (for electron collisions in plasma, see 52.20.F)**
- 34.80.Bm Elastic scattering of electrons by atoms and molecules
- 34.80.Dp Atomic excitation and ionization by electron impact
- 34.80.Gs Molecular excitation and ionization by electron impact
- 34.80.Ht Dissociation and dissociative attachment by electron impact
- 34.80.Kw Electron–ion scattering; excitation and ionization
- 34.80.Lx Electron–ion recombination and electron attachment
- 34.80.My Fundamental electron inelastic processes in weakly ionized gases
- 34.80.Nz Spin dependence of cross sections; polarized electron beam experiments
- 34.80.Pa Coherence and correlation in electron scattering
- 34.80.Qb Laser-modified scattering
- 34.85.+x Positron scattering**
- 34.90.+q Other topics in atomic and molecular collision processes and interactions (restricted to new topics in section 34)**
- 36. Studies of special atoms, molecules, and their ions; clusters**
- 36.10.–k Exotic atoms and molecules (containing mesons, muons, and other unusual particles)**
- 36.10.Dr Positronium, muonium, muonic atoms and molecules
- 36.10.Gv Mesonic atoms and molecules, hyperonic atoms and molecules
- 36.20.–r Macromolecules and polymer molecules (for polymer reactions and polymerization, see 82.35; for biological macromolecules and polymers, see 87.15)**
- 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 Clusters, nanoparticles and nanocrystalline materials)**
- 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 special atoms, molecules, ions, and clusters (restricted to new topics in section 36)**

39. Instrumentation and techniques for atomic and molecular physics

39.10.+j Atomic and molecular beam sources and techniques

39.20.+q Atom interferometry techniques

(see also 03.75.D Atom and neutron interferometry)

39.30.+w Spectroscopic techniques *(see also 78.47 Time-resolved optical spectroscopies and other ultrafast optical measurements in condensed matter)*

39.90.+d Other instrumentation and techniques for atomic and molecular physics (restricted to new topics in section 39)

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

41. Electromagnetism; electron and ion optics

41.20.–q Applied classical electromagnetism

- 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.B; for electromagnetic waves in plasma, see 52.35.H; for ionospheric and magnetospheric propagation, see 94.20.B and 94.30.T*)

41.50.+h X-ray beams and x-ray optics (*see also 07.85.F in instruments*)

41.60.–m Radiation by moving charges

- 41.60.Ap Synchrotron radiation (*for synchrotron radiation instrumentation, see 07.85.Q*)
- 41.60.Bq Cherenkov radiation
- 41.60.Cr Free-electron lasers (*see also 52.75.M Free-electron devices—in plasma physics*)

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 52.40.N Laser-plasma interactions*)
- 41.75.Lx Other advanced accelerator concepts

41.85.–p Beam optics (*see also 07.77 Atomic, molecular, and charged particle sources and detectors, 29.27 Beams in particle accelerators*)

- 41.85.Ar Beam extraction, beam injection
- 41.85.Ct Beam shaping, beam splitting
- 41.85.Ew Beam profile, beam intensity
- 41.85.Gy Chromatic and geometrical aberrations
- 41.85.Ja Beam transport
- 41.85.Lc Beam focusing and bending magnets, wiggler magnets, and quadrupoles (*see also 07.55.D—in instruments; for superconducting magnets, see 85.25.L*)
- 41.85.Ne Electrostatic lenses, septa
- 41.85.Qg Beam analyzers, beam monitors, and Faraday cups
- 41.85.Si 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; for optical properties of bulk materials and thin films, see 78.20; for x-ray optics, see 41.50*)

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.J—in electromagnetism; for propagation in atmosphere, see 42.68.A; see also 52.40.D, N—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 moire 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 read-out methods (*see also 42.70.L Holographic recording materials; optical storage media*)
- 42.40.Jv Computer-generated holograms
- 42.40.Kw Holographic interferometry; other holographic techniques (*see also 07.60.L Interferometers*)
- 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 and 42.60; see also 42.65 Nonlinear optics; 03.65 Quantum mechanics*)

- 42.50.Ar Photon statistics and coherence theory
- 42.50.Ct Quantum statistical description of interaction of light and matter; related experiments
- 42.50.Dv Nonclassical field states; squeezed, antibunched, and sub-Poissonian states; operational definitions of the phase of the field; phase measurements
- 42.50.Fx Cooperative phenomena; superradiance and superfluorescence
- 42.50.Gy Effects of atomic coherence on propagation, absorption, and amplification of light
- 42.50.Hz Strong-field excitation of optical transitions in quantum systems; multi-photon processes; dynamic Stark shift (*for multiphoton ionization and excitation of atoms and molecules, see 32.80.R, and 33.80.R, 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.S*
- ... Optical solitons; nonlinear guided waves, *see 42.65.T*
- 42.50.Vk Mechanical effects of light on atoms, molecules, electrons, and ions (*see also 32.80.P and 33.80.P Optical cooling and trapping of atoms and molecules, respectively*)
- ... Optical tests of fundamental laws and forces, *see 12.20.F Experimental tests in quantum electrodynamics and 03.65.B Theory of measurements in quantum mechanics*
- #### 42.55.–f Lasers
- 42.55.Ah General laser theory
- 42.55.Ks Chemical lasers (*for chemical laser kinetics, see 82.40.T*)
- 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.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.D *Stimulated Raman scattering; CARS*)
- Free-electron lasers, *see* 41.60.C
- 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.T
- Dynamics of nonlinear optical systems, *see* 42.65.S
- 42.62. –b Laser applications**
- 42.62.Be Biological and medical applications
- 42.62.Cf Industrial applications
- 42.62.Eh Metrological applications (*see also* 06.20 *Metrology*, and 06.30 *Measurements common to several branches of physics and astronomy*)
- 42.62.Fi Laser spectroscopy
- 42.65. –k Nonlinear optics**
- 42.65.An Optical susceptibility, hyperpolarizability (*see also* 33.15.M *Electric and magnetic moments, polarizability and magnetic susceptibility of molecules*)
- 42.65.Dr Stimulated Raman scattering; CARS
- 42.65.Es Stimulated Brillouin and Rayleigh scattering
- 42.65.Hw Phase conjugation, optical mixing, and photorefractive effect
- 42.65.Jx Beam trapping, self-focusing, and thermal blooming
- 42.65.Ky Harmonic generation, frequency conversion (*see also* 42.79.N *Optical frequency converters*)
- 42.65.Pc Optical bistability, multistability, and switching (*see also* 42.60.G *Q-switching; 42.79.T 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.D)
- 42.65.Wi Nonlinear waveguides
- 42.65.Yj Optical parametric oscillators and amplifiers
- 42.66. –p Physiological optics**
- 42.66.Ct Anatomy and optics of eye
- 42.66.Ew Physiology of eye; optic-nerve structure and function
- 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 optics**
- 42.68.Ay Propagation, transmission, attenuation, and radiative transfer (*see also* 92.60.T *Interaction of atmosphere with electromagnetic waves; propagation*)
- 42.68.Bz Atmospheric turbulence effects (*see also* 92.60.E *Convection, turbulence, and diffusion*)
- 42.68.Ca Spectral absorption by atmospheric gases (*see also* 94.10.G *Absorption and scattering of radiation*)
- 42.68.Ge Effects of clouds and water (*see also* 92.60.J *Water in the atmosphere; 92.60.N Cloud physics*)
- 42.68.Jg Effects of aerosols (*see also* 92.60.M *Particles and aerosols*)
- 42.68.Kh Effects of air pollution (*see also* 92.60.S *Air quality and air pollution*)
- 42.68.Mj Scattering, polarization (*see also* 94.10.G *Absorption and scattering of radiation*)
- 42.68.Sq Image transmission and formation
- 42.68.Wt Remote sensing; LIDAR and adaptive systems
- 42.70. –a Optical materials** (*see also* 81.05 *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)
- 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 *Dielectric, piezoelectric, and ferroelectric materials*)
- 42.70.Nq Other nonlinear optical materials; photorefractive and semiconductor materials
- 42.70.Qs Photonic bandgap materials
- 42.72. –g Optical sources and standards** (*for lasers, see* 42.55; *see also* 07.57.H *in instruments*)
- 42.72.Ai Infrared sources
- 42.72.Bj Visible and ultraviolet sources
- 42.79. –e Optical elements, devices, and systems** (*for integrated optics, see* 42.82; *for fiber optics, see* 42.81)
- *Optical instruments, equipment and techniques, see* 07.60 and 07.57
- *Optical spectrometers, see* 07.57.T and 07.60.R
- *Photography, photographic instruments and techniques, see* 07.68
- *Magneto-optical devices, see* 85.70.S
- 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.E)
- 42.79.Ek Solar collectors and concentrators (*see also* 84.60.J *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.Q and 42.82.E, *respectively*)
- 42.79.Hp Optical processors, correlators, and modulators
- 42.79.Jq Acousto-optical devices (*see also* 43.38.Z—*in acoustics appendix*)
- 42.79.Kr Display devices, liquid-crystal devices (*see also* 85.60.P *Display systems*)
- 42.79.Ls Scanners, image intensifiers, and image converters (*see also* 85.60 *Optoelectronic devices*)
- 42.79.Mt Schlieren devices
- 42.79.Nv Optical frequency converters
- 42.79.Pw Imaging detectors and sensors (*see also* 85.60.G *Photodetectors*)
- 42.79.Qx Range finders, remote sensing devices; laser Doppler velocimeters, SAR, and LIDAR (*see also* 42.68.W *Remote sensing; LIDAR and adaptive systems*)
- 42.79.Ry Gradient-index (GRIN) devices (*for fiber GRIN devices, see* 42.81.H)
- 42.79.Sz Optical communication systems, multiplexers, and demultiplexers
- 42.79.Ta Optical computers, logic elements, interconnects, switches; neural networks
- 42.79.Vb Optical storage systems, optical disks (*see also* 42.40.H *Hologram recording and readout methods*)

- 42.79.Wc Optical coatings systems
- 42.81.-i Fiber optics**
- ... Fiber-optic instruments, *see* 07.60.V
- 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.Wg Other fiber-optical devices (*for fiber lasers, see* 42.55.W)
- 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 *Microelectronics: LSI, VLSI, ULSI; integrated circuit fabrication technology*)
- 42.82.Ds Interconnects, including holographic interconnects (*see also* 42.79.T *Optical computers, logic elements, interconnects, switches; neural networks*)
- 42.82.Et Waveguides, couplers, and arrays (*for fiber waveguides, see* 42.81.Q)
- 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 (*see also* 07.60.L *Interferometers*)
- 42.88.+h 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 43*)
- 43.20.+g General linear acoustics**
- 43.25.+y Nonlinear acoustics**
- 43.28.+h Aeroacoustics and atmospheric sound** (*see also* 92.60 *Meteorology*)
- 43.30.+m Underwater sound** (*see also* 92.10.V—*in physics of oceans*)
- 43.35.+d Ultrasonics, quantum acoustics, and physical effects of sound**
- ... Phonons in crystal lattices, *see* 63.20
- ... Acoustical properties of rocks and minerals, *see* 91.60.L
- ... Sound waves in plasma, *see* 52.35.D
- ... Low-temperature acoustics and sound in liquid helium, *see* 67
- ... Acoustical properties of solids, *see* 62.65; *for ultrasonic relaxation, see* 62.80
- ... Acoustic properties of thin films, *see* 68.60.B
- ... Surface waves in liquids and solids, *see* 68.10 and 68.35.G
- ... Acoustoelectric effects, *see* 72.50 and 73.50.R
- ... Magnetoacoustic effects, oscillations, and resonance, *see* 72.55, 73.50.R, and 75.80
- ... Acoustic holography, *see* 43.60; *for acoustooptical effects, see* 78.20.H
- 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.K
- 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* 66.60 and 66.70 *in 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.T *Convection and 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 *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.Dd Newtonian mechanics
- 45.20.Jj Lagrangian and Hamiltonian mechanics
- 45.30.+s General linear dynamical systems (for nonlinear dynamical systems, see** 05.45)
- 45.40.-f Dynamics and kinematics of rigid bodies**
- 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.C *in fundamental astronomy*)
- 45.50.Tn Collisions
- 45.70.-n Granular systems** (*see also* 05.65 *Self-organized systems*)
- 45.70.Cc Stasis 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* 46.60 *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.F in rheology)
- 46.05.+b** General theory of continuum mechanics of solids
- 46.15.–x** Computational methods in continuum mechanics (see also 02.70 Computational techniques 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 83.50.B,N in rheology)
- 46.40.–f** Vibrations and mechanical waves (see also 43.40 Structural acoustics and vibration; 62.30 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 in mechanical properties of solids)
- 46.55.+d** Tribology and mechanical contacts (see also 81.40.P Friction, lubrication and wear in materials science; 62.20.Q in mechanical properties of solids)
- 46.65.+g** Random phenomena and media (see also 05.40 in statistical physics, thermodynamics and nonlinear dynamical systems)
- 46.70.–p** Applications 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 (see also 07.10 Mechanical instruments, equipment, and techniques)
- 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 67; see also 83 Rheology; for sound generation by fluid flow, see 43.28.R in acoustics appendix)
- 47.10.+g** General theory (see also 83.10—in rheology)
- 47.11.+j** Computational methods in fluid dynamics (see also 83.85.P Flow computation—in rheology; 02.70—in mathematical methods in physics)
- 47.15.–x** Laminar flows
- 47.15.Cb Laminar boundary layers
- 47.15.Fe Stability of laminar flows
- 47.15.Gf Low-Reynolds-number (creeping) flows
- 47.15.Hg Potential flows
- 47.15.Ki Inviscid flows with vorticity
- 47.15.Pn Laminar suspensions
- 47.15.Rq Laminar flows in cavities
- 47.17.+e** Mechanical properties of fluids (see also 62.10 Mechanical properties of liquids)
- 47.20.–k** Hydrodynamic stability
- 47.20.Bp Buoyancy-driven instability
- 47.20.Cq Inviscid instability
- 47.20.Dr Surface-tension-driven instability
- 47.20.Ft Instability of shear flows
- 47.20.Gv Viscous instability
- 47.20.Hw Morphological instability; phase changes (see also 64 Equations of state, phase equilibria, and phase transitions)
- 47.20.Ky Nonlinearity (including bifurcation theory)
- 47.20.Lz Secondary instability
- 47.20.Ma Interfacial instability
- 47.20.Pc Receptivity
- ... Chaotic phenomena, see 47.52 and 05.45
- 47.27.–i** Turbulent flows, convection, and heat transfer
- 47.27.Ak Fundamentals
- 47.27.Cn Transition to turbulence
- 47.27.Eq Turbulence simulation and modeling
- 47.27.Gs Isotropic turbulence; homogeneous turbulence
- 47.27.Jv High-Reynolds-number turbulence
- 47.27.Lx Wall-bounded thin shear flows
- 47.27.Nz Boundary layer and shear turbulence
- 47.27.Pa Thick shear flows
- 47.27.Qb Turbulent diffusion
- 47.27.Rc Turbulence control
- 47.27.Sd Noise (turbulence generated)
- 47.27.Te Convection and heat transfer (see also 44.25 in heat transfer)
- 47.27.Vf Wakes
- 47.27.Wg Jets
- 47.32.–y** Rotational flow and vorticity
- 47.32.Cc Vortex dynamics
- 47.32.Ff Separated flows
- 47.35.+i** Hydrodynamic waves
- 47.37.+q** Hydrodynamic aspects of superfluidity (see also 67.40.H and 67.57.D—in quantum fluids and solids)
- 47.40.–x** Compressible flows; shock and detonation phenomena (see also 28.70 Nuclear explosions, 52.35.T Shock waves in plasma, 83.50.T—in rheology, 43.25.C, 43.28.M and 43.40.J—in acoustics appendix)
- 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.F)
- 47.45.–n** Rarefied gas dynamics
- 47.45.Dt Free molecular flows
- 47.45.Gx Slip flows
- 47.45.Nd Accommodation
- 47.50.+d** Non-Newtonian fluid flows (see also 83.50 Deformation, material flow)
- 47.52.+j** Chaos (see also 05.45 Nonlinear dynamics and nonlinear dynamical systems; 83.50.W Chaotic flows; drag reduction)
- 47.53.+n** Fractals
- 47.54.+r** Pattern selection; pattern formation
- 47.55.–t** Nonhomogeneous flows
- 47.55.Bx Cavitation
- 47.55.Dz Drops and bubbles
- 47.55.Hd Stratified flows
- ... Rotational flows, see 47.32
- 47.55.Kf Multiphase and particle-laden flows
- 47.55.Mh Flows through porous media (for heat transfer in porous media, see 44.30)
- 47.60.+i** Flows in ducts, channels, nozzles, and conduits (see also 83.10 and 83.50—in rheology)
- ... Biological fluid dynamics, see 87.19T
- 47.62.+q** Flow control
- 47.65.+a** Magnetohydrodynamics and electrohydrodynamics (for MHD in plasma, see 52.30)
- 47.70.–n** Reactive, radiative, or nonequilibrium flows

