

CURRICULUM VITAE: Ward B. Manchester IV

Current Position

Assistant Research Scientist University of Michigan
Department of Atmospheric Oceanic and Space Sciences
2455 Hayward Street
Ann Arbor, MI 48109
office phone number: 734-647-3475
email: chipm@umich.edu

Educational Background

1985-1989, University of Illinois: B.S. Astronomy
1992-2000, University of Illinois: Ph.D. Astronomy

Professional Experience

09/2001-present, Assistant Research Scientist, University of Michigan
07/2000-08/2001, Research Fellow, University of Michigan
04/2000-06/2000, Post-Doctorate Position, High Altitude Observatory
09/1996-04/2000, Newkirk Graduate Research Assistant, High Altitude Observatory
08/1995-10/1995, Graduate Student Visitor, High Altitude Observatory
10/1995-09/1996, Research Assistant, University of Illinois
06/1995, Summer School on Radiation Hydrodynamics, University of Oslo
08/1992-05/1995, Teaching Assistant, University of Illinois

Brief Summary of Research Interests

My research interests concern solar magnetism and magnetic flux transport from below the photosphere into the corona and through the heliosphere. In this context, I have contributed to basic theory and modeling efforts with analytical work and large scale numerical simulations. The topics that I am particularly interested in are: magnetic flux emergence, magnetohydrodynamic instabilities, coronal mass ejection initiation and propagation, and global heliospheric structure. Flux emergence was the topic of my thesis, which demonstrates that the buoyant rise of magnetic fields from the solar interior naturally leads to the formation of highly sheared coronal arcades. I have extended this modeling effort to include the buoyant rise of magnetic flux ropes from the convection zone into the corona. While at the University of Michigan, I have performed numerical MHD simulations describing the time-dependent expulsion of CMEs from the solar corona. More recently, I have modeled the propagation of CMEs from the corona to the Earth with unprecedented numerical resolution to predict the impact on the Earth's magnetosphere. Another project I am currently involved with is modeling of the global heliosphere, which is lead by M. Opher from NASA's Jet Propulsion Laboratory (JPL).

Service Activity

Review proposals for NSF and NASA. Review papers for the Astrophysical Journal, the Journal of Geophysical Science, and for Advances in Space Research.

Honors and Recognitions

- 1996, Newkirk Fellowship at the High Altitude Observatory
- 2000, Visiting Scientist Position at the High Altitude Observatory
- 2005, Visiting Scientist Position at the High Altitude Observatory

Professional Organizations

- American Astronomical Society
- American Geophysical Union

Grants and Subcontracts Awarded as PI

Title: Evolution of CME Shocks in a Realistic Lower Corona
Sponsor: NASA through subcontracts from JPL and George Mason University
Period: 03/11/05-08/31/07
Amount: 109,000
Capacity: PI

Title: 3D MHD Numerical Simulations of Magnetic Flux Emergence with Comparisons to TRACE and MDI observations
Sponsor: NASA SR&T Program
Period: 02/15/2006-02/14/2009
Amount: 292,661
Capacity: PI

Title: Tomographic Determination of Lower Boundary Conditions in the Corona
Sponsor: NSF through a subcontract from the University of Illinois
Period: 01/01/06-12/31/08
Amount: 86,945
Capacity: PI

Title: Modeling the 3D Density Structure and White-Light Appearance of CME Events
Sponsor: NASA LWS TR&T Program
Period: 08/01/06-07/31/09
Amount: 261,103
Capacity: PI

Supervision of Graduate Students

Noé Lugaz Ph.D. candidate, 2004 - present; co-adviser with principle advisor Prof. Tamas Gombosi

