

Richard A. Frazin

Associate Research Scientist

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Education:

Ph. D., 2002, Astronomy, University of Illinois at Urbana-Champaign

M.S., 1994, Physics, Georgia State University

B.S., 1992, Physics, Mathematics, & Astronomy, University of Wisconsin-Madison

Work History:

2011 - present, Associate Research Scientist, Dept. of Climate and Space Sciences and Engineering, Univ. of Michigan, Ann Arbor, MI

2007 - 2011, Assistant Research Scientist, Dept. of Ocean, Atmospheric and Space Science, Univ. of Michigan, Ann Arbor, MI

2002 - 2007, Postdoctoral Researcher, Dept. of Electrical and Computer Engineering, Univ. of Illinois, Urbana, IL

2001 - 2002, Astrophysicist, Smithsonian Astrophysical Observatory, Cambridge, MA

1997 - 2001, Pre-doctoral Fellow, Smithsonian Astrophysical Observatory, Cambridge, MA

1994-1997 Graduate Teaching Assistant, Astronomy Dept., Univ. of Illinois Urbana, IL

1992-1994 Graduate Teaching Assistant, Physics and Astronomy Dept. Georgia State Univ. Atlanta, GA

Principle Investigator Awards:

- “Adding Density to the Wang-Sheeley-Arge Model,” years: 2008-2011, NNX08AJ09G, (NASA: Heliophysics Guest Investigator Program), **PI: Richard Frazin**, Co-PI’s: W.B. Manchester IV, Nick Arge
- “Advanced statistical methods for exoplanet detection,” years: 2011-2012, Keck Futures Initiative Imaging Science Grant, **PI: Richard Frazin**
- “Stray Light Correction for NASA’s EUV Imaging Instruments,” years: 2013-2016, NNX13AE22G (NASA: Heliophysics Guest Investigator Programs) **PI: Richard Frazin**

- “Development of Tomographic Reconstruction Algorithms in Support of the WISPR Science Analysis Efforts,” years: 2017-2018, (Contract from the Naval Research Laboratory through PRAXIS, Inc.) **PI: Richard Frazin**
- “Exploration of Millisecond Exposures for Exoplanet Imaging,” years: 2016-2022, Award #1600138 (NSF: Advanced Technology and Instrumentation) **PI: Richard Frazin**
- “Enabling a New Era of Exoplanet Direct Imaging and Spectroscopy,” years: 2020-2023, Award #2020-1826 (Heising-Simons Foundation), **PI: Richard Frazin**

Co-Investigator Awards:

- “New Cyber Technologies to Enable Space Weather Forecasting,” 2010-2013, (NSF CDI-Type II program), PI: Tamas Gomobosi, CO-Is: Quentin Stout, Mark Moldwin, Aaron Ridley, **Richard Frazin**
- “SHINE: Differential Emission Measure Determination in Three-Dimension (3D) Using Atmospheric Imaging Assembly (AIA) Data,” 2012-2015, #1154443 (NSF SHINE program), PI: E. Landi, **Co-I: Richard Frazin**
- “Simultaneous Measurements of Coronal Magnetic Field and Plasma Properties with Upgraded CoMP (UCoMP),” years: 2014-2019, #1408789, (NSF Solar-Terrestrial program), PI: E. Landi, **Co-Is: Richard Frazin**, W.B. Manchester
- “Linear Wavefront Control for High Contrast Imaging,” (NASA: Strategic Astrophysics Technology) years: 2019-2022, PI: O. Guyon, Co-Is: J. Lozi, J. Males, R. Bellikov, E. Pluzhnic, D. Sirbu, M. Chun, D. Hall, B. Mazin, T. Currie, B. Kern, **Richard Frazin**, H. Subedi, T. Groff, C. Bond
- “Causal Modeling of Human Drivers,” (Toyota Research Institute) years: 2019-2020, UM-2019-32, PI: J. Gangon-Bartsch, Co-I: **Richard Frazin**

