Tamas I. Gombosi

Rollin M. Gerstacker Professor of Engineering

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EMPLOYMENT

University of Michigan
Professor and Chair, Department of Atmospheric, Oceanic, and Space Sciences
Director, Center for Space Environment Modeling

EDUCATION

Ph.D. (Physics) 1974, Lóránd Eötvös University, Budapest, Hungary
M.Sc. (Physics) 1970, Lóránd Eötvös University, Budapest, Hungary

PROFESSIONAL

American Geophysical Union (Fellow)
American Physical Society (member)
American Astronomical Society (member)
International Academy of Astronautics (elected lifetime member)
Senior Editor, JGR-Space Physics (1992–1997)
Over 250 refereed publications and more than 500 presentations

AWARDS

Elected Full Member, International Academy of Astronautics
Fellow of the American Geophysical Union
NASA Group Achievement Award (Cassini Orbiter), 1998
Steven S. Attwood Award, 2002
Seven other scientific awards

SCIENTIFIC BIOGRAPHY

A native of Hungary, Professor Gombosi was educated in theoretical physics. In the mid-1970s he was the first foreign national to do postdoctoral research at the Space Research Institute in Moscow, where he participated in theoretical studies of the solar wind interaction with Venus and in data interpretation of the Venera-9 and Venera-10 Venus orbiters. A few years later he came to the U.S. to participate in theoretical work related to NASA's Venus exploration. In the early 1980s he played a leading role in the planning and implementation of the international VEGA mission to Venus and Halley's comet. In the mid-1980s he permanently moved to the U.S., and in 1987 he joined the faculty of the University of Michigan, where presently he is Professor and Chair in the Department of Atmospheric, Oceanic and Space Sciences and Professor of Aerospace Engineering. In addition, he is Director of the Space Physics Research Laboratory at the University of Michigan and Director of the Center for Space Environment Modeling.

Over the last two decades Professor Gombosi played a leading role in many areas of space and planetary physics. He is a pioneer of modern cometary plasma physics and he is particularly active in the exploration of Mars, Venus, Jupiter and Saturn. He served on many national and international committees, organized major congresses as well as small workshops. He chaired or co-chaired 14 PhD committees, about half his students carried out planetary research.

Professor Gombosi is author of two widely used graduate level textbooks: *Gaskinetic Theory* and *Physics of the Space Environment*

RESEARCH INTERESTS

Present research interests include:

(i) Development of a first-principles based, predictive global space weather simulation framework (SWMF) extending from the solar photosphere to the terrestrial atmosphere;
(ii) Physics of the heliosphere and the space environments of planets (including Earth) and comets;
(iii) Theoretical investigations of plasma transport in various regions of the heliosphere;
(iv) Fundamental kinetic theory of gases and plasmas; and
(v) High-performance multiscale 3D MHD simulations of solar system plasmas on solution adaptive unstructured grids.

He continues to participate in the exploration of our solar system. He is Interdisciplinary Scientist of the international Cassini/Huygens mission to Saturn and its moon, Titan. He is a Co-Investigator of the ROSINA ion-neutral mass spectrometer on the international ROSETTA mission to comet Churyumov-Gerasimenko, Co-Investigator of the IMPACT plasma instrument on NASA's STEREO mission to explore solar storms, and Co-Investigator of the SMART (MMS) mission. In addition, he is part of several phase A mission studies to investigate magnetospheric and planetary plasmas. He is leading an interdisciplinary effort to simulate solar storms and leads the team that developed the Space Weather Simulation Framework (SWMF) for flexible Sun-to-Earth simulations.

SCIENTIFIC CONTRIBUTIONS

His scientific contributions span across many areas of space and planetary physics. Here is an incomplete list of his most important scientific contributions:

(i) He was a member of the group that first measured the directional anisotropy of $\sim 10^{14}$ eV galactic cosmic rays;
(ii) Using theoretical calculations and plasma observations by the Venera-9 and -10 Venus orbiters he and his Russian colleagues were the first to establish that during solar minimum conditions energetic electrons originating from the solar wind are responsible for the maintenance of the nighttime ionosphere of Venus;
(iii) He played a pioneering role in the development of modern cometary plasma physics;
(iv) With the help of his students and colleagues he pioneered the modeling of the complicated physical process controlling the interface region between the comet nucleus and the continuously escaping cometary coma;
(v) He lead the international team that developed the first multidimensional numerical model describing the strongly coupled dusty gas flow near cometary nuclei;
(vi) He developed the first time-dependent model of the terrestrial polar wind that accounted for the dynamics and energetics of the transonic ion outflows from the high-latitude ionosphere;
(vii) He derived new transport equations from higher-order velocity moments of the Boltzmann equation using a non-isotropic Gaussian base-function;
(viii) He is leading an interdisciplinary group of faculty, students and staff that pioneered the development of a new generation of high-performance 3D MHD codes using solution adaptive grids. The same team recently developed the Space Weather Modeling Framework (SWMF).

