

# Nicholas A. Murphy

## Contact Information

Center for Astrophysics | Harvard & Smithsonian  
60 Garden Street, MS-58 (Office: P-137)  
Cambridge, Massachusetts 02138

Phone number: +1-617-384-7830

Email address: [namurphy@cfa.harvard.edu](mailto:namurphy@cfa.harvard.edu)

Website: <https://www.cfa.harvard.edu/~namurphy>

ORCID: <https://orcid.org/0000-0001-6628-8033>

GitHub: <https://github.com/namurphy>

## Research Interests

Plasma astrophysics; heliophysics; open source scientific software development; computational plasma physics; magnetic reconnection; chromospheric physics; partially ionized plasmas; solar flares; coronal mass ejections; non-equilibrium ionization modeling; and relationships between laboratory, astrophysical, heliospheric, & space plasma physics.

## Education

### Ph.D. in Astronomy

University of Wisconsin

Advisors: Carl Sovinec and Ellen Zweibel

Thesis: *Simulation and Analysis of Magnetic Reconnection in a Laboratory Plasma Astrophysics Experiment*

2009

Madison, Wisconsin

### M.S. in Astronomy

University of Wisconsin

2005

Madison, Wisconsin

### B.S. in Astronomy & Astrophysics, General Physics, & Mathematical Physics

University of Michigan

2003

Ann Arbor, Michigan

## Current Appointments

### Astrophysicist (Solar & Stellar X-Ray Group)

Smithsonian Astrophysical Observatory

*Developing open source software infrastructure for plasma physics. Using numerical simulations and analytical theory to investigate the roles of partial ionization and 3D effects during magnetic reconnection in the solar atmosphere and laboratory plasma experiments. Using non-equilibrium modeling to investigate the thermodynamic history of erupting solar plasma.*

2012–

Cambridge, Massachusetts

### Lecturer on Astronomy

Harvard University

*Developed and co-taught Astronomy 253: Plasma Astrophysics, a new graduate course. Advising a Harvard Astronomy graduate student.*

2014–

Cambridge, Massachusetts

## Prior Appointments

- Postdoctoral Fellow (Advisor: John Raymond)** **2009–2012**  
Smithsonian Astrophysical Observatory Cambridge, Massachusetts  
*Investigated plasma heating during coronal mass ejections using observations from the Ultraviolet Coronagraph Spectrometer (UVCS) on the Solar and Heliospheric Observatory (SOHO) and performed simulations of asymmetric magnetic reconnection in the solar atmosphere.*
- Research Assistant (Advisors: Carl Sovinec & Ellen Zweibel)** **2004–2009**  
University of Wisconsin Madison, Wisconsin  
*Investigated the interplay between local and global effects during magnetic reconnection by performing two-fluid simulations of a dedicated laboratory plasma experiment and developed a model to describe the scaling of asymmetric outflow reconnection.*
- Research Assistant (Advisor: Joseph Cassinelli)** **2003–2004**  
University of Wisconsin Madison, Wisconsin  
*Investigated the emission properties of bow shocks in inhomogeneous stellar winds using numerical simulations.*
- Undergraduate Researcher (Advisor: John Monnier)** **2002–2003**  
University of Michigan Ann Arbor, Michigan  
*Used bootstrap methods to quantify errors in aperture masking interferometry measurements of Wolf-Rayet stars.*
- Research Experience for Undergraduates (Advisor: Joel Smoller)** **2002**  
University of Michigan Ann Arbor, Michigan  
*Numerically solved systems of nonlinear partial differential equations to test a shock wave cosmology model.*
- Undergraduate Researcher (Advisor: Rachel Somerville)** **2001**  
University of Michigan Ann Arbor, Michigan  
*Analyzed the output of semi-analytic models of galaxy formation.*
- Research Experience for Undergraduates (Advisor: Jack Baldwin)** **2001**  
Michigan State University East Lansing, Michigan  
*Reduced and analyzed mosaic observations for the Chandra Multiwavelength Survey.*

## Refereed Publications

Katharine K. Reeves, Tibor Török, Zoran Mikić, Jon Linker, and **Nicholas A. Murphy**, *Exploring Plasma Heating in the Current Sheet Region in a Three-Dimensional Coronal Mass Ejection Simulation*, accepted for publication in the *Astrophysical Journal*

The Astropy Collaboration, A. M. Price-Whelan, B. M. Sipőcz, H. M. Günther, P. L. Lim, S. M. Crawford, S. Conseil, D. L. Shupe, M. W. Craig, N. Dencheva, A. Ginsburg, J. T. VanderPlas, L. D. Bradley, D. Pérez-Suárez, M. de Val-Borro, T. L. Aldcroft, K. L. Cruz, T. P. Robitaille, E. J. Tollerud, C. Ardelean, T. Babej, M. Bachetti, A. V. Bakanov, S. P. Bamford, G. Barentsen, P. Barmby, A. Baumbach, K. L. Berry, F. Biscani, M. Boquien, K. A. Bostroem, L. G. Bouma, G. B. Brammer, E. M. Bray, H. Breytenbach, H.