Awards from Proposals I Wrote as a Self-Funded Postdoc:

- “Determination of the Three-Dimensional Electron Density Distribution in the Extended Solar Corona from SOHO-LASCO,” 2004 - 2006, SECGIP03-0000-0088 (NASA: Sun-Earth Connection Guest Investigator Program). PI: Farzad Kamalabadi, **Science-PI: Richard Frazin.**
- “Driving Global Heliospheric Magnetohydrodynamics (MHD) Models with Tomographically-Determined Lower Boundary Conditions,” 2006 - 2009, Abstract #0555561 (NSF: SHINE program). PI: Farzad Kamalabadi, Co-Is: Ward Manchester, Ilia Roussev
- “Particle Filtering for Time-Dependent Tomographic Analysis of the Solar Atmosphere,” 2006-2012, Abstract #0620550 (NSF Programs: Mathematical Geosciences, Opportunities for Research CMG). PI: Farzad Kamalabadi, Co-I: Yuguo Chen.

Coverage in Popular Media:

“Cold’ solar loops may help solve corona puzzle,” New Scientist Magazine, issue 2878 (2012)

Public Outreach

1. “3D Imaging of the Sun’s Corona with Satellite Images,” Invited Lecture: Kalamazoo Astronomical Society (Kalamazoo, MI), June 4, 2010.

Ph.D. Dissertation Committees:

- Paul Shearer 2013, Dept. of Mathematics, Univ. of Michigan
- Zhenguang Huang 2014, Dept. of Climate and Space Sciences and Engineering, Univ. of Michigan

Other University Services:

- Faculty Advisor for the Undergraduate Research Opportunities (UROP) Program, 2010
- CLaSP Qualifying Exam Committee, 2014
- Faculty Judge for the (UMich) Engineering Research Symposium, 2021
- Faculty Judge for Michigan Geophysical Union poster session, 2021

Journal Peer Review Services:

Applied Optics (1), Astronomy & Astrophysics (1), Astrophysical Journal/Astrophysical Journal Letters (8), IEEE Signal Processing Magazine (1), IEEE Transactions on Computational Imaging (2), Journal of Astronomical Telescopes, Instruments and Systems (4), Journal of Atmospheric and Solar-Terrestrial Physics (1), Journal of the Optical Society of America A (6), Optics Letters (2), Optics Express (1), Reviews of Geophysics (1), SIAM Journal on Imaging Sciences (1), Solar Physics (12)

Proposal Review Services:

NSF, NASA, Air Force Office of Scientific Research, European Research Council, South Carolina Institutions of Higher Education

Refereed Optics Publications (mostly for astronomy):

