

# Subject index

## Volume 50, 2007

[This subject index is based on the Physics and Astronomy Classification Scheme (PACS 2006)]

### 00. GENERAL

#### 01. Communication, education, history, and philosophy

##### 01.10–m Announcements, news, and organizational activities

01.10.Fv Conferences, lectures, and institutes 103, 301, 303, 308, 315, 331, 332, 333, 354, 359, 368, 377, 380, 390, 397, 529, 534, 540, 545, 649, 656, 741, 744, 749, 847, 853, 862, 870, 965, 971, 1083

##### 01.30.–y Physics literature and publications

01.30.Tt Bibliographies 111, 221, 327, 767, 875, 979, 1291

01.30.Vv Book reviews 977

##### 01.52. + r National and international laboratory facilities 656

##### 01.55. + b General physics 1239

01.60. + q Biographies, tributes, personal notes, and obituaries 109, 219, 325, 557, 559, 661, 663, 763, 1189, 1191, 1193, 1283, 1287

01.65. + g History of science 377, 380, 649, 656, 977, 1179, 1239, 1259

01.70. + w Philosophy of science 397

01.90. + g Other topics of general interest 113, 223, 329, 453, 561, 667, 769, 877, 983, 1089, 1195, 1289

#### 02. Mathematical methods in physics

02.20.–a Group theory 1217

#### 03. Quantum mechanics, field theories, and special relativity

03.30. + p Special relativity 95

03.65.–w Quantum mechanics 1243

03.65.Ca Formalism 1217

03.65.Fd Algebraic methods 1217

03.65.Ge Solutions of wave equations: bound states 37, 293

03.65.Sq Semiclassical theories and applications 37

03.65.Ta Foundations of quantum mechanics; measurement theory 397

03.65.Ud Entanglement and quantum nonlocality 107, 555

03.65.Yz Decoherence; open systems; quantum statistical methods 397

#### 04. General relativity and gravitation

04.20.–q Classical general relativity 965

04.70.–s Physics of black holes 965

#### 05. Statistical physics, thermodynamics, and nonlinear dynamical systems

05.10–a Computational methods in statistical physics and nonlinear dynamics

05.10.Ln Monte Carlo methods 985

05.45.–a Nonlinear dynamics and chaos 79, 263, 819, 939

05.45.Ac Low-dimensional chaos 939

05.45.Pq Numerical simulations of chaotic systems 819

05.45.Tp Time series analysis 819

##### 05.60.–k Transport processes

05.60.Cd Classical transport 1239

#### 07. Instruments, apparatus, and components common to several branches of physics and astronomy

07.57.–c Infrared, submillimeter wave, microwave and radio-wave instruments and equipment 489

07.60.–j Optical instruments and equipment 513

07.85.–m X- and gamma-ray instruments 368

07.85.Qe Synchrotron radiation instrumentation 368

#### 11. General theory of fields and particles

##### 11.15.–q Gauge field theories

11.15.Ex Spontaneous breaking of gauge symmetries 669

##### 11.30.–j Symmetry and conservation laws

11.30.Er Charge conjugation, parity, time reversal, and other discrete symmetries 380