EDITORIAL EXPERIENCE

He was Senior Editor of JGR-Space Physics (1992–1997), the leading publication in space physics. Additional editorial experience includes:

(i) Member, Publishing Policy Committee, American Institute of Physics, 1998–2000;
(ii) Editor of four scientific monographs;
(iii) Associate Editor, Icarus, 1991–1997;
(iv) Member, Translation Journals Board, American Institute of Physics, 1993–97;
(v) Member, Publications Committee, American Geophysical Union, 1990–92;
(vi) Associate Editor, Geophysical Research Letters, 1986–88.

SERVICE

Served on a large number of international and national scientific committees. An incomplete list includes:

(i) Co-Chair, NASA Advanced Modeling and Simulations Capability Roadmap Team, 2004-2005

(ii) Member, Basic Sciences Committee, International Academy of Astronautics, 1994–present;

(iii) Chair, COSPAR Commission D (Space Plasmas including Planetary Magnetospheres), 1996–2000;

(iv) Committee on Solar and Space Physics, Space Studies Board, US National Research Council, 1996–1999.

(v) Chair (1987–91) and Co-chairman (1979–87), IAGA Division IV (Solar Wind and Interplanetary Magnetic Field).

SELECTED PUBLICATIONS:

G. Toth, D. L. De Zeeuw, T. I. Gombosi, and K. G. Powell, A parallel explicit/implicit time stepping scheme on block-adaptive grids, *J. Comput. Phys., 217*, 722-758, 2006.

T. I. Gombosi and K. C. Hansen, Saturn's variable magnetosphere, *Science*, *307*, 1224-1226, 2005.

K. C. Hansen, A. J. Ridley, G. B. Hospodarsky, N. Achilleos, M. K. Dougherty, T. I. Gombosi and G. Toth, Global MHD simulations of Saturn's magnetosphere at the time of Cassini approach, *Geophys. Res. Lett.*, *32*, L20S06, doi:10.1029/2005GL022835, 2005.

G. Toth, I. V. Sokolov, T. I. Gombosi, D, R. Chesney, C. R. Clauer, D. L. De Zeeuw, K. C. Hansen, K. J. Kane, W. B. Manchester, R. C. Oehmke, K. G. Powell, A. J. Ridley, I. I. Roussev, Q. F. Stout, O. Volberg, R. A. Wolf, S. Sazykin, A. Chan, and Bin Yu, Space Weather Modeling Framework: A new tool for the space science community, *J. Geophys. Res., 10*, A12226, doi:10.1029/2005JA011126, 2005.

A. J. Lovell, N. Kallivayalil, F. P. Schloerb, M. R. Combi, K. C. Hansen, and T. I. Gombosi, On the effect of electron collisions in the excitation of cometary HCN, Astrophys. J., 613, 615--621, 2004.

G. Toth, D. Kovacs, K. C. Hansen, and T. I. Gombosi, Three-dimensional MHD simulations of the magnetosphere of Uranus, *J. Geophys. Res., 109*, A11210, doi:10.1029/2004JA010406, 2004.

T.I. Gombosi, K.G. Powell, D.L. De Zeeuw, C.R. Clauer, K.C. Hansen, W.B. Manchester, A.J. Ridley, I.I. Roussev, I.V. Sokolov, Q.F. Stout, and G. Tóth, Solution Adaptive MHD for Space Plasmas: Sun-to-Earth Simulations, *Computing in Science and Engineering, 6, No 2*, 14-35, 2004.

T.E. Cravens, and T.I. Gombosi, Cometary magnetospheres: A tutorial, *Adv. Space Res., 33*(11), 1968-1976, 2004.

T. H. Zurbuchen, P. Koehn, L. A. Fisk, T. Gombosi, G. Gloeckler and K. Kabin, On the space environment of Mercury, *Adv. Space Sci., 33*(11), 1884-1889, 2004.

T.E. Cravens,, J.H. Waite, T.I. Gombosi, N. Lugaz, G.R. Gladstone, B.H. Mauk, and R.J. MacDowall, Implications of Jovian X-ray emission for magnetosphere-ionosphere coupling, *J. Geophys. Res., 108*(A12), 1465, doi:10.1029/2003JA010050, 2003.

T.I. Gombosi, G. Toth, D.L. De Zeeuw, K.C. Hansen, K. Kabin, and K.G. Powell, Semi-relativistic magnetohydrodynamics and physics-based convergence acceleration, *J. Comput. Phys., 177*, 176, 2002.

K.G. Powell, P.L. Roe, T.J. Linde, T.I. Gombosi, and D.L. De Zeeuw, A Solution-Adaptive Upwind Scheme for Ideal Magnetohydrodynamics, *J. Comput. Phys., 154*, 284, 1999.

T.I. Gombosi, Physics of the Space Environment (graduate textbook), Cambridge Univ. Press, 1998.

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