CURRICULUM VITAE

William B. Hubbard

Present position:

Professor Emeritus, Department of Planetary Sciences and Lunar and Planetary Laboratory, University of Arizona

Education:

1962 - B.A., Physics, Rice University (*magna cum laude*)

1967 - Ph.D., Astronomy, University of California, Berkeley

Dissertation Title: "Electron Conduction in Degenerate Stellar Matter"

Dissertation Director: L.G. Henyey

Academic and Professional Appointments:

1966, Fellow, Lick Observatory

1967-1968, Postdoctoral Research Fellow, Kellogg Radiation Laboratory, California Institute of Technology

1968-1972, Assistant Professor of Astronomy, University of Texas at Austin

1970-1977, Consultant, Jet Propulsion Laboratory, Pasadena, California

1972-1982, Consultant, NASA Headquarters, Washington, DC

1972-1986, Consultant, Lawrence Livermore National Laboratory, Livermore, California

1972-1975, Associate Professor, Department of Planetary Sciences and Lunar and Planetary Laboratory, University of Arizona, Tucson, Arizona

1973, National Academy of Sciences Exchange Scientist to the USSR (O. Yu. Schmidt Institute of Geophysics, Moscow)

1975-2017, Professor, Department of Planetary Sciences and Lunar and Planetary Laboratory, University of Arizona, Tucson, Arizona

1977, Acting Director, Lunar and Planetary Laboratory, and Acting Head, Department of Planetary Sciences, University of Arizona

1978-1981, Director, Lunar and Planetary Laboratory, and Head, Department of Planetary Sciences, University of Arizona

2017- , Professor Emeritus, Department of Planetary Sciences and Lunar and Planetary Laboratory, University of Arizona, Tucson, Arizona

Memberships:

American Association for the Advancement of Science

American Astronomical Society (Division for Planetary Sciences)

American Geophysical Union

International Astronomical Union

Awards and Honors:

1989, Fellow, Japan Society for the Promotion of Science

1991, Fellow, American Geophysical Union

2003, Fellow, American Association for the Advancement of Science

2005, Gerard P. Kuiper Prize in Planetary Sciences, Division for Planetary Sciences, American Astronomical Society

2010, main-belt asteroid 11216 Billhubbard (1999 JG1)

2012, NASA Group Achievement Award for *Juno* proposal

2012, NASA Group Achievement Award for *Juno* development, launch, and early operations
2013, Blitzer Award for Excellence in the Teaching of Physics and Related Sciences, University of Arizona
2017, AIAA Space Systems Medal to *Juno* project, for exceptional achievement in the development and implementation of the *Juno* mission
2019, Fellow, American Astronomical Society

Professional Service:

1971-1972, Science Advisory Group on Outer Solar System Exploration, NASA
1972-1973, Outer Planets Science Working Group, NASA
1973, 1974, Jupiter-Uranus Science Advisory Group, NASA
1973-1975, Interchange participant, Ames Research Center
1977-1980, Member, *Icarus* Editorial Board
1978, Shuttle-Salyut Payload Study Group, NASA
1980-2003, Associate Editor, *Icarus*
1984-1985, Nomination committee, Kuiper and Urey awards of the Division for Planetary Sciences, American Astronomical Society
1986-1988, Member, Division for Planetary Sciences Committee
1989-1990, Member, Planetary Panel, Astronomy and Astrophysics Survey Committee, National Research Council
1991-1996, Member, Outer Planets Science Working Group, NASA
1994-1996, Chairman, Outer Planets Science Working Group, NASA
1996-1998, Chairman, Astrophysical Analogs Campaign Strategy Working Group, NASA
1994-1998, Member, Solar System Exploration Subcommittee, NASA
1998-2001, Member, Electorate Nominating Committee, Astronomy, AAAS (Chair, 2000)
2000, Group Chief, Planetary Astronomy Review Panel, NASA
2001, *ad hoc* member, Core Writing Committee, NASA Planetary Astronomy Program
2003-2006, member, Committee on Planetary and Lunar Exploration (COMPLEX), NAS-NRC
2004-2006, member, Steering Committee, Outer Planets Advisory Group, NASA
2005-2010, Receiving Editor, *New Astronomy* (Elsevier)
2003-2006, Member, IAU Working Group on Extrasolar Planets
2006-2015, Member, IAU Commission 53 on Extrasolar Planets
2015-, Member, IAU Commission C.F2 on Exoplanets and the Solar System
2007, Member, Cassini Extended Mission Senior Review Board
2008-2009, Prize Subcommittee, Division for Planetary Sciences, American Astronomical Society
2009, Atmospheres Panel Chair, NASA Cassini Data Analysis Program
2009-2010, Member, Giant Planets Panel, Decadal Survey of Astronomy and Astrophysics, NAS-NRC
2020, Member, Paolo Farinella Prize Committee, Europlanet Society

2005-2023…, Co-Investigator, NASA *Juno* Jupiter orbiter mission

Major Fields of Research:

Planetary interiors, high pressure physics, structure of rotating planets, stellar structure, occultation theory and observation, turbulence, extrasolar giant planets and brown dwarfs.

Publications:

RESEARCH PAPERS IN REFEREED JOURNALS

[1] Photoelectric Spectrophotometry of Gaseous Nebulae. I. The Orion Nebula, C.R. O'Dell and W.B. Hubbard, *Astrophys. J.*, **142**, 591, 1965.

[2] Photoelectric Spectrophotometry of Gaseous Nebulae. III. Scattered Light in Three Bright HII Regions, C.R. O'Dell, W.B. Hubbard, and M. Peimbert, *Astrophys. J.*, **143**, 743, 1966.

[3] Studies in Stellar Evolution. V. Transport Coefficients of Degenerate Stellar Matter, W. B. Hubbard, *Astrophys. J.*, **146**, 858, 1966.

[4] Thermal Structure of Jupiter, W. B. Hubbard, *Astrophys. J.*, **152**, 745, 1968.

[5] Thermal Models of Jupiter and Saturn, W. B. Hubbard, *Astrophys. J.*, **155**, 333, 1969.

[6] Thermal Conduction by Electrons in Stellar Matter, W.B. Hubbard and M. Lampe, *Astrophys. J. Supplement*, **18**, 297, 1969.

[7] Hot White Dwarfs, W.B. Hubbard and R.L. Wagner, *Astrophys. J.*, **159**, 93, 1970.

[8] Structure of Jupiter: Chemical Composition, Contraction, and Rotation, W. B. Hubbard, *Astrophys. J.*, **162**, 687, 1970.

[9] Statistical Mechanics of Light Elements at High Pressures. I. Theory and Results for Metallic Hydrogen with Simple Screening, W.B. Hubbard and W.L. Slattery, *Astrophys. J.*, **168**, 131, 1971.

[10] The Occultation of Beta Scorpii C by Io on 1971 May 14, W. B. Hubbard and 10 other coauthors, *Nature*, **234**, 405, 1971.

[11] The Occultation of Beta Scorpii by Jupiter and Io. I. Jupiter, W.B. Hubbard, R.E. Nather, D.S. Evans, F.G. Tull, D.C. Wells, G.W. Van Citters, B. Warner, and P. Vanden Bout, *Astron. J.*, **77**, 41, 1972.

[12] The Occultation of Beta Scorpii by Jupiter and Io. III. Astrometry, W. B. Hubbard and T.C. Van Flandern, *Astron. J.*, **77**, 65, 1972.

[13] Statistical Mechanics of Light Elements at High Pressure. II. Hydrogen and Helium Alloys, *Astrophys. J.*, **176**, 525, 1972.

[14] Thermodynamics of Hydrogen-Helium Mixtures at High Pressure and Finite Temperature, W. B. Hubbard, *Phys. of the Earth and Planetary Interiors*, **6**, 65, 1972.

[15] Observations of Rapid Blue Variables. XI. DQ Herculis, B. Warner, W. Peters, R. Nather, and W.B. Hubbard, *Mon. Not. Roy. Astron. Soc.*, **159**, 321, 1972.

[16] Solidification of a Carbon-Oxygen Plasma, W. B. Hubbard and G. Loumos, *Astrophys. J.*, **180**, 199, 1973.

[17] Discrepancies in Measurements of the Jupiter Atmospheric Scale Height, W. B. Hubbard and D. S. Evans, *Nature Phys. Sci*., **240**, 162, 1972.

[18] Statistical Mechanics of Light Elements at High Pressure. III. Molecular Hydrogen, W. L. Slattery and W. B. Hubbard, *Astrophys. J.*, **181**, 1031, 1973.

