Jay Robert Johnson

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Employment

- **Princeton Plasma Physics Laboratory**, Princeton, NJ
  May 2005 to present: Head, Space Physics Division
  October 2005 to present: Principal Research Physicist
  October 2000 to September 2005: Research Physicist Rank III
  October 1997 to September 2000: Staff Research Physicist Rank II
  January 1995 to September 1997: Research Associate Rank I
  Developed kinetic-fluid model which is well suited to include important kinetic effects in fluid models. Demonstrated that the dominant compressional waves in the magnetosheath can mode convert to kinetic Alfvén waves at the magnetopause and that the associated wave induced transport can be significant. Developed magnetosphere-ionosphere coupling model to explain ion outflows self-consistently. Studied nonlinear dynamics of particle transport in Alfven waves. Demonstrated a solar cycle dependence of nonlinearity in magnetospheric dynamics by comparing discriminating statistical measures of nonlinearity with surrogate data sets.

- **Massachusetts Institute of Technology**, Cambridge, MA
  October 1993 to January 1995: Research Associate
  Investigated the role of kinetic Alfvén waves for particle diffusion at the magnetopause boundary. Determined that a class of nonlinear wave structures with strongly divergent electric fields may be responsible for the black aurora.

- **Geophysical Institute at the University of Alaska**, Fairbanks, AK
  June 1992 to September 1993: Research Associate
  Worked under the direction of Prof. L. C. Lee. Conducted basic research ranging from ionosphere to solar corona with an emphasis on kinetic theory and particle dynamics.

Education

- **Massachusetts Institute of Technology**, Cambridge, MA
  Ph.D. degree in Physics, June 1992
  Thesis under Dr. Tom Chang on "Excitation of Low Frequency Plasma Turbulence Along Auroral Field Lines." Concentration in space plasma physics dealing with global models of wave propagation in inhomogeneous media and the origin of auroral turbulence.

- **University of Colorado**, Boulder, CO
  Bachelor of Arts in Physics (with distinction) and Math, August, 1987
  As part of the honors program worked with Prof. Martin V. Goldman doing original research in plasma physics. Chancellor's Recognition Award for 4.0 GPA, Sigma Pi Sigma, Society of Physics students, Phi Beta Kappa, Golden Key National Honor Society, Regents Scholar scholarship.

Academic Service

- Advised students (Sorin Zaharia, Luis Delgado, and Andrew Burlingame) and postdocs (Eun-Hwa Kim) at Princeton Plasma Physics Laboratory (1999-present).
- Served as co-organizer and lecturer of graduate student class AST-558 (special topics in space physics) at Princeton University (2000-2001).
- Guest lecturer for graduate course 8.613J—Introduction to Plasma Physics I at Massachusetts Institute of Technology, 1994.

Professional Service

- Program Committee representative from Nonlinear Geophysics for Fall AGU meeting, 2008. Organizer of AGU sessions on plasma entry and transport at Western Pacific Geophysics Meeting (2008) and workshop in Fairbanks, AK (2009). Organizer of entropy session at American Geophysical Union meeting (2007) and guest editor of special Journal of Geophysical Research section on entropy constraints in space (2009). Organizer of ongoing NSF GEM session on transport processes in the plasma sheet and sessions at: IAGA scientific assembly in Sopron, Hungary 2009; IAGA scientific assembly in Toulouse, 2005; AOGS meeting in Singapore, 2004; and IAGA scientific assembly in Sapporo, Japan, 2003. Served on program committee of Chapman Conference on ULF Waves in San Diego, 2005.
- Collaborated with Dr. Tom Chang (MIT), Prof. L. C. Lee (University of Alaska), Prof. A. Otto (University of Alaska), Dr. Dirk Lummerzheim (Univeristy of Alaska), Prof. D-H Lee (Kyung-Hee University), Dr. Anatoly Streltsov (Dartmouth College), Simon Wing (Applied Physics Laboratory), Prof. M. Engebretson (Augsburg College), Prof. P. Song (U Mass at Lowell), Dr. Eric Lund (University of New Hampshire), Prof. Yu Lin (Auburn University), and Dr. P. Yoon (University of Maryland) in the area of space physics, and Prof. Ross Snider (University of Montana) and Prof. X. Wang (John Hopkins Medical School) in the area of biosciences.
- Theory seminar and colloquium chairman at Princeton Plasma Physics Laboratory
- Served on NASA review panels.
- Served on the internal review of Physics Department at the University of Colorado, 1987

Funding Sources

Principal Investigator:

- "Heavy Ion Effects on Magnetopause Entry and Plasma Sheet Transport" awarded by NASA Heliophysics Guest Investigator proposal for a total of $530,800/4 years to be completed in 2012.