1. Rodack, A.T., Frazin, R.A., Males, J.R. and Guyon, O., “Millisecond Exoplanet Imaging, I: Method and Simulation Results,” *Journal of the Optical Society of America A* (under review, 2021)
2. Frazin, R.A. and Rodack, A.T., “Millisecond Exoplanet Imaging, II: Regression Equations and Technical Discussion,” *Journal of the Optical Society of America A* (under review, 2021)
3. Currie, T., Pluzhnik, E. Guyon, O. Belikov, R. Miller, K. Bos, S. Males, J., Sirbu, D. Bond, C., **Frazin, R.**, Groff, T., Kern, B., Lozi, J., Mazin, B., Nemati, B., Norris, B., Subedi, H. and Will, S., “Laboratory Demonstration of Spatial Linear Dark Field Control For Imaging Extrasolar Planets in Reflected Light,” *Pub. Astron. Soc. Pacific*, v. 132, p. 10452 (2020)
4. Frazin, R.A., “Efficient, nonlinear phase estimation with the nonmodulated pyramid wavefront sensor,” *Journal of the Optical Society of America A*, v. 35, p. 594 (2018)
5. Frazin, R.A., “Statistical framework for the utilization of simultaneous pupil plane and focal plane telemetry for exoplanet imaging I Accounting for aberrations in multiple planes,” *Journal of the Optical Society of America A*, v. 33, p. 712 (2016)
6. Frazin, R.A., “Utilization of the Wavefront Sensor and Short-exposure Images for Simultaneous Estimation of Quasi-static Aberration and Exoplanet Intensity,” *The Astrophysical Journal*, vol. 767, article id. 21 (2013).
7. Fischer, D.G., Frazin, R.A., Asipauskas, M., Carney, P.S., “Information content of the near field: three-dimensional samples,” *Journal of the Optical Society of America A*, vol. 28, pp. 296-306 (2011).
8. Carney, P.S., Frazin, R.A., Bozhevolyi, S., Volkov, V.S., Boltasseva, A., Schotland, J.C., “A Computational Lens for the Near Field,” *Physical Review Letters*, vol. 92, n. 16, #163903 (2004)
9. Frazin, R.A., Fischer, D.G. & Carney, P.S., “Information Content of the Near-Field: Two-Dimensional Samples,” *The Journal of the Optical Society of America A*, vol. 21, pp. 1050-1057 (2004)
10. Frazin, R.A., “Optical Path Stability and Fringe Tracking in Optical Stellar Interferometry,” *Optics Communications*, vol. 153, pp. 323-330 (1998)

Refereed Solar Physics Publications:

1. Lloveras, D.G., Vásquez, A.M., Nuevo, F.A., Mac Cormack, C., Sachdeva, N., Manchester, W. Van der Holst, B. and Frazin, R.A., “Thermodynamic Structure of the Solar

- Corona: Tomographic Reconstructions and MHD Modeling,” *Solar Physics*, v. 295, n. 6, p. 76 (2020)
2. Vázquez, A.M., Frazin, R.A., Vourlidas, A., Manchester, W.B., van der Holst, B. Howard, R.A., Lamy, P., “Tomography of the Solar Corona with the Wide-Field Imager for the Parker Solar Probe,” *Solar Physics*, vol. 294, n. 6, article id. 81 (2019)
 3. Lloveras, D.G., Vázquez, A. M., Landi, E., Frazin, R. A., “Tomography of the Solar Corona with Multiple Instruments: First Steps,” *Boletín de la Asociación Argentina de Astronomía*, vol. 61a, p. 35 (2019)
 4. Mac Cormack, C., Nuevo, F. A., Vázquez, A. M., López Fuentes, M., Frazin, R. A., Landi, E., “Estudio del balance de energía en la corona solar con tres y cuatro bandas de SDO/AIA,” *Boletín de la Asociación Argentina de Astronomía*, vol. 60, p. 204 (2018)
 5. Lloveras, D.G., Vázquez, A.M., Nuevo, F.A., Frazin, R.A., “Comparative Study of the Three-Dimensional Thermodynamical Structure of the Inner Corona of Solar Minimum Carrington Rotations 1915 and 2081,” *Solar Physics*, vol. 292, n. 10, article id. 153 (2017).
 6. Lloveras, D.G., Vázquez, A. M., Shearer, P., Frazin, R. A., “Effect of stray light correction of extreme-ultraviolet solar images in tomography,” *Boletín de la Asociación Argentina de Astronomía*, vol. 59, p. 145 (2017)
 7. Mac Cormack, C., Vázquez, A.M., López Fuentes, M., Nuevo, F.A., Landi, E., Frazin, R.A., “Energy Input Flux in the Global Quiet-Sun Corona,” *The Astrophysical Journal*, vol. 843, article id. 70 (2017)
 8. Mac Cormack, C., López Fuentes, M., Vázquez, A. M., Nuevo, F. A., Frazin, R. A., Landi, E., “Comparison between two models of energy balance in coronal loops,” *Boletín de la Asociación Argentina de Astronomía*, vol. 59, p. 142 (2017)
 9. Jensen, E. A., Frazin, R., Heiles, C., Lamy, P., Llebaria, A., Anderson, J. D., Bisi, M. M., Fallows, R. A., “The Comparison of Total Electron Content Between Radio and Thompson Scattering,” *Solar Physics*, vol. 291, 465-485 (2016)
 10. Vibert, D., Peillon, C., Lamy, P., Frazin, R.A., Wojak, J., “Time-dependent tomographic reconstruction of the solar corona,” *Astronomy and Computing*, v. 17, p. 144 (2016)
 11. Lloveras, D.G., Nuevo, F.A., Vázquez, A.M., Frazin, R.A., “Comparative analysis of solar minima with EUV tomography,” *Boletín de la Asociación Argentina de Astronomía*, vol. 58, p. 272 (2016)