Buddelmeijer, D. J. Burke, G. Calderone, J. L. Cano Rodríguez, M. Cara, J. V. M. Cardoso, S. Cheedella, Y. Copin, D. Crichton, D. D'Avella, C. Deil, É. Depagne, J. P. Dietrich, A. Donath, M. Droettboom, N. Earl, T. Erben, S. Fabbro, L. A. Ferreira, T. Finethy, R. T. Fox, L. H. Garrison, S. L. J. Gibbons, D. A. Goldstein, R. Gommers, J. P. Greco, P. Greenfield, A. M. Groener, F. Grollier, A. Hagen, P. Hirst, D. Homeier, A. J. Horton, G. Hosseinzadeh, L. Hu, J. S. Hunkeler, Ž. Ivezić, A. Jain, T. Jenness, G. Kanarek, S. Kendrew, N. S. Kern, W. E. Kerzendorf, A. Khvalko, J. King, D. Kirkby, A. M. Kulkarni, A. Kumar, A. Lee, D. Lenz, S. P. Littlefair, Z. Ma, D. M. Macleod, M. Mastropietro, C. McCully, S. Montagnac, B. M. Morris, M. Mueller, S. J. Mumford, D. Muna, **N. A. Murphy**, S. Nelson, G. H. Nguyen, J. P. Ninan, M. Nöthe, S. Ogaz, S. Oh, J. K. Parejko, N. Parley, S. Pascual, R. Patil, A. A. Patil, A. L. Plunkett, J. X. Prochaska, T. Rastogi, V. Reddy Janga, J. Sabater, P. Sakurikar, M. Seifert, L. E. Sherbert, H. Sherwood-Taylor, A. Y. Shih, J. Sick, M. T. Silbiger, S. Singanamalla, L. P. Singer, P. H. Sladen, K. A. Sooley, S. Sornarajah, O. Streicher, P. Teuben, S. W. Thomas, G. R. Tremblay, J. E. H. Turner, V. Terrón, M. H. van Kerkwijk, A. de la Vega, L. L. Watkins, B. A. Weaver, J. B. Whitmore, J. Woillez, and V. Zabalza, *The Astropy Project: Building an Open-science Project and Status of the v2.0 Core Package*, *Astronomical Journal*, **156**, 123 (2018), doi: 10.3847/1538-3881/aabc4f

Lei Ni, Vyacheslav S. Lukin, **Nicholas A. Murphy**, and Jun Lin, *Magnetic reconnection in the low solar chromosphere with a more realistic radiative cooling model*, *Physics of Plasmas*, **25**, 42903 (2018), doi: 10.1063/1.5018351

Lei Ni, Vyacheslav S. Lukin, **Nicholas A. Murphy**, and Jun Lin, *Magnetic reconnection in strongly magnetized regions of the low solar chromosphere*, *Astrophysical Journal*, **852**, 95 (2018), doi: 10.3847/1538-4357/aa9edb

Chengcai Shen, John C. Raymond, Zoran Mikić, Jon A. Linker, Katharine K. Reeves, and **Nicholas A. Murphy**, *Time-dependent ionization in a Steady Flow in an MHD Model of the Solar Corona and Wind*, *Astrophysical Journal*, **850**, 26 (2017), doi: 10.3847/1538-4357/aa93f3

Lei Ni, Qing-Min Zhang, **Nicholas A. Murphy**, and Jun Lin, *Blob Formation and Ejection in Coronal Jets due to the Plasmoid and Kelvin-Helmholtz Instabilities*, *Astrophysical Journal*, **841**, 27 (2017), doi: 10.3847/1538-4357/aa6ffe

**Nicholas A. Murphy**, Clare E. Parnell, and Andrew L. Haynes, *The appearance, motion, and disappearance of magnetic null points*, *Physics of Plasmas*, **22**, 102117 (2015), doi: 10.1063/1.4934929

Jun Lin, **Nicholas A. Murphy**, Chengcai Shen, John C. Raymond, Katharine K. Reeves, Jiayong Zhong, Ning Wu, and Yan Li, *Review on Current Sheets in CME Development: Theories and Observations*, *Space Science Reviews*, **194**, 237 (2015), doi: 10.1007/s11214-015-0209-0

Chengcai Shen, John C. Raymond, **Nicholas A. Murphy**, and Jun Lin, *A Lagrangian Scheme for Time-Dependent Ionization in Simulations of Astrophysical Plasmas*, *Astronomy and Computing*, **12**, 1 (2015), doi: 10.1016/j.ascom.2015.04.003

**Nicholas A. Murphy** and Vyacheslav S. Lukin, *Asymmetric Magnetic Reconnection in Weakly Ionized Chromospheric Plasmas*, *Astrophysical Journal*, **805**, 134 (2015), doi: 10.1088/0004-637X/805/2/134

Hui Tian, Gang Li, Katharine K. Reeves, John C. Raymond, Fan Guo, Wei Liu, Bin Chen, and **Nicholas A. Murphy**, *Imaging and Spectroscopic Observations of Magnetic Reconnection and Chromospheric Evaporation in a Solar Flare*, *Astrophysical Journal Letters*, doi: **797**, L14 (2014), doi: 10.1088/2041-8205/797/2/L14

H. Tian, E. E. DeLuca, S. R. Cranmer, B. De Pontieu, H. Peter, J. Martínez-Sykora, L. Golub, S. McKillop, K. K. Reeves, M. P. Miralles, P. McCauley, S. Saar, P. Testa, M. Weber, **N. Murphy**, J. Lemen, A. Title,