Publication List: Ward B. Manchester, IV

Refereed Publications

- [1] Low, B.C., and Manchester, IV, W., Equilibrium and Stability of Magnetostatic Atmospheres, I. Dungey Type Isothermal States, *Astrophysical Journal*, **528**, 1026, 2000.
- [2] Manchester, IV, W., and Low, B.C., Magnetostatic Atmospheres Possessing Identical Invariants of Ideal Magnetohydrodynamics, *Physics of Plasmas*, **7**, 4, 1263, 2000.
- [3] Manchester, IV, W., The Role of Nonlinear Alfvén Waves in Shear Formation During Solar Magnetic Flux Emergence, *Astrophysical Journal* **547**, 503, 2001.
- [4] Manchester, IV, W., Buoyant Disruption of Magnetic Arcades with Self-Induced Shearing, *Journal of Geophysical Research*, **108**(A4), A01162, doi10.1029/2002JA009252, 2003.
- [5] Opher, M., Liewer, P., Gombosi, T., Manchester, IV, W., DeZeeuw, D., Sokolov, I., and Toth, G., Probing the Edge of the Solar System: Formation of an Unstable Jet-Sheet *Astrophysical Journal*, **591**, L61, 2003.
- [6] Rousev, I., Gombosi, T., Sokolov, I., Velli, M., Manchester, IV, W., DeZeeuw, D., Liewer, P., Toth, G., and Luhmann, J., A Three-dimensional model of the solar wind incorporating solar magnetogram observations *Astrophysical Journal*, **595**, L57, 2003.
- [7] Manchester, IV, W., Gombosi, T., Rousev, I., DeZeeuw, D.L., Sokolov, I., Powell, K., Toth, G., and Opher, M. Three-Dimensional MHD Simulation of a Flux Rope Driven CME *Journal of Geophysical Research*, **109**, A01102, doi:10.1029/2003JA010150, 2004.
- [8] Manchester, IV, W., Gombosi, T., Ridley, A., Rousev, I., DeZeeuw, D.L., Sokolov, I., Powell, K., and Toth, G., Modeling a Space Weather Event from the Sun to the Earth: CME Generation and Interplanetary Propagation. *Journal of Geophysical Research*, **109**, A02107, doi:10.1029/2002JA009672, 2004.
- [9] Gombosi, T., Powell, K., DeZeeuw, D., Hansen, K., Manchester, IV, W., Ridley, A., Rousev, I., Sokolov, I., Stout, Q., and Toth, G., Solution Adaptive MHD for Space Plasma Simulations: Sun-to-Earth Simulations *Computing in Science and Engineering*, March/April 2004.
- [10] Manchester, IV, W., Gombosi, T., DeZeeuw, D., and Fan, Y., Eruption of a Buoyantly Emerging Magnetic Flux Rope, *Astrophysical Journal* **610**, 588, 2004.
- [11] Opher, M., Liewer, P., Velli, M., Bettarini, L., Gombosi, T., Manchester, IV, W., DeZeeuw, D., Toth, G., and Sokolov, I., Magnetic Effects at the Edge of the Solar System: MHD Instabilities, the de Laval nozzle Effect and an Extended Jet *Astrophysical Journal*, **611**, 575, 2004.
- [12] Sokolov, I., Rousev, I., Gombosi, T., Lee, M., Kota, J., Forbes, T., Manchester, IV, W., and Sakai, J., A New Field Line Advection Model for Solar Particle Acceleration *Astrophysical Journal* **616**, L171, 2004.
- [13] Manchester, IV, W., Gombosi, T., DeZeeuw, D., Sokolov, I., Rousev, I., Powell, K., Kota, J., Toth, G., and Zurbuchen, T. CME Shock and Sheath Structures Relevant to Particle Acceleration *Astrophysical Journal*, **622**, 1225, 2005.
- [14] Lugaz, N., Manchester, IV, W., and Gombosi, T., The Evolution of CME Density Structures, *Astrophysical Journal*, **627**, 1019, 2005.
- [15] Toth et al., Space Weather Modeling Framework: A new tool for the space science community, *Journal of Geophysical Research*, **110**, A12226, doi:10.1029/2005JA011126, 2005.
- [16] Lugaz, N., Manchester, IV, W., and Gombosi, T., Numerical Simulation of the Interaction of