11.30.Fs Global symmetries 669

#### 12. Specific theories and interaction models; particle systematics

12.15.–y Electroweak interactions 1

12.60.–i Models beyond the standard model 1, 380, 390, 669

#### 13. Specific reactions and phenomenology

##### 13.20.–v Leptonic, semileptonic, and radiative decays of mesons

13.20.He Decays of bottom mesons 669

#### 14. Properties of specific particles

##### 14.40.–n Mesons

14.40.Nd Bottom mesons 669

##### 14.80.–j Other particles

14.80.Bn Standard-model Higgs bosons 1

14.80.Cp Non-standard-model Higgs bosons 1

### 20. NUCLEAR PHYSICS

#### 25. Nuclear reactions: specific reactions

25.20.–x Photonuclear reactions 853

- 28. Nuclear engineering and nuclear power studies**
- 28.41. –i Fission reactors 1259
- 28.50. –k Fission reactor types 1179, 1259
- 29. Experimental methods and instrumentation for elementary-particle and nuclear physics**
- 29.20. –c Cyclic accelerators and storage rings
- 29.20.Hm Cyclotrons 847
- 29.20.Lq Synchrotrons 847, 862, 870
- 29.40. –n Radiation detectors 377
- 30. ATOMIC AND MOLECULAR PHYSICS**
- 31. Electronic structure of atoms and molecules: theory**
- 31.15. –p Calculations and mathematical techniques in atomic and molecular physics 835
- 31.50. –x Potential energy surfaces
- 31.50.Bc Potential energy surfaces for ground electronic states 835
- 32. Atomic properties and interactions with photons**
- 32.80. –t Photon interactions with atoms
- 32.80.Fb Photoionization of atoms and ions 835
- 33. Molecular properties and interactions with photons**
- 33.20. –t Molecular spectra
- 33.20.Kf Visible spectra 985
- 33.80. –b Photon interactions with molecules
- 33.80.Eh Autoionization, photoionization, and photodetachment 53
- 34. Atomic and molecular collision processes and interactions**
- 34.70. + e Charge transfer 985
- 36. Exotic atoms and molecules; macromolecules; clusters**
- 36.20. –r Macromolecules and polymer molecules 53
- 36.40. –c Atomic and molecular clusters 354, 455, 907
- 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.Jb Electromagnetic wave propagation; radiowave propagation 287, 315, 489, 1091
- 41.60. –m Radiation by moving charges 377, 545
- 41.60.Cr Free-electron lasers 303, 368
- 42. Optics**
- 42.25. –p Wave optics
- 42.25.Bs Wave propagation, transmission and absorption 37
- 42.25.Gy Edge and boundary effects; reflection and refraction 37
- 42.25.Hz Interference 595
- 42.25.Ja Polarization 301
- 42.25.Lc Birefringence 595
- 42.50. –p **Quantum optics** 649
- 42.50.Lc Quantum fluctuations, quantum noise, and quantum jumps 1243
- 42.55. –f Lasers 649, 1147
- 42.55.Ah General laser theory 1243
- 42.62. –b **Laser applications** 656
- 42.65. –k **Nonlinear optics** 595, 729
- 42.65.Dr Stimulated Raman scattering; CARS 705
- 42.65.Ky Frequency conversion; harmonic generation, including higher-order harmonic generation 705, 729
- 42.65.Re Ultrafast processes; optical pulse generation and pulse compression 705
- 42.65.Wi Nonlinear waveguides 705
- 42.72. –g **Optical sources and standards** 741
- 42.82. –m **Integrated optics**
- 42.82.Cr Fabrication techniques; lithography, pattern transfer 741
- 43. Acoustics**
- 43.25. + y **Nonlinear acoustics** 359
- 43.25. – x **Nonlinear acoustics** 359
- 43.35. –c **Ultrasonics, quantum acoustics, and physical effects of sound**
- 43.35.Mr Acoustics of viscoelastic materials 359
- 43.80. –n **Bioacoustics**
- 43.80.Cs Acoustical characteristics of biological media: molecular species, cellular level tissues 359
- 43.80.Qf Medical diagnosis with acoustics 359
- 44. Heat transfer**
- 44.40. + a **Thermal radiation** 879
- 50. PHYSICS OF GASES, PLASMAS, AND ELECTRIC DISCHARGES**
- 52. Physics of plasmas and electric discharges**
- 52.20. –j **Elementary processes in plasmas** 545
- 52.20.Hv Atomic, molecular, ion, and heavy-particle collisions 1147
- 52.25. –b **Plasma properties** 333, 409, 771
- 52.27. –h **Basic studies of specific kinds of plasmas**
- 52.27.Lw Dusty or complex plasmas; plasma crystals 409, 545
- 52.35. –g **Waves, oscillations, and instabilities in plasmas and intense beams** 141, 1091
- 52.35.Mw Nonlinear phenomena: waves, wave propagation, and other interactions 315, 729
- 52.35.Tc Shock waves and discontinuities 333, 771
- 52.40. –w **Plasma interactions (nonlaser)**
- 52.40.Db Electromagnetic (nonlaser) radiation interactions with plasma 1091
- 52.40.Hf Plasma-material interactions; boundary layer effects 907
- 52.40.Mj Particle beam interactions in plasmas 907
- 52.59. –f **Intense particle beams and radiation sources** 141, 303