- P. Boerner, N. Hurlburt, T. D. Tarbell, J. P. Wuelser, L. Kleint, C. Kankelborg, S. Jaeggli, M. Carlsson, V. Hansteen, and S. W. McIntosh, *Prevalence of small-scale jets from the networks of the solar transition region and chromosphere*, *Science*, **346**, 1255711 (2014), doi: 10.1126/science.1255711
- Yan Li, Henry D. Winter, **Nicholas A. Murphy**, Jun Lin, and Ning Wu, *The Dependence of Particle Acceleration on Initial Locations in Reconnecting Current Sheets*, *Publications of the Astronomical Society of Japan*, **65**, 101 (2013), doi: 10.1093/pasj/65.5.101
- Chengcai Shen, Katharine K. Reeves, John C. Raymond, **Nicholas A. Murphy**, Yuan-Kuen Ko, Jun Lin, Zoran Mikić, and Jon A. Linker, *Non-Equilibrium Ionization Modeling of the Current Sheet in a Simulated Solar Eruption*, *Astrophysical Journal*, **773**, 110 (2013), doi: 10.1088/0004-637X/773/2/110
- Chengcai Shen, Jun Lin, **Nicholas A. Murphy**, and John C. Raymond, *Statistical and spectral properties of magnetic islands in reconnecting current sheets during two-ribbon flares*, *Physics of Plasmas*, **20**, 072114 (2013), doi: 10.1063/1.4816711
- Nicholas A. Murphy**, Aleida K. Young, Chengcai Shen, Jun Lin, and Lei Ni, *The plasmoid instability during asymmetric inflow magnetic reconnection*, *Physics of Plasmas*, **20**, 061211 (2013), doi: 10.1063/1.4811470
- Lei Ni, Jun Lin, and **Nicholas A. Murphy**, *Effects of the non-uniform initial environment and the guide field on the plasmoid instability*, *Physics of Plasmas*, **20**, 061206 (2013), doi: 10.1063/1.4811144
- Z. Mei, C. Shen, N. Wu, J. Lin, **N. A. Murphy**, and I. I. Roussev, *Numerical experiments on magnetic reconnection in solar flare and coronal mass ejection current sheets*, *Monthly Notices of the Royal Astronomical Society*, **425**, 2824 (2012), doi: 10.1111/j.1365-2966.2012.21625.x
- N. A. Murphy**, M. P. Miralles, C. L. Pope, J. C. Raymond, H. D. Winter, K. K. Reeves, D. B. Seaton, A. A. van Ballegooijen, and J. Lin, *Asymmetric Magnetic Reconnection in Solar Flare and Coronal Mass Ejection Current Sheets*, *Astrophysical Journal*, **751**, 56 (2012), doi: 10.1088/0004-637X/751/1/56
- M. Oka, T.-D. Phan, J. P. Eastwood, V. Angelopoulos, **N. A. Murphy**, M. Øieroset, Y. Miyashita, M. Fujimoto, J. McFadden, and D. Larson, *Magnetic Reconnection X-Line Retreat Associated with Dipolarization of the Earth's Magnetosphere*, *Geophysical Research Letters*, **38**, L20105 (2011), doi: 10.1029/2011GL049350
- Chengcai Shen, Jun Lin, and **Nicholas A. Murphy**, *Numerical Experiments on Fine Structure Within Reconnecting Current Sheets in Solar Flares*, *Astrophysical Journal*, **737**, 14 (2011), doi: 10.1088/0004-637X/737/1/14
- H. Johnson, J. C. Raymond, **N. A. Murphy**, S. Giordano, Y.-K. Ko, A. Ciaravella, and R. Suleiman, *Transition Region Emission from Solar Flares During the Impulsive Phase*, *Astrophysical Journal*, **735**, 70 (2011), doi: 10.1088/0004-637X/735/2/70
- N. A. Murphy**, J. C. Raymond, and K. E. Korreck, *Plasma Heating During a Coronal Mass Ejection Observed by the Solar and Heliospheric Observatory*, *Astrophysical Journal*, **735**, 17 (2011), doi: 10.1088/0004-637X/735/1/17
- N. A. Murphy**, *Resistive magnetohydrodynamic simulations of X-line retreat during magnetic reconnection*, *Physics of Plasmas*, **17**, 112310 (2010), doi: 10.1063/1.3494570
- N. A. Murphy**, C. R. Sovinec, and P. A. Cassak, *Magnetic reconnection with asymmetry in the outflow direction*, *Journal of Geophysical Research*, **115**, A09206 (2010), doi: 10.1029/2009JA015183
- J. P. Cassinelli, R. Ignace, W. L. Waldron, J. Cho, **N. A. Murphy**, and A. Lazarian, *The Effects of*

*Clumps in Explaining X-ray Emission Lines from Hot Stars*, *Astrophysical Journal*, **683**, 1052 (2008), doi: 10.1086/589760

**N. A. Murphy** and C. R. Sovinec, *Global axisymmetric simulations of two-fluid reconnection in an experimentally relevant geometry*, *Physics of Plasmas*, **15**, 042313 (2008), doi: 10.1063/1.2904600

J. D. Monnier, P. G. Tuthill, W. C. Danchi, **N. Murphy**, and T. J. Harries. *The Keck Aperture Masking Experiment: Near-Infrared Sizes of Dusty Wolf-Rayet Stars*, *Astrophysical Journal*, **655**, 1033 (2007), doi: 10.1086/509873

## Additional Publications and Reports

**Nick Murphy**, Nomita Vazirani, Henry D. Winter, and B. L. Alterman, *Conferences on equity and inclusion for plasma science* (2019, submitted to the APS Division of Plasma Physics Community Planning Process)

**Nicholas A. Murphy**, Dominik Stańczak, Andrew J. Leonard, Tulasi N. Parashar, Sofia P. Moschou, Erik T. Everson, Julien Hillairet, and Alexa J. Halford, *The PlasmaPy Project: Building an Open Source Software Ecosystem for Plasma Research and Education*, Zenodo, doi: 10.5281/zenodo.3470369 (2019, submitted to the APS Division of Plasma Physics Community Planning Process)

**Nicholas A. Murphy**, B. L. Alterman, D. Stansby, Arturo Dominguez, and Dominik Stańczak, *Enabling scientific reproducibility in plasma research*, Zenodo, doi: 10.5281/zenodo.3265454 (2019, submitted to the APS Division of Plasma Physics Community Planning Process)

**Nicholas A. Murphy**, Erik Everson, Stephen Vincena, Tulasi Parashar, & David Schaffner, *An open source software ecosystem for plasma physics*, Zenodo, doi: 10.5281/zenodo.3406803 (2019, a successful NSF Cyberinfrastructure for Sustained Scientific Innovation proposal)

**Nicholas A. Murphy**, Dominik Stańczak, Andrew J. Leonard, Tulasi N. Parashar, Pawel M. Kozlowski, B. L. Alterman, D. Aaron Roberts, S. D. Christe, Martin Connors, Monica G. Bobra, James Paul Mason, Will Barnes, Ryan M. McGranahan, Asti Bhatt, Philip J. Erikson, Frank D. Lind, Ryan Volz, John Swoboda, Nick Hatzigeorgiu, Andrew Inglis, Felipe Nathan deOliviera-Lopes, Jack Ireland, John C. Coxon, Sophie A. Murray, Japheth N. Yates, Mark C. M. Cheung, Jeff Klenzing, David Stansby, Han He, Yi-Min Huang, Chuanfei Dong, Henry Winter, Juan-Camilo Buitrago-Casas, Manjit Kaur, Sterling Smith, Benjamin Dudson, Daniel B. Seaton, Luca Comisso, Alexa J. Halford, D. H. Barnak, R. S. Weigel, A. Tavant, Jon D. Vandegriff, Miguel de Val-Borro, & Antonia Savcheva, *Building an open source software ecosystem for cross-disciplinary plasma research and education*, Zenodo, doi: 10.5281/zenodo.2578277 (2019, submitted to the Plasma 2020 decadal review)