- Two Coronal Mass Ejections from Sun to Earth, *Astrophysical Journal*, **634**, 651, 2005.
- [17] Manchester, IV, W., and Zurbuchen, T., Are High-Latitude Forward-Reverse Shock Pairs Driven by Over-Expansion? *Journal Geophysical Research*, **111**, A05101, doi:10.1029/2005JA011461, 2006.
- [18] Manchester, IV, W., Ridley, A., Gombosi, T., and DeZeeuw, D., Modeling the Sun-Earth Propagation of a Very Fast CME, *Advances in Space Research*, **38**, 253, 2006.
- [19] Ridley, A., DeZeeuw, D., Manchester, IV, W., and Hansen, K., The Magnetospheric and Ionospheric Response to a Very Strong Interplanetary Shock and Coronal Mass Ejection, *Advances in Space Research*, **38**, 263, 2006.
- [20] Aschwanden, M., et al., Theoretical Modeling For the Stereo Mission, *Space Science Reviews*, DOI 10.1007/s11214-0006-9027-8, 2006.
- [21] Cohen, O., Sokolov, I., Roussev, I., Arge, C., Manchester, IV, W., Gombosi, T., Frazin, R., Park, H., Butala, M., Kamalabadi, F., and Velli, M., A Semiempirical Magnetohydrodynamic Model of the Solar Wind, *Astrophysical Journal*, **654**, L163, 2007.
- [22] Lugaz, N., Manchester IV, W., Roussev, I., Toth, G., and Gombosi, T., Numerical Simulation of the Homologous CMEs From Active Region 9236, *Astrophysical Journal*, **659**, 788, 2007.
- [23] Lugaz, N., Manchester, IV, W., Roussev, I., and Gombosi, T., Observational Evidence of CMEs Interacting in the Inner Heliosphere Based on MHD Simulations, *Journal of Atmospheric and Solar-Terrestrial Physics*, in press, 2007.
- [24] Cohen, O., Sokolov, I., Roussev, I., Lugaz, N., Manchester, IV, W., Gombosi, T., Arge, C., Validation of a Global 3D Heliospheric Model with Observations for the May 12, 1997 CME Event, *Journal of Atmospheric and Solar-Terrestrial Physics*, in press, 2007.
- [25] Toth, G., De Zeeuw, D., Gombosi, T., Manchester, IV, W., Ridley, A., Sokolov, I., Sun to Thermosphere Simulation of the October 28-30, 2003 Storm with the Space Weather Modeling Framework, *Space Weather*, in press, 2007.
- [26] Manchester, IV, W., Solar Atmospheric Dynamic Coupling Due to Shear Motions Driven by the Lorentz Force, *Astrophysical Journal*, in press, 2007.
- [27] Manchester, IV, W., and T. Zurbuchen, Reply to Comment on Are High-Latitude Forward-Reverse Shock Pairs Driven by Over-Expansion? *Journal of Geophysical Research*, in press, 2007.
- [28] Kasper, J.C., and Manchester IV, W., Confirmation of Equatorial Dimples in Solar Minimum Shock Surfaces, *Astrophysical Journal*, submitted, 2007.
- [29] Ying, L., Kasper, J., Manchester IV, W., Richardson, J., and Belcher, J., Determining the Magnetic Field Orientation of Coronal Mass Ejections from Faraday Rotation, *Astrophysical Journal*, submitted, 2007.

Conference Proceedings

- [1] Opher, M., Liewer, P., Velli, M., Gombosi, T., Manchester, IV, W., DeZeeuw, D., Toth, G., and Sokolov, I., Magnetic Effects Change our View of the Heliosheath, in Physics of the Outer Heliosphere, *AIP Conference Proceedings* vol. 719, pp 105-110, 2004.
- [2] Zurbuchen, T., von Steiger, R., Manchester, IV, W., Fisk, L., Heliospheric Magnetic Field Configuration at Solar Maximum Conditions, in Physics of the Outer Heliosphere, *AIP Conference Proceedings*, vol. 719, pp 70-80, 2004.