- 52.75.–d Plasma devices 1147  
 52.80.–s Electric discharges 1147  
 52.80.Sm Magnetoactive discharges 455
- 60. CONDENSED MATTER: STRUCTURAL, MECHANICAL, AND THERMAL PROPERTIES**
- 61. Structure of solids and liquids; crystallography**
- 61.12.–q Neutron diffraction and scattering  
 61.12.Ex Neutron scattering 1083  
 61.20.–p Structure of liquids 1083  
 61.43.–j Disordered solids  
 61.43.Dq Amorphous semiconductors, metals, and alloys 691  
 61.46.–w Nanoscale materials 225, 691, 907  
 61.46.Bc Clusters 354, 455  
 61.46.Fg Nanotubes 749  
 61.48.+c Fullerenes and fullerene-related materials 691
- 62. Mechanical and acoustical properties of condensed matter**
- 62.20.–x Mechanical properties of solids  
 62.20.Mk Fatigue, brittleness, fracture, and cracks 359  
 62.25.+g Mechanical properties of nanoscale materials 225  
 62.50.+p High-pressure and shock wave effects in solids and liquids 771  
 62.65.+k Acoustical properties of solids 359
- 64. Equations of state, phase equilibria, and phase transitions 333, 771**
- 64.70.–p Specific phase transitions  
 64.70.Dv Solid-liquid transitions 354
- 65. Thermal properties of condensed matter**
- 65.80.+n Thermal properties of small particles, nanocrystals, and nanotubes 879
- 68. Surfaces and interfaces; thin films and low-dimensional systems**
- 68.43.–h Chemisorption/physisorption: adsorbates on surfaces 53  
 68.65.–k Low-dimensional, mesoscopic, and nanoscale systems: structure and nonelectronic properties 879
- 70. CONDENSED MATTER: ELECTRONIC STRUCTURE, ELECTRICAL, MAGNETIC, AND OPTICAL PROPERTIES**
- 71. Electronic structure of bulk materials**
- 71.10.–w Theories and models of many-electron systems 1171  
 71.10.Ay Fermi-liquid theory and other phenomenological models 933  
 71.15.–m Methods of electronic structure calculations  
 71.15.Mb Density functional theory, local density approximation, gradient and other corrections 933
- 71.23.–k Electronic structure of disordered solids 1031  
 71.27.+a Strongly correlated electron systems; heavy fermions 563, 1171  
 71.30.+h Metal-insulator transitions and other electronic transitions 1171  
 71.35.–y Excitons and related phenomena 985  
 71.55.–i Impurity and defect levels 1031
- 72. Electronic transport in condensed matter**
- 72.80.–r Conductivity of specific materials  
 72.80.Tm Composite materials 1239
- 73. Electronic structure and electrical properties of surfaces, interfaces thin films, and low-dimensional structures**
- 73.40.–c Electronic transport in interface structures 1171  
 73.43.–f Quantum Hall effects 197  
 73.43.Fj Novel experimental methods; measurements 197
- 74. Superconductivity**
- 74.20.–z Theories and models of superconducting state 933  
 74.20.De Phenomenological theories 540  
 74.20.Fg BCS theory and its development 563  
 74.20.Mn Nonconventional mechanisms 540  
 74.25.–q Properties of type I and type II superconductors  
 74.25.Jb Electronic structure 563  
 74.62.–c Transition temperature variations  
 74.62.Dh Effects of crystal defects, doping and substitution 1171  
 74.72.–h Cuprate superconductors 540, 933
- 75. Magnetic properties and materials**
- 75.10.–b General theory and models of magnetic ordering 613  
 75.20.–g Diamagnetism, paramagnetism, and superparamagnetism 1031  
 75.30.–m Intrinsic properties of magnetically ordered materials  
 75.30.Ds Spin waves 613  
 75.40.–s Critical-point effects, specific heats, short-range order  
 75.40.Cx Static properties 613  
 75.40.Gb Dynamic properties 793  
 75.40.Mg Numerical simulation studies 793  
 75.50.–y Studies of specific magnetic materials  
 75.50.Mm Magnetic liquids 1083  
 75.75.+a Magnetic properties of nanostructures 1031
- 76. Magnetic resonances and relaxations in condensed matter, Mössbauer effect**
- 76.30.–v Electron paramagnetic resonance and relaxation 977  
 76.50.+g Ferromagnetic, antiferromagnetic, and ferrimagnetic resonances; spin-wave resonance 793  
 76.60.–k Nuclear magnetic resonance and relaxation 1053
- 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**  
78.20.Ci Optical constants 287
- 78.40.–q **Absorption and reflection spectra: visible and ultraviolet**  
78.40.Me Organic compounds and polymers 985
- 78.55.–m **Photoluminescence, properties and materials**  