**N. A. Murphy**, B. Alterman, & D. Stansby, *Making plasma research reproducible*, Zenodo, doi: 10.5281/zenodo.2578291 (2019, submitted to the Plasma 2020 decadal review)

**Nicholas A. Murphy**, *Equity and inclusion in plasma physics* (2019, submitted to the Plasma 2020 decadal review, with a revised version submitted to the APS Division of Plasma Physics Community Planning Process with Arturo Dominguez as a co-author)

**Nicholas A. Murphy** and Stuart J. Mumford, *PLEP-0005 – PlasmaPy Versioning and Releases*, Zenodo, 2018, doi: 10.5281/zenodo.1451974

**Nicholas A. Murphy**, *PLEP-0004 – Licensing of PlasmaPy Repositories*, Zenodo, 2018, doi: 10.5281/zenodo.1435990

**Nicholas A. Murphy**, *PLEP-0002 – PlasmaPy Governance*, Zenodo, 2018, doi: 10.5281/zenodo.1435980

**Nicholas A. Murphy**, *PLEP-0001 – Purpose and Guidelines for PlasmaPy Enhancement Proposals*, 2018, Zenodo, doi: 10.5281/zenodo.1435976

PlasmaPy Community, **N. A. Murphy**, A. J. Leonard, D. Stańczak, P. M. Kozłowski, S. J. Langendorf, C. C. Haggerty, J. P. Beckers, S. J. Mumford, T. N. Parashar, and Y.-M. Huang, *PlasmaPy: an open source community-developed Python package for plasma physics*, Zenodo, 2018, doi: 10.5281/zenodo.1238132

**Nicholas A. Murphy**, Dominik Stańczak, and Andrew J. Leonard, *Open Science in U.S. Magnetic Fusion Research*, Zenodo, 2017, doi: 10.5281/zenodo.1455807

J. Lin, C. Shen, **N. A. Murphy**, and N. Wu, *Fine Structures of the Reconnecting Current Sheet in Two-Ribbon Flares*, in *The Fifth Hinode Science Meeting: Exploring the Active Sun*, ASP Conf. Ser., Vol. 456, edited by L. Golub, I. De Moortel, and T. Shimizu, pages 195–197 (2012)

**N. A. Murphy**, M. P. Miralles, C. L. Pope, J. C. Raymond, K. K. Reeves, D. B. Seaton, and D. F. Webb, *Asymmetric Magnetic Reconnection in Coronal Mass Ejection Current Sheets*, in *The Fifth Hinode Science Meeting: Exploring the Active Sun*, ASP Conf. Ser., Vol. 456, edited by L. Golub, I. De Moortel, and T. Shimizu, pages 199–201 (2012)

S. R. Cranmer, J. L. Kohl, D. Alexander, A. Bhattacharjee, B. A. Breech, N. S. Brickhouse, B. D. G. Chandran, A. K. Dupree, R. Esser, S. P. Gary, J. V. Hollweg, P. A. Isenberg, S. W. Kahler, Y.-K. Ko, J. M. Laming, E. Landi, W. H. Matthaeus, **N. A. Murphy**, S. Oughton, J. C. Raymond, D. B. Reisenfeld, T. S. Suess, A. A. van Ballegoijen, and B. E. Wood. *Ultraviolet Coronagraph Spectroscopy: A Key Capability for Understanding the Physics of Solar Wind Acceleration*, a white paper submitted to the NRC Solar/Space Physics Decadal Survey project, arXiv:1011.2469 (2010)

J. P. Cassinelli, R. Ignace, W. L. Waldron, J. Cho, **N. A. Murphy**, and A. Lazarian, *X-ray line emission produced in clump bow shocks*, in *Clumping in Hot Star Winds*, W.-R. Hamann, A. Feldmeier, and L. M. Oskinova, eds., Potsdam: Univ.-Verl., pages 217–220 (2008)

**N. A. Murphy** and C. R. Sovinec, *An Analysis of Mass Matrix Lumping in NIMROD*, Center for Plasma Theory and Computation Report UW-CPTC 05-1 (2005), doi: 10.5281/zenodo.1456170

## Citable Scientific Software

PlasmaPy Community, **Nicholas A. Murphy**, Dominik Stańczak, Pawel M. Kozłowski, Riteek Malhotra, Samuel J. Langendorf, Andrew J. Leonard, David Stansby, Colby C. Haggerty, Stuart J. Mumford, Jasper P. Beckers, Manas Satish Bedmutha, Justin Bergeron, Ludovico Bessi, Sean Carroll, Sean Chambers, Apoorv Choubey, Jacob Deal, Robert Díaz Pérez, Leah Einhorn, Erik Everson; Thomas Fan, Samaiyah Farid, Graham Goudeau, Silvina Guidoni, Julien Hillairet, Poh Zi How, Yi-Min Huang, Nabil Humphrey, Maria Isupova, Siddharth Kulshrestha, Piotr Kuszaj, Joshua Munn, Tulasi Parashar, Neil Patel, Raajit Raj, Antonia Savcheva, Chengcai Shen, Dawa Nurbu Sherpa, Frank Silva, Ankit Singh, Brigitta Sipócz, Antoine Tavant, Sixue Xu, and Carol Zhang, *PlasmaPy*, Zenodo, doi: 10.5281/zenodo.1436011

**Nicholas A. Murphy**, *A solver for the growth rate of the two-fluid tearing instability in a force-free magnetic configuration*, Zenodo, 2017, doi: 10.5281/zenodo.1052863

## Selected Talks

*Writing clean scientific software for plasma simulation*, 61st Annual Meeting of the APS Division of Plasma Physics, Fort Lauderdale, Florida, October 21–25, 2019

*Building an open source software ecosystem for plasma physics*, Python in Astronomy 2019, Baltimore, Maryland, July 29–August 2, 2019