12. Nuevo, F.A., Vásquez, A.M., Landi, E., Frazin, R., “Multimodal Differential Emission Measure in the Solar Corona,” *The Astrophysical Journal*, vol. 811, article id. 128 (2015)
13. Oran, R., Landi, E., van der Holst, B., Lepri, S.T., Vásquez, A.M., Nuevo, F.A., Frazin, R., Manchester, W., Sokolov, I., Gombosi, T.I., “A Steady-state Picture of Solar Wind Acceleration and Charge State Composition Derived from a Global Wave-driven MHD Model,” *The Astrophysical Journal*, vol. 806, article id. 55 (2015)
14. Nuevo, F.A., Vásquez, A.M., Frazin, R.A., Landi, E., “Multi-modal DEM in the solar corona,” *Boletín de la Asociación Argentina de Astronomía*, vol. 56, p. 395 (2013)
15. Nuevo, F.A., Huang, Z., Frazin, R., Manchester, W.B. IV, Jin, M., Vásquez, A.M., “Evolution of the Global Temperature Structure of the Solar Corona during the Minimum between Solar Cycles 23 and 24,” *The Astrophysical Journal*, vol. 773, article id. 9 (2013)
16. Nuevo, F. A., Vásquez, A. M., Huang, Z., Frazin, R. A., “Evolución de la Estructura Térmica Global de la Corona alrededor del Último Mínimo de Actividad Solar,” *Boletín de la Asociación Argentina de Astronomía*, vol. 55, p. 127 (2012)
17. Frazin, R.A., “Coronal Mass Ejection Reconstruction from Three Viewpoints via Simulation Morphing. I. Theory and Examples,” *The Astrophysical Journal*, vol. 761, article id. 24 (2012)
18. Frazin, R.A., Vásquez, A.M., Thompson, W.T., Hewett, R.J., Lamy, P., Llebaria, A., Vourlidas, A., Burkepile, J., “Intercomparison of the LASCO-C2, SECCHI-COR1, SECCHI-COR2, and Mk4 Coronagraphs,” *Solar Physics*, vol. 280, pp. 273-293 (2012).
19. Evans, R.M., Opher, M., Oran, R., van der Holst, B., Sokolov, I.V., Frazin, R., Gombosi, T.I., Vásquez, A., “Coronal Heating by Surface Alfvén Wave Damping: Implementation in a Global Magnetohydrodynamics Model of the Solar Wind,” *The Astrophysical Journal*, vol. 756, article id. 155 (2012)
20. Huang, Z., Frazin, R.A., Landi, E., Manchester, W.B., Vásquez, A.M., Gombosi, T.I., “Newly Discovered Global Temperature Structures in the Quiet Sun at Solar Minimum,” *The Astrophysical Journal*, vol. 755, article id. 86 (2012).
21. Shearer, P., Frazin, R.A., Hero, A.O. III, Gilbert, A.C., “The First Stray Light Corrected EUV Images of Solar Coronal Holes,” *The Astrophysical Journal Letters*, vol. 749, article id. L8, (2012)
22. Jin, M., Manchester, W.B., van der Holst, B., Gruesbeck, J.R., Frazin, R.A., Landi, E., Vasquez, A.M., Lamy, P.L., Llebaria, A., Fedorov, A., “A Global Two-temperature