47.70.Fw Chemically reactive flows (*see also*
83.80.J Chemically reactive
materials—in rheology)

47.70.Mc Radiation gas dynamics

47.70.Nd Nonequilibrium gas dynamics

47.75.+f Relativistic fluid dynamics (*for*
astrophysical aspects, see 95.30.L
and 95.30.Q)

47.80.+v Instrumentation for fluid
dynamics (*see also 83.85—in*
rheology; 07.30 Vacuum apparatus
and techniques)

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

50. PHYSICS OF GASES, PLASMAS, AND ELECTRIC DISCHARGES *(for flow properties of gases, see 47; for atomic and molecular properties, see 30)*

51. Physics of gases

- 51.10.+y Kinetic and transport theory of gases**
- 51.20.+d Viscosity, diffusion, and thermal conductivity**
- 51.30.+i Thermodynamic properties, equations of state**
- 51.35.+a Mechanical properties; compressibility**
- 51.40.+p Acoustical properties** *(see also 43.28 Aeroacoustics and atmospheric sound; for ultrasonic relaxation in gases, see 43.35.F in acoustics appendix)*
- 51.50.+v Electrical properties (ionization, breakdown, electron and ion mobility, etc.)** *(see also 52.80 Electric discharges)*
- 51.60.+a Magnetic properties**
- 51.70.+f Optical and dielectric properties**
 *Sorption, see 82.65.M, and 68.45.D*
 *Gas-surface interactions, see 82.65.P*
 *Gas sensors and detectors, see 07.07.D*
- 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 astrophysical plasmas, see 95.30.Q; for physics of the ionosphere and magnetosphere, see 94.20 and 94.30)*

- 52.20.-j Elementary processes in plasma**
- 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 82.40.R)*
- 52.25.Dg Plasma kinetic equations
- 52.25.Fi Transport properties
- 52.25.Gj Fluctuation phenomena *(for plasma turbulence, see 52.35.R)*
- 52.25.Jm Ionization of plasmas
- 52.25.Kn Thermodynamics of plasmas
- 52.25.Mq Dielectric properties
- 52.25.Nr Emission, absorption, and scattering of X and γ radiation
- 52.25.Qt Emission, absorption, and scattering of ultraviolet radiation
- 52.25.Rv Emission, absorption, and scattering of visible and infrared radiation

- 52.25.Sw Emission, absorption, and scattering of radio-wave and microwave radiation
- 52.25.Tx Emission, absorption, and scattering of particles
- 52.25.Ub Strongly-coupled plasmas
- 52.25.Vy Impurities in plasmas
- 52.25.Wz Nonneutral plasmas
- 52.25.Ya Neutrals in plasma
- 52.25.Zb Dusty plasmas; plasma crystals
- 52.30.-q Plasma flow; magnetohydrodynamics** *(see also 47.65—in fluid dynamics; for MHD generators, see 52.75.F)*
- 52.30.Bt MHD equilibria
- 52.30.Jb Resistive MHD effects
- 52.35.-g Waves, oscillations, and instabilities in plasma**
- 52.35.Bj Magnetohydrodynamic 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 waves and nonlinear wave propagation (including parametric effects, mode coupling, ponderomotive effects, etc.)
- 52.35.Nx Other nonlinear interactions and phenomena (e.g., Brillouin scattering and Rayleigh scattering)
- 52.35.Py Plasma macroinstabilities (hydromagnetic, e.g., kink, fire-hose, mirror, ballooning, tearing, trapped-particle, flute, Rayleigh–Taylor, etc.)
- 52.35.Qz Plasma 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
- 52.40.-w Plasma interactions**
- 52.40.Db Electromagnetic (nonlaser) radiation interactions with plasma
- 52.40.Fd Plasma interactions with antennas; plasma-filled waveguides
- 52.40.Hf Plasma-wall interactions; boundary layer effects; plasma sheaths
- 52.40.Mj Particle beam interactions in plasma

- 52.40.Nk Laser-plasma interactions (e.g., anomalous absorption, backscattering, magnetic field generation, fast particle generation)
- 52.50.-b Plasma production and heating**
- 52.50.Dg Plasma sources
 *Electric discharges, see 52.80*
- 52.50.Gj Plasma heating (beam injection, radio-frequency and microwave, ohmic, ICR, ECR, and current drive heating)
- 52.50.Jm Plasma production and heating by laser beams
- 52.50.Lp Plasma production and heating by shock waves and compression
- 52.55.-s Magnetic confinement and equilibrium**
- 52.55.Dy General theory and basic studies of plasma lifetime, particle and heat loss, energy balance, etc.
- 52.55.Ez Z-Pinch, theta pinch, plasma focus and other pinch devices
- 52.55.Fa Tokamaks
- 52.55.Hc Stellarators, spheromaks, compact tori, bumpy tori, and other toroidal confinement devices
- 52.55.Jd Magnetic mirrors
- 52.55.Lf Astron, cusp, and other magnetic traps
- 52.55.Pi Fusion products effects (e.g., alpha-particles, etc.)
- 52.58.-c Nonmagnetic confinement**
- 52.58.Ei Light-ion inertial confinement
- 52.58.Hm Heavy-ion inertial confinement
- 52.58.Ns Other inertial confinement (including laser)
- 52.58.Qv Electrostatic, high frequency, and other nonmagnetic confinement
- 52.60.+h Relativistic plasma**
- 52.65.-y Plasma simulation**
- 52.65.Cc Particle orbit and trajectory
- 52.65.Ff Fokker–Planck 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
- 52.70.-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
- 52.75.–d Plasma devices and applications**
(see also 28.52 *Fusion reactors; for ion sources, see 29.25.L, N; for plasma sources, see 52.50.D*)
- 52.75.Di Accelerators and propulsion
- 52.75.Fk Magnetohydrodynamic generators and thermionic convertors; plasma diodes (see also 84.60.L, N in *direct energy conversion and storage*)
- 52.75.Hn Plasma torches
- 52.75.Kq Plasma switches (e.g., spark gaps)
- 52.75.Ms Free-electron devices (*for free-electron lasers, see 41.60.C*)
- 52.75.Pv High-voltage diodes (*for high-current and high-voltage technology, see 84.70*)
- 52.75.Rx Plasma applications in manufacturing and materials processing (etching, surface cleaning, spraying, arc welding, ion implantation, film deposition, etc.)
- 52.75.Va Devices for generation of coherent radiation
- 52.80.–s Electric discharges** (see also 51.50 *Electrical properties of gases*)
- 52.80.Dy Low-field and Townsend discharges
- 52.80.Hc Glow; corona
- 52.80.Mg Arcs; sparks; lightning
- 52.80.Pi High-frequency 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 (*for electric breakdown in liquids, see 77.22.J*)
- 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: STRUCTURE, MECHANICAL AND THERMAL PROPERTIES

- 61. Structure of solids and liquids; crystallography** (*for surface, interface, and thin film structure, see 68*)
- 61.10.−i X-ray diffraction and scattering** (*for x-ray diffractometers, see 07.85.J, for x-ray studies of crystal defects, see 61.72.D, F*)
- 61.10.Dp Theories of diffraction and scattering
- 61.10.Eq X-ray scattering (including small-angle scattering)
- 61.10.Ht X-ray absorption spectroscopy: EXAFS, NEXAFS, XANES, etc.
- 61.10.Kw X-ray reflectometry (surfaces, interfaces, films)
- 61.10.Nz Single-crystal and powder diffraction
- 61.12.−q Neutron diffraction and scattering**
- 61.12.Bt Theories of diffraction and scattering
- 61.12.Ex Neutron scattering techniques (including small-angle scattering)
- 61.12.Ha Neutron reflectometry
- 61.12.Ld Single-crystal and powder diffraction
- 61.14.−x Electron diffraction and scattering** (*for electron diffractometers, see 07.65*)
- 61.14.Dc Theories of diffraction and scattering
- 61.14.Hg Low-energy electron diffraction (LEED) and reflection high-energy electron diffraction (RHEED)
- 61.14.Lj Convergent-beam electron diffraction, selected-area electron diffraction, nanodiffraction
- 61.14.Nm Electron holography
- 61.14.Qp X-ray photoelectron diffraction
- 61.16.−d Electron, ion, and scanning probe microscopy** (*for electron microscopy of crystal defects, see 61.72.F*)
- 61.16.Bg Transmission, reflection and scanning electron microscopy (including EBIC)
- 61.16.Ch Scanning probe microscopy: scanning tunneling, atomic force, scanning optical, magnetic force, etc.
- 61.16.Fk Field emission and field-ion microscopy
- ... *EPR and NMR methods for defect structures, see 61.72.H*
- 61.16.Ms Scanning Auger microscopy, photoelectron microscopy
- 61.18.−j Other methods of structure determination**
- 61.18.Bn Atom, molecule, and ion scattering
- 61.18.Fs Magnetic resonance techniques; Mössbauer spectroscopy
- 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.Hq Macromolecular and polymer solutions; polymer melts; swelling
- 61.25.Mv Liquid metals and alloys
- 61.30.−v Liquid crystals** (*for phase transitions in liquid crystals, see 64.70.M*)
- 61.30.Cz Theory and models 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.Jf Defects in liquid crystals
- 61.41.−e Polymers, elastomers, and plastics** (*for materials synthesis, treatments, testing and analysis, see 81.05.L; for rheology of polymers, see 83; for biopolymers, see 87.15*)
- 61.43.−j Disordered solids**
- 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 Clusters, nanoparticles, and nanocrystalline materials** (*see also 36.40 Atomic and molecular clusters*)
- 61.48.−c Fullerenes and fullerene-related materials**
- 61.50.−f Crystalline state**
- 61.50.Ah Theory of crystal structure, crystal symmetry; calculations and modeling
- ... *Crystal growth, see 81.10*
- 61.50.Ks Crystallographic aspects of phase transformations; pressure effects (*see also 81.30.H*)
- 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.C*
- 61.68.−n Crystallographic databases**
- 61.72.−y Defects and impurities in crystals; microstructure** (*for radiation induced defects, see 61.80; for defects in surfaces, interfaces and thin films, see 68.35.D and 68.55.L; see also 85.40.R 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.Ji Point defects (vacancies, interstitials, color centers, etc.) and defect clusters
- 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.Ss Impurity concentration, distribution, and gradients (*for impurities in thin films, see 68.55.L; see also 66.30.J Diffusion of impurities*)
- 61.72.Tt Doping and impurity implantation in germanium and silicon