*Equity, inclusion, and openness in plasma science*, Joint Community Planning Workshop for Magnetic Fusion Energy and Fusion Materials & Technology for the APS Division of Plasma Physics Community Planning Process, Madison, Wisconsin, July 22–26, 2019

*Equity, inclusion, and openness in plasma science*, First Community Workshop for High Energy Density Physics for the APS Division of Plasma Physics Community Planning Process, College Park, Maryland, July 16–17, 2019

*Building an open source Python ecosystem for plasma physics*, Plasma Seminar, Dartmouth College, April 16, 2019, doi: 10.5281/zenodo.2652446

*Building open source scientific software for plasma physics*, Physics Seminar, Swarthmore College, December 7, 2018

*Building an open source Python software ecosystem for plasma physics*, MIT Plasma Science and Fusion Center Seminar, September 21, 2018

*Magnetic Reconnection in Partially Ionized Chromospheric Plasmas*, US-Japan Workshop on Magnetic Reconnection, Princeton, New Jersey, September 4–8, 2018

*Introduction to Magnetohydrodynamics*, SAO REU program in solar physics, Cambridge, Massachusetts, given annually each summer since 2012, doi: 10.5281/zenodo.1317626

*The appearance, motion, and disappearance of 3D magnetic null points*, US-Japan Workshop on Magnetic Reconnection, Napa, California, March 7–11, 2016, doi: 10.5281/zenodo.189276

*Asymmetric Magnetic Reconnection in the Solar Atmosphere*, Space Science Seminar, University of Massachusetts, Lowell, Massachusetts, March 13, 2015

*Magnetic Reconnection in Heliospheric, Laboratory, and Astrophysical Plasmas*, ITC Lunch Talk, Harvard-Smithsonian Center for Astrophysics, Cambridge, Massachusetts, March 3, 2015

*Asymmetric Magnetic Reconnection in Partially Ionized Chromospheric Plasmas*, AGU Fall Meeting, San Francisco, California, December 15–19, 2014, doi: 10.5281/zenodo.47869

*Magnetic Reconnection in Heliospheric, Laboratory, and Astrophysical Plasmas*, Lunch Talk, Boston University, Boston, Massachusetts, December 2, 2014

*Asymmetric Magnetic Reconnection in Partially Ionized Chromospheric Plasmas*, Living With a Star Science Meeting, Portland, Oregon, November 2–6, 2014

*Asymmetric Magnetic Reconnection in Partially Ionized Chromospheric Plasmas*, 224th Meeting of the American Astronomical Society, Boston, Massachusetts, June 2–5, 2014

*Asymmetric Magnetic Reconnection in the Solar Atmosphere*, AGU Fall Meeting, San Francisco, California, December 9–13, 2013, doi: 10.5281/zenodo.47870

*Asymmetric Magnetic Reconnection in the Solar Atmosphere*, MIT Plasma Science and Fusion Center Seminar, Cambridge, Massachusetts, November 1, 2013

*Asymmetric Magnetic Reconnection in the Solar Atmosphere*, NASA Goddard Space Flight Center, Greenbelt, Maryland, October 23, 2013

*Asymmetric Magnetic Reconnection and the Motion of Magnetic Null Points*, 10th Cambridge Workshop on Magnetic Reconnection, Santa Fe, New Mexico, September 9–13, 2013

*Asymmetric Magnetic Reconnection in the Solar Atmosphere*, Plasma Theory Seminar, Princeton Plasma Physics Laboratory, Princeton, New Jersey, August 29, 2013

*Asymmetric Magnetic Reconnection in the Solar Atmosphere*, NIMROD Team Meeting, Providence, Rhode Island, October 27, 2012

*Plasma Heating During Coronal Mass Ejections*, Hinode 6 Meeting, St. Andrews, Scotland, August 13–17, 2012

*The Onset and Dynamics of the Plasmoid Instability During Asymmetric Inflow Reconnection*, 2012 SHINE Meeting, Wailea Maui, Hawaii, June 11–15, 2012

*Magnetic Reconnection in Solar, Space, and Laboratory Plasmas*, 220th Meeting of the American Astronomical Society, Anchorage, Alaska, June 10–14, 2012, doi: 10.5281/zenodo.47877

*Asymmetric Magnetic Reconnection in the Solar Atmosphere*, US-Japan Workshop on Magnetic Reconnection, Princeton University, Princeton, New Jersey, May 23–25, 2012

*Plasma Heating and Asymmetric Magnetic Reconnection in Coronal Mass Ejections*, Naval Research Laboratory, Washington, D.C., April 6, 2012

*Plasma Heating and Asymmetric Magnetic Reconnection in Coronal Mass Ejections*, Space Science Laboratory, University of California, Berkeley, California, March 20, 2012

*Plasma Heating and Asymmetric Magnetic Reconnection in Coronal Mass Ejections*, Lockheed Martin Solar & Astrophysics Laboratory, Palo Alto, California, December 13, 2011

*Asymmetric Magnetic Reconnection in Coronal Mass Ejection Current Sheets*, 8th Cambridge Workshop on Magnetic Reconnection, Durham, New Hampshire, August 15–19, 2011

*Plasma Heating During a Coronal Mass Ejection Observed by SOHO*, Solar Physics Division Meeting of the American Astronomical Society, Las Cruces, New Mexico, June 12–16, 2011, doi: 10.5281/zenodo.47881

*Asymmetric Magnetic Reconnection and Plasma Heating During Coronal Mass Ejections*, Space Science Seminar, University of New Hampshire, Durham, New Hampshire, November 3, 2010

*Plasma Heating Rates and Asymmetric Magnetic Reconnection During Coronal Mass Ejections*, NASA Goddard Space Flight Center, Greenbelt, Maryland, September 28, 2010

*Asymmetric Magnetic Reconnection in Coronal Mass Ejections*, Yunnan Astronomical Observatory, Kunming, Yunnan, China, April 22, 2010



*Magnetic Reconnection with Asymmetry in the Outflow Direction*, U.S.-Japan Workshop on Magnetic Reconnection, Madison, Wisconsin, October 5–7, 2009