- "A novel Statistical Method for Extracting Dependencies in Mulivariate Geospace Data Sets" awarded by NASA Applied Information Systems Research program for a total of $485,700/3 years to be completed in 2010.
- "Hybrid Simulations of Transport due to Kinetic Alfven Waves at the Magnetopause" awarded by NASA Living with a Star program for a total of $397,800/3 years to be completed in 2010.
- "Thin Ionization Layer of the Enhanced Aurora" awarded by NSF at $336K/3 years by NSF to be completed in 2009.
- "Electromagnetic Full Particle Simulations of the Structure and Stability of the Magnetopause with Velocity Shear" awarded by NASA at $301,300/3 years completed in 2008.
- "Self-Consistent Model for Regions of Downward Auroral Current" awarded by NSF at $268K/3 years completed in 2006.
- "Energy Transport and Dissipation of Electromagnetic Ion Cyclotron Waves in the Magnetosphere/Ionosphere" awarded by NASA at $288K/3 years completed in 2005.

Analysis Skills Asymptotic analysis, complex analysis, variational analysis, nonlinear systems, information theory, numerical analysis

Computer Skills Working knowledge of UNIX, PERL, HTML, LaTeX, Matlab, IDL, Mathematica, Fortran95, C, C^{++}.

Awards
- Outstanding Student Paper Award for Fall 1990 AGU Meeting in the Solar-Planetary Relationships section.
- Chancellor's Recognition Award, University of Colorado, August 1987.
- Commended by the F.L. Scarf Award committee for an outstanding thesis, 1993

Professional Affiliations Member of American Geophysical Union, American Physical Society, Sigma Pi Sigma and Phi Beta Kappa.

Background/ Interests Raised in Boulder, CO. Married. Enjoy raising our two children, mountain climbing, cross-country skiing, hiking, gardening, woodworking, and making/playing ancient musical instruments.

Refereed Publications
- Johnson, J. R., E. Choueiri, and H. Okuda, Cross-field current instabilities in thin ionization layers and the enhanced aurora, to be submitted to *J. Geophys. Res.*, 2009.
- Johnson, J. R., and S. Wing, Exploring causal relationships in space plasmas with transfer entropy, to be submitted to *J. Geophys. Res.*, 2009.
- Johnson, J. R. and S. Wing, A cumulant-based analysis of nonlinear magnetospheric dynamics, PPPL-3919rev, to be submitted to *Nonlinear Processes in Geophysics*, 2009.
- Lin, Y., J. R. Johnson, and X. Y. Wang, Hybrid Simulation of mode conversion at the magnetopause, to be submitted to *J. Geophys. Res.*, 2009.