[19] Observational Constraint on the Structure of Hydrogen Planets, W. B. Hubbard, *Astrophys. J. Lett.*, **182**, 132, 1973.

[20] Gravitational Field of a Rotating Planet of Unit Polytropic Index, *Astronomicheskii Zhurnal*, **51**, 1052, 1974.

[21] Significance of Gravitational Moments for Interior Structure of Jupiter and Saturn, W.B. Hubbard, V.N. Zharkov, and V.P. Trubitsyn, *Icarus*, **21**, 147, 1974.

[22] Inversion of Gravity Data for Giant Planets, W. B. Hubbard, *Icarus*, **21**, 157, 1974.

[23] Deuterium Enrichment of Metallic Hydrogen, W. B. Hubbard, *Astrophys. J.*, **190**, 223, 1974.

[24] Tides in the Giant Planets, W. B. Hubbard, *Icarus*, **23**, 42, 1974.

[25] Structure of the Jovian Envelope from Pioneer 10 Gravity Data, W. B. Hubbard, J. D. Anderson, and W. L. Slattery, *Astrophys. J. Lett.*, **193**, 1149, 1974.

[26] Interior Structure of Uranus: Critical Measurements for an MJU Mission, *Icarus*, **24**, 285, 1975.

[27] High Zonal Harmonics of Rapidly Rotating Planets, W. B. Hubbard, W. L. Slattery, and C.L. DeVito, *Astrophys. J.*, **199**, 504, 1975.

[28] Effect of the Jovian Oblateness on Pioneer 10/11 Radio Occultation, W. B. Hubbard, D. M. Hunten, and A. Kliore, *Geophys. Res. Lett.*, **2**, 265, 1975.

[29] Effects of Turbulence on Radio-Occultation Scale Heights, W. B. Hubbard and J. R. Jokipii, *Astrophys. J. Lett.*, **199**, L193, 1975.

[30] Comparison of Geometrical Effects in Radio and Stellar Occultations, W. B. Hubbard, *Icarus*, **26**, 175, 1975.

[31] Ray Propagation in Oblate Atmospheres, W. B. Hubbard, *Icarus*, **27**, 387, 1976.

[32] Statistical Mechanics of Light Elements at High Pressure. IV. A Model Free Energy for the Metallic Phase, H. E. DeWitt and W. B. Hubbard, *Astrophys. J.*, **205**, 295, 1976.

[33] Thermodynamics of a Solar Mixture of Molecular Hydrogen and Helium at High Pressure, W. L. Slattery and W. B. Hubbard, *Icarus*, **29**, 187, 1976.

[34] Temperature of the Atmosphere of Jupiter from Pioneer 10/11 Radio Occultations, A. Kliore, P. Woiceshyn, and W. B. Hubbard, *Geophys. Res.Lett.*, **3**, 113, 1976.

[35] DeSitter's Theory Flattens Jupiter, W. B. Hubbard, *Icarus*, **30**, 305, 1977.

[36] The Jovian Surface Condition and Cooling Rate, W. B. Hubbard, *Icarus*, **30**, 305, 1977.

[37] Stellar Occultations by Turbulent Planetary Atmospheres: A Heuristic Scattering Model, W. B. Hubbard and J. R. Jokipii, *Icarus*, **30**, 531, 1977.

[38] Stellar Occultations by Turbulent Planetary Atmospheres: The Beta Sco Events, J. R. Jokipii and W. B. Hubbard, *Icarus*, **30**, 537, 1977.

[39] Effects of Particle Drift on Cosmic- Ray Transport. I. General Properties, Application to Solar Modulation, J. R. Jokipii, E. H. Levy, and W. B. Hubbard, *Astrophys. J.*, **213**, 861, 1977.

[40] The Occultation of Epsilon Geminorum by Mars: Analysis of McDonald Data, W. B. Hubbard and 9 coauthors, *Astrophys. J.*, **214**, 934, 1977.

[41] Turbulent Scattering in an Exponential Atmosphere: A Wave-Optical Model, W. B. Hubbard and J. R. Jokipii, *Astrophys. J.*, **214**, 924, 1977.

[42] Possible Flyby Measurements of Galilean Satellite Interior Structure, W. B. Hubbard and J. D. Anderson, *Icarus*, **33**, 336, 1978.

[43] Wave Optics of the Central Spot in Planetary Occultations, W. B. Hubbard, *Nature*, **268**, 34, 1977.

[44] Observations of Uranus Occultation Events, W. B. Hubbard, G. Coyne, T. Gehrels, B. Smith, and B. Zellner, *Nature*, **268**, 33, 1977.

[45] Stellar Occultations by Turbulent Planetary Atmospheres: A Wave-Optical Theory Including a Finite Scale Height, W. B. Hubbard, J. R. Jokipii, and B. A. Wilking, *Icarus*, **34**, 374, 1978.

[46] Comparative Thermal Evolution of Uranus and Neptune, *Icarus*, **35**, 177, 1978.

[47] Comment on the Paper, "On the Wavelength Dependence..., by Haugstad and Eshleman," W.B. Hubbard and J.R. Jokipii, *Astrophys, J.*, **299**, 399, 1979.

[48] The Epsilon Geminorum Occultation: Evidence for Waves or Turbulence, W. B. Hubbard, *Astrophys. J.*, **299**, 821, 1979.

[49] On the Atmosphere with Exponential Turbulence, W. B. Hubbard, *Icarus*, **39**, 473, 1979.

[50] Structure and Evolution of Uranus and Neptune, W. B. Hubbard and J. J. MacFarlane, *J. Geophys. Res.*, **85**, 225, 1980.

[51] Pioneer Saturn Celestial Mechanics Experiment, J. D. Anderson, G. W. Null, E. D. Biller, S. K.Wong, W. B. Hubbard, and J. J. MacFarlane, *Science*, **207**, 449, 1980.

[52] Results from the 10 March 1977 Occultation by the Uranus System, W. B. Hubbard and B. H. Zellner, *Astron. J.*, **85**, 1663, 1980.

[53] Theoretical Predictions of Deuterium Abundances in the Jovian Planets, W. B. Hubbard and J. J. MacFarlane, *Icarus*, **44**, 676, 1980.

[54] Interior Structure of Saturn Inferred from Pioneer 11 Gravity Data, W. B. Hubbard, J. J. MacFarlane, J. D. Anderson, G. W. Null, and E. D. Biller, *J. Geophys. Res.*, **85**, 5909, 1980.

[55] High-Speed Photometry of the 11 December 1979 Juno Occultation, H. J. Reitsema, W. B. Hubbard, B. H. Zellner, and L. A. Lebofsky, *Astron. J.*, **86**, 121, 1981.

[56] The Diameter of Juno From its Occultation of AGK $+0^{o}$ 1022, by 43 authors (Millis, et al.), including W. B. Hubbard, *Astron. J.*, **86**, 306, 1981.

[57] Scintillation at Two Optical Frequencies, W. B. Hubbard and H. J. Reitsema, *Applied Optics*, **20**, 3227, 1981.

[58] Monte Carlo and Perturbation Theory Calculations for Liquid Metals, M. Ross, H. E. DeWitt, and W. B. Hubbard, *Phys. Rev. A*, **24**, 1016, 1981.

[59] Occultation by a Possible Third Satellite of Neptune, H. J. Reitsema, W. B. Hubbard, L. A. Lebofsky, and D. J. Tholen, *Science*, **215**, 289, 1982.

[60] Effects of Differential Rotation on the Gravitational Figures of Jupiter and Saturn, W. B. Hubbard, *Icarus*, **52**, 509, 1982.

[61] Computation of Jupiter Interior Models from Gravitational Inversion Theory, W. B. Hubbard and G. P. Horedt, *Icarus*, **54**, 456, 1983.

[62] Statistical Mechanics of Light Elements at High Pressure. V. Three-Dimensional Thomas-Fermi-Dirac Theory, J. J. MacFarlane and W. B. Hubbard, *Astrophys. J.*, **272**, 301, 1983.

[63] Two- and Three-Layer Models of Uranus, G. P. Horedt and W. B. Hubbard, *The Moon and Planets*, **29**, 229, 1983.

[64] Results from Observations of the 15 June 1983 Occultation by the Neptune System, W. B. Hubbard, H. P. Avey, B. Carter, J. Frecker, H. H. Fu, J. A. Gehrels, T. Gehrels, D. M. Hunten, H. D. Kennedy, L. A. Lebofsky, K. Mottram, T. Murphy, A. Nielsen, A. A. Page, H. J. Reitsema, B. A. Smith, D. J. Tholen, B. Varnes, F. Vilas, M. D. Waterworth, H. H. Wu, B. Zellner, *Astron. J.*, **90**, 655, 1985.