*Simulation and Analysis of Magnetic Reconnection in an Experimental Geometry*, 213th Meeting of the American Astronomical Society, Long Beach, California, January 4–8, 2009, doi: 10.5281/zenodo.47876

*Global Simulations of Magnetic Reconnection in an Experimental Geometry*, General Meeting, Center for Magnetic Self-Organization in Laboratory and Astrophysical Plasmas, Princeton, New Jersey, July 8–10, 2008

*Global Two-Fluid Simulations of Reconnection in MRX*, Center for Plasma Theory and Computation Seminar, University of Wisconsin, Madison, Wisconsin, September 17, 2007

*NIMROD Simulations of Reconnection in MRX and SSX*, General Meeting, Center for Magnetic Self-Organization in Laboratory and Astrophysical Plasmas, Chicago, Illinois, August 2–4, 2006

## Selected Posters

*The PlasmaPy Project: Toward an Open Source Software Ecosystem for Plasma Physics*, 61st Annual Meeting of the APS Division of Plasma Physics, Fort Lauderdale, Florida, October 21–25, 2019

*PlasmaPy: an open source package for plasma physics*, SHINE Conference, Boulder, Colorado, August 5–9, 2019

*PlasmaPy: an open source community-developed Python package for plasma physics*, AGU Fall Meeting, Washington, D.C., December 10–14, 2018

*PlasmaPy: an open source community-developed Python package for plasma physics*, 60th Annual Meeting of the APS Division of Plasma Physics, Portland, Oregon, November 5–9, 2018, doi: 10.5281/zenodo.1477096

*PlasmaPy: an open source Python package for plasma physics*, SHINE Conference, Cocoa Beach, Florida, July 30–August 3, 2018

*PlasmaPy: Beginning a Community Python Package for Plasma Physics*, SciPy 2018, Austin, Texas, July 9–15, 2018

*PlasmaPy: initial development of an open source core Python package for plasma physics*, 59th Annual Meeting of the APS Division of Plasma Physics, Milwaukee, Wisconsin, October 23–27, 2017, doi: 10.5281/zenodo.1238125

*Plasma Heating During Coronal Mass Ejections*, AGU Fall Meeting, San Francisco, California, December 12–16, 2016

*PlasmaPy: beginning a community developed Python package for plasma physics*, 58th Annual Meeting of the APS Division of Plasma Physics, San Jose, California, October 31–November 4, 2016, doi: 10.5281/zenodo.163752

*Plasma heating during coronal mass ejections*, SHINE conference, Santa Fe, New Mexico, July 11–15, 2016

*The plasmoid instability and Hall effect during chromospheric magnetic reconnection*, 227th Meeting of the American Astronomical Society, Kissimmee, Florida, January 4–8, 2016

*The Emergence, Motion, and Disappearance of Magnetic Null Points*, SHINE conference, Stowe, Vermont, July 6–10, 2015

*Asymmetry and the plasmoid instability during magnetic reconnection in partially ionized chromospheric plasmas*, Triennial Earth-Sun Summit, Indianapolis, Indiana, April 26–30, 2015, doi: 10.5281/zenodo.47791

*Asymmetric Magnetic Reconnection in Partially Ionized Chromospheric Plasmas*, SHINE Meeting, Telluride, Colorado, June 23–27, 2014

*The Emergence, Motion, and Disappearance of Magnetic Null Points*, 55th Annual Meeting of the APS Division of Plasma Physics, Denver, Colorado, November 11–15, 2013, doi: 10.5281/zenodo.47871

*The Emergence, Motion, and Disappearance of Magnetic Null Points*, 44th Meeting of the Solar Physics Division of the American Astronomical Society, Bozeman, Montana, July 8–11, 2013

*The plasmoid instability during asymmetric inflow magnetic reconnection*, 54th Annual Meeting of the APS Division of Plasma Physics, Providence, Rhode Island, October 29–November 2, 2012, doi: 10.5281/zenodo.47879

*Modeling Magnetic Reconnection in Partially Ionized Chromospheric Plasmas*, SDO-4/Hinode/IRIS Workshop, Monterey, California, March 12–16, 2012

*Asymmetric Magnetic Reconnection in Coronal Mass Ejection Current Sheets*, AGU Fall Meeting, San Francisco, California, December 5–9, 2011

*Asymmetric Magnetic Reconnection in Coronal Mass Ejection Current Sheets*, Hinode 5, Cambridge, Massachusetts, October 11–14, 2011

*Asymmetric Magnetic Reconnection During Coronal Mass Ejections*, 42nd Meeting of the Solar Physics Division of the American Astronomical Society, Las Cruces, New Mexico, June 12–16, 2011

*Plasma Heating During Coronal Mass Ejections*, 218th Meeting of the American Astronomical Society, Boston, Massachusetts, May 22–26, 2011

*Plasma Heating During Coronal Mass Ejections Observed by SOHO and SDO*, The First LWS/SDO Workshop: The Many Spectra of Solar Activity, Squaw Valley, California, May 1–5, 2011

*Candidate coronal mass ejection heating mechanisms*, AGU Fall Meeting, San Francisco, California, December 13–17, 2010

*Resistive MHD Simulations of X-Line Retreat and Competing Reconnection Sites*, 52nd Annual Meeting of the APS Division of Plasma Physics, Chicago, Illinois, November 8–12, 2010, doi: 10.5281/zenodo.47883

*The Energy Budget and Plasma Heating Rates of a Coronal Mass Ejection*, 216th Meeting of the American Astronomical Society, Miami, Florida, May 23–27, 2010

*Plasma Heating Rates for a Coronal Mass Ejection on 28 June 2000*, AGU Fall Meeting, San Francisco, California, December 14–18, 2009

*Magnetic reconnection with asymmetry in the outflow direction*, 50th Annual Meeting of the APS Division of Plasma Physics, Dallas, Texas, November 17–21, 2008, doi: 10.5281/zenodo.47874

*Magnetic Reconnection with Asymmetric Downstream Conditions*, General Meeting, Center for Magnetic Self-Organization in Laboratory and Astrophysical Plasmas, Princeton, New Jersey, July 8–10, 2008