- 61.72.Vv Doping and impurity implantation in III–V and II–VI semiconductors
- 61.72.Ww Doping and impurity implantation in other materials
- 61.72.Yx Interaction between different crystal defects; gettering effect
- 61.80.–x Physical radiation effects, radiation damage** (for chemical radiation effects, see 82.50)
- · · · Radiation treatments, see 81.40.W
- 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 Electrons and positron radiation effects
- 61.80.Hg Neutron radiation effects
- 61.80.Jh Ion radiation effects (for ion implantation, see 61.72.T, V, W)
- 61.80.Lj Atom and molecule irradiation effects
- · · · Channeling, blocking, and energy loss of particles, see 61.85
- 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 (restricted to new topics in section 61)**
- 62. Mechanical and acoustical properties of condensed matter** (for nonlinear acoustics of solids, see 43.25.D in acoustics appendix; for mechanical and acoustical properties of interfaces and thin films, see 68.35.G, 68.45.N and 68.60.B; for mechanical properties related to treatment conditions, see 81.70.J, L, N in material science; for mechanical properties of rocks and minerals, see 91.60)
- 62.10.+s Mechanical properties of liquids** (for viscosity of liquids, see 66.20)
- 62.20.–x Mechanical properties of solids**
- 62.20.Dc Elasticity, elastic constants
- 62.20.Fe Deformation and plasticity (including yield, ductility, and superplasticity) (see also 83.50 Deformation; material flow)
- 62.20.Hg Creep
- 62.20.Mk Fatigue, brittleness, fracture, and cracks
- 62.20.Qp Tribology and hardness (see also 46.30.P in continuum mechanics of solids and 83.50.L in rheology)
- 62.30.+d Mechanical and elastic waves; vibrations** (see also 43.40 Structural acoustics and vibration; 46.40 in continuum mechanics of solids)
- 62.40.+i Anelasticity, internal friction, stress relaxation, and mechanical resonances** (see also 81.40.J Elasticity and anelasticity)
- · · · Thermomechanical effects, see 65.70
- · · · Magnetomechanical effects, see 75.80
- · · · Piezoelectric effects, see 77.65
- · · · Elastooptical effects, see 78.20.H
- 62.50.+p High-pressure and shock-wave effects in solids and liquids** (for high pressure apparatus and techniques, see 07.35)
- 62.60.+v Acoustical properties of liquids** (see also 43.35 in acoustics appendix)
- · · · Lattice dynamics, phonons, see 63
- · · · Second sound in quantum fluids, see 67.40.P
- 62.65.+k Acoustical properties of solids**
- · · · Magnetoacoustic effects, see 72.55 and 73.50.R
- · · · Acoustoelectric effects, see 72.50, 73.50.R, and 77.65.D
- · · · Acoustooptical effects, see 78.20.H
- 62.80.+f Ultrasonic relaxation** (see also 43.35.F Ultrasonic relaxation processes in liquids and solids in acoustics appendix; for ultrasonic attenuation in superconductors, see 74.25.L)
- 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 Infrared and Raman spectra; for surface and interface vibrations, see 68.35.J and 68.45.K)
- 63.10.+a General theory**
- 63.20.–e Phonons in crystal lattices** (for phonons in superconductors, see 74.25.K; see also 43.35.G Phonons in crystal lattice, quantum acoustics in acoustics appendix)
- 63.20.Dj Phonon states and bands, normal modes, and phonon dispersion
- 63.20.Kr Phonon–electron and phonon–phonon interactions
- 63.20.Ls Phonon interactions with other quasiparticles
- 63.20.Mt Phonon–defect interactions
- 63.20.Pw Localized modes
- 63.20.Ry Anharmonic lattice modes
- 63.22.+m Phonons in low-dimensional structures and small particles**
- 63.50.+x Vibrational states in disordered systems**
- 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 Chemical thermodynamics)
- 64.10.+h General theory of equations of state and phase equilibria** (see also 05.70.C Thermodynamic functions and equations of state)
- 64.30.+t Equations of state of specific substances**
- 64.60.–i General studies of phase transitions** (see also 63.75 Statistical mechanics of lattice vibrations and displacive phase transitions; for critical phenomena in solid surfaces and interfaces, and in magnetism, see 68.35.R, and 75.40, respectively)
- 64.60.Ak Renormalization-group, fractal, and percolation studies of phase transitions (see also 61.43.H Fractals; macroscopic aggregates)
- 64.60.Cn Order–disorder transformations; statistical mechanics of model systems
- 64.60.Fr Equilibrium properties near critical points, critical exponents
- 64.60.Ht Dynamic critical phenomena
- 64.60.Kw Multicritical points
- 64.60.My Metastable phases
- 64.60.Qb Nucleation (see also 82.60.N Thermodynamics of nucleation in physical chemistry)
- 64.70.–p Specific phase transitions**
- 64.70.Dv Solid–liquid transitions
- 64.70.Fx Liquid–vapor transitions
- 64.70.Hz Solid–vapor transitions
- 64.70.Ja Liquid–liquid transitions

- 64.70.Kb Solid–solid transitions (*see also* 61.50.K *Crystallographic aspects of phase transformations, pressure effects; 75.30.K and 77.80.B for magnetic and ferroelectric transitions, respectively; for material science aspects, see 81.30*)
- 64.70.Md Transitions in liquid crystals
- 64.70.Pf Glass transitions
- 64.70.Rh Commensurate–incommensurate transitions
- 64.75.+g Solubility, segregation, and mixing; phase separation** (*see also* 82.60.L *Thermodynamics of solutions*)
- 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* 05.70 *Thermodynamics and 44 Heat transfer; for thermodynamic properties of quantum fluids and solids, see 67; for thermal properties of thin films, see 68.60.D; for nonelectronic thermal conduction, see 66.60, 66.70; for thermal properties of rocks and minerals, see 91.60*)
- 65.20.+w Heat capacities of liquids**
- 65.40.+g Heat capacities of solids** (*for specific heat of superconductors, see 74.25.B; for specific heat of magnetic systems, see 75.40.C*)
- 65.50.+m Thermodynamic properties and entropy**
- 65.70.+y Thermal expansion and density changes; thermomechanical effects**
- 65.90.+i Other topics in thermal properties of condensed matter** (restricted to new topics in section 65)
- 66. Transport properties of condensed matter (nonelectronic)**
- 66.10.–x Diffusion and ionic conduction in liquids**
- 66.10.Cb Diffusion and thermal diffusion (*for osmosis, see also 82.65.F*)
- 66.10.Ed Ionic conduction
- 66.20.+d Viscosity of liquids; diffusive momentum transport**
- 66.30.–h Diffusion in solids** (*for surface and interface diffusion, see 68.35.F*)
- 66.30.Dn Theory of diffusion and ionic conduction in solids
- 66.30.Fq Self-diffusion in metals, semimetals, and alloys
- 66.30.Hs Self-diffusion and ionic conduction in nonmetals
- 66.30.Jt Diffusion of impurities
- 66.30.Lw Diffusion of other defects
- 66.30.Ny Chemical interdiffusion; diffusion barriers
- 66.30.Qa Electromigration
- 66.35.+a Quantum tunneling of defects**
- 66.60.+a Thermal conduction in nonmetallic liquids** (*for thermal conduction in liquid metals, see 72.15.C*)
- 66.70.+f Nonelectronic thermal conduction and heat-pulse propagation in solids; thermal waves** (*for thermal conduction in metals and alloys, see 72.15.C and 72.15.E*)
- 66.90.+r Other topics in nonelectronic transport properties of condensed matter** (restricted to new topics in section 66)
- 67. Quantum fluids and solids; liquid and solid helium** (*see also* 05.30 *Quantum statistical mechanics*)
- 67.20.+k Quantum effects on the structure and dynamics of nondegenerate fluids** (e.g., normal phase liquid ^4He)
- 67.40.–w Boson degeneracy and superfluidity of ^4He**
- 67.40.Bz Phenomenology and two-fluid models
- 67.40.Db Quantum statistical theory; ground state, elementary excitations
- 67.40.Fd Dynamics of relaxation phenomena
- 67.40.Hf Hydrodynamics in specific geometries, flow in narrow channels
- 67.40.Jg Ions in liquid ^4He
- 67.40.Kh Thermodynamic properties
- 67.40.Mj First sound
- 67.40.Pm Transport processes, second and other sounds, and thermal counterflow; Kapitza resistance
- 67.40.Rp Films and weak link transport
- 67.40.Vs Vortices and turbulence
- 67.40.Yv Impurities and other defects
- 67.55.–s Normal phase of liquid ^3He**
- 67.55.Cx Thermodynamic properties
- 67.55.Fa Hydrodynamics
- 67.55.Hc Transport properties
- 67.55.Ig Ions in normal liquid ^3He
- 67.55.Jd Collective modes
- 67.55.Lf Impurities
- 67.57.–z Superfluid phase of liquid ^3He**
- 67.57.Bc Thermodynamic properties
- 67.57.De Superflow and hydrodynamics
- 67.57.Fg Textures and vortices
- 67.57.Gh Ions in superfluid ^3He
- 67.57.Hi Transport properties
- 67.57.Jj Collective modes
- 67.57.Lm Spin dynamics
- 67.57.Np Behavior near interfaces
- 67.57.Pq Impurities
- 67.60.–g Mixed systems; liquid ^3He , ^4He mixtures**
- 67.60.Dm He I– ^3He
- 67.60.Fp He II– ^3He
- 67.60.Hr Dilutesuper fluid ^3He in He II
- 67.60.Js Ions in liquid ^3He – ^4He mixtures
- 67.65.+z Spin-polarized hydrogen and helium** (restricted to new topics in section 67)
- 67.70.+n Films** (including physical adsorption)
- 67.80.–s Solid helium and related quantum crystals**
- 67.80.Cx Structure, lattice dynamics, and sound propagation
- 67.80.Gb Thermal properties
- 67.80.Jd Magnetic properties and nuclear magnetic resonance
- 67.80.Mg Defects, impurities, and diffusion
- 67.90.+z Other topics in quantum fluids and solids; liquid and solid helium** (restricted to new topics in section 67)
- 68. Surfaces and interfaces; thin films and whiskers (structure and nonelectronic properties)**
- 68.10.–m Fluid surfaces and fluid–fluid interfaces**
- 68.10.Cr Surface energy (surface tension, interface tension, angle of contact, etc.)
- 68.10.Et Interface elasticity, viscosity, and viscoelasticity
- 68.10.Gw Interface activity, spreading
- 68.10.Jy Kinetics (evaporation, adsorption, condensation, catalysis, etc.) (*see also 82.65 Surface and interface chemistry*)
- 68.15.+e Liquid thin films**
- 68.18.+p Langmuir–Blodgett films** (*for methods of film deposition, see 81.15.L*)
- 68.35.–p Solid surfaces and solid–solid interfaces**
- 68.35.Bs Surface structure and topography
- 68.35.Ct Interface structure and roughness
- 68.35.Dv Composition; defects and impurities

68.35.Fx	Diffusion; interface formation (<i>see also 66.30 Diffusion in solids</i>)	68.45.Gd	Wetting	68.60.Dv	Thermal stability; thermal effects
68.35.Gy	Mechanical and acoustical properties; adhesion	68.45.Kg	Dynamics; vibrations	68.60.Wm	Other nonelectronic physical properties
68.35.Ja	Surface and interface dynamics and vibrations	68.45.Nj	Mechanical and acoustical properties	68.65.+g	Low-dimensional structures (superlattices, quantum well structures, multilayers): structure, and nonelectronic properties
68.35.Md	Surface energy; thermodynamic properties (<i>see also 82.65.D Thermodynamics of surfaces and interfaces in Physical chemistry; 05.70.N Interface and surface thermodynamics in statistical physics, thermodynamics, and nonlinear dynamical systems</i>)	68.45.Ws	Other nonelectronic properties	<i>Growth of low-dimensional structures, see 81.15</i>
68.35.Rh	Phase transitions and critical phenomena	68.55.-a	Thin film structure and morphology (<i>for methods of thin film deposition, film growth and epitaxy, see 81.15</i>)	68.70.+w	Whiskers and dendrites (growth, structure, and nonelectronic properties)
68.35.Wm	Other nonelectronic properties	68.55.Jk	Structure and morphology; thickness	68.75.+x	Thick films (growth, structure, and non-electronic properties)
. . . .	<i>heat transfer through interfaces, see 44.20</i>	68.55.Ln	Defects and impurities: doping, implantation, distribution, concentration, etc. (<i>for diffusion of impurities, see 66.30</i>)	68.90.+g	Other topics in structure, and nonelectronic properties of surfaces and interfaces; thin films and whiskers (restricted to new topics in section 68)
68.45.-v	Solid-fluid interfaces	68.55.Nq	Composition and phase identification		
68.45.Da	Adsorption and desorption kinetics; evaporation and condensation (<i>for chemisorption, see 82.65.M</i>)	68.60.-p	Physical properties of thin films, nonelectronic		
		68.60.Bs	Mechanical and acoustical properties		