[65] Statistical Mechanics of Light Elements at High Pressure. VII. A Perturbative Free Energy for Arbitrary Mixtures of H and He, W. B. Hubbard and H. E. DeWitt, *Astrophys. J.*, **290**, 388, 1985.

[66] Statistical Mechanics of Light Elements at High Pressure. VIII. Thomas-Fermi-Dirac Theory for Binary Mixtures of H with He, C, and O, W. B. Hubbard and J. J. MacFarlane, *Astrophys. J.*, **297**, 133, 1985.

[67] Low-Frequency Electric Microfield Distributions in Plasmas, C. A. Iglesias, H. E. DeWitt, J. L. Lebowitz, D. MacGowan, and W. B. Hubbard, *Phys. Rev. A.*, **31**, 1698, 1985.

[68] Occultation Detection of a Neptunian Ringlike Arc, W. B. Hubbard, A. Brahic, B. Sicardy, L. R. Elicer, F. Roques, and F. Vilas, *Nature*, **319**, 636, 1986.

[69] 1981N1: A Neptune Arc? , W. B. Hubbard, *Science*, **231**, 1276, 1986.

[70] Evolution and Infrared Spectra of Brown Dwarfs, J. I. Lunine, W. B. Hubbard and M. S. Marley, *Astrophys. J.*, **310**, 238, 1986.

[71] Occultation Determination of Neptune's Oblateness and Methane Stratospheric Methane Mixing Ratio, E. Lellouch, W. B. Hubbard, B. Sicardy, F. Vilas, and P. Bouchet, *Nature*, **324**, 227, 1986.

[72] The Size, Shape, Density, and Albedo of Ceres From its Occultation of BD +8°471, by 42 authors (Millis, et al.) including W. B. Hubbard, *Icarus*, **72**, 507, 1987.

[73] Oblateness, Radius, and Mean Stratospheric Temperature of Neptune from the 20 August 1985 Occultation, W. B. Hubbard, P. D. Nicholson, E. Lellouch, B. Sicardy, A. Brahic, F. Vilas, P. Bouchet, R. A. McLaren, R. L. Millis, L. H. Wasserman, J. H. Elias, K. Matthews, J. D. McGill, and C. Perrier, *Icarus*, **72**, 635, 1987.

[74] Structure of Scintillations in Neptune's Occultation Shadow, W. B. Hubbard, E. Lellouch, B. Sicardy, A. Brahic, F. Vilas, P. Bouchet, R. A. McLaren, and C. Perrier, *Astrophys. J.*, **325**, 490, 1988.

[75] Theory of Anisotropic Refractive Scintillation --Application to Stellar Occultations by Neptune, R. Narayan and W. B. Hubbard, *Astrophys. J.*, **325**, 503, 1988.

[76] Thermodynamics of Dense Molecular Hydrogen-Helium Mixtures at High Pressure, M. S. Marley and W. B. Hubbard, *Icarus*, **73**, 536, 1988.

[77] No Effects of Diffraction on Pluto - Charon Mutual Events, D. J. Tholen and W. B. Hubbard, *Astronomy and Astrophysics*, **204**, L5, 1988.

[78] Optimized Jupiter, Saturn, and Uranus Interior Models, W. B. Hubbard and M. S. Marley, *Icarus*, **78**, 102, 1989.

[79] The Effect of Grain Formation on the Cooling of Brown Dwarfs, J. I. Lunine, W. B. Hubbard, A. S. Burrows, and Y. P. Wang, *Astrophys. J.*, **338**, 314, 1989.

[80] Occultation Evidence for a Pluto Atmosphere, W. B. Hubbard, D. M. Hunten, S. W. Dieters, K. M. Hill and R. D. Watson, *Nature*, **336**, 452, 1988.

[81] Theoretical Models of Very Low Mass Stars and Brown Dwarfs, A. S. Burrows, W. B. Hubbard, and J. I. Lunine, *Astrophys. J.*, **345**, 939, 1989.

[82] Nonisothermal Pluto Atmosphere Models, W. B. Hubbard, R. V. Yelle, and J. I. Lunine, *Icarus*, **84**, 1-11, 1990.

[83] Observations of the 8 December 1987 Occultation of AG +40°0783 by 324 Bamberga, R. L. Millis, L. H. Wasserman, O. G. Franz, E. Bowell, R. A. Nye, D. T. Thompson, N. M. White, W. B. Hubbard, R. E. Eplee, L. A. Lebofsky, R. L. Marcialis, R. J. Greenberg, D. M. Hunten, H. J. Reitsema, Q. Bochen, D. W. Dunham, P. D. Maley, A. R. Klemola, and D. K. Yeomans, *Astron. J.*, **98**, 1094, 1989.

[84] The Periodicities in the Infrared Excess of G29--38: An Oscillating Brown Dwarf?, M. S. Marley, J. I. Lunine, and W. B. Hubbard, *Astrophys. J.*, **348**, L37- L40, 1990.

[85] Results for Titan's Atmosphere from its Occultation of 28 Sagittarii, W. B. Hubbard, D. M. Hunten, H. J. Reitsema, N. Brosch, Y. Nevo, E. Carreira, F. Rossi, and L. H. Wasserman, *Nature*, **343**, 353-355, 1990.

[86]The Size and Shape of (2) Pallas From the 1983 Occultation of 1 Vulpeculae, D. W. Dunham, J. B. Dunham, R. P. Binzel, D. S. Evans, M. Freuh, G. W. Henry, M. F. A'Hearn, R. G. Schnurr, R. Betts, H. Haynes, R. Orcutt, E. Bowell, L. H. Wasserman, R. A. Nye, H. L. Giclas, C. R. Chapman, R. D. Dietz, C. Moncivais, W. T. Douglass, D. C. Parker, J. D. Beish, J. O. Martin, D. R. Monger, W. B. Hubbard, H. J. Reitsema, A. R. Klemola, P. D. Lee, B. R. McNamara, P. D. Maley, P. Manly, N. L. Markworth, R. Nolthenius, T. D. Oswalt, J. A. Smith, E. F. Strother, H. R. Povenmire, R. D. Purrington, C. Trenary, G. H. Schneider, W. J. Schuster, M. A. Moreno, J. Guichard, G. R. Sanchez, G. E. Taylor, A. R. Upgren, and T. C. Van Flandern, *Astron. J.*, **99**, 1636, 1990.

[87] The Initial Mass Function for Very Low Mass Stars in the Hyades, W. B. Hubbard, A. Burrows, and J. I. Lunine, *Astrophys. J.*, **358**, L53-L55, 1990.

[88] Interior Structure of Neptune: Comparison with Uranus, W. B. Hubbard, W. J. Nellis, A. C. Mitchell, N. C. Holmes, S. S. Limaye, and P. C. McCandless, *Science*, **253**, 648, 1991.

[89] The Role of the Molecular-Metallic Transition of Hydrogen in the Evolution of Jupiter, Saturn, and Brown Dwarfs, D. Saumon, W. B. Hubbard, G. Chabrier, and H. M. Van Horn, *Astrophys. J.*, **391**, 827, 1992.

[90] The Molecular-Metallic Transition of Hydrogen and the Structure of Jupiter and Saturn, G. Chabrier, D. Saumon, W. B. Hubbard, and J. I. Lunine, *Astrophys. J.*, **391**, 817, 1992.

[91] The Occultation of 28 Sgr by Titan. W. B. Hubbard, Bruno Sicardy, R. Miles, A. J. Hollis, R. W. Forrest, I. K. M. Nicolson, G. Appleby, W. Beisker, C. Bittner, H.-J. Bode, M. Bruns, H. Denzau, M. Nezel, E. Riedel, H. Struckmann, J. E. Arlot, F. Roques, F. Sèvre, W. Thuillot, M. Hoffmann, E. H. Geyer, C. Buil, F. Colas, J. Lecacheux, A. Klotz, E. Thouvenot, J. L.Vidal, E. Carreira, F. Rossi, C. Blanco, S. Cristaldi, Y. Nevo, H. J.Reitsema, N. Brosch, K. Cernis, K. Zdanavicius, L. H. Wasserman, D. M. Hunten, D. Gautier, E. Lellouch, R. V. Yelle, B. Rizk, F. M. Flasar, C. C. Porco, D. Toublanc, G. Corugedo, *A & A*, **269**, 541-563, 1993.