- Johnson, J. R., and S. Wing, Northward IMF plasma sheet entropies, submitted to *J. Geophys. Res.*, 2008.
- Wing., S, and J. R. Johnson, Substorm Entropies, submitted to *J. Geophys. Res.*, 2008.
- Chaston, C. C., J. R. Johnson, M. Wilber, M. Acuna, M. L. Goldstein, and H. Reme, Kinetic Alfvén wave turbulence and transport through a reconnection diffusion region, *Phys. Rev. Lett.*, 102, 015001, 2009.
- Lee D.-H., J. R. Johnson, K. Kim, K.-S. Kim, Effects of heavy ions on ULF wave resonances near the equatorial region, *J. Geophys. Res.*, 113, A11212, doi:10.1029/2008JA 013088, 2008.
- Kim, Kim E.-H., J. R. Johnson, D.-H. Lee, Resonant absorption of ULF waves at Mercury's magnetosphere, *J. Geophys. Res.*, 113, A11207, doi:10.1029/2008JA 013310, 2008.
- Wing, S., J. W. Gjerloev, J. R. Johnson, and R. A. Hoffman, Substorm plasma sheet ion pressure profiles, *Geophys. Res. Lett.*, 34, L16110, doi:10.1029/2007GL 030453, 2007.
- Wing, S., J. R. Johnson, J. R., and M. Fujimoto, Timescale for the formation of the cold-dense plasma sheet: A case study, *Geophys. Res. Lett.*, 33, L23106, doi:10.1029GL027110, 2006.
- M. J. Engebretson, A. Keiling, K.-H. Fornacon, J. L. Posch, S. R. Quick, C. A. Cattell, Jay R. Johnson, K.-H. Glassmeier, G. K. Parks, H. Reme, and A. Balogh, Cluster observations of Pc 1-2 waves and associated ion signatures during the October and November 2003 magnetic storms, Planetary and Space Science, 54, doi:10.1016/j.pss.2006.03.015, 2006.
- Kim, H., M. R. Lessard, J. W. Labelle, and J. R. Johnson, Narrow-band ELF (Extremely Low Frequency) wave phenomena observed at South Pole station, *Geophys. Res. Lett.*, 33, L06109, doi:10.1029/1005/GL023638, 2006.
- Wing, S., J. R. Johnson, P. T. Newell, and C.-I. Meng, Dawn-dusk asymmetries, ion spectra, and sources in the northward IMF plasma sheet, *J. Geophys. Res.*, 110, A08205, doi:10.1029/2005JA011086, 2005.
- Wing, S., J. R. Johnson, J. Jen, C.-I. Meng, D. G. Sibeck, K. Bechtold, J. Freeman, K. Costello, M. Balikhin, and K. Takahashi, Kp forecast models, *J. Geophys. Res.*, *110*, A04203, doi:10.1029/2004JA10500, 2005.
- Johnson, J. R. and S. Wing, A solar cycle dependence of nonlinearity in magnetospheric activity, *J. Geophys. Res.*, *110*, A04211, doi:10.1029/2004JA010638, 2005.
- Johnson, J. R. and C. Z. Cheng, Kinetic Alfvén waves at the magnetopause—mode conversion, transport, and formation of the LLBL, in *Earth's Low-Latitude Boundary Layer, Geophys. Monogr. 133*, edited by P. Newell and T. Onsager, pp. 211–222, American Geophysical Union, 2003.
- Johnson, J. R. and C. Z. Cheng, Stochastic ion heating at the magnetopause due to kinetic Alfvén waves, *23*, 4421-4424, *Geophys. Res. Lett.*, 2001.
- Johnson, J. R., C. Z. Cheng, and P. Song, Signatures of mode conversion and kinetic Alfvén Waves at the magnetopause, *Geophys. Res. Lett.*, *28*, 227–230, 2001.

- Zaharia, S., C. Z. Cheng, and J. R. Johnson, Particle transport and energization associated with disturbed magnetospheric events, *J. Geophys. Res.*, *105*, 18741–18752, 1999.
- Johnson, J. R. and C. Z. Cheng, Can ion cyclotron waves propagate to the ground?, *Geophys. Res. Lett.*, *26*, 671–674, 1999.
- Cheng, C. Z. and J. R. Johnson, A kinetic-fluid model, *J. Geophys. Res.*, *104*, 413–427, 1999.
- Streltsov, A. V., W. Lotko, J. R. Johnson, and C. Z. Cheng, Small-scale dispersive field line resonances in the hot magnetospheric plasma, *J. Geophys. Res.*, *103*, 25559–26572, 1998.
- Johnson, J. R., and C. Z. Cheng, Kinetic Alfvén waves and plasma transport at the magnetopause, PPPL Report 3232, *Geophys. Res. Lett.*, *24*, 1423–1426, 1997.
- Johnson, J. R., and C. Z. Cheng, Global structure of mirror modes in the magnetosheath, *J. Geophys. Res.*, *102*, 7179–7189, 1997.
- Johnson, J. R., T. Chang, and G. B. Crew, A study of mode conversion in an oxygen-hydrogen plasma, *Phys. Plasmas*, *2*, 1274–1284, 1995.
- Johnson, J. R., and T. Chang, Nonlinear vortex structures with diverging electric fields and their relation to the black aurora, *Geophys. Res. Lett.*, *22*, 1481–1484, 1995.
- Lee, L. C., J. R. Johnson, and Z. W. Ma, Kinetic Alfvén waves as a source of plasma transport at the dayside magnetopause, *J. Geophys. Res.*, *99*, 17405–17411, 1994.
- Ball, L., M. André, and J. R. Johnson, Wave observations and their relation to "nonresonant" ion heating in a "weakly turbulent" plasma, *Ann. Geophys.*, *9*, 37–41, 1991.
- Johnson, J. R., T. Chang, G. B. Crew, and M. André, Equatorially generated ULF waves as a source for the turbulence associated with ion conics, *Geophys. Res. Lett.*, *16*, 1469–1472, 1989.