- [3] Fan, Y., Gibson, S.E., Manchester, W. "The Emergence and Evolution of Twisted Magnetic Flux Ropes in the Solar Corona", Proceedings of the International Scientific Conference on Chromospheric and Coronal Magnetic Fields, 30 August - 2 September 2005, Eds. D. Innes, A. Lagg, S. Solanki, D. Danesy, ESA SP-596, pp 26, November 2005.
- [4] Kota, J., Manchester IV, W., Jokipii, J. R., DeZeeuw, D., and Gombosi, T., Simulation of SEP Acceleration and Transport at CME Driven Shocks, in in *The Physics of Collisionless Shocks, AIP Conference Proceedings*, eds. G. Li, G. Zank and C.T. Russel, vol. 781, pp 201-206, 2005.
- [5] Palanhandalam-Madapusi, H., Edamana, B., Bernstein, D., Manchester IV, W., Ridley, A., NARMAX Identification for Space Weather Prediction Using Polynomial Radial Basis Functions, *46th IEEE Conference on Decision and Control*, submitted, 2007.

Invited Presentations at Conferences

- [1] Manchester, IV, W., D. De Zeeuw, T. Gombosi, A. Ridley, I. Sokolov, G. Toth, Modeling the Carrington Event: sun-to-earth propagation of a very fast CME Presented at Spring AGU, Montreal Canada, May, 2004
- [2] Manchester, IV, W., I. Roussev, I. Sokolov, A. Ridley, T. Gombosi, D. De Zeeuw, K. Hansen, G. Toth, Modeling the May 1, 1998 CME propagation from the Sun to the Earth Presented at Fall AGU, San Francisco CA, December, 2004
- [3] Manchester, IV, W., N. Lugaz, T. Gombosi, D. De Zeeuw, I. Sokolov, G. Toth, 3D Density Structure and LOS Observations of a Model CME Presented at Fall AGU, San Francisco CA, December, 2004
- [4] Manchester, IV, W., T. H. Zurbuchen, J. Kota, T. I. Gombosi, D. L. DeZeeuw, I. V. Sokolov, G. Toth Post-shock compression and forward-reverse shock pair resulting from CME interaction with a bimodal solar wind Presented at the SHINE Meeting, Kona Hawaii, July 11-15, 2005
- [5] Manchester, IV, W., Gombosi, T.I., Toth, G., Sokolov, I.I., De Zeeuw, D.L., and Ridley, A.J. Simulations of the Sun-Earth System: Modeling the Halloween Events with SWMF, Presented at the CAWSES International Workshop on Space Weather Modeling, Earth Simulator Center, Yokohama, Japan, November 14 to 17, 2006.

Contributed Presentations at Conferences

- [1] Manchester, IV, W., Topologically Equivalent Magnetostatic Atmospheres and MHD Simulations of Buoyancy Instabilities with Magnetic Shear Propagation by Alfvén Waves, Presented at American Astronomical Society meeting, Chicago IL, June 1999.
- [2] Manchester, IV, W., The Disruption of Solar Magnetic Arcades by MHD Instabilities with Self-Induced Shearing, Presented at Ultraviolet Coronal Spectrograph meeting, Bar Harbor, ME, September 2000.
- [3] Manchester, IV, W., T.I. Gombosi, D.L. DeZeeuw, and K. Powell, Coronal Mass Ejections in Global MHD Simulations, Presented at European Geophysical Society meeting, Nice, France March 2001.
- [4] Manchester, IV, W., T.I. Gombosi, D.L. DeZeeuw, and K. Powell, Global Scale MHD Simulations of Coronal Mass Ejections, Presented at Space Weather Week meeting, Boulder CO, May 2001.