[92] An Expanded Set of Brown Dwarf and Very Low Mass Star Models. A. Burrows, W. B. Hubbard, D. Saumon, and J. I. Lunine, *Astrophys. J.*, **406**, 158-171, 1993.

[93] The Occultation of 28 Sgr by Saturn: Saturn Pole Position and Astrometry. W. B. Hubbard, C. C. Porco, D. M. Hunten, G. H. Rieke, M. J. Rieke, D. W. McCarthy, V. Haemmerle, R. Clark, E. P. Turtle, J. Haller, B. McLeod, L. A. Lebofsky, R. Marcialis, and J. B. Holberg, *Icarus*, **103**, 215-234, 1993.

[94] Cool Zero-metallicity Stellar Atmospheres. D. Saumon, P. Bergeron, J. I. Lunine, W. B. Hubbard, and A. Burrows, *Astrophys. J.*, **424**, 333-344, 1994.

[95] Neptune's Upper Stratosphere, 1983--1990: Ground-based Stellar Occultation Observations. F. Roques, B. Sicardy, R. G. French, W. B. Hubbard, A. Barucci, P. Bouchet, A. Brahic, J.-A. Gehrels, T. Gehrels, I. Grenier, T. Lebertre, J. Lecacheux, J. P. Maillard, R. A. McLaren, C. Perrier, F. Vilas, and M. D. Waterworth, *A & A*, **288**, 985-1011, 1994.

[96] Mirages and the Nature of Pluto's Atmosphere. J. A. Stansberry, J. I. Lunine, W. B. Hubbard, R. V. Yelle, and D. M. Hunten, *Icarus*, **111**, 503-513, 1994

[97] Jet-like Features near the Nucleus of Chiron. J. L. Elliot, C. B. Olkin, E. W. Dunham, C. H. Ford, D. K. Gilmore, D. Kurtz, D. Lazzaro, D. M. Rank, P. Temi, R. M. Bandyopadhyay, J. Barroso, A. Barucci, A. S. Bosh, M. W. Buie, S. J. Bus, C. C. Dahn, D. W. Foryta, W. B. Hubbard, D. F. Lopes, R. L. Marcialis, S. W. McDonald, R. L. Millis, H. Reitsema, D. G. Schleicher, B. Sicardy, R. P. S. Stone, and L. H. Wasserman, *Nature*, **373**, 46-49, 1995.

[98] The Occultation of SAO 78505 by Jupiter. W.B. Hubbard, V. Haemmerle, C. C. Porco, G. H. Rieke, and M. J. Rieke, *Icarus*, **113**, 103-109, 1995.

[99] Prospects for Detection of Extra-solar Giant Planets by Next-generation Telescopes. A. Burrows, D. Saumon, T. Guillot, W. B. Hubbard, and J. I. Lunine, *Nature*, **375**, 299-301, 1995.

[100] Giant Planets at Small Orbital Distances. T. Guillot, A. Burrows, W. B. Hubbard, J. I. Lunine, and D. Saumon, *Astrophys. J.*, **459**, L35-L38, 1996.

[101] A Theory of Extrasolar Giant Planets. D. Saumon, W. B. Hubbard, A. Burrows, T. Guillot, J. I. Lunine, and G. Chabrier, *Astrophys. J.*, **460**, 993-1018, 1996.

[102] Atmospheric, Evolutionary, and Spectral Models of the Brown Dwarf Gliese 229 B, M. S. Marley, D. Saumon, T. Guillot, R. S. Freedman, W. B. Hubbard, A. Burrows, and J. I. Lunine, *Science*, **272**, 1919-1921, 1996.

[103] Stellar Occultation by 2060 Chiron, S. J. Bus, M. W. Buie, D. G. Schleicher, W. B. Hubbard, R. L. Marcialis, R. Hill, L. H. Wasserman, J. R. Spencer, R. L. Millis, O. G. Franz, A. S. Bosh, E. W. Dunham, C. H. Ford, J. W. Young, J. L. Elliot, R. Meserole, C. B. Olkin, S. W. McDonald, J. A. Foust, L. M. Sopata, and R. M. Bandyopadhyay, *Icarus*, **123**, 478-490, 1996.

[104] The Thermal Structure of Triton's Atmosphere: Results from the 1993 and 1995 Occultations, C. B. Olkin, J. L. Elliot, H. B. Hammel, A. R. Cooray, S. W. McDonald, J. A. Foust, A. S. Bosh, M. W. Buie, R. L. Millis, L. H. Wasserman, E. W. Dunham, J. McDonald, L. A. Young, R. Howell, W. B. Hubbard, R. Hill, R. L. Marcialis, D. M. Rank, J. C. Holbrook, and H. J. Reitsema, *Icarus*, **129**, 178-201, 1997.

[105] Liquid Metallic Hydrogen and the Structure of Brown Dwarfs and Giant Planets, W. B. Hubbard, T. Guillot, J. I. Lunine, A. Burrows, D. Saumon, M. S. Marley, and R. S. Freedman, *Physics of Plasmas*, **4**, 2011-2015, 1997.

[106] Neptune's Deep Chemistry, W. B. Hubbard, *Science*, **275**, 1279-1280, 1997.

[107] Structure of Saturn's Mesosphere from the 28 Sgr Occultations, W. B. Hubbard, C. C. Porco, D. M. Hunten, G. H. Rieke, M. J. Rieke, D. W. McCarthy, V. Haemmerle, J. Haller, B. McLeod, L.A. Lebofsky, R. Marcialis, J. B. Holberg, R. Landau, L. Carrasco, J. Elias, M. W. Buie, E. W. Dunham, S. E. Persson, T. Boroson, S. West, R. G. French, J. Harrington, J. L. Elliot, W. J. Forrest, J. L. Pipher, R. J. Stover, A. Brahic, and I. Grenier, *Icarus*, **130**, 404-425, 1997.

[108] A Non-Gray Theory of Extrasolar Giant Planets and Brown Dwarfs, A. Burrows, M. Marley, W. B. Hubbard, J. I. Lunine, T. Guillot, D. Saumon, R. Freedman, D. Sudarsky, and C. Sharp, *Astrophys. J.*, **491**, 856-875, 1997.

[109] New Constraints on the Composition of Jupiter from Galileo Measurements and Interior Models, T. Guillot, D. Gautier, and W. B. Hubbard, *Icarus*, 130, 534-539, 1997.

[110] Lensing by Triton's Atmosphere, W. B. Hubbard, *Science*, **278**, 403-404, 1997.

[111] Orbital Evolution and Migration of Giant Planets: Modeling Extrasolar Planets, D. R. Trilling, W. Benz, T. Guillot, J. I. Lunine, W. B. Hubbard, and A. Burrows, *Astrophys. J.*, **500**, 428-439, 1998.

[112] The Structure of Titan's Stratosphere from the 28 Sgr Occultation. B. Sicardy, F. Ferri, F. Roques, J. Lecacheux, S. Pau, N. Brosch, Y. Nevo, W. B. Hubbard, H. J. Reitsema, C. Blanco, E. Carreira, W. Beisker, C. Bittner, H.-J. Bode, M. Bruns, G. Appleby, R. W. Forrest, I. K. M. Nicolson, A. J. Hollis, R. Miles, *Icarus*, **142**, 357-390, 1999.

[113] Gravitational Signature of Jupiter's Deep Zonal Flows, W. B. Hubbard, *Icarus*, **137**, 357-359, 1999.

114] Comparative Evolution of Jupiter and Saturn, W. B. Hubbard, T. Guillot, M. S. Marley, A. Burrows, J. I. Lunine, and D. S. Saumon, *Planetary and Space Science*, **47**, 1175-1182, 1999.

[115] On the Radii of Close-In Giant Planets, A. Burrows, T. Guillot, W. B. Hubbard, M. S. Marley, D. Saumon, J. I. Lunine, and D. Sudarsky, *Astrophys. J.*, **534**, L97-L100, 2000.

[116] The Prediction and Observation of the 1997 July 18 Stellar Occultation by Triton: More Evidence for Distortion and Increasing Pressure in Triton's Atmosphere, J. L. Elliot, M. J. Person, S. W. McDonald, M. W. Buie, E. W. Dunham, R. L. Millis, R. A. Nye, C. B. Olkin, L. H. Wasserman, L. A. Young, W. B. Hubbard, R. Hill, H. J. Reitsema, J. M. Pasachoff, T. H. McConnochie, B. A. Babcock, R. C. Stone, and P. Francis, *Icarus*, **148**, 347-369, 2000.