Conference Publications

- Johnson, J. R., and T. Chang, Nonlinear vortex structures with diverging electric fields, PPPL Report 3193, published in *Physics of Space Plasmas (1995), Proceedings of the 1995 Cambridge Workshop in Geoplasma Physics*, 665–683, MIT Center for Theoretical Geo/Cosmo Plasma Physics, Cambridge, MA, 1996.
- Johnson, J. R., and C. Z. Cheng, Global mirror modes in the magnetosheath, PPPL Report 3190, published in*Physics of Space Plasmas (1995) Proceedings of the 1995 Cambridge Workshop in Geoplasma Physics*, 261–276, MIT Center for Theoretical Geo/Cosmo Plasma Physics, Cambridge, MA, 1996.
- Cheng, C. Z. and J. R Johnson, A kinetic-MHD model for low frequency multiscale phenomena,, PPPL Report 3193, published in *Physics of Space Plasmas (1995) Proceedings of the 1995 Cambridge Workshop in Geoplasma Physics*, 127–145, MIT Center for Theoretical Geo/Cosmo Plasma Physics, Cambridge, MA, 1996.

- Johnson, J. R., T. Chang, G. B. Crew, and M. André, Propagation characteristics of ULF waves present along closed field lines in the central plasma sheet, in *Physics of Space Plasmas (1990), Proceedings of the 1990 Cambridge Workshop in Geoplasma Physics*, Scientific Publishers, Inc., 277–289, 1991.
- Johnson, J. R., T. Chang, G. B. Crew, and M. André, Equatorially generated ULF waves as a source for the turbulence associated with ion conics, in *Physics of Space Plasmas (1989), Proceedings of the 1989 Cambridge Workshop in Geoplasma Physics*, Scientific Publishers, Inc., 433–445, 1990.

Invited Talks

- How Does Wave Turbulence in the Cusp Affect Ion Precipiation?, American Geophysical Union Meeting, San Francisco, CA, December, 2008.
- Plasma Heating and Transport at the Magnetopause due to ULF Waves at High Altitude Observatory, Boulder, CO, October, 2008.
- Insights into the Nature and Morphology of the Substorm Process from Mapping Global Features of Diffuse Auroral Precipitation to the Plasma Sheet, STAMMS2 workshop, Orleans, France, Sept, 2007.
- The variability of magnetospheric dynamics over the solar cycle, International Symposium on Space Climate held, Sinaia, Romania Sept, 2006.
- The Response of the Magnetosphere to the Solar Wind, Interface 2006 meeting (multidisciplinary symposium on the interface of statistics, computing science, and applications), Pasadena, CA, May 2006.
- Plasma Heating and Transport at the Magnetopause due to Nonlinear interactions with Kinetic ULF Waves, Jay R. Johnson, Simon Wing, Yu Lin, and C. Z. Cheng, American Geophysical Union Meeting, San Francisco, CA, December 2005.
- An Information Theoretical Approach to Solar Flare Occurrence, Jay R. Johnson and Gwangson Choe, American Geophysical Union Meeting, San Francisco, CA, December 2005.
- Dawn-Dusk Asymmetries, Ion Spectra, and Sources in the Northward IMF Plasma Sheet, Simon Wing, J. R. Johnson, P. Newell, and C.-I. Meng, International Association of Geomagnetism and Aeronomy meeting, Toulouse, France, July 2005.
- Feedback Between Electromagnetic Ion Cyclotron Waves And Ionospheric Outflows, J. R. Johnson, University of Texas, Arlington, TX, April 2005.
- Plasma Heating and Transport at the Magnetopause due to Kinetic Alfvén Waves, J. R. Johnson, Chapman Conference on ULF Waves, San Diego, CA, March 2005.
- The Response of the Magnetosphere to the Solar Wind, J. R. Johnson, Theory Seminar, Princeton Plasma Physics Laboratory, March 2005.
- Kinetic Alfvén Waves and Plasma Heating and Transport at the Magnetopause, C. Z. Cheng and J. R. Johnson, American Geophysical Union Meeting, San Francisco, CA, December 2004.
- A Self-Consistent Model for Ion Outflows Associated with Electromagnetic Ion Cyclotron Waves, J. R. Johnson and C. Z. Cheng, Asia Oceania Geosciences Society Meeting, Singapore, July 2004.