- [5] Manchester, IV, W., T.I. Gombosi, D.L. DeZeeuw, K. Powell, B.C. Low, and S. Gibson, Dynamics of Expanding Flux Ropes in Coronal Mass Ejections, Presented at Spring AGU, Boston MA, May 2001
- [6] Manchester, IV, W., T.I. Gombosi, D.L. DeZeeuw, K. Powell, G. Toth, B.C. Low, and S. Gibson, Global Scale MHD Simulations of CMEs Presented at SHINE meeting, Snow Mass, CO, June 2001.
- [7] Manchester, IV, W., T.I. Gombosi, D.L. DeZeeuw, K. Powell, and G. Toth, 3D MHD Simulation of a Coronal Arcade Eruption by Self-Induced Shearing Presented at Fall AGU, San Francisco, CA, December 2001
- [8] Gombosi, T.I., W. Manchester, IV, D.L. DeZeeuw, K. Powell, and G. Toth, 3D Global MHD Simulations of Flux Rope Driven CMEs Presented at Fall AGU, San Francisco, CA, December, 2001
- [9] Manchester, IV, W., T.I. Gombosi, D.L. DeZeeuw, I.I. Roussev, I.V. Sokolov, G. Toth, K. Powell, P. Liewer, M. Opher, and J. Cook, SECCHI and IMPACT Teams Simulated Stereo/SECCHI White Light Images using 3D MHD Models of CMEs Presented at Spring STEREO Meeting, Paris, France, March 2002
- [10] Manchester, IV, W., I.V. Roussev, M. Opher, T.I. Gombosi, D.L. DeZeeuw, P. Liewer, G. Toth, I.V. Sokolov, and K. Powell, Magnetically Driven CME for 3D Space Weather Simulations Presented at Space Weather Week, Boulder, CO, April 2002
- [11] Manchester, IV, W., I.I. Roussev, M. Opher, T.I. Gombosi, D.L. DeZeeuw, G. Toth, I.V. Sokolov, and K. Powell, 3D MHD Simulations of Flux Rope Driven CMEs Presented at Spring AGU, Washington D.C., May 2002
- [12] Manchester, IV, W., I.I. Roussev, M. Opher, T.I. Gombosi, D.L. DeZeeuw, G. Toth, I.V. Sokolov, and K. Powell, 3D Global MHD Simulations of Flux Rope Driven CMEs Presented at Solar Wind 10, Pisa, Italy, June 2002
- [13] Manchester IV, W., T.I. Gombosi, I.I. Roussev, M. Opher, D.L. DeZeeuw, G. Toth, I.V. Sokolov, K. Powell, 3D MHD Simulation of CME Propagation from Solar Corona to 1 AU Presented at Fall AGU, San Francisco, CA, December, 2002.
- [14] Manchester IV, W., D. DeZeeuw, T. Gombosi, I. Roussev, I. Sokolov, G. Toth, K. Powell, P. Liewer, M. Opher, J. Cook, Simulated STEREO/SECCHI White Light Images using 3D MHD models of CMEs Presented at Elmau CME workshop, Elmau, Germany, February, 2003
- [15] Manchester, IV, W., D. De Zeeuw, T. Gombosi, K. Hansen, A. Ridley, I. Roussev, I. Sokolov, G. Toth, Modeling a space weather event from the sun to earth: CME generation and interplanetary propagation Presented at joint Spring AGU and EGS meeting, Nice, France, March 6-11, 2003
- [16] Manchester, IV, W., D. De Zeeuw, T. Gombosi, K. Hansen, A. Ridley, I. Roussev, I. Sokolov, G. Toth, Modeling a space weather event from the sun to earth: CME generation and interplanetary propagation Presented at Space Weather Week, Boulder, CO, May 19-22, 2003
- [17] Manchester, IV, W., M. Opher, P. Liewer, M. Velli, D. De Zeeuw, T. Gombosi, I. Roussev, I. Sokolov, G. Toth, K. Powell, J. Cook, Simulated Coronagraph Images using 3D MHD Models of CMEs Presented at SHINE meeting, Hawaiian Island of Maui, July 7-11, 2003
- [18] Manchester, IV, W., D. De Zeeuw, T. Gombosi, K. Hansen, A. Ridley, I. Roussev, I. Sokolov, G. Toth, Modeling a space weather event from the sun to earth: CME generation and interplanetary propagation Presented at SHINE meeting, Hawaiian Island of Maui, July 7-11, 2003
- [19] Manchester, IV, W., D. De Zeeuw, T. Gombosi, K. Powell, A. Ridley, I. Roussev, I. Sokolov,