[117] Theory of Extrasolar Giant Planet Transits, W. B. Hubbard, J. J. Fortney, J. I. Lunine, A. Burrows, D. Sudarsky, and P. Pinto, *Astrophys. J.*, **560**, 413-419, 2001.

[118] Morphology and Time Variability of Io's Visible Aurora, P. E. Geissler, W. H. Smyth, A. S. McEwen, W. Ip, M. J. S. Belton, T. V. Johnson, A. P. Ingersoll, K. Rages, W. Hubbard, and A. Dessler, *J. Geophys. Res.*, **106**, 26137-26146, 2001.

[119] The 10 October 1999 HIP 9369 Occultation by the Northern Polar Region of Jupiter: Ingress and Egress Lightcurves Analysis, E. Raynaud, P. Drossart, K. Matcheva, B. Sicardy, W. B. Hubbard, F. Roques, T. Widemann, G. R. Gladstone, J. H. Waite, P. Bastien, R. Doyon, D. Nadeau, R. Hill, M. J. Rieke, M. Marley, *Icarus*, **162**, 344-361, 2003.

[120] On the Indirect Detection of Sodium in the Atmosphere of the Planetary Companion to HD 209458, J. J. Fortney, D. Sudarsky, I. Hubeny, C. S. Cooper, W. B. Hubbard, A. Burrows, J. I. Lunine, *Astrophys. J.*, **589**, 615-622, 2003.

[121] Phase Separation in Giant Planets: Inhomogeneous Evolution of Saturn, J. J. Fortney, W. B. Hubbard, *Icarus*, **164**, 228-243, 2003.

[122] A Theory for the Radius of the Transiting Giant Planet HD 209458b, A. Burrows, D. Sudarsky, W. B. Hubbard, *Astrophys. J.*, **594**, 545-551, 2003.

[123] Effects of Helium Phase Separation on the Evolution of Extrasolar Giant Planets, J. J. Fortney, W. B. Hubbard, *Astrophys. J.*, **608**, 1039-1049, 2004.

[124] Theoretical Radii of Transiting Giant Planets: The Case of OGLE-TR-56b, A. Burrows, I. Hubeny, W. B. Hubbard, D. Sudarsky, J. J. Fortney, *Astrophys. J. Lett.*, **610**, L53-56, 2004.

[125] Hydrogen EOS at Megabar Pressures and the Search for Jupiter's Core, W. B. Hubbard, *Astrophysics and Space Sci.*, **298**, 129-134, 2005.

[126] Effects of Mass Loss for Highly-Irradiated Giant Planets, W. B. Hubbard, M. F. Hattori, A. Burrows, I. Hubeny, D. Sudarsky, *Icarus* **187**, 358-364, 2007.

[127] A Mass Function Constraint on Extrasolar Giant Planet Evaporation Rates, W. B. Hubbard, M. F. Hattori, A. Burrows, I. Hubeny, *Astrophysical J. Lett.*, **658**, L59-L62, 2007.

[128] Possible Solutions to the Radius Anomalies of Transiting Giant Planets, A. Burrows, I. Hubeny, J. Budaj, W. B. Hubbard, *Astrophys. J.* **661**, 502-514, 2007.

[129] Waves in Pluto's Upper Atmosphere, M. J. Person, J. L. Elliot, A. A. S. Gulbis, C. A. Zuluaga, B. A. Babcock, A. J. McKay, J. M. Pasachoff, S. P. Souza, W. B. Hubbard, C. A. Kulesa, D. W. McCarthy, S. D. Benecchi, S. E. Levine, A. S. Bosh, E. V. Ryan, W. H. Ryan, A. Meyer, J. Wolf, J. Hill, *Astron. J.* **136**, 1510-1518, 2008.

[130] Long-wavelength Density Fluctuations Resolved in Pluto's High Atmosphere, D. W. McCarthy, W. B. Hubbard, C. A. Kulesa, S. D. Benecchi, M. J. Person, J. L. Elliot, A. A. S. Gulbis, *Astron. J.* **136**, 1519-1522, 2008.

[131] A Massive Core in Jupiter Predicted from First-principles Simulations, B. Militzer, W. B. Hubbard, J. Vorberger, I. Tamblyn, S. A. Bonev, *Astrophys. J. Lett.* **688**, L45-L48, 2008.

[132] Buoyancy Waves in Pluto's High Atmosphere: Implications for Stellar Occultations, W. B. Hubbard, D. W. McCarthy, C. A. Kulesa, S. D. Benecchi, M. J. Person, J. L. Elliot, A. A. S. Gulbis, *Icarus* **204**, 284-289, 2009.

[133] Comparison of Jupiter Interior Models Derived from First-Principles Simulations, B. Militzer, W. B. Hubbard, *Astrophysics and Space Science* **322**, 129-133, 2009.

[134] Titania's Radius and an Upper Limit on its Atmosphere from the September 8, 2001 Stellar Occultation, T. Widemann, B. Sicardy, R. Dusser, C. Martinez, W. Beisker, E. Bredner, D. Dunham, P. Maley, E. Lellouch, J.-E. Arlot, J. Berthier, F. Colas, W.B. Hubbard, R. Hill, … , Icarus **199**, 458–476, 2009.

[135] Detecting the Wind-Driven Shapes of Extrasolar Giant Planets from Transit Photometry, J. W. Barnes, C. S. Cooper, A. P. Showman, W. B. Hubbard, *Astrophys. J.* **706**, 877-884, 2009.

[136] The Gravitational Signature of Jupiter's Internal Dynamics, Y. Kaspi, W. B. Hubbard, A. P. Showman, G. R. Flierl, *Geophysical Research Letters* **37**, L01204, doi: 10.1029/2009GL041385, 2010.

[137] High-precision Maclaurin-based Models of Rotating Liquid Planets, W. B. Hubbard, *Astrophys. J. Lett.* **756**, L15, 2012.

[138] Atmospheric confinement of jet streams on Uranus and Neptune, Y. Kaspi, A. P. Showman, W. B. Hubbard, O. Aharonson, R. Helled, *Nature* **497**, 344-347, 2013.

[139] Concentric Maclaurin Spheroid Models of Rotating Liquid Planets, W. B. Hubbard, *Astrophys. J.* **768**, 43, 2013.

[140] Ab Initio Equation of State for Hydrogen-Helium Mixtures with Recalibration of the Giant-Planet Mass-Radius Relation, B. Militzer, W. B. Hubbard, *Astrophys. J.* **774**, 148, 2013.

[141] The effect of an asymmetric core on convection in Enceladus' ice shell: Implications for south polar tectonics and heat flux, A. P. Showman, L.Han, W. B. Hubbard, *Geophysical Research Letters* **40**, 5610-5614, doi: 10.1002/2013GL057149, 2013.

[142] On the Convergence of the Theory of Figures, W. B. Hubbard, G. Schubert, D. Kong, K. Zhang, *Icarus* **242**, 138, 2014.

[143] Differential Rotation in Jupiter: A Comparison of Methods, J. Wisdom, W. B. Hubbard, *Icarus* **267**, 315, 2016.

[144] A Preliminary Jupiter Model, W. B. Hubbard, B. Militzer, *Astrophys. J.* **820**, 80, 2016.

[145] The gravitational signature of internal flows in giant planets: Comparing the thermal wind approach with barotropic potential-surface methods, Y. Kaspi, J. E. Davighi, E. Galanti, W. B. Hubbard, *Icarus* **276**, 170, 2016.

[146] Tidal Response of Preliminary Jupiter Model, S. Wahl, W. B. Hubbard, B. Militzer, *Astrophys. J.* **831**, 15, 2016.

[147] The Concentric Maclaurin Spheroid method with tides and a rotational enhancement of Saturn's tidal response, S. Wahl, W. B. Hubbard, B. Militzer, *Icarus* **282**, 183, 2017.

[148] Analytic Scattering and Refraction Models for Exoplanet Transit Spectra, Tyler D. Robinson, Jonathan J. Fortney, William B. Hubbard, *Astrophys. J.* **850**, 128, 2017.

[149] The effect of differential rotation on Jupiter's low-degree even gravity moments, Y. Kaspi, T. Guillot, E. Galanti, Y. Miguel, R. Helled, W. B. Hubbard, B. Militzer, S. M. Wahl, S. M. Levin, J. E. P. Connerney, S. J. Bolton, *Geophysical Research Letters* **44**, 5960, 2017.

[150] Comparing Jupiter interior structure models to Juno gravity measurements and the role of a dilute core, S. M. Wahl, W. B. Hubbard, B. Militzer, T. Guillot, Y. Miguel, N. Movshovitz, Y. Kaspi, R. Helled, D. Reese, E. Galanti, S. M. Levin, J. E. P. Connerney, S. J. Bolton, *Geophysical Research Letters* **44**, 4649, 2017.