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

- 71. Electronic structure** (*see also 73.20 Surface and interface electron states*)
- 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.M*)
- 71.15.–m Methods of electronic structure calculations**
- 71.15.Ap Plane-wave methods (including augmented plane-wave method)
- 71.15.Cr Scattering methods
- 71.15.Fv Atomic- and molecular-orbital methods (including tight binding approximation, valence-band method, etc.)
- 71.15.Hx Pseudopotential method
- 71.15.La Atomic sphere approximation methods
- 71.15.Mb Density functional theory, local density approximation
- 71.15.Nc Total energy and cohesive energy calculations
- 71.15.Pd Molecular dynamics calculations (Car–Parinello) and other numerical simulations
- 71.15.Rf Relativistic effects
- 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** (*for electronic structure of superconductors, see 74.25.J*)
- 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.Q*
- 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
- 71.24.+q Electronic structure of clusters and nanoparticles**
- 71.27.+a Strongly correlated electron systems; heavy fermions**
- 71.28.+d Narrow-band systems; intermediate-valence solids** (*for magnetic aspects, see 75.20.H and 75.30.M*)
- 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)
- 71.36.+c Polaritons (including photon–phonon and photon–magnon interactions)**
- 71.38.+i Polarons and electron–phonon interactions** (*see also 63.20.K Phonon–electron interactions in lattices*)
- 71.45.–d Collective effects**
- 71.45.Gm Exchange, correlation, dielectric and magnetic functions, plasmons
- 71.45.Lr Charge-density-wave systems (*see also 75.30.F Spin-density waves*)
- ... Localized states, *see 71.23.A*
- 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.B*)
- 71.70.–d Level splitting and interactions** (*see also 73.20 Surface and interface electron states, 75.30.E 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 73; for electrical properties related to treatment conditions, see 81.40.R*)
- 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 Collective effects*)
- 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 (*for giant magnetoresistance, see 75.70.P*)
- 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.H *Local moments in compounds and alloys; Kondo effect, valence fluctuations, heavy fermions*)
- 72.15.Rn Localization effects (Anderson or weak localization)
- 72.20.-i Conductivity phenomena in semiconductors and insulators** (*see also* 66.70 *Nonelectronic thermal conduction in solids*)
- 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
- 72.30.+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 *Magnetomechanical effects*)
- 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)
- 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, and thin films** (*for electronic structure and electrical properties of superconducting films, see* 74.25 and 74.76)
- 73.20.-r Surface and interface electron states**
- 73.20.At Surface states, band structure, electron density of states
- 73.20.Dx Electron states in low-dimensional structures (superlattices, quantum well structures and multilayers)
- 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 plasmons and other charge-density excitations)
- 73.23.-b Mesoscopic systems**
- 73.23.Ad Ballistic transport
- 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**
- 73.40.-c Electronic transport in interface structures**
- 73.40.Cg Contact resistance, contact potential
- 73.40.Ei Rectification
- 73.40.Gk Tunneling
- 73.40.Hm Quantum Hall effect (integer and fractional)
- 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
- 73.50.-h Electronic transport phenomena in thin films and low-dimensional structures**
- 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 and layer structures (multilayers, superlattices, quantum wells, wires, and dots)** (*for optical properties of thin films, see* 78.20 and 78.66; *for magnetic properties of thin films, see* 75.70)
- 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.Tm Nanocrystalline materials
- 73.61.Wp Fullerenes and related materials
- 73.90.+f Other topics in electronic structure and electrical properties of surfaces, interfaces, and thin films (restricted to new topics in section 73)**
- 74. Superconductivity**
- 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.)
- 74.25.-q General properties; correlations between physical properties in normal and superconducting states**
- 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.)
- 74.40.+k Fluctuations (noise, chaos, nonequilibrium superconductivity, localization, etc.)**
- 74.50.+r Proximity effects, weak links, tunneling phenomena, and Josephson effects**
- 74.55.+h Type-I superconductivity**
- 74.60.–w Type-II superconductivity**
- 74.60.Ec Mixed state, critical fields, and surface sheath
- 74.60.Ge Flux pinning, flux creep, and flux-line lattice dynamics
- 74.60.Jg Critical currents
- 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 (excluding high- T_c compounds)**
- 74.70.Ad Metals; alloys and binary compounds (including A15, Laves phases etc.)
- 74.70.Dd Ternary, quaternary and multinary compounds (including Chevrel phases, borocarbides etc.)
- 74.70.Kn Organic superconductors
- 74.70.Tx Heavy-fermion superconductors
- 74.70.Wz Fullerenes and related materials
- 74.72.–h High- T_c compounds**
- 74.72.Bk Y-based cuprates
- 74.72.Dn La-based cuprates
- 74.72.Fq Tl-based cuprates
- 74.72.Gr Hg-base cuprates
- 74.72.Hs Bi-based cuprates
- 74.72.Jt Other cuprates
- 74.76.–w Superconducting films**
- 74.76.Bz High- T_c films
- 74.76.Db Conventional superconducting films
- 74.80.–g Spatially inhomogeneous structures**
- 74.80.Bj Granular, melt-textured, and amorphous superconductors; powders
- 74.80.Dm Superconducting layer structures: superlattices, heterojunctions, and multilayers
- 74.80.Fp Point contacts; SN and SNS junctions
- ... Superconducting devices, see 85.25
- 74.90.+n Other topics in superconductivity (restricted to new topics in section 74)**
- 75. Magnetic properties and materials (for magnetic properties related to treatment conditions, see 81.40.R; for magnetic properties of rocks and minerals, see 91.60.P)**
- 75.10.–b General theory and models of magnetic ordering (see also 05.50 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
- 75.20.–g Diamagnetism and paramagnetism**
- 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.Q Scattering mechanisms and Kondo effect in electronic conduction of metals and alloys)
- 75.25.+z Spin arrangements in magnetically ordered materials (including neutron and spin-polarized electron studies, synchrotron-source x-ray scattering, etc.)**
- 75.30.–m Intrinsic properties of magnetically ordered materials (for critical point effects, see 75.40)**
- 75.30.Cr Saturation moments and magnetic susceptibilities
- 75.30.Ds Spin waves (for spin-wave resonance, see 76.50)
- 75.30.Et Exchange and superexchange interactions (see also 71.70 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 Strongly correlated electron systems, heavy fermions)
- 75.30.Pd Surface magnetism
- 75.30.Sg Magnetocaloric effect, magnetic cooling
- 75.30.Vn Colossal magnetoresistance
- 75.40.–s Critical-point effects, specific heats, short-range order (see also 65.40 Heat capacities of solids)**
- 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**
- 75.50.–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 nanocrystalline magnetic materials; quasicrystals
- 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 Magnetic devices)
- 75.50.Tt Fine-particle systems
- 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.K)
- 75.60.Ej Magnetization curves, hysteresis, Barkhausen and related effects
- 75.60.Lr Magnetic aftereffects
- 75.60.Nt Magnetic annealing and temperature–hysteresis effects
- 75.70.–i Magnetic films and multilayers**
- 75.70.Ak Magnetic properties of monolayers and thin films
- 75.70.Cn Interfacial magnetic properties (multilayers, magnetic quantum wells, superlattices, magnetic heterostructures)
- 75.70.Kw Domain structure (including magnetic bubbles)
- 75.70.Pa Giant magnetoresistance
- 75.80.+q Magnetomechanical and magnetoelectric effects, magnetostriction**
- ... Galvanomagnetic effects, see 72.15.G and 72.20.M
- ... Magneto-optical effects, see 78.20.L
- 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 Electron resonance and relaxation in atomic and molecular 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.D Spin waves*)
- 76.60.–k **Nuclear magnetic resonance and relaxation** (*see also 33.25 Nuclear resonance and relaxation in atomic and molecular physics*)
- 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*)
- 76.70.–r **Magnetic double resonances and cross effects** (*see also 33.40 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 Mössbauer spectra—in atomic and molecular physics*)
- ... Magnetic resonance spectrometers, 07.57.P
- 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 and 72.80; for dielectric properties related to treatment conditions, see 81.40.T*)
- 77.22.–d **Dielectric properties of solids and liquids**
- 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.P Surface waves in solids and liquids in acoustics appendix; for surface acoustic wave transducers, see 43.38.R 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, and ferroelectric, and antiferroelectric materials** (*for nonlinear optical materials, see 42.70*)
- 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
- 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.T; for optical materials, see 42.70; for optical properties of rocks and minerals, see 91.60.M*)
- 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 Thermo-optical and photothermal effects
- ... Nonlinear optical properties, *see 42.65*
- 78.30.–j **Infrared and Raman spectra** (*for vibrational states in crystals and disordered systems, see 63.20 and 63.50 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*)
- 78.40.–q **Absorption and reflection spectra: visible and ultraviolet** (*for infrared spectra, see 78.30*)
- 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 Lasers*)
- 78.47.+p **Time-resolved optical spectroscopies and other ultrafast optical measurements in condensed matter** (*see also 42.65.R—in nonlinear optics*)

· · · · *Impurity and defect absorption in solids, see 78.30 and 78.40*

78.55. –m Photoluminescence

- 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

78.60. –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 82.40.T Chemiluminescence and chemical laser kinetics*)

78.66. –w Optical properties of specific thin films, surfaces, and low-dimensional structures

- 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; nanocrystalline materials

- 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 Small particles

78.70. –g Interactions of particles and radiation with matter

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

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. INTER-DISCIPLINARY 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 and 74.72
- · · · Magnetic materials, *see* 75.50
- · · · Optical materials, *see* 42.70
- · · · Dielectric, piezoelectric, and ferroelectric materials, *see* 77.80
- · · · Colloids, gels, and emulsions, *see* 82.70.D, G, K respectively
- · · · Biological materials, *see* 87.14
- 81.05.Bx Metals, semimetals, and alloys
- 81.05.Cy Elemental semiconductors
- 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)
- 81.05.Kf Glasses (including metallic glasses)
- 81.05.Lg Polymers and plastics; rubber; synthetic and natural fibers; organometallic and organic materials
- 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, vitroceraamics
- 81.05.Qk Reinforced polymers and polymer-based composites
- 81.05.Rm Porous materials; granular materials
- 81.05.Tp Fullerenes and related materials; diamonds, graphite
- 81.05.Ys Nanophase materials
- 81.05.Zx New materials: theory, design, and fabrication
- 81.10.-h Methods of crystal growth; physics of crystal growth (for crystal structure, *see* 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; *see also* 85.40.S 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.)
- 81.15.Hi Molecular, atomic, ion, and chemical beam epitaxy
- 81.15.Jj Ion and electron beam-assisted deposition; ion plating
- 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

81.20.-n Methods of materials synthesis and materials processing (for ion implantation and doping, *see* 61.72)

- · · · Crystal growth, *see* 81.10
- · · · Film deposition, film growth and epitaxy, *see* 81.15
- · · · Plasma applications in manufacturing and materials processing, *see* 52.75.R
- 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
- · · · Chemical vapor deposition, *see* 81.15.G
- 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.D)

- 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 Solubility, segregation, and mixing; phase separation)
- 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
- 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—in rheology)
- 81.40.Np Fatigue, corrosion fatigue, embrittlement, cracking, fracture and failure
- 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 and shock-wave effects in solids and liquids)
- 81.40.Wx Radiation treatment (particle and electromagnetic) (*see also* 61.80 Physical radiation effects, radiation damage)
- · · · Etching, corrosion, oxidation, and other surface treatments, *see* 81.65
- 81.65.-b Surface treatments (*see also* 85.40 Microelectronics: LSI, VLSI, ULSI; integrated circuit fabrication technology)**
- 81.65.Cf Surface cleaning, etching, patterning
- 81.65.Kn Corrosion protection
- 81.65.Lp Surface hardening: nitridation, carburization, carbonitridation
- 81.65.Mq Oxidation
- 81.65.Ps Polishing
- 81.65.Rv Passivation
- 81.65.Tx Gettering
- 81.70.-q Methods of materials testing and analysis (for specific chemical analysis methods, *see* 82.80)**

- 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
- 81.90.+c Other topics in materials science (restricted to new topics in section 81)**
- 82. Physical chemistry**
- 82.20.–w Chemical kinetics** (*see also 31.15 Calculations and mathematical techniques in atomic and molecular physics and 31.25 Electronic correlation calculations for atoms and molecules*)
- 82.20.Db Statistical theories (including transition state)
- 82.20.Fd Stochastic and trajectory models, other theories and models
- 82.20.Hf Mechanisms and product distribution
- 82.20.Kh Potential energy surfaces for chemical reactions (*for potential energy surfaces for collisions, see 34.20.M*)
- 82.20.Mj Nonequilibrium kinetics
- 82.20.Pm Rate constants, reaction cross sections, and activation energies
- 82.20.Rp Energy distribution and transfer; relaxation (*see also 31.70.H Time-dependent phenomena—in atomic and molecular physics*)
- 82.20.Tr Kinetic and isotope effects
- 82.20.Wt Computational modeling; simulation
- 82.30.–b Specific chemical reactions; reaction mechanisms**
- 82.30.Cf Atom and radical reactions; chain reactions
- 82.30.Eh Molecule–molecule reactions
- 82.30.Fi Ion–molecule, ion–ion, and charge-transfer reactions (*see also 34.70 Charge transfer in atomic and molecular collisions*)
- 82.30.Hk Chemical exchanges (substitution, atom transfer, abstraction, disproportionation, and group exchange)
- 82.30.Lp Decomposition reactions (pyrolysis, dissociation, and group ejection)
- 82.30.Nr Association, addition, insertion, cluster formation, hydrogen bonding
- 82.30.Qt Isomerization and rearrangement
- 82.30.Vy Homogeneous catalysis (*for heterogeneous catalysis at surfaces, see 82.65.J*)
- 82.35.+t Polymer reactions and polymerization**
- 82.40.–g Chemical kinetics and reactions: special regimes and techniques**
- · · · *Chemically reactive flows, see 47.70.F*
- 82.40.Bj Oscillations, chaos, and bifurcations in homogeneous nonequilibrium reactors
- 82.40.Ck Pattern formation in vortices–diffusion systems (*see also 47.54 Pattern selection; pattern formation and 47.32.C Vortex dynamics*)
- 82.40.Dm Atomic and molecular beam reactions
- 82.40.Fp Shock waves (*see also 47.40.N Shock-wave interactions and shock effects in fluid dynamics*)
- 82.40.Js Fast and ultrafast reactions
- 82.40.Mw Pulse techniques
- 82.40.Py Flames, combustion, and explosions
- 82.40.Ra Plasma reactions (including flowing afterglow and electric discharges) (*see also 81.15.G Chemical vapor deposition*)
- 82.40.Tc Chemiluminescence and chemical laser kinetics (*see also 78.60.P Chemiluminescence in optical properties of condensed matter*)
- 82.40.We Atmospheric chemistry (*see also 94.10.F Atmospheric composition, chemical reactions and processes*)
- 82.45.+z Electrochemistry and electrophoresis** (*see also 66.10.E Ionic conduction; for electroosmosis, see 82.65.F; for electrochemical processes in biological membranes, see 87.16.D; see also 87.15.T Electrophoresis in biomolecules: structure and properties*)
- 82.50.–m Photochemistry and radiation chemistry** (*for photochemical reactions of biomolecules, see 87.15.R*)
- 82.50.Fv Photolysis, photodissociation, and photoionization by infrared, visible, and ultraviolet radiation
- 82.50.Gw Radiolysis, dissociation, and ionization by x-ray, γ -ray, and particle radiation
- 82.55.+e Radiochemistry (including hot atom reactions, positronium and muonium chemistry)** (*see also 23 Radioactive decay and in-beam spectroscopy*)
- 82.60.–s Chemical thermodynamics** (*see also 05.70 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*)
- 82.65.–i Surface and interface chemistry** (*see also 68.35.M Surface energy; thermodynamic properties*)
- 82.65.Dp Thermodynamics of surfaces and interfaces (*see also 05.70.N in statistical physics, thermodynamics and nonlinear dynamical systems*)
- 82.65.Fr Film and membrane processes: ion exchange, dialysis, osmosis, electroosmosis (*for biological membranes, see 87.16.D*)
- 82.65.Jv Heterogeneous catalysis at surfaces (*for homogeneous catalysis, see 82.30.V*)
- 82.65.My Chemisorption
- 82.65.Pa Surface-enhanced molecular states and other gas–surface interactions (*see also 34.50.D Interactions of atoms, molecules, and their ions with surfaces; photon and electron emission; neutralization of ions*)
- 82.70.–y Disperse systems**
- 82.70.Dd Colloids
- 82.70.Gg Gels and sols
- 82.70.Kj Emulsions and suspensions
- 82.70.Rr Aerosols and foams
- 82.80.–d Chemical analysis and related physical methods of analysis** (*for related instrumentation, see 07; for chemical analysis techniques in biophysics, see 87.64*)
- 82.80.Bg Chromatography
- 82.80.Ch Ultraviolet, visible, infrared, Raman, microwave, and magnetic resonance spectroscopic analysis methods; spectrophotometry; colorimetry
- 82.80.Ej X-ray, Mössbauer, and other γ -ray spectroscopic analysis methods
- 82.80.Fk Electrochemical methods
- 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)