*Global Two-Fluid Simulations of Magnetic Reconnection*, 49th Annual Meeting of the APS Division of Plasma Physics, Orlando, Florida, November 12–16, 2007, doi: 10.5281/zenodo.47873

*Two-fluid Simulations of Reconnection in an Experimental Geometry*, U.S.-Japan Workshop on Magnetic Reconnection, St. Michaels, Maryland, March 26–29, 2007

*NIMROD Simulations of Reconnection in MRX and SSX*, 48th Annual Meeting of the APS Division of Plasma Physics, Philadelphia, Pennsylvania, October 30–November 3, 2006

*NIMROD Simulations of Reconnection in MRX and SSX*, American Physical Society April Meeting, combined with the Sherwood Fusion Theory Conference, Dallas, Texas, April 22–26, 2006

*NIMROD Simulations of Reconnection in MRX and SSX*, 47th Annual Meeting of the APS Division of Plasma Physics, Denver, Colorado, October 24–28, 2005

## Grants

I have been the principal investigator of the following grants:

- *Collaborative Research: Frameworks: An open source software ecosystem for plasma physics*, NSF CSSI Grant 1931388, 2019-10-01 to 2024-09-30, \$1,439,530, doi: 10.5281/zenodo.3406803
- *Collaborative Research: The Evolution of Magnetic Skeletons During 3D Reconnection*, DOE Grant DE-SC0016363 through the NSF/DOE Partnership in Basic Plasma Science and Engineering, 2016-08-01 to 2019-07-31, \$235,000
- *Plasma Heating During Coronal Mass Ejections*, NSF SHINE Grant AGS-1156076, 2012-04-01 to 2017-03-31, \$463,848
- *Magnetic Reconnection in Partially Ionized Chromospheric Plasma*, NASA Solar and Heliospheric Physics Supporting Research & Technology (SR&T) Grant NNX12AB25G, 2012-01-01 to 2015-12-31, \$168,673

I have been a co-investigator on the following grants to SAO:

- *The Stability of Magnetic Flux Ropes: Bridging Observations and Experiments with Simulations*, NASA H-SR Grant 80NSSC19K0860, 04-16-2019 to 04-15-2022
- *The Energy Budget of Coronal Mass Ejection Ejecta*, NASA H-SR Grant 80NSSC19K0853, 06-01-2019 to 05-31-2022, PI: John Raymond (SAO)
- *Improving Models of Magnetic Reconnection in Weakly Ionized Chromospheric Plasma with a Large-scale Survey of UV Bursts*, NASA H-SR Grant 80NSSC18K1124, 2018-06-26 to 2021-06-25, \$447,000, PI: Chad Madsen (SAO)
- *Developing an open source Python package to model spectra in non-equilibrium ionization plasmas*, Smithsonian Institution Scholarly Studies Award, 2018-02-01 to 2018-09-30, \$74,632, PI: Chengcai Shen (SAO)
- *Exploring Time-Dependent Ionization in Magnetic Reconnection During Solar Eruptions*, NSF SHINE Grant AGS-1723313, 2017-09-01 to 2020-08-31, \$359,537, PI: Chengcai Shen (SAO)
- *Studies of Reconnection in Coronal Jets Observed with IRIS*, NASA Heliophysics Guest Investigator (H-GI) Grant NNX15AF43G, 2015-02-01 to 2018-01-31, \$450,429, PI: Katharine Reeves (SAO)
- *Small-Scale Structure in Reconnecting Current Sheets*, NSF SHINE Grant AGS-1358342, 2014-03-01 to 2018-06-30, \$441,747, PI: Chengcai Shen (SAO)

- *Characterization of Solar Eruptions with Space-Based Instrumentation*, Smithsonian Institution Competitive Grants Program for Science, beginning 2014-01-01, \$99,939, PI: Mari Paz Miralles (SAO)
- *Impulsive, Asymmetric Reconnection in Flare/CME Current Sheets*, NASA Solar and Heliospheric Physics Supporting Research & Technology (SR&T) Grant NNX11AB61G, 2010-10-01 to 2014-09-30, \$363,091, PI: John Raymond (SAO)

I have been the principal investigator on the following subcontracts to SAO:

- *Multi-fluid Studies of Chromospheric Reconnection in a Partially Ionized Laboratory Plasma*, subcontract S014981-F from Princeton University supported through NASA H-TIDES grant NNH15AB29I with PI: Hantao Ji (Princeton)

## Education and Public Outreach

### **Astronomy 253: Plasma Astrophysics**

**2014, 2016**

Harvard University

Cambridge, Massachusetts

*Developed and co-taught an introduction to plasma physics and plasma processes in an astrophysical context. Topics include charged particle motions, kinetic theory, magnetohydrodynamics, waves, shocks, instabilities, partially ionized plasmas, collisionless plasmas, magnetized turbulence, particle acceleration, astrophysical dynamos, and magnetic reconnection. Astrophysical applications include accretion disks, interstellar turbulence, cosmic rays, galactic magnetic fields, and solar/stellar flares.*

### **Mentor, Research Experience for Undergraduates**

**2010–**

Harvard-Smithsonian Center for Astrophysics

Cambridge, Massachusetts

*Mentored or co-mentored students during multiple summers on solar and plasma physics projects, and provided introductions to IDL and magnetohydrodynamics.*

### **Public Viewing Nights**

**2004–2009**

Washburn Observatory

Madison, Wisconsin

*Opened and operated the telescope for viewing by the public, answered questions, and explained astronomical phenomena.*

### **Astronomy 104: The Solar System**

**Spring 2004**

University of Wisconsin

Madison, Wisconsin

*Teaching Assistant for Jordan Marché. Responsible for planning and teaching six discussion sections per week, holding office hours, and maintaining class records.*

### **Student Astronomical Society**

**2000–2003**

University of Michigan

Ann Arbor, Michigan

*Tutored for introductory classes, organized public lectures, and volunteered for public observing nights (Publicity Officer from 2000–2001 and Vice-President/Tutoring Coordinator from 2001–2002).*

## Meeting Organization

I have co-organized several one-day meetings at the Center for Astrophysics as well as through the New England Space Science Consortium (NESSC). Some of these meetings have been jointly organized with the Plasma Science and Fusion Center (PSFC) at MIT.