[151] Jupiter's interior and deep atmosphere: The initial pole-to-pole passes with the Juno spacecraft, S. J. Bolton, A. Adriani, V. Adumitroaie, M. Allison, J. Anderson, S. Atreya, J. Bloxham, S. Brown, J. E. P. Connerney, E. DeJong, W. M. Folkner, D. Gautier, D. Grassi, S. Gulkis, T. Guillot, C. Hansen, W. B. Hubbard, L. Iess, A. P. Ingersoll, M. Janssen, J. Jorgensen, Y. Kaspi, S. M. Levin, C. Li, J. I. Lunine, Y. Miguel, A. Mura, G. Orton, T. Owen, M. Ravine, E. Smith, P. Steffes, E. Stone, D. J. Stevenson, R. Thorne, J. Waite, D. Durante, R. W. Ebert, T. K. Greathouse, V. Hue, M. Parisi, J. R. Szalay, R. Wilson, *Science* **356**, 821, 2017.

[152] Measurement of Jupiter's asymmetric gravity field, L. Iess, W. M. Folkner, D. Durante, M. Parisi, Y. Kaspi, E. Galanti, T. Guillot, W. B. Hubbard, D. J. Stevenson, J. D. Anderson, D. R. Buccino, L. Gomez Casajus, A. Milani, R. Park, P. Racioppa, D. Serra, P. Tortora, M. Zannoni, H. Cao, R. Helled, J. I. Lunine, Y. Miguel, B. Militzer, S. M. Wahl, J. E. P. Connerney, S. M. Levin, S. J. Bolton, *Nature* **555**, 220, 2018.

[153] Jupiter's atmospheric jet streams extend thousands of kilometres deep, Y. Kaspi, E. Galanti, W. B. Hubbard, D. J. Stevenson, S. J. Bolton, L. Iess, T. Guillot, J. Bloxham, J. E. P. Connerney, H. Cao, D. Durante, W. M. Folkner, R. Helled, A. P. Ingersoll, S. M. Levin, J. I. Lunine, Y. Miguel, B. Militzer, M. Parisi, *Nature* **555**, 223, 2018.

[154] A suppression of differential rotation in Jupiter's deep interior, T. Guillot, Y. Miguel, B. Militzer, W. B. Hubbard, D. J. Stevenson, Y. Kaspi, E. Galanti, H. Cao, R. Helled, S. M. Wahl, L. Iess, W. M. Folkner, J. I. Lunine, D. R. Reese, A. Biekman, M. Parisi, D. Durante, J. E. P. Connerney, S. M. Levin, S. J. Bolton, *Nature* **555**, 227, 2018.

[155] Measurement and implications of Saturn's gravity field and ring mass, L. Iess, B. Militzer, Y. Kaspi, P. Nicholson, D. Durante, P. Racioppa, A. Anabtawi, E. Galanti, W. Hubbard, M. J. Mariani, P. Totora, S. Wahl, M. Zannoni, *Science* **364**, 1052, 2019.

[156] Models of Saturn's interior constructed with an accelerated concentric Maclaurin spheroid method, B. Militzer, S. Wahl, W. B. Hubbard, *Astrophys. J.* **879**, 78, 2019.

[157] Equilibrium tidal response of Jupiter: detectability by the Juno spacecraft, S. M. Wahl, M. Parisi, W. M. Folkner, W. B. Hubbard, B. Militzer, *Astrophys. J.* **891**, 42, 2020.

[158] Updated equipotential shapes of Jupiter and Saturn using Juno and Cassini Grand Finale gravity science measurements, D. R. Buccino, R. Helled, M. Parisi, W. B. Hubbard, W. M. Folkner, *J. Geophys. Res -- Planets* **125**, e2019JE006354, 2020.

[159] Constraints on the structure and seasonal variations of Triton's atmosphere from the 5 October 2017 stellar occultation and previous observations, J. Marquez Oliveira and 154 coauthors including W. B. Hubbard, *Astron. & Astrophys.* **659**, A136, 2022.

[160] Jupiter's inhomogeneous envelope, Y. Miguel , M. Bazot, T. Guillot, S. Howard, E. Galanti, Y. Kaspi, W. B. Hubbard, B. Militzer, R. Helled , S. K. Atreya, J. E. P. Connerney, D. Durante , L. Kulowski , J. I. Lunine, D. Stevenson, S. Bolton, ***Astron. & Astrophys.*** 662, A18, 2022.

[161] Juno spacecraft measurements of Jupiter's gravity imply a dilute core**,** B. Militzer, W. B. Hubbard, S. Wahl, J. I. Lunine, E. Galanti, Y. Kaspi, Y. Miguel, T. Guillot, K. M. Moore, M. Parisi, J. E. P. Connerney, R. Helled, Hao Cao, C. Mankovich, D. J. Stevenson, R. S. Park, M. Wong, S. K. Atreya, J. Anderson, S. J. Bolton, *Planetary Sci. J.* **3**, 185, 2022.

[162] Loss of a satellite could explain Saturn's obliquity and young rings, J. Wisdom, R. Dbouk, B. Militzer, W. B. Hubbard, F. Nimmo, B. G. Downey, R. G. French, *Science* **377**, 1285, 2022.

CHAPTERS IN BOOKS

[1] Convection in Degenerate Stars, in ``Low-Luminosity Stars," (S. Kumar, Ed.), p. 297, 1969, Gordon and Breach.

[2] Gravitational Fields and the Interior Structure of the Giant Planets, J. D. Anderson and W.B. Hubbard, in ``Exploration of the Outer Solar System," *Prog. in Astronautics and Aeronautics*, **50**, AIAA, 1976.

[3] Interior Structure of Jupiter: Theory of Gravity Sounding, W. B. Hubbard and W. L. Slattery, in "Jupiter" (T. Gehrels, Ed.), p. 179, University of Arizona Press, 1976.

[4] Interior Structure of Uranus, In "Uranus and Neptune" (Ed. J. T. Bergstrahl), NASA Conference Publication **2330**, 291, 1984.

[5] Interior Structure of Saturn, W. B. Hubbard and D. J. Stevenson, in "Saturn" (ed. T. Gehrels and M. Matthews), Tucson: University of Arizona Press, 1984, pp. 47-87.

[6] Interior Structure and Evolution of the Planets, in "Planets: Their Origin, Interior, and Atmosphere,'" (ed. P. Bartholdi, P. Bochsler, and Y. Chmielewski), 14th Advanced Course of the Swiss Society of Astronomy and Astrophysics, 63, 1984.

[7] Evolution of Super-Jupiters, in “Astrophysics of Brown Dwarfs”, Cambridge Univ. Press, 1986, p 160.

[8] The Phase Diagram of Hydrogen with Other Elements, and Applications to Jovian Planet Interiors, in “The Physics of Planets” (ed. S. K. Runcorn), John Wiley & Sons, 1988.

[9] On the Oblateness and Rotation Rate of Neptune's Atmosphere, in “Conference on the Jovian Atmospheres” (Eds. M. Allison and L.C. Travis), NASA Conference Publ., 1986, p. 264.

[10] Structure of the Jovian Envelope and the Equation of State of Dense Hydrogen, W. B. Hubbard and M. S. Marley, in “Strongly Coupled Plasma Physics” (Eds. H. E. DeWitt and F. J. Rogers), Plenum Publishing Co., pp. 407-413, 1987.

[11] Models of Jovian Planets, W.B. Hubbard, in “Simple Molecular Systems at Very High Density”, (ed. P. Loubeyre, A. Polian, and N. Boccara), p. 203, New York: Plenum, 1989.

[12] Structure and Composition of Giant Planet Interiors, W. B. Hubbard, in “Origin and Evolution of Planetary and Satellite Atmospheres” (ed. S. K. Atreya, J. B. Pollack, and M. S. Matthews), p. 539, University of Arizona Press, 1989.

[13] Plasma Thermodynamics and the Evolution of Brown Dwarfs and Planets, in “Strongly Coupled Plasma Physics” (ed. S. Ichimaru), p. 21, Elsevier Science Publishers B.V./Yamada Science Foundation, 1990.

[14] Outer-Planet Interiors, in “The New Solar System” (IIIrd Ed., ed. J. Kelly Beatty and Andrew Chaikin), Sky Publishing Corporation, 1990.