- 82.80.Pv Electron spectroscopy (x-ray photoelectron (XPS), Auger electron spectroscopy(AES), etc.)
- 82.80.Sy Methods using colligative properties
- 82.80.Yc Rutherford backscattering (RBS), and other methods of chemical analysis
- 82.90.+j Other topics in physical chemistry (restricted to new topics in section 82)**

83. Rheology (see also 47 Fluid dynamics)

- 83.10.–y Fundamentals and general**
- 83.10.Bb Kinematics of deformation and flow
- 83.10.Dd Dynamics of continuous media
- 83.10.Ff Continuum mechanics
- 83.10.Hh Flow of solids
- 83.10.Ji Fluid dynamics (nonlinear fluids)
- 83.10.Lk Multiphase flows
- 83.10.Nn Polymer dynamics
- 83.10.Pp Particle dynamics
- 83.20.–d Constitutive relations**
- 83.20.Bg Macroscopic (phenomenological) theories
- 83.20.Di Microscopic (molecular) theories
- 83.20.Fk Reptation theories
- 83.20.Hn Structural and phase changes
- 83.20.Jp Computer simulation
- 83.20.Lr Boundary conditions
- 83.50.–v Deformation; material flow**
- 83.50.Ax Steady shear flows
- 83.50.By Transient deformation and flow; time-dependent properties: start-up, stress relaxation, creep, recovery, etc.
- 83.50.Cz Injection molding
- 83.50.Da Compression molding
- 83.50.Eb Weissenberg effect
- 83.50.Fc Linear viscoelasticity
- 83.50.Gd Nonlinear viscoelasticity
- 83.50.Jf Extensional and combined flows
- 83.50.Lh Interfacial and free surface flows; slip
- 83.50.Nj Viscoplasticity; yield stress
- 83.50.Pk Effects of electric and magnetic fields
- 83.50.Qm Thixotropy; thickening flows
- 83.50.Sp Thermorheological properties; non-isothermal rheology
- 83.50.Tq Wave propagation, shocks, fracture, and crack healing
- 83.50.Vr Wave speed
- 83.50.Ws Chaotic flows; drag reduction
- 83.50.Yt Flows in processing machinery
- 83.70.–f Material form**
- 83.70.Bi Homogeneous solids

- 83.70.Dk Composite solids
- 83.70.Fn Granular solids
- 83.70.Gp Homogeneous isotropic liquids; solutions and melts
- 83.70.Hq Heterogeneous liquids: suspensions, dispersions, emulsions, pastes, slurries, foams, block copolymers, etc.
- 83.70.Jr Liquid crystals: nematic, cholesteric, smectic, discotic, etc.
- 83.80.–k Material types**
- 83.80.Bp Thermoplastic polymers
- 83.80.Cq Thermosetting polymers
- 83.80.Dr Elastomeric polymers
- 83.80.Es Polymer blends
- 83.80.Gv Electro- and magnetorheological fluids
- 83.80.Jx Chemically reactive materials
- 83.80.Lz Biological materials: blood, collagen, wood, food, etc.
- 83.80.Nb Geological materials: Earth, magma, ice, rocks, etc.
- 83.80.Pc Inorganic materials
- 83.85.–c Techniques and apparatus**
- 83.85.Cg Rheological measurements
- 83.85.Ei Optical methods; sonography
- 83.85.Gk Sensors
- 83.85.Jn Viscosity measurements
- 83.85.Lq Normal stress measurements
- 83.85.Ns Data analysis (interconversion of experiments; computation of relaxation and retardation spectra; time–temperature superposition, etc.)
- 83.85.Pt Flow computation (e.g. finite element) (see also 02.70—in *Mathematical methods in physics*)
- 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, for microwave circuits, see 84.40.D)**
- 84.30.Bv Circuit theory (including computer-aided circuit design and analysis)
- 84.30.Jc Power electronics; power supply circuits (see also 84.70 *High-current and high-voltage technology*)
- 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

- ... *Special purpose circuits, see 07.50.E*
- 84.32.–y Passive circuit components (see also 07.50 *Electrical and electronic components, instruments, and techniques*)**
- 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
- 84.32.Vv Fuses
- 84.35.+i Neural networks (for optical neural networks, see 42.79.T, see also 07.05.M *Neural networks, fuzzy logic, artificial intelligence in computers in experimental physics; see also 87.18.S in multicellular phenomena*)**
- 84.37.+q Electric variable measurements (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.K*
- ... *Microwave and radiowave spectrometers, see 07.57.P*
- ... *Electromagnetic wave propagation, see 41.20.J*
- 84.40.Az Waveguides, transmission lines, striplines
- 84.40.Ba Antennas: theory, components and accessories (for plasma interactions with antennas, see 52.40.F 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.S)
- 84.40.Xb Telemetry: remote control, remote sensing; radar
- 84.47.+w Vacuum tubes (see also 85.45 *Vacuum microelectronics*)**
- ... *Phototubes, see 85.60.H*
- ... *Microwave tubes, see 84.40.F*
- 84.50.+d Electric motors**
- 84.60.–h Direct energy conversion and storage**

- 84.60.Bk Performance characteristics of energy conversion systems; figure of merit
- 84.60.Dn Electrochemical conversion and storage: electrochemical cells and batteries; fuel cells
- 84.60.Jt Photoelectric conversion: solar cells and arrays (*for solar collectors and concentrators, see 42.79.E*)
- 84.60.Lw Magnetohydrodynamic conversion (*for MHD generators, see 52.75.F—in plasma physics*)
- 84.60.Ny Thermionic conversion (*for thermionic generators, see 52.75.F—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 (including superconducting cables)**
- 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*
- ... Microwave tubes, *see 84.40.F*
- ... Cathode-ray and storage tubes, *see 84.47*
- ... Phototubes, *see 85.60.H*
- ... Conductors, inductors, and switches, *see 84.32*
- 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
- 85.25.Kx Superconducting wires, fibers, and tapes
- 85.25.Ly Superconducting magnets; magnetic levitation devices (*for superconducting cables, see 84.70*)
- 85.25.Na Superconducting microelectronic circuits
- 85.25.Pb Superconducting infrared, submillimeter and millimeter wave detectors
- ... High power superconducting devices, *see 84.70*
- 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.D; for laser diodes, see 42.55.P)**
- 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.St Quantum interference devices
- 85.30.Tv Field effect devices
- 85.30.Vw Low-dimensional quantum devices (quantum dots, quantum wires etc.)
- 85.30.Wx Single electron devices
- 85.40.–e Microelectronics: LSI, VLSI, ULSI; integrated circuit fabrication technology (see also 85.45 Vacuum microelectronics)**
- ... Microwave integrated electronics, *see 84.40.L*
- ... Integrated optics, *see 42.82*
- ... Superconducting microelectronic circuits, *see 85.25.N*
- 85.40.Bh Computer-aided design of microcircuits; layout and modeling
- 85.40.Hp Lithography, masks and pattern transfer
- ... Micromechanical devices and systems, *see 07.10.C*
- 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 52.75.R*)
- 85.40.Ux Nanometer-scale fabrication technology
- ... Bipolar integrated circuits, *see 85.30.P*
- ... Field effect integrated circuits, *see 85.30.T*
- 85.40.Xx Hybrid microelectronics; thick films
- ... Nanophase materials, *see 81.05.Y*
- 85.45.–w Vacuum microelectronics**
- ... Microwave vacuum microelectronic devices, *see 84.40*
- 85.45.Bz Vacuum microelectronic device characterization, design, and modeling
- 85.45.Db Field emitter and arrays, cold electron emitters
- 85.45.Fd Field emission displays (FEDs)
- 85.50.+k Dielectric, ferroelectric, and piezoelectric devices (see also 43.38.F Piezoelectric and ferroelectric transducers in acoustic appendix)**
- ... Capacitors, *see 84.32.T*
- 85.60.–q Optoelectronic devices (see also 42.79 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.P*)
- 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.F, for optical display devices, see 42.79.K, see also 07.07.H Display and recording equipment, oscilloscopes, TV cameras, etc.*)
- 85.65.+h Molecular electronic devices**
- 85.70.–w Magnetic devices**
- ... Molecular magnets, *see 75.50.X*
- ... Magnets, *see 07.55.D*
- ... Superconducting magnets and magnetic levitation devices, *see 85.25.L*
- ... Beam bending magnets, *see 41.85.L*
- 85.70.Ay Magnetic device characterization, design, and modeling
- 85.70.Ec Magnetostrictive, magnetoacoustic, and magnetostatic devices (*for magnetostrictive transducers, see 43.38.C in acoustics appendix*)
- ... Magnetic recording materials, *see 75.50.S*
- 85.70.Ge Ferrite and garnet devices
- 85.70.Kh Magnetic thin film devices: magnetic heads (magneto-resistive, 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 85.25.L*)
- 85.70.Sq Magneto-optical devices
- 85.80.–b Electrochemical, thermoelectromagnetic, and other devices (restricted to new topics**

in section 85) (for acoustoelectric devices, see 43.38)

- 85.80.Dg Electrochemical devices
- 85.80.Fi Thermoelectric devices
- 85.80.Jm Magnetoelectric devices
- 85.80.Lp Magnetothermal devices

85.90.+h Other topics in electronic and magnetic devices and microelectronics

87. Biological and medical physics

87.10.+e General theory and mathematical aspects

87.14.–g Biomolecules: types

- 87.14.Cc Lipids
- 87.14.Ee Proteins
- 87.14.Gg DNA, RNA

87.15.–v Biomolecules: structure and physical properties

- 87.15.Aa Theory and modeling; computer simulation
- 87.15.By Structure and bonding
- 87.15.Cc Folding and sequence analysis
- 87.15.He Dynamics and conformational changes
- 87.15.Kg Molecular interactions; membrane-protein interactions
- 87.15.La Mechanical properties
- 87.15.Mi Spectra, photodissociation, and photoionization; luminescence
- 87.15.Nn Properties of solutions; aggregation and crystallization of macromolecules
- 87.15.Rn Reactions and kinetics; polymerization
- 87.15.Tt Electrophoresis (see also 82.45 *Electrochemistry and electrophoresis*)
- 87.15.Vv Diffusion
- 87.15.Ya Fluctuations

87.16.–b Subcellular structure and processes

- 87.16.Ac Theory and modeling; computer simulation
- 87.16.Dg Membranes, bilayers, and vesicles
- 87.16.Gj Cell walls
- 87.16.Ka Filaments, microtubules, their networks, and supramolecular assemblies
- 87.16.Nn Motor proteins
- 87.16.Qp Pseudopods, lamellipods, cilia, and flagella
- 87.16.Sr Chromosomes, histones
- 87.16.Tb Organelles
- 87.16.Uv Active transport processes; ion channels
- 87.16.Xa Signal transduction
- 87.16.Yc Regulatory chemical networks

87.17.–d Cellular structure and processes

- 87.17.Aa Theory and modeling; computer simulation
- 87.17.Ee Growth and division
- 87.17.Jj Cell locomotion; chemotaxis and related directed motion
- 87.17.Nn Electrophysiology of nerve cells
- 87.18.–h Multicellular phenomena**
- 87.18.Bb Computer simulation
- 87.18.Ed Aggregation and other collective behavior of motile cells
- 87.18.Hf Spatiotemporal pattern formation in cellular populations
- 87.18.La Morphogenesis
- 87.18.Pj Chemical waves
- 87.18.Sn Neural networks