- G. Toth, Modeling an Extremely energetic CME: the 1859 Carrington Event Presented at the Carrington Workshop, Ann Arbor, MI, October 2-3, 2003
- [20] Manchester, IV, W., Y. Fan, T. Gombosi, D. De Zeeuw, I. Sokolov, G. Toth, Eruption of a Buoyantly Emerging Magnetic Flux Rope, Presented at Fall AGU, San Francisco CA, December 12, 2003
- [21] Manchester, IV, W., I. Roussev, T. Gombosi, I.V. Sokolov, T. Forbes, 3D MHD simulations of the May 2, 1998 halo CME: Comparison of CME initiation models and their characteristics at L1 Presented at Spring AGU, Montreal Canada, May16-21, 2004
- [22] Manchester, IV, W., I. Roussev, T. Gombosi, I.V. Sokolov, T. Forbes, 3D MHD simulations of the May 2, 1998 halo CME: Comparison of CME initiation models and their characteristics at L1 Presented at 35th COSPAR Scientific Assembly, Paris France, July 18-25, 2004
- [23] Manchester, IV, W., J. Kota, I. Roussev, T. Zurbuchen, N. Lugaz, D. De Zeeuw, T. Gombosi, I. Sokolov, G. Toth, Signatures of fast CME Propagation near 1 AU Presented at the SHINE Meeting, Big Sky Montana, June 20-25, 2004
- [24] Lugaz, N., W. Manchester, I. Roussev, T. Gombosi, D. DeZeeuw, I. Sokolov, G. Toth, The line-of-sight Appearance of a CME near 1 AU Presented at the SHINE Meeting, Big Sky Montana, June 20-25, 2004
- [25] Manchester, IV, W., T.I. Gombosi, D.L. DeZeeuw, I.V. Sokolov, I.I. Roussev, K.G. Powell, J. Kota, G. Toth, T.H. Zurbuchen, CME Shock and Sheath Structures Relevant to Particle Acceleration Presented at Fall AGU, San Francisco CA, December 13-17, 2004
- [26] Lugaz, N., W. Manchester, T. Gombosi, I. Roussev, Modeling Interactions of Coronal Mass Ejections in the Lower Heliosphere Presented at Fall AGU, San Francisco CA, December 13-17, 2004
- [27] Manchester, IV, W., T. H. Zurbuchen, T. I. Gombosi, D. L. DeZeeuw I. V. Sokolov, G. Toth, Are high-latitude forward-reverse shock pairs driven by over-expansion? Presented at Spring AGU, New Orleans LA, May 23-27, 2005
- [28] Manchester, IV, W., Y. Fan, T. I. Gombosi The Source of Magnetic Shear in CME Source Regions, Presented at Spring AGU, New Orleans LA, May 23-27, 2005
- [29] Manchester, IV, W., and Y. Fan The Source of Magnetic Shear that Drives CMEs Presented at the SHINE Meeting, Kona Hawaii, July 11-15, 2005
- [30] Manchester, IV, W., M. Opher, T. I. Gombosi, D. L. DeZeeuw, I. V. Sokolov, G. Toth Kelvin-Helmholtz Instability and Turbulence Forming Behind a CME-driven Shock Presented at Fall AGU, San Francisco CA, Dec 5-9, 2005
- [31] Manchester, IV, W., The Source of Magnetic Shear that Drives Flares and Coronal Mass Ejections, Presented at the Solar Physics Division Meeting of the AAS, Durham, New Hampshire, June 2006.
- [32] Manchester, IV, W., Vourlidas, A., Toth, G., Lugaz, N., Roussev, I.I., Sokolov, I.V., Gombosi, T.I., De Zeeuw, D.L., 2003 October 28 CME Shock Structure: Comparison of 3D MHD Model Results and White-Light Observations, Presented at the SHINE Meeting, Midway UT, July 30-August 4, 2006
- [33] Manchester, IV, W., Coupling of the Convection Zone to the Corona by Shearing Motions Driven by the Lorentz Force, Presented at the SHINE Meeting, Midway UT, July 30-August 4, 2006
- [34] Manchester, IV, W., The Source of Magnetic Shear that Drives Flares and Coronal Mass Ejec-

tions, Presented at the General Assembly of the IAU meeting, Prague, Czech Republic, August 16-17, 2006.