[15] Models of Uranus' Interior and Magnetic Field, M. Podolak, W. B. Hubbard, and D. J. Stevenson, in “Uranus” (ed. J. T. Bergstralh, E.D. Miner and M. S. Matthews), p. 29, University of Arizona Press, 1991.

[16] Gaseous Accretion and the Formation of Giant Planets, M. Podolak, W. B. Hubbard and J. B. Pollack, in “Protostars and Planets III” (ed. E. H. Levy, J. I. Lunine and M. S. Matthews), pp. 1109-1147, University of Arizona Press, 1993.

[17] The Plasma Phase Transition of Hydrogen in Giant Planets, D. Saumon, G. Chabrier, W. B. Hubbard, and J. I. Lunine, “Physics of Nonideal Plasmas”, selected papers of the International workshop PNP VI, Eds. W. Ebeling, A. Förster and R. Radtke (Teubner: Stuttgart, Germany), p. 286, 1992.

[18] Giant Planets and the Plasma Phase Transition of Hydrogen, D. Saumon, G. Chabrier, W. B. Hubbard, and J. I. Lunine, in “Strongly Coupled Plasma Physics” (ed. H. M. Van Horn and S. Ichimaru), pp. 111-120, University of Rochester Press, 1993.

[18] Strongly Coupled Plasmas in Uranus and Neptune, W.B. Hubbard, in "Strongly Coupled Plasma Physics" (ed. H.M. Van Horn and S. Ichimaru), pp. 131-135, University of Rochester Press, 1993.

[19] Recent Theoretical Results on Brown Dwarf Properties and Evolution, J. I. Lunine, D. Saumon, W. B. Hubbard, and A. S. Burrows, in "Strongly Coupled Plasma Physics" (ed. H.M. Van Horn and S. Ichimaru), pp. 137-145, University of Rochester Press, 1993.

[20] Giant Planet, Brown Dwarf, and Low-mass Star Interiors, W. B. Hubbard, in "The Equation of State in Astrophysics" (ed. G. Chabrier and E. Schatzman), pp. 443-462, Cambridge University Press, 1994.

[21] Astronomy on the Edge: The Physical Theory of Brown Dwarfs and Late M Dwarfs, A. Burrows, W. B. Hubbard, and J. I. Lunine, in "Proceedings of The 8th Cambridge Workshop on Cool Stars, Stellar Systems, and the Sun" (ed. J.-P. Caillaut), PASP Conference Series #64, p. 528, 1994.

[22] The Quiet Lives of Very-Low Mass Stars and Brown Dwarfs, D. Saumon, A. Burrows, and W. B. Hubbard, in "The Bottom of the Main Sequence -- and Beyond" (ed. C. Tinney), pp. 3-12, Springer Verlag: Heidelberg, 1995.

[23] Current Uncertainties in the Interior Physics of Brown Dwarfs and Giant Planets, W. B. Hubbard, A. Burrows, J. I. Lunine, and D. Saumon, in "Elementary Processes in Dense Plasmas" (eds. S. Ichimaru and S. Ogata), pp. 227-238, Addison-Wesley: Reading, 1995.

[24] Properties of Objects Near the Main Sequence Edge, A. Burrows, W. B. Hubbard, J. I. Lunine, and D. Saumon, in "Sources of Dark Matter in the Universe" (ed. D.B. Cline), p. 129, World Scientific, 1995.

[25] The Interior of Neptune, W. B. Hubbard, M. Podolak, and D. J. Stevenson, in "Neptune and Triton" (ed. D.P. Cruikshank), pp. 109-138, University of Arizona Press, 1995.

[26] On the Nature of the Newly Discovered Extrasolar Planets, T. Guillot, D. Saumon, A. Burrows, W. B. Hubbard, J. I. Lunine, M. S. Marley, and R. S. Freedman, in Astronomical and Biochemical Origins and the Search for Life in the Universe" (eds. C. B. Cosmovici, S. Bowyer, and D. Werthimer), pp. 343--350, 1996.

[27] Theoretical Models of Extrasolar Giant Planets, A. Burrows, W. B. Hubbard, J. I. Lunine, T. Guillot, D. Saumon, M. Marley, and R. Freedman, in "Proceedings of the International Conference on the Sources and Detection of Dark Matter in the Universe" (eds. D. Sanders et al.), *Nuclear Physics B* (*Proc. Suppl.*), **51B**, 76--85, 1996.

[28] Extrasolar Giant Planet and Brown Dwarf Models, A. Burrows, W. B. Hubbard, J. I. Lunine, M. Marley, T. Guillot, D. Saumon, and R. S. Freedman, in "Proceedings of Planets Beyond the Solar System and the Next Generation of Space Missions," (ed. David R. Soderblom), *A. S. P. Conf. Series*, **119**, p. 9, 1997.

[29] The Spectral Character of Giant Planets and Brown Dwarfs, A. Burrows, M. Marley, W. B. Hubbard, D. Sudarsky, C. Sharp, J. I. Lunine, T. Guillot, D. Saumon, and R. Freedman, in "Proceedings of The 10th Cambridge Workshop on Cool Stars, Stellar Systems, and the Sun" (ed. R. Donahue and J. Bookbinder), *PASP Conference Series*, 1997.

[30] Mutual Events and Stellar Occultations, R. P. Binzel and W. B Hubbard, in "Pluto and Charon" (eds. S.A. Stern and D.J. Tholen), pp. 85-102, University of Arizona Press, 1997.

[31] Advances in the Theory of Brown Dwarfs and Extrasolar Giant Planets, A Burrows, D. Sudarsky, C. Sharp, M. Marley, W. B. Hubbard, J. I. Lunine, T. Guillot, D. Saumon, and R. S. Freedman, in "Brown Dwarfs and Extrasolar Planets -- Proceedings of a workshop held in Tenerife, Spain, 17-21 March 1997" (eds. R. Rebolo, E. L. Martin, and M. R. Zapatero Osorio), p. 354, ASP Conference Series #134, 1998.

[32] Orbital Evolution of Extrasolar Giant Planets, D. Trilling, W. Benz, T. Guillot, J. I. Lunine, A. Burrows, and W. B. Hubbard, in "Brown Dwarfs and Extrasolar Planets -- Proceedings of a workshop held in Tenerife, Spain, 17-21 March 1997" (eds. R. Rebolo, E. L. Martin, and M. R. Zapatero Osorio), p. 280, ASP Conference Series #134, 1998.

[33] Ices in the Giant Planets, M. Podolak and W. B. Hubbard, in "Solar System Ices" (eds. B. Schmitt et al.), pp. 735-748, Kluwer Academic Publishers, 1998.

[34] New Ideas in the Theory of Extrasolar Giant Planets and Brown Dwarfs, A. Burrows, W. B. Hubbard, J. I. Lunine, M. Marley, and D. Saumon, in "Protostars and Planets IV" (eds. V. Manning, A. Boss, and S. Russell), pp. 1339-1361, University of Arizona Press, 2000.

[35] Speed of Sound in Planetary Atmospheres, R. D. Lorenz and W. B. Hubbard, in "Handbook of Elastic Properties of Materials", Vol. IV, *Elastic Properties of Fluids: Liquids and Gases* (eds. Levy, Bass, and Stern), pp. 389-398, Academic Press, 2001.

[36] Evolution of Giant Planets, W. B. Hubbard, in "From Giant Planets to Cool Stars" (eds. C. A. Griffith and M. S. Marley), pp. 223-229, Astron. Soc. Pacific Conference Series, **212**, 2000.

[37] The Atmospheres of Extrasolar Planets, J. I. Lunine, W. B. Hubbard, and A. S. Burrows, in *ERCA*, Vol. 4, (ed. C. Boutron), pp. 379-394. EDP Sciences, Les Ulis, France, 2001.

[38] The Interior of Jupiter, T. Guillot, D. J. Stevenson, W. B. Hubbard, and D. Saumon, Chapter 3 in "Jupiter -- The Planet, Satellites, and Magnetosphere" (ed. Fran Bagenal), Cambridge University Press, 2005.

[39] The Interior of Saturn, W. B. Hubbard, M. K. Dougherty, D. Gautier, and R. Jacobson, Chapter 4 in "Saturn from Cassini-Huygens" (eds. M. Dougherty, L. Esposito, and S. Krimigis), pp. 75-81, Springer, 2009.

POPULAR ARTICLES

[1] Jupiter and Beta Scorpii, D. S. Evans and W. B. Hubbard, *Sky and Telescope*, **42**, 337, 1971.

[2] The Tucson Jupiter Conference, W. B. Hubbard and J. R. Jokipii, *Sky and Telescope*, **50**, 212, 1975.