- Heating and Transport at the Magnetopause Associated with Kinetic Alfvén Waves, J. R. Johnson and C. Z. Cheng, Asia Oceania Geosciences Society Meeting, Singapore, July 2004.
- Information-Dynamical Modeling using Cumulant-Based Methods, J. R. Johnson, Montana State University, Bozeman, MT, March 2004.
- Coupling Between Ion Cyclotron Waves and Ionospheric Outflows, J. R. Johnson, Dartmouth College, VT, May 2003.
- Solar Wind-Magnetosphere-Ionosphere Coupling Mediated by Low Frequency Waves, J. R. Johnson, High Altitude Observatory, Boulder, CO, December 2002.
- Kinetic Alfvén Waves At The Magnetopause And Resulting Plasma Transfer, J. R. Johnson and C. Z. Cheng, International Association of Geomagnetism and Aeronomy meeting, Hanoi, Vietnam, August 2001.
- Kinetic Alfvén Waves at the Magnetopause—Mode Conversion, Transport, and Formation of the LLBL, J. R. Johnson, and C. Z. Cheng, Chapman Conference on Earth's Low-Latitude Boundary Layer, New Orleans, April 2001.
- Propagation and Dissipation of Ion Cyclotron Waves in the Auroral Ionosphere, J. R. Johnson, Theory Seminar, Princeton Plasma Physics Laboratory, March 2000.
- Observational Study of Mode conversion of Low Frequency MHD Waves at the Magnetopause: Dependence on Magnetic Rotation, J. R. Johnson, University of California, Los Angeles, CA, September, 1999.
- Correlations Between Ion Cyclotron Waves in the Equatorial Magnetosphere and Ground Based Magnetometers, J. R. Johnson, Applied Physics Laboratory, Johns Hopkins University, MD, April, 1999.
- MHD Waves and Plasma Transport at the Magnetopause: Role of Interplanetary Magnetic Field, J. R. Johnson, American Physical Society/Division of Plasma Physics meeting, New Orleans, LA, November, 1998.
- MHD Waves and Transport at the Magnetopause, J. R. Johnson and C. Z. Cheng, Cambridge Workshop on Multiscale Phenomena in Space Plasmas II, Cascais, Portugal, June, 1998.
- Kinetic Alfvén Waves at the Magnetopause: Wave Structure and Consequences for Plasma Transport, J. R. Johnson, Dartmouth College, VT, October 1997.
- Low-Frequency MHD Waves and Plasma Transport at the Magetopause, J. R. Johnson, GEM workshop, Snowmass, CO, June 1997.
- Wave Effects on Transport at the Magnetopause, J. R. Johnson, GEM Workshop, Snowmass, CO, June 1996.
- Wave Interaction and Mode Conversion at the Magnetopause, J. R. Johnson, GEM Workshop, Snowmass, CO, June 1995.
- MHD Waves and Plasma Transport at the Magnetopause J. R. Johnson, Applied Physics Laboratory/Goddard Space Flight Center, MD, April 1995.
- Global Mirror Modes in the Magnetosheath, J. R. Johnson and C. Z. Cheng, Cambridge Workshop in Geoplasma Physics, Bermuda, February 1995.

- Are Equatorially Excited ULF Waves a Viable Source for Generating Ion Conics in the Central Plasma Sheet?, J. R. Johnson, Theory Seminar, Princeton Plasma Physics Laboratory, October 1994.
- Nonlinear Waves With Divergent Electric Fields With Applications to the Black Aurorae and Non-Neutral Periodic Propagations in the Acceleration Region, J. R. Johnson, FREJA International Scientific Workshop on Small-Scale Auroral Physics, Banff, Alberta, Canada, August 1994.
- Plasma Transport Across the Magnetopause by Kinetic Alfven Waves J. R. Johnson, Chapman Conference on the Magnetopause, Fairbanks, AK, September 1993.
- Plasma Tranport Associated with Kinetic Alfvén Waves, at High Altitude Observatory/University Center for Atmospheric Research, Boulder, CO, September, 1993.
- Propagation Characteristics of ULF Waves Present Along Closed Field Lines in the Central Plasma Sheet, J. R. Johnson, T. Chang, G. B. Crew, and M. André, Cambridge Workshop in Geoplasma Physics, Cambridge, MA, 1991.