78.55.Mb Porous materials 595
79. **Electron and ion emission by liquids and solids; impact phenomena**
- 79.60.–i **Photoemission and photoelectron spectra** 1079  
79.60.Dp Adsorbed layers and thin films 1079
- 79.70. + q **Field emission, ionization, evaporation, and desorption** 53
80. **INTERDISCIPLINARY PHYSICS AND RELATED AREAS OF SCIENCE AND TECHNOLOGY**
81. **Materials science**
- 81.07.–b **Nanoscale materials and structures: fabrication and characterization** 225, 691, 744
- 81.16.–c **Methods of nanofabrication and processing** 744  
81.16.Ta Atom manipulation 744
82. **Physical chemistry and chemical physics**
- 82.20.–w **Chemical kinetics and dynamics** 985  
82.39.–k **Chemical kinetics in biological systems** 79  
82.56.–b **Nuclear magnetic resonance** 1053
84. **Electronics; radiowave and microwave technology; direct energy conversion and storage**
- 84.40.–x **Radiowave and microwave (including millimeter wave) technology** 489  
84.40.Ik Masers; gyrotrons 303
85. **Electronic and magnetic devices; microelectronics**
- 85.85. + j **Micro- and nano-electromechanical systems (MEMS/NEMS) and devices** 225, 749
87. **Biological and medical physics**
- 87.10. + e **General theory and mathematical aspects** 301  
87.15.–v **Biomolecules: structure and physical properties** 175  
87.16.–b **Subcellular structure and processes** 513  
87.18.–h **Multicellular phenomena**  
87.18.Hf Spatiotemporal pattern formation in cellular populations 263
- 87.19.–j **Properties of higher organisms**  
87.19.Uv Haemodynamics, pneumodynamics 79
- 87.23.–n **Ecology and evolution**  
87.23.Cc Population dynamics and ecological pattern formation 263  
87.23.Kg Dynamics of evolution 175
- 87.61.–c **Magnetic resonance imaging** 1053  
87.64.–t **Spectroscopic and microscopic techniques in biophysics and medical physics** 513
- 87.80.–y **Biological techniques and instrumentation; biomedical engineering**  
87.80.Mj Micromachining 749
90. **GEOPHYSICS, ASTRONOMY, AND ASTROPHYSICS**
91. **Solid Earth physics**
- 91.25.–r **Geomagnetism and paleomagnetism; geoelectricity**  
91.25.Qi Geoelectricity, electromagnetic induction, and telluric currents 1197
- 91.45.–c **Tectonophysics**  
91.45.Nc Evolution of the Earth 175
92. **Hydrospheric and atmospheric geophysics**
- 92.60.–e **Properties and dynamics of the atmosphere; meteorology**  
92.60.Iv Paleoclimatology 175
94. **Physics of the ionosphere and magnetosphere**
- 94.05.–a **Space plasma physics**  
94.05.Bf Plasma interactions with dust and aerosols 409
- 94.20.–y **Physics of the ionosphere** 315, 1091  
94.30.–d **Physics of the magnetosphere** 1197  
94.30.Tz Electromagnetic wave propagation 1197
95. **Fundamental astronomy and astrophysics; instrumentation, techniques, and astronomical observations**
- 95.30.–k **Fundamental aspects of astrophysics** 103, 529  
95.30.Qd Magnetohydrodynamics and plasmas 141
- 95.35. + d **Dark matter** 390, 971  
95.36. + x **Dark energy** 390
- 95.55.–n **Astronomical and space-research instrumentation**  
95.55.Jz Radio telescopes and instrumentation; heterodyne receivers 529
- 95.55.Qf Photometric, polarimetric, and spectroscopic instrumentation 637
- 95.75.–z **Observation and data reduction techniques; computer modeling and simulation** 115
- 95.85.–e **Astronomical observations**  
95.85.Bh Radio, microwave (> 1 mm) 529  
95.85.Kr Visible (390–750 nm) 637
96. **Solar system; planetology**
- 96.30.–t **Solar system objects**  
96.30.Ys Asteroids, meteoroids 637
- 96.50.–e **Interplanetary physics**  
96.50.S– **Cosmic rays** 308, 534
97. **Stars**
- 97.10.–q **Stellar characteristics and properties** 1123  
97.60.–s **Late stages of stellar evolution**  
97.60.Jd Neutron stars 1123  
97.80.–d **Binary and multiple stars** 1123

- 
- 98. Stellar systems; interstellar medium; galactic and extragalactic objects and systems; the Universe**
- 98.52. – b Normal galaxies; extragalactic objects and systems**  
98.52.Nr Spiral galaxies 115
- 98.62. – g Characteristics and properties of external galaxies and extragalactic objects**  
98.62.Hr Spiral arms and bars; galactic disks 115
- 98.70. – f Unidentified sources of radiation outside the Solar System**  
98.70.Sa Cosmic rays 308, 534
- 98.80. – k Cosmology** 965, 971