- [35] Manchester, IV, W., The Eruption of Emerging Magnetic Flux Ropes by Shear Flows Driven by the Lorentz Force: An Initiation Mechanism for CMEs, Presented at Fall AGU, San Francisco CA, Dec 9-14, 2006

Seminars and Colloquia

- [1] Global MHD Simulations of Flux Rope Driven CMEs, Colloquium presented at High Altitude Observatory, Boulder, CO, April 17, 2002
- [2] 3D Simulations of Magnetically Driven Coronal Mass Ejections, Colloquium presented at University of Michigan, Ann Arbor, MI, June 07, 2002
- [3] Flux Rope Propagation from the Solar Convection Zone to the Earth, Colloquium presented at High Altitude Observatory, Boulder, CO, March 04, 2004
- [4] Flux Rope Emergence from the Solar Convection Zone, Colloquium presented at Lockheed-Martin, Palo Alto, CA, October 25, 2004
- [5] The Source of Magnetic Shear that Drives Solar Eruptions, Colloquium presented at JPL, Pasadena, CA, June 24, 2005
- [6] CME-driven Shock Structure and Reverse Shock Formation Resulting from Interaction with a Bimodal Solar Wind, Science Talk presented at High Altitude Observatory, Boulder, CO, August 17, 2005
- [7] Adaptive Solution of the Magnetohydrodynamic Equations with Finite Volume Upwind Schemes, Colloquium presented at Scientific Computing Division, Boulder, CO, August 25, 2005
- [8] The Source of Magnetic Shear that Drives Coronal Eruptions, Seminar presented at the University of Michigan, Ann Arbor, MI, December 19, 2005
- [9] The Source of Magnetic Shear that Drives Flares and Coronal Mass Ejections, Colloquium presented at Laboratory for Atmospheric and Space Physics, Boulder, CO, March 15, 2006
- [10] Simulations of the Sun-Earth System, Science Talk presented at High Altitude Observatory, Boulder, CO, March 17, 2006
- [11] The Source of Magnetic Shear that Drives Flares and Coronal Mass Ejections Colloquium presented at the Naval Research Laboratory, Washington D.C., April 18, 2006
- [12] The Source of Magnetic Shear that Drives Flares and Coronal Mass Ejections Colloquium presented at George Mason University, Fairfax, VA, April 19, 2006
- [13] A Source of Magnetic Shear and a Mechanism for Flares and Coronal Mass Ejections Science Talk presented at the High Altitude Observatory, Boulder, CO, July 7, 2006
- [14] The Source of Magnetic Shear that Drives Flares and Coronal Mass Ejections Seminar presented at the Center of Integrated Plasma Studies, Boulder, CO, July 7, 2006
- [15] Shear Flows Driven by the Lorentz Force During Flux Emergence: The Energy Source for Coronal Mass Ejections and Flares, Seminar presented at Michigan State University, East Lansing, MI, October 4, 2006
- [16] Shear Flows Driven by the Lorentz Force During Flux Emergence: The Energy Source for Coronal Mass Ejections and Flares, Seminar given at Massachusetts Institute of Technology, Cambridge, MA, October 13, 2006
- [17] The Source of Magnetic Shear that Drives Flares and Coronal Mass Ejections, Seminar presented

at Center for Astrophysics, Harvard University, Cambridge, MA, October 16, 2006

- [18] Shear Flows Driven by the Lorentz Force During Flux Emergence: The Energy Source for Coronal Mass Ejections and Flares, Seminar presented at New Jersey Institute of Technology, March 27, 2007.
- [19] Simulations of Stellar Magnetic Eruptions and their Interaction with Stellar Winds, Seminar present at the University of Chicago, March 30, 2007.