87.19.–j Properties of higher organisms

- · · · *Physiological optics, see 42.66*
- · · · *Physiological acoustics, see 43.64*
- · · · *Psychological acoustics, see 43.66*
- · · · *Speech production, see 43.70*
- · · · *Speech perception, see 43.71*
- · · · *Speech processing and communication systems, see 43.72*
- 87.19.Bb Sensory perceptions
- 87.19.Dd Information processing in vision and hearing
- 87.19.Ff Muscles
- 87.19.Hh Cardiac dynamics
- 87.19.Jj Circadian rhythms
- 87.19.La Neuroscience
- 87.19.Nn Electrophysiology
- 87.19.Pp Biothermics
- 87.19.Rr Mechanical properties of tissues and organs
- 87.19.St Movement and locomotion
- 87.19.Tt Rheology of body fluids
- 87.19.Uv Haemodynamics, pneumodynamics
- 87.19.Xx 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 radiation and external fields on biomolecules, cells and higher organisms

- 87.50.Gi Ionizing radiations (ultraviolet, x-rays, γ -rays, ions, electrons, positrons, neutrons, and mesons, etc.)
- 87.50.Hj Optical radiation (near ultraviolet, visible, and infrared)
- 87.50.Jk Radio frequency and microwave radiation (power lines)
- 87.50.Kk Sound and ultrasound
- 87.50.Mn Magnetic fields
- 87.50.Rr Electric fields

87.52.–g Radiation monitoring, control, and safety

- 87.52.Df Low LET: therapeutic and diagnostic x-rays and electrons
- 87.52.Ga Low LET: associated neutron shielding and measurement
- 87.52.Ln High LET
- 87.52.Px Risk/benefit analysis
- 87.52.Tr Regulatory issues
- 87.53.–j Ionizing-radiation therapy physics**
- 87.53.Bn Photon dosimetry: theory and algorithms
- 87.53.Dq Photon dosimetry: measurements
- 87.53.Fs Electron and positron dosimetry: theory and algorithms
- 87.53.Hv Electron and positron dosimetry: measurements
- 87.53.Jw Brachytherapy
- 87.53.Kn Conformal radiation treatment
- 87.53.Ly Stereotactic radiosurgery
- 87.53.Mr Beam intensity modification: wedges, compensators
- 87.53.Na Radioimmunotherapy
- 87.53.Oq Portal imaging in therapy
- 87.53.Pb Proton, neutron, and heavier particle dosimetry: theory and algorithms
- 87.53.Qc Proton, neutron, and heavier particle dosimetry: measurements
- 87.53.Rd Microdosimetry
- 87.53.St Record and verify systems and applications
- 87.53.Tf Treatment planning, optimization, tissue response factors, and dose-volume analysis
- 87.53.Uv Collimation
- 87.53.Vb Simulation
- 87.53.Wz Monte Carlo applications
- 87.53.Xd Quality assurance in radiotherapy
- 87.54.–n Non-ionizing radiation therapy physics**
- 87.54.Br Thermotherapy (hyperthermia and cryogenic therapy)
- 87.54.Dt Electrotherapy
- 87.54.Fj Photodynamic therapy
- 87.56.–v Radiation therapy equipment**
- 87.56.By Radiation generators
- 87.56.Da Ancillary equipment
- 87.56.Fc Quality assurance equipment
- 87.57.–s Medical imaging: general**
- 87.57.Ce Image quality: contrast, resolution, noise, etc.
- 87.57.Gg Image reconstruction and registration
- 87.57.Nk Image analysis
- 87.58.–b Nuclear medicine imaging, dosimetry, labeling, metabolic studies**
- 87.58.Ce Single photon emission computed tomography (SPECT)

- 87.58.Fg Positron emission tomography (PET)
- 87.58.Ji Radiopharmaceuticals
- 87.58.Mj Digital imaging
- 87.58.Pm Scintillation cameras
- 87.58.Sp Dosimetry
- 87.58.Vr Quantitative measurements and scanning
- 87.58.Xs Bone densitometry
- 87.59. – e X-ray imaging**
- 87.59.Bh X-ray radiography
- 87.59.Ci Fluoroscopy
- 87.59.Dj Angiography
- 87.59.Ek Mammography
- 87.59.Fm Computed tomography (CT)
- 87.59.Hp Digital radiography
- 87.59.Jq Transmission imaging
- 87.59.Ls Bone densitometry
- 87.61. – c Magnetic resonance imaging**
- 87.61.Cd Pulse sequences for imaging
- 87.61.Ff Instrumentation
- 87.61.Lh Angiography and macroscopic flow estimation
- 87.61.Pk Clinical imaging studies
- 87.62. + n Medical imaging equipment**
- 87.63. – d Non-ionizing radiation equipment and techniques**
- 87.63.Df Ultrasonography
- 87.63.Hg Thermography
- 87.63.Lk Visible radiation: diaphanography, transillumination, laser imaging
- 87.63.Pn Electrical impedance tomography (EIT)
- 87.64. – t Spectroscopic and microscopic techniques in biophysics and medical physics** (*for spectrometers, see 07 Instruments, apparatus, components, and techniques common to several branches of physics and astronomy*)
- 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.Fb EXAFS spectroscopy
- 87.64.Hd EPR and NMR spectroscopy
- 87.64.Je Infrared and Raman spectroscopy
- 87.64.Lg Electron and photoelectron spectroscopy
- 87.64.Ni Optical absorption, magnetic circular dichroism, and fluorescence spectroscopy
- 87.64.Pj Mössbauer spectroscopy
- 87.64.Rr Light microscopy: bright-field, dark-field, phase contrast, DIC
- 87.64.Tt Confocal microscopy
- 87.64.Vv Multiphoton microscopy
- 87.64.Xx Near-field scanning optical microscopy
- 87.65. + y Aerospace bio- and medical physics (effects of accelerations, weightlessness, and space environment)**
- 87.66. – a Radiation measurement**
- 87.66.Cd Films: silver bromide based, radiochromic, etc.
- 87.66.Ff Chemical dosimetry
- 87.66.Jj Ionization dosimetry
- 87.66.Na Calorimetric dosimetry
- 87.66.Pm Solid state detectors
- 87.66.Sq Thermoluminescence, bioluminescence, etc.
- 87.66.Uv Magnetic resonance
- 87.66.Xa Phantoms
- 87.68. + z Biomaterials and biological interfaces**
- 87.80. – y Biological techniques and instrumentation; biomedical engineering**
- 87.80.Cc Optical trapping
- 87.80.Fe Micromanipulators
- 87.80.Jg Patch clamping
- 87.80.Mj Micromachining
- 87.80.Pa Morphometry and stereology
- 87.80.Rb Tissue and cellular engineering and biotechnology
- 87.80.Tq Biological signal processing and instrumentation
- 87.80.Vt Dynamical, regulatory, and integrative biology
- 87.80.Xa Neural engineering
- 87.90. + y Other topics in biological and medical physics (restricted to new topics in section 87)**
- 89. Topics of general interest to physicists**
- 89.20. + a Industrial and technological research and development**
- 89.30. + f Energy resources**
- 89.40. + k Transportation**
- 89.50. + r Urban planning and development**
- 89.60. + x Environmental studies** (*for ecology, see 87.23 in biological and medical physics*)
- 89.70. + c Information science** (*for quantum information, see 03.67*)
- 89.80. + h Computer science and technology** (*see also 07.05 Computers in experimental physics; for computers in education, see 01.50.H, L*)
- 89.90. + n Other topics of general interest to physicists (restricted to new topics in section 89)**

90. GEOPHYSICS, ASTRONOMY, AND ASTROPHYSICS

91. Solid Earth physics

91.10.—v Geodesy and gravity

- 91.10.By Mathematical geodesy; general theory
- 91.10.Da Cartography
- 91.10.Fc Space geodetic surveys
- 91.10.Jf Topography; geometric observations
- 91.10.Kg Crustal movements
- 91.10.Lh Photogrammetry
- 91.10.Nj Rotational variations; polar wobble
- 91.10.Qm Harmonics of the gravity potential field
- · · · *Relations of gravity observations to tectonics and isostasy, see 91.45.S*
- 91.10.Rn Rheology of lithosphere and mantle
- 91.10.Sp Satellite orbits
- 91.10.Tq Earth tides
- 91.10.Vr Ocean/Earth/atmosphere interaction
- 91.10.Ws Reference systems

91.25.—r Geomagnetism and paleomagnetism; geoelectricity

- 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.Ga Spatial variations: all harmonics and anomalies
- 91.25.Jc Spatial variations attributed to sea floor spreading
- 91.25.Le Time variations: diurnal to secular
- 91.25.Mf Reversals
- 91.25.Ng Paleomagnetism
- 91.25.Ph Magnetostratigraphy
- 91.25.Qi Geoelectricity; electromagnetic induction and conductivity (magnetotelluric effects)

91.30.—f Seismology

- 91.30.Bi Seismic sources (mechanisms, magnitude, moment frequency spectrum)
- 91.30.Dk Seismicity: space and time distribution
- 91.30.Fn Surface and body waves
- 91.30.Ks Free oscillations (periods less than 12 hours)
- 91.30.Mv Strong motions and shock waves
- 91.30.Nw Tsunamis (*for dynamics of oceans, see 92.10.D and 92.10.F*)
- 91.30.Px Phenomena related to earthquake prediction
- 91.30.Rz Explosion seismology
- 91.30.Tb Volcano seismology
- 91.30.Vc Continental crust seismology
- 91.30.Ye Oceanic crust seismology

91.35.—x Earth's interior structure and properties

- 91.35.Cb Models of interior structure
- 91.35.Dc Heat flow; geothermy
- 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 of Earth's interior
- 91.35.Nm Geochronology
- 91.35.Pn Tomography of the Earth's interior (*see also 91.30 Seismology*)

91.40.—k Volcanology

- 91.40.Bp Ash deposits
- 91.40.Dr Atmospheric effects (*see also 92.60.M Particles and aerosols—in Meteorology*)
- 91.40.Ft Eruptions
- 91.40.Hw Lava

91.45.—c Physics of plate tectonics

- 91.45.Cg Continental margins
- 91.45.Dh Plate tectonics
- 91.45.Ei Neotectonics
- 91.45.Fj Convection currents
- 91.45.Pt Slow vertical crustal movements (including isostasy and postglacial phenomena)
- 91.45.Qv Tomography of plate tectonics
- 91.45.Sx Relations of gravity observations to tectonics and isostasy
- 91.45.Ty Folds and Folding
- 91.45.Vz Fractures and faults
- 91.45.Yb Pluton emplacement

91.50.—r Marine geology and geophysics

- 91.50.Cw Beach, coastal, and shelf processes
- 91.50.Ey Ocean bottom processes (*for ocean basin thermometry, see 43.30.Q in acoustics appendix*)
- 91.50.Ga Bathymetry and noncoastal underwater morphology
- 91.50.Jc Turbidity currents, sedimentation (*for acoustics of sediments, see 43.30.M in acoustics appendix*)

91.60.—x Physical properties of rocks and minerals (*for rheological properties of geological materials, see 83.50 and 83.80.N*)

- 91.60.Ba Elasticity, fracture, and flow
- 91.60.Dc Creep and deformation
- 91.60.Ed Crystal structure and defects
- 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.Pn Magnetic and electric properties

91.65.—n Geophysical aspects of geology, mineralogy, and petrology (*for geophysical prospecting, see 43.40.P in acoustics appendix*)

- 91.65.Br Geochemical cycles
- 91.65.Dt Isotopic composition/chemistry
- 91.65.Fw Low-temperature geochemistry
- 91.65.Hy Organic geochemistry
- 91.65.Nd Trace elements
- 91.65.Rg Mineral occurrences and deposits
- 91.65.Ti Sedimentary petrology
- 91.65.Vj Major element composition

91.70.—c Information related to geologic time

- 91.70.Bf Cenozoic
- 91.70.Dh Mesozoic
- 91.70.Fj Paleozoic
- 91.70.Hm Precambrian

91.90.+p Other topics in solid Earth physics (restricted to new topics in section 91)

92. Hydrospheric and atmospheric geophysics

92.10.—c Physics of the oceans

- 92.10.Bf Physical properties of seawater
- 92.10.Cg Capillary waves
- 92.10.Dh Dynamics of the deep ocean
- 92.10.Ei Coriolis effects
- 92.10.Fj Dynamics of the upper ocean
- 92.10.Gk El Nino
- 92.10.Hm Surface waves, tides, and sea level
- 92.10.Jn Seiches
- 92.10.Kp Sea-air energy exchange processes
- 92.10.Lq Turbulence and diffusion
- 92.10.Mr Thermohaline structure and circulation
- 92.10.Ns Fine structure and microstructure
- 92.10.Pt Optical properties of sea water
- 92.10.Rw Sea ice
- 92.10.Sx Coastal and estuarine oceanography
- 92.10.Ty Fronts and jets
- 92.10.Vz Underwater sound (*see also 43.30 Underwater sound—in acoustic appendix*)
- 92.10.Wa Sediment transport
- 92.10.Yb Hydrography (*for ocean parameter estimation by acoustical methods, see 43.30.P in underwater sound in acoustic appendix*)
- · · · *Marine geology and geophysics, see 91.50*

92.20.—h Interdisciplinary aspects of oceanography

- 92.20.Bk Aerosols
- 92.20.Cm Chemistry of the ocean

92.20.Gr Ocean energy extraction
 92.20.Hs Anoxic environments
 92.20.Jt Biological aspects of oceanography
 92.20.Kv Photochemistry
 92.20.Lw Photosynthesis
 92.20.Mx Physicochemical properties
 92.20.Ny Marine pollution
 92.20.Pz Bacteria
 92.20.Rb Plankton
 92.20.Td Radioactivity