- *Diagnostics in Laboratory, Heliospheric, and Astrophysical Plasmas*, MIT PSFC, Cambridge, Massachusetts, May 5, 2014 (NESSC/PSFC)
- *The Solar Cycle 24 Mini Maximum*, Boston College, Newton, Massachusetts, April 17, 2014 (NESSC)
- *Turbulence in Laboratory, Heliospheric, and Astrophysical Plasmas*, CfA, October 28, 2013 (NESSC/PSFC)
- *One Day Symposium on Laboratory Astrophysics at the CfA*, CfA, April 26, 2013
- *Magnetic Reconnection in the Solar Atmosphere*, CfA, February 7, 2012 (NESSC)
- *CfA Postdoc Science Symposium*, CfA, October 13, 2010
- *One Day Symposium on Laboratory Astrophysics at the CfA*, CfA, September 20, 2010

Conference sessions that I have co-organized include:

- *Connecting Heliophysics and Laboratory Plasma Studies*, SHINE Meeting, Boulder, Colorado, August 5–9, 2019
- *Tutorial: Using SunPy and HelioPy to work with remote and in situ data*, SHINE Meeting, Boulder, Colorado, August 5–9, 2019
- *What are the Energy Partition and Dominant Energy Transport Mechanisms Associated with Magnetic Reconnection for Different Heliospheric Plasmas?* SHINE Meeting, Saint-Sauveur, Quebec, Canada, July 24–28, 2017
- *Observational Signatures and Modeling of Intermittent Reconnection in the Solar Corona*, SHINE Meeting, Santa Fe, New Mexico, July 11–15, 2016
- *Magnetic Reconnection in Partially Ionized Chromospheric Plasmas*, SHINE Meeting, Telluride, Colorado, June 23–27, 2014
- *Magnetic reconnection and flux redistribution: multi-scale and 3D dynamics*, SHINE Meeting, Telluride, Colorado, June 23–27, 2014

From 2014–2015, I was on the organizing committee for **Inclusive Astronomy 2015** which was held from June 17–19, 2015 at Vanderbilt University in Nashville, Tennessee. While much of the work toward equity and inclusion in astronomy focuses primarily along a single dimension of identity (e.g., Women in Astronomy I–III), the goal of this conference was to take an intersectional approach that considers multiple dimensions of identity. I participated in recruiting organizers, the submission of a successful NSF proposal to fund travel by early career scientists, the development of the conference program, the invitation of presenters, the drafting of blog posts about the meeting, development of the ground rules for conference attendees, development of the accessibility policy, and drafting the set of inclusive astronomy recommendations that are a product of the meeting.

I served as a member of the Program Committee for the 60th Annual Meeting of the American Physical Society’s Division of Plasma Physics that was held from November 5–9, 2008 in Portland, Oregon.

## Professional Service

### Working Group on Accessibility and Disability (WGAD)

2016–

American Astronomical Society

*Collaborated with students and scientists to propose and form this new working group. Served as co-chair of WGAD’s coordinating committee from January 2016 to January 2017. Collaborated on a set of recommendations to make astronomical journals more accessible, and contributed to recommendations on how to make conferences more accessible. WGAD is tasked with reducing the barriers to access facing disabled students and astronomers; actively addressing the intersections of ableism with racism, sexism,*

*heterosexism, cissexism, and classism; increasing awareness of disability in astronomy; and promoting the development and use of access tools and software.*

**APS Division of Plasma Physics Community Planning Process** **2019**

Participated in Discovery Plasma Science topical area and the Workforce cross-cutting group to develop community consensus recommendations

**Symposium Organizer** **2012–**

New England Space Science Consortium

*Organized multiple one-day NESSC meetings on topics such as magnetic reconnection and turbulence in laboratory, heliospheric, and astrophysical plasmas.*

**Committee on the Status of Women in Astronomy (CSWA)** **2012–2014**

American Astronomical Society

*Served as an editor of the AASWOMEN weekly newsletter; organized a town hall at the June 2014 AAS meeting on “Addressing Sexual Violence on College Campuses” in conjunction with the Boston Area Rape Crisis Center; contributed to the Women in Astronomy blog; helped establish and maintain a wiki of parental leave policies on the AstroBetter website; served as a liaison to the AAS Committee on the Status of Minorities in Astronomy; helped developed surveys for the CSWA’s newly established site visit program (including working with a representative from the AAS Working Group on LGBTIQ Equality to make the surveys more inclusive); and advocated for an intersectional approach to ensure that women of color and LGBTIQ astronomers are actively included in the CSWA’s advocacy.*

**Seminar Organizer** **2010–2011**

Harvard-Smithsonian Center for Astrophysics

Cambridge, Massachusetts

*Invited speakers and organized weekly seminars for the Solar, Stellar, and Planetary Sciences division.*

**Postdoc Council** **2010–2011**

Harvard-Smithsonian Center for Astrophysics

Cambridge, Massachusetts

*Co-organized a one-day postdoc research symposium, career workshops, and social events for the postdoc community.*

**Symposium Organizer** **2010, 2013**

Harvard-Smithsonian Center for Astrophysics

Cambridge, Massachusetts

*Organized one-day symposia on laboratory astrophysics performed at the Center for Astrophysics.*

**Member, U.S. Delegation** **October 8–10, 2008**

Third IUPAP International Conference on Women in Physics

Seoul, South Korea

*Represented the United States in an international conference on issues related to the representation of women in physics.*

**Vice-President of Contract Enforcement** **2006–2008**

Teaching Assistants’ Association

Madison, Wisconsin

*Co-chaired the graduate employee union’s Contract Enforcement Committee; answered questions from graduate employees about contractual rights; advocated for graduate employees who experienced a hostile work environment, pregnancy discrimination, or overwork; served as a member of the union’s Executive Board; and ensured that the union’s duty of fair representation was fulfilled.*

**Astronomy Department Steward** **2004–2005**

Teaching Assistants’ Association

Madison, Wisconsin

*Representative from the Department of Astronomy to the Steward’s Council of the graduate employee union.*