[3] The Baffling Ring Arcs of Neptune, A. Brahic and W. B. Hubbard, *Sky and Telescope*, **77**, 606, 1989.

[4] Planetary Interiors, Jovian Planets, by W.B. Hubbard, in "The Astronomy and Astrophysics Encyclopedia" (ed. S. P. Maran), Van Nostrand Reinhold, 1992, pp. 525-527.

[5] Saturn, by W. B. Hubbard, in *Encyclopedia Britannica*, originally published in 15th Edition, 1993, vol. 27, pp. 508-514, and updated through 2007.

[6] Jupiter: Interior Structure, by W. B. Hubbard, in *Encyclopedia of Planetary Sciences* (eds. J.H. Shirley and R.W. Fairbridge), Chapman & Hall, 1st Edition, 1997, pp. 371-372.

[7] Neptune, by W.B. Hubbard, in *Encyclopedia of Planetary Sciences* (eds. J.H. Shirley and R.W. Fairbridge), Chapman & Hall, 1st Edition, 1997, pp. 521-523.

[8] Saturn: Interior Structure, by W.B. Hubbard, in *Encyclopedia of Planetary Sciences* (eds. J.H. Shirley and R.W. Fairbridge), Chapman & Hall, 1st Edition, 1997, pp. 717-718.

[9] Uranus, by W.B. Hubbard, in *Encyclopedia of Planetary Sciences* (eds. J.H. Shirley and R.W. Fairbridge), Chapman & Hall, 1st Edition, 1997, pp. 856-857.

[10] Interiors of the Giant Planets, in "The New Solar System" (IVth Ed., ed. J. Kelly Beatty, Carolyn Collins Peterson, and Andrew Chaikin), Sky Publishing Corporation, 1999, pp. 193-200.

[11] Uranus, by W. B. Hubbard, in *Microsoft Encarta Encyclopedia*, CD version, 1999.

[12] Neptune, by W.B. Hubbard, in *Microsoft Encarta Encyclopedia*, CD version, 1999.

[13] Caliban, by W.B. Hubbard, in *Microsoft Encarta Encyclopedia*, CD version, 1999.

[14] Sycorax, By W.B. Hubbard, in *Microsoft Encarta Encyclopedia*, CD version, 1999.

REVIEW PAPERS AND SCIENTIFIC COMMENTARIES

[1] Significance of Atmospheric Measurements for Interior Models of the Major Planets, W. B. Hubbard, *Space Sci. Rev.*, **14**, 424, 1973.

[2] Interior of Jupiter and Saturn, *Ann. Rev. of Earth and Planet. Sci.*, **1**, 85, 1973.

[3] Structure of Jupiter and Saturn, W.B. Hubbard and R. Smoluchowski, *Space Sci. Rev.*, **14**, 579, 1973.

[4] A Strategy of Investigation of the Outer Solar System, W. B. Hubbard and other members of the Science Advisory Group, *Space Sci. Rev.*, **14**, 347, 1973.

[5] White Dwarfs and Giant Planets, W. B. Hubbard, *Fundamentals of Cosmic Physics*, **3**, 167, 1978.

[6] Intrinsic Luminosities of the Jovian Planets, W. B. Hubbard, *Rev. Geophys. and Space Phys.*, **18**, 1, 1980.

[7] Constraints on the Origin and Interior Structure of the Major Planets, W. B. Hubbard, *Phil. Trans. Royal Soc. London*, **A 303**, 315, 1981.

[8] Interiors of the Giant Planets, W. B. Hubbard, *Science*, **214**, 145, 1981.

[9] Internal Structure of Uranus, J. J. MacFarlane and W. B. Hubbard, *Proceedings of IAU/RAS Colloq. No. 60*, "Uranus and the Outer Planets" (Ed. G. Hunt), Cambridge Univ. Press, 1982.

[10] Structure of the Martian Atmosphere from Epsilon-Gem Occultation Observations, *Advances in Space Research*, **2**, 103, 1982.

[11] Big Planets and Little Stars, J. Liebert and W. B. Hubbard, *Nature*, **400**, 316-317, 1999.

[12] The Theory of Brown Dwarfs and Extrasolar Giant Planets, A. Burrows, W. B. Hubbard, J. I. Lunine, and J. Liebert, *Rev. Mod. Phys.*, **73**, 719-765, 2001.

[13] The Theory of Giant Planets, W. B. Hubbard, A. Burrows, and J. I. Lunine, *Annual Rev. Astronomy and Astrophys.*, **40**, 103-136, 2002.

[14] Pluto's Atmospheric Surprise, W. B. Hubbard, *Nature*, **424**, 137-138, 2003.

[15] Planet Formation: The Core Problem, W. B. Hubbard, *Nature*, **431**, 32-33, 2004.

[16] Planetary Formation and Evolution Revealed with a Saturn Entry Probe: The Importance of Noble Gases, J. J. Fortney, K. Zahnle, I. Baraffe, A. Burrows, S. E. Dodson-Robinson, G. Chabrier, T. Guillot, R. Helled, F. Hersant, W. B. Hubbard, J. J. Lissauer, and M. S. Marley, White Paper submitted to Astronomy Decadal Review, National Research Council, National Academy of Sciences, 2009.

[19] The Giant Planets: Local Laboratories and Ground Truth for Planets Beyond, W. B. Hubbard and other members of the Giant Planets Panel, in *Vision and Voyages for Planetary Science in the Decade 2013-2022*, The National Academies Press, pp. 175-216, 2011.

[20] Understanding Jupiter's Interior, B. Militzer, F. Soubiran, S. Wahl, and W. B. Hubbard, *J. Geophys. Res. – Planets* (25th anniversary issue), **121**, doi:10.1002/2016JE005080, 2016.

[21] The Juno Mission, S. J. Bolton, J. I. Lunine, D. J. Stevenson, J. E. P. Connerney, S. M. Levin, T. C. Owen, F. Bagenal, D. Gautier, A. P. Ingersoll, G. S. Orton, T. Guillot, W. B. Hubbard, A. Coradini, S. K. Stephens, P. Mokashi, R. Thorne, R. Thorpe, *Space Science Reviews,* **213**, 5-37, 2017.

[22] Revelations on Jupiter's formation, evolution and interior: Challenges from Juno results, R. Helled, D. J. Stevenson, J. I. Lunine, S. J. Bolton, N. Nettelmann, S. Atreya, T. Guillot, B. Militzer, Y. Miguel, W. B. Hubbard, *Icarus* **378**, 114937, 2022

BOOKS

[1] Physics of Planetary Interiors, by V. N. Zharkov and V. P. Trubitsyn (edited and translated by W. B. Hubbard), Tucson: Pachart Publishing House, 1978.

[2] Planetary Interiors, by W. B. Hubbard, New York: Van Nostrand Reinhold Co., Inc., 1984.

[3] Interior Structure of the Earth and Planets, by V. N. Zharkov (translated by W. B. Hubbard and R. Mastaler), Gordon And Breach/Harwood: Chur, 1986.

REFEREED EXTENDED ABSTRACTS

[1] Occultation Detection of a Neptune Ring Segment, W. B. Hubbard, A. Brahic, P. Bouchet, L. R. Elicer, R. Haefner, J. Manfroid, F. Roques, B. Sicardy, and F. Vilas, *Lunar and Planetary Sci. XVI*, 368, 1985.

[2] Occultation Diameter of Asteroid 1 Ceres, W. B. Hubbard, L. A. Lebofsky, D. M. Hunten, H. J. Reitsema, B. H. Zellner, R. Goff, R. Marcialis, M. Sykes, J. Frecker, A. Sanchez I., M. Rios H., and M. Izaguirre M., *Lunar and Planetary Sci. XVI*, 370, 1985.

ELECTRONIC PUBLICATIONS

[1] High Pressure Physics and Interiors of Giant Planets and Brown Dwarfs, W. B. Hubbard, T. Guillot, J. I. Lunine, A. Burrows, D. Saumon, M. S. Marley, and R. S. Freedman, *Proceedings of the Adriatico Research Conference: Simple Systems at High Pressures and Temperatures: Theory and Experiment*, ICTP Science Abstract No 22, http://www.ictp.trieste.it/$\sim$pub_off/sci-abs/smr999 (ICTP, Trieste, October 1997).

BOOK REVIEWS by W. B. Hubbard

[1] Jupiter: The Giant Planet, by Reta Beebe. *American Scientist*, **84**, 181-183, 1996.

[2] Planetary Sciences, by Imke de Pater and Jack J. Lissauer. *Physics Today*, **55**, 64, 2002.