92.40.–t Hydrology and glaciology
 92.40.Cy Modeling; general theory
 92.40.Ea Precipitation
 92.40.Fb Rivers, runoff, and streamflow
 92.40.Gc Erosion and sedimentation
 92.40.Je Evaporation
 92.40.Kf Groundwater
 92.40.Lg Soil moisture
 92.40.Ni Limnology
 92.40.Qk Water quality and water resources
 92.40.Rm Snow
 92.40.Sn Ice
 92.40.Vq Glaciers

92.60.–e Meteorology (*see also 43.28 Aeroacoustics and atmospheric sound, 42.68 atmospheric optics, 94.10.D Atmospheric structure, pressure, density, and temperature*)
 92.60.Bh General circulation
 92.60.Dj Gravity waves, tides, and compressional waves
 92.60.Ek Convection, turbulence, and diffusion
 92.60.Fm Boundary layer structure and processes
 92.60.Gn Winds and their effects
 92.60.Hp Chemical composition and chemical interactions
 92.60.Jq Water in the atmosphere (humidity, clouds, evaporation, precipitation)
 92.60.Ls Ionic interactions and processes
 92.60.Mt Particles and aerosols (*see also 94.20 Physics of the ionosphere*)
 92.60.Nv Cloud physics
 92.60.Pw Atmospheric electricity
 92.60.Qx Storms
 92.60.Ry Climatology
 92.60.Sz Air quality and air pollution
 92.60.Ta Interaction of atmosphere with electromagnetic waves; propagation
 92.60.Vb Solar radiation
 92.60.Wc Weather analysis and prediction

92.70.–j Global change (*see also 92.60 Meteorology*)
 92.70.Cp Atmosphere
 92.70.Er Biogeochemical processes
 92.70.Gt Climate dynamics
 92.70.Jw Oceans
 92.70.Ly Water cycles

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

93.65.+e Data acquisition and storage

93.85.+q Instrumentation and techniques for geophysical research

94. Aeronomy and magnetospheric physics

94.10.–s Physics of the neutral atmosphere (*for atmospheres of the planets, see 96.35.H*)

94.10.Bw General properties of the high atmosphere
 94.10.Dy Atmospheric structure, pressure, density, and temperature (stratosphere, mesosphere, thermosphere, exosphere) (*see also 92.60 Meteorology and 92.70 Global change*)
 94.10.Fa Atmospheric composition (atomic or molecular), chemical reactions and processes (*see also 82.40.W Atmospheric chemistry*)
 94.10.Gb Absorption and scattering of radiation
 94.10.Jd Tides, waves, and winds
 94.10.Lf Convection, diffusion, mixing, turbulence, and fallout
 94.10.Nh Cosmic dust
 94.10.Rk Aurora and airglow

94.20.–y Physics of the ionosphere (*for ionospheres of the planets, see 96.35.K; for radiowave propagation, see 41.20.J in electromagnetism, see also 52 Physics of plasmas and electric discharges*)

94.20.Bb Wave propagation
 94.20.Dd Ionospheric structure (*D, E, F, and topside regions*) including steady-state ion densities and temperatures
 94.20.Ee *D* region
 94.20.Gg *E* region
 94.20.Ji *F* region
 94.20.Kj Polar cap ionosphere
 94.20.Lk Topside region
 94.20.Mm Plasmasphere
 94.20.Pp Plasmopause
 94.20.Qq Particle precipitation
 94.20.Rr Interactions between waves and particles
 94.20.Ss Electric fields
 94.20.Tt Ionospheric soundings
 94.20.Vv Ionospheric disturbances
 94.20.Ww Plasma motion, convection, or circulation
 94.20.Yx Interaction between ionosphere and magnetosphere

94.30.–d Physics of the magnetosphere (*for magnetospheres of the planets, see 96.35.K; for radiowave propagation, see 41.20.J in electromagnetism; see also 52 Physics of plasmas and electric discharges*)

94.30.Bg Magnetic coordinate systems
 94.30.Ch Magnetospheric configuration
 94.30.Di Magnetopause
 94.30.Ej Magnetic tail
 94.30.Fk Plasma motion, convection, or circulation
 94.30.Gm Plasma instabilities
 94.30.Hn Trapped particles
 94.30.Jp Ring currents
 94.30.Kq Electric fields
 94.30.Lr Magnetic storms, substorms
 94.30.Ms Magnetic pulsations
 94.30.Tz Waves: propagation and excitation
 94.30.Va Magnetosheath; interaction with interplanetary space (including solar wind) (*for cosmic-ray interactions, see 13.85.T in elementary particle physics; see also 96.40 Cosmic rays—in Astronomy*)

94.80.+g Instrumentation for aeronomy and magnetospheric studies (*see also 95.55 Astronomical and space-research instrumentation in astronomy; 07.87 spaceborne and space research instruments, apparatus, and components*)

- 94.90.+m Other topics in aeronomy and magnetospheric physics (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.P in classical mechanics of discrete systems)
- ... Dynamics and kinematics of stellar systems, *see* 98.10
- 95.10.Eg Orbit determination and improvement
- 95.10.Fh Chaotic dynamics (*see also* 05.45 Nonlinear dynamics and nonlinear dynamical systems)
- 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**
- 95.30.Cq Elementary particle processes (*see also* 26 Nuclear astrophysics)
- 95.30.Dr Atomic processes and interactions (*see also* 32 Atomic properties and interactions with photons; 34 Atomic and molecular collision processes and interactions)
- 95.30.Ft Molecular and chemical processes and interactions; (*see also* 33 Molecular properties and interactions with photons; 34 Atomic and molecular collision 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.) (*see also* 32.10, 32.30, 32.70, 33.15, 33.20, 33.20, and 33.70 in atomic and molecular physics)
- 95.30.Lz Hydrodynamics
- 95.30.Qd Magnetohydrodynamics and plasmas
- 95.30.Sf Relativity and gravitation (*see also* 04 General relativity and gravitation, 98.80.H Mathematical and relativistic cosmology)
- 95.30.Tg Thermodynamic processes, conduction, convection, equations of state (*see also* 05.70 Thermodynamics)
- 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.C Elementary particle processes; for brown dwarfs, *see* 97.20.V; for galactic halos, *see* 98.35.G or 98.62.G; for models of the early Universe, *see* 97.10.F)
- 95.40.+s Artificial Earth satellites** (for lunar and planetary probes, *see* 95.55.P)
- 95.45.+i Observatories and site testing**
- 95.55.—n Astronomical and space-research instrumentation** (*see also* 94.80 Instrumentation for aeronomy and magnetospheric studies, 07.87 spaceborne and space research instrument, apparatus, and components)
- 95.55.Aq Charge-coupled devices, image detectors, and IR detector arrays (*see also* 85.60.G 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 (*see also* 07.60 Optical instruments, equipment, and techniques)
- 95.55.Rg Photoconductors and bolometers (*see also* 07.57.K Bolometers, infrared submillimeter wave, microwave and radiowave receivers and detectors)
- 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 Radiation detectors—in nuclear physics)
- 95.55.Ym Gravitational radiation detectors; mass spectrometers; and other instrumentation and techniques (*see also* 04.80 Experimental studies of gravity 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 Atmospheric optics)
- 95.75.Rs Remote observing techniques
- 95.75.Tv Digitization techniques (*see also* 07.05.P Image processing)
- 95.75.Wx Time series analysis, time variability
- 95.80.+p Astronomical catalogues, 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 (for the Earth, *see* 91–94)**
- 96.10.+i General, solar nebula, and cosmogony**
- 96.20.—n Moon**
- 96.20.Br Origin, formation, and age
- 96.20.Dt Features, landmarks, mineralogy, petrology, and atmosphere
- 96.20.Jz Gravitational field, selenodesy, magnetic fields
- 96.20.Ka Cratering
- 96.30.—t Planets, their satellites and rings; asteroids** (for comets, *see* 96.50.G)
- 96.30.Dz Mercury
- 96.30.Ea Venus
- 96.30.Gc Mars
- 96.30.Kf Jupiter

- 96.30.Mh Saturn
 96.30.Pj Uranus
 96.30.Rm Neptune
 96.30.Sn Pluto
 96.30.Wr Planetary rings
 96.30.Ys Asteroids (minor planets)
- 96.35.–j Planetary, asteroid, cometary, and satellite characteristics and properties** (see also 97.82 for extrasolar planetary systems)
- 96.35.Cp Origin, formation, evolution, and ages
 96.35.Er Chemical composition
 96.35.Fs Mass, size; gravitational fields; rotation; orbits
 96.35.Gt Surface features, cratering, and topography
 96.35.Hv Neutral atmospheres
 96.35.Kx Ionospheres; magnetospheres
 96.35.Mz Interiors
 96.35.Na Volcanism and tectonics
 96.35.Pb Electric and magnetic fields
 96.35.Se Interplanetary comparisons
- 96.40.–z Cosmic rays** (for cosmic rays outside the Solar System, see 98.70.S)
- 96.40.Cd Interplanetary propagation and effects
 96.40.De Composition, energy spectra, and interactions
 96.40.Fg Energetic solar particles and photons
 96.40.Kk Solar modulation and geophysical effects
 96.40.Pq Extensive air showers
 96.40.Tv Neutrinos and muons
 96.40.Vw Cosmic-ray effects in meteorites and terrestrial matter
- 96.50.–e Interplanetary space** (for asteroids, see 96.30.Y)
- 96.50.Bh Solar electric and magnetic fields (including solar wind fields)
 96.50.Ci Solar wind plasma
 96.50.Dj Interplanetary gas and dust (including gegenschein and zodiacal light)
 96.50.Ek Solar wind interactions with planets, satellites, and comets (for interactions with Earth, see 94.30.V)
 96.50.Fm Shock waves
 96.50.Gn Comets
 96.50.Hp Oort cloud
 96.50.Jq Kuiper belt
 96.50.Kr Meteors, meteoroids, and meteor streams
 96.50.Mt Meteorites, micrometeorites, and tektites
 96.50.Pw Particle acceleration
 96.50.Qx Stream-stream interactions
 96.50.Ry Waves and discontinuities
- 96.60.–j Solar physics**
- 96.60.Bn Diameter, figure, rotation, mass
 96.60.Fs Chemical composition
 96.60.Hv Electric and magnetic fields
 96.60.Jw Solar interior (for solar neutrinos, see 26.65)
 96.60.Ly Oscillations and waves; helioseismology
 96.60.Mz Photosphere, granulation
 96.60.Na Chromosphere and chromosphere–corona transition; spicules
 96.60.Pb Corona; coronal loops, streamers, and holes
 96.60.Qc Sunspots, faculae, plages
 96.60.Rd Flares, bursts, and related phenomena
 96.60.Se Prominences
 96.60.Tf Solar electromagnetic radiation (see also 92.60.V, Solar radiation in meteorology)
 96.60.Vg Particle radiation, solar wind (see also 96.50.C, Solar wind plasma and 96.50.E Solar wind interactions with planets, satellites, and comets)
 96.60.Wh Coronal mass ejection
- 96.90.+c Other topics on the solar system (restricted to new topics in section 96)**
- 97. Stars**
- 97.10.–q Stellar characteristics and properties** (see also 04.40.D Relativistic stars and 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.E or 98.58.E)
 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, color, 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.J 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.L or 98.58.L)
 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.F and 98.58.F Jets, outflows and bipolar flows in the Milky Way and external galaxies)
- 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 Phoenicis, 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.G, J Cataclysmic binaries and X-ray binaries*)
- 97.30.Sw Unusual and peculiar variables
- 97.60.—s Late stages of stellar evolution (including black holes)** (*see also 04.40.D Relativistic stars*)
- 97.60.Bw Supernovae (*see also 26.30 Nucleosynthesis in novae, supernovae and other explosive stars and 26.50 Nuclear physics aspects of supernovae evolution*)
- 97.60.Gb Pulsars
- 97.60.Jd Neutron stars (*see also 26.60 Nuclear matter aspects of neutron stars*)
- 97.60.Lf Black holes (*see also 04.70 Physics of black holes; for galactic black holes, see 98.35.J and 98.62.J*)
- 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.Q Novae*)
- 97.80.Hn Eclipsing binaries
- 97.80.Jp X-ray binaries (*see also 98.70.Q X-ray sources and 97.60.G Pulsars*)
- 97.80.Kq Multiple stars
- 97.82.—j Extrasolar planetary systems**
- 97.82.Cp Photometric and spectroscopic detection; coronagraphic 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) (*see also 04.70 Physics of black holes*)
- 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, and chemical, and grain processes
- 98.38.Cp Interstellar dust grains; diffuse emission; infrared cirrus
- 98.38.Dq Molecular clouds, H₂ clouds, dense clouds, and dark clouds
- 98.38.Er Interstellar masers (*for circumstellar masers, see 97.10.F*)
- 98.38.Fs Jets, outflows, and bipolar flows (*for pre-main sequence objects, see 97.21*)
- 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.R*)
- 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.R*)
- 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, H₂ clouds, dense clouds, and dark clouds
- 98.58.Ec Interstellar masers (*for circumstellar masers, see 97.10.F*)
- 98.58.Fd Jets, outflows and bipolar flows (*for pre-main sequence objects, see 97.21*)
- 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.R*)
- 98.58.Mj Supernova remnants
- 98.58.Nk Tidal tails; HI shells
- 98.62.—g Characteristics and properties of external galaxies and extragalactic objects** (*for the Milky Way, see 98.35*)
- 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 (*see also 04.70 Physics of black holes*)
- 98.62.Lv Stellar content and populations; radii; morphology and overall structure
- 98.62.Mw Infall, accretion, and accretion disks (*see also 04.70 Physics of black holes*)
- 98.62.Nx Jets and bursts; galactic winds and fountains
- 98.62.Py Distances, redshifts, radial velocities; spatial distribution of galaxies (*see also 98.80.E Observational cosmology*)
- 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.A; for intracluster matter see 98.65.H*)
- 98.62.Sb Gravitational lenses and luminous arcs (*see also 95.30.S 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** (*for cosmic rays in the Solar System, see 96.40; for pulsars, see 97.60.G*)
- 98.70.Dk Radio sources
 *Quasars, see 98.54.A*
- 98.70.Lt IR sources (*for IR sources in interstellar medium, see 98.38.J and/or 98.58.J*)
- 98.70.Qy X-ray sources; X-ray bursts (*see also 97.30.Q Novae, dwarf novae, 97.80.J X-ray binaries*)
- 98.70.Rz Gamma-ray sources; gamma-ray bursts
- 98.70.Sa Cosmic rays (including sources, origin, acceleration, and interactions)
- 98.70.Vc Background radiations
- 98.80.–k Cosmology**
- 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 Big Bang nucleosynthesis*)
- 98.80.Hw Mathematical and relativistic aspects of cosmology; quantum cosmology (*see also 04.60 Quantum gravity*)
- 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.+g Errata**

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 (<i>in PACS, see also 01.10.H</i>)			
43.05.Bp	Constitution and bylaws		
43.05.Dr	History		
43.05.Ft	Honorary members		
43.05.Gv	Publications		
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) (<i>in PACS, see also 01.10.C and 01.10.F</i>)		
43.10.Df	Other acoustical societies and their publications		
43.10.Eg	Biographical, historical, and personal notes (not of the Acoustical Society of America) (<i>in PACS, see also 01.60</i>)		
43.10.Gi	Editorials		
43.10.Hj	Books and book reviews (<i>in PACS, see also 01.30</i>)		
43.10.Jk	Bibliographies (<i>in PACS, see also 01.30.T</i>)		
43.10.Km	Patents		
43.10.Ln	Surveys and tutorial papers; historical and philosophical literature (<i>in PACS, see also 01.30.R, 01.65, and 01.70</i>)		
43.10.Nq	Nonacoustical theories		
43.10.Pr	Nonacoustical devices		
43.10.Qs	Notes on general acoustics		
43.10.Sv	Education in acoustics (<i>in PACS, see also 01.40, 01.50</i>)		
43.10.Vx	Errata		
43.15.+s Standards (<i>in PACS, see also 06.20.F</i>)			
43.20.–f General linear acoustics			
43.20.Bi	Mathematical theory of wave propagation (<i>see also 43.40.A</i>)		
43.20.Dk	Ray acoustics		
43.20.El	Reflection, refraction, diffraction of acoustic waves (<i>see also 43.30.E</i>)		
43.20.Fn	Scattering of acoustic waves (<i>see also 43.30.F, G, H</i>)		
43.20.Gp	Reflection, refraction, diffraction, interference, and scattering of elastic and poroelastic waves		
43.20.Hq	Velocity and attenuation of acoustic waves (<i>see also 43.30.B, C, E and 43.35.A, B, C</i>)		
43.20.Jr	Velocity and attenuation of elastic and poroelastic waves		
43.20.Ks	Standing waves, resonance, normal modes (<i>see also 43.25.G, 43.40.A, and 43.55.B</i>)		
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 (<i>see also 43.28.H and 43.30.J</i>)		
43.20.Tb	Interaction of vibrating structures with surrounding medium (<i>see also 43.40.R</i>)		
43.20.Wd	Analogies		
43.20.Ye	Measurement methods and instrumentation (<i>see also 43.58</i>)		
43.25.–x Nonlinear acoustics			
43.25.Ba	Parameters of nonlinearity of the medium		
43.25.Cb	Macrosonic propagation, finite amplitude sound; shock waves (<i>see also 43.28.M and 43.30.L</i>)		
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 (<i>see also 43.20.K</i>)		
43.25.Hg	Interaction of intense sound waves with noise		
43.25.Jh	Reflection, refraction, interference, scattering, and diffraction of intense sound waves (<i>see also 43.30.L and 43.20.F</i>)		
43.25.Lj	Parametric arrays, interaction of sound with sound, virtual sources (<i>see also 43.30.L</i>)		
43.25.Nm	Acoustic streaming		
43.25.Qp	Radiation pressure (<i>see also 43.58.P</i>)		
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	Acoustic cavitation, vibration of gas bubbles in liquids		
43.25.Zx	Measurement methods and instrumentation for nonlinear acoustics (<i>see also 43.58</i>)		
43.28.–g Aeroacoustics and atmospheric sound			
43.28.Bj	Mechanisms affecting sound propagation in air, sound speed in the air, acoustic-gravity waves		
43.28.Dm	Infrasound		
43.28.En	Interaction of sound with ground surfaces, ground cover and topography, and acoustic impedance of outdoor surfaces (<i>see also 43.50.V, 43.58.B</i>)		
43.28.Fp	Outdoor sound propagation through a stationary atmosphere, meteorological factors (<i>see also 43.50.V</i>)		
43.28.Gq	Outdoor sound propagation and scattering in a turbulent atmosphere, and in non-uniform flowfields (<i>see also 43.20.F and 43.50.V</i>)		
43.28.Hr	Outdoor sound sources (<i>see also 43.50.L, N, S</i>)		
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 (<i>see also 43.50.R, 43.60.C</i>)		
43.28.Mw	Shock and blast waves, sonic boom (<i>see also 43.25.C and 43.50.P</i>)		
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, turbulence (<i>see also 43.30.N and 43.50.E, N</i>)		
43.28.Tc	Sound-in-air measurements, methods and instrumentation for location, navigation, altimetry, and sound ranging (<i>see also 43.30.V and 43.58</i>)		
43.28.Vd	Measurement methods and instrumentation to determine or evaluate atmospheric parameters, winds, turbulence, temperatures, and pollutants in air (<i>see also 43.58</i>)		
43.28.We	Measurement methods and instrumentation for remote sensing and for inverse problems (<i>see also 43.58</i>)		
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.B*)
- 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.C, L*)
- 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.N and 43.28.R*)
- 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 (*see also 43.60.G*)
- 43.30.Xm Underwater measurement and calibration instrumentation and procedures (*see also 43.58*)
- 43.30.Yj Transducers and transducer arrays for underwater sound; transducer calibration (*see also 43.58.V*)
- 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.E to H*)
- 43.35.Cg Ultrasonic velocity, dispersion, scattering, diffraction, and attenuation in solids; elastic constants (*see also 43.20.G, J*)
- 43.35.Dh Pretersonics (sound of frequency above 10^{10} Hz); Brillouin scattering
- 43.35.Ei Acoustic cavitation in liquids (*see also 43.30.N*)
- 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*)
- 43.35.Hl Sonoluminescence (*in PACS, see also 78.60.M*)
- 43.35.Kp Plasma acoustics (*in PACS, see also 52.35.D*)
- 43.35.Lq Low-temperature acoustics, sound in liquid helium (*in PACS, see also 67.40.M*)
- 43.35.Mr Acoustics of viscoelastic materials
- 43.35.Ns Acoustical properties of thin films (*in PACS, see also 68.60.B*)
- 43.35.Pt Surface waves in solids and liquids (*in PACS, see also 68.35.G and 68.45.N*)
- 43.35.Rw Magnetoacoustic effect; oscillations and resonance (*in PACS, see also 75.80 and 72.55*)
- 43.35.Sx Acoustooptical effects, optoacoustics, acoustical visualization, acoustical microscopy, and acoustical holography (*see also 43.60.G, S; in PACS, see also 78.20.H*)
- 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.N and 43.80.G, J, S*)
- 43.35.Xd Nuclear acoustical resonance, acoustical magnetic resonance
- 43.35.Yb Ultrasonic instrumentation and measurement techniques (*see also 43.58*)
- 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.Y and 43.40.Y*)
- 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.Y*)
- 43.38.Ja Loudspeakers and horns, practical sound sources (*see also 43.20.R and 43.38.T*)
- 43.38.Kb Microphones and their calibration (*see also 43.30.Y and 43.40.Y*)
- 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.F and 43.35.P*)
- 43.38.Si Telephones, earphones, sound power telephones, and intercommunication systems
- 43.38.Tj Public address systems, sound-reinforcement systems (*see also 43.55.J*)
- 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.S*)
- 43.40.—r Structural acoustics and vibration**
- 43.40.At Experimental and theoretical studies of vibrating systems (*see also 43.20.B, K, R*)
- 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; velocity of shock waves (*see also 43.25.C, 43.28.M, and 43.30.Q*)
- 43.40.Kd Impact and impact reduction, mechanical transients
- 43.40.Le Techniques for nondestructive evaluation and monitoring, acoustic emission (*see also 43.35.Z*)
- 43.40.Ng Effects of vibration and shock on biological systems, including man (*see also 43.35.W, 43.50.Q, and 43.80*)
- 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 Mechanical filters (*see also 43.58.K*)
- 43.40.Tm Vibration isolators, attenuators, and dampers (*see also 43.55.V*)
- 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.R)
- 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.D)
- 43.50.Hg Noise control at the ear (*see also* 43.66.V)
- 43.50.Jh Noise in buildings and general machinery noise (*see also* 43.55.E, F, R)
- 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.R)
- 43.50.Pn Impulse noise and noise due to impact (*see also* 43.40.K)
- 43.50.Qp Effects of noise on man and society (*see also* 43.66.E and 43.80.N)
- 43.50.Rq Environment noise, measurements, 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)
- 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.F, K)
- 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.J)
- 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.G, J)
- 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.T)
- 43.55.Ka Computer simulation of acoustics in enclosures, modeling (*see also* 43.58.T)
- 43.55.Lb Electrical simulation of reverberation
- 43.55.Mc Room acoustics measuring instruments, computer measurement of room properties (*see also* 43.58.F)
- 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.J)
- 43.55.Vj Vibration-isolating supports in building acoustics (*see also* 43.40.T; in PACS, *see* 07.10.F)
- 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.J, 43.20.R, and 43.40.Y)
- 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.M)
- 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.S)
- 43.58.Ls Acoustical lenses and microscopes (*see also* 43.35.S)
- 43.58.Mt Phase meters
- 43.58.Pw Rayleigh disks (*see also* 43.25.Q)
- 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.W, 43.55.K, 43.60.G, and 43.70.J)
- 43.58.Vb Calibration of acoustical devices and systems
- 43.58.Wc Electrical and mechanical oscillators
- 43.60. – c Acoustic signal processing**
- 43.60.Bf Acoustic signal detection for system control
- 43.60.Cg Statistical properties of signals and noise
- 43.60.Dh Acoustical system communication, telemetry
- 43.60.Gk Space–time signal processing, matched field processing (*see also* 43.35.S, 43.30.W)
- 43.60.Lq Displays, pattern recognition, learning machines, adaptive processing
- 43.60.Pt Acoustical inverse problems
- 43.60.Qv Instrumentation and measurement methods (*see also* 43.58)
- 43.60.Rw Remote sensing methods, acoustic tomography
- 43.60.Sx Acoustical holography processing
- 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 emission
- 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)
- 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
- 43.66.Ki Subjective tones

- 43.66.Lj Perceptual effects of sound (*see also 43.71*)
- 43.66.Mk Temporal and sequential aspects of hearing
- 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.H*)
- 43.66.Wv Vibration and tactile senses
- 43.66.Yw Instruments and methods related to hearing and its measurement (*see also 43.58*)
- 43.70.—h Speech production**
- 43.70.Aj Anatomy and physiology of the vocal tract, larynx function, speech aerodynamics, articulatory kinematics, artificial larynx
- 43.70.Bk Models and theories of speech production
- 43.70.Dn Disordered speech; speech training
- 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 Voice and talker characteristics
- 43.70.Jt Instrumentation and methodology for speech production research
- 43.70.Kv Cross-language analysis
- 43.71.—k Speech perception**
- 43.71.An Models and theories of speech perception (*see also 43.66.B*)
- 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.L*)
- 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.T*)
- 43.71.Lz Speech perception by the aging
- 43.71.Ma Visual and tactile speech perception
- 43.71.Pc Peripheral and central mechanisms in speech perception
- 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.Ew Speech enhancement techniques
- 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 speech performance (*see also 43.38.S*)
- 43.72.Lc Time and frequency alignment procedures for speech
- 43.72.Ne Automatic speech recognition systems
- 43.72.Pf Automatic talker recognition systems
- 43.75.—z Music and musical instruments**
- 43.75.Bc Intonation, vibrato, musical scales, and musical composition
- 43.75.Cd Music perception and cognition
- 43.75.De Bowed stringed instruments
- 43.75.Ef Woodwinds
- 43.75.Fg Brass wind instruments (lip vibrated)
- 43.75.Gh Plucked stringed instruments
- 43.75.Hi Drums and other membranophonic instruments
- 43.75.Kk Bells, xylophones, and other instruments having rigid vibrators
- 43.75.Mn Pianos and other keyboard stringed instruments
- 43.75.Np Pipe organs
- 43.75.Pq Reed wind instruments
- 43.75.Qr Flue wind instruments
- 43.75.Rs Singing
- 43.75.St Musical performance analysis and training
- 43.75.Tv Electrical musical instruments
- 43.75.Wx Electronic music, computer music (*see also 43.58.T*)
- 43.75.Yy Instrumentation and techniques for measurements (*see also 43.58*)
- 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.K*)
- 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.K*)
- 43.80.Ka Sound production by animals: mechanisms, characteristics, populations, biosonar (*see also 43.30.N and 43.64.T*)
- 43.80.Lb Sound reception by animals: anatomy, physiology, auditory capacities, processing (*see also 43.64.T, 43.66.G*)
- 43.80.Nd Effects of noise on animals and associated behavior, protective mechanisms (*see also 43.50.Q, 43.64.T*)
- 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.K*)
- 43.80.Vj Acoustical medical instrumentation and measurement techniques (*see also 43.66.T and 43.58*)
- 43.90.+v Other topics in acoustics (restricted to new topics in section 43)