- Corona and Inner Heliosphere Model: A Comprehensive Validation Study,” *The Astrophysical Journal*, vol. 745, article id. 6, (2012)
23. Vásquez, A.M., Huang, Z., Manchester, W.B. IV, Frazin, R.A., “The WHI Corona from Differential Emission Measure Tomography,” *Solar Physics*, vol. 274, pp. 274-259 (2011).
 24. van der Holst, B., Manchester, W.B. IV, Frazin, R.A., Vásquez, A.M., Tóth, G., Gombosi, T.I., “A Data-Driven, Two-Temperature Solar Wind Model with Alfvén Waves,” *The Astrophysical Journal*, vol. 725, pp. 1373-1383 (2010)
 25. Frazin, R.A., Lamy, P., Llebaria, A., Vásquez, A.M., “Three-Dimensional Electron Density from Tomographic Analysis of LASCO-C2 Images of the K-Corona Total Brightness,” *Solar Physics*, vol. 265, pp. 19-30 (2010)
 26. Vásquez, A.M., Frazin, R.A., Manchester, W.B. IV, “The Solar Minimum Corona from Differential Emission Measure Tomography,” *The Astrophysical Journal*, vol. 715, 1352-1365 (2010)
 27. Butala, M.D., Hewett, R.J., Frazin, R.A., Kamalabadi, F., “Dynamic Three Dimensional Tomography of the Solar Corona,” *Solar Physics*, vol. 262, pp. 495-509 (2010)
 28. Frazin, R.A., Vásquez, A.M. & Kamalabadi, F., “Quantitative, 3D Analysis of the Global Coronal with Multi-Spacecraft Differential Emission Measure Tomography,” *The Astrophysical Journal*, vol. 701, pp. 547-560 (2009)
 29. Vásquez, A.M., Frazin, R.A. & Kamalabadi F., “3D Temperatures and Densities of the Solar Corona Via Multi-Spacecraft EUV Tomography: Analysis of Prominence Cavities,” *Solar Physics*, vol. 256, pp. 73-85 (2009)
 30. Vásquez, A. M., Frazin, R. A., “Multi-Spacecraft 3D differential emission measure tomography of the solar corona: STEREO results,” *Boletín de la Asociación Argentina de Astronomía*, vol. 52, p. 23 (2009)
 31. Frazin, R.A., Jacob, M., Manchester IV, W.B., Morgan, H., Wakin, M.B., “Towards Reconstruction of CME Density from Only Three Points of View,” *The Astrophysical Journal*, vol. 695, pp. 636-641 (2009)
 32. Butala, M.D., Frazin, R.A., Chen, Y., Kamalabadi, F., “Tomographic Imaging of Dynamic Objects with the Ensemble Kalman Filter,” *IEEE Transactions on Image Processing*, vol. 18, pp. 1573-1587 (2009)
 33. Butala, M.D., Kamalabadi, F., Frazin, R.A., Chen, Y., “Dynamic Tomographic Imaging of the Solar Corona,” *IEEE Journal of Selected Topics in Signal Processing*, vol. 2, pp. 755-766 (2008)

34. Vásquez, A.M., Frazin, R.A., Hayashi, K., Sokolov, I.V., Cohen, O., Manchester, W.B. IV, Kamalabadi, F., “Validation of Two MHD Models of the Solar Corona with Rotational Tomography,” *The Astrophysical Journal*, vol. 682, pp. 1328-1337 (2008)
35. Frazin, R.A., Vásquez, A.M., Kamalabadi, F., Park, H., “Three-Dimensional Tomographic Analysis of a High Cadence LASCO-C2 Polarized Brightness Sequence,” *The Astrophysical Journal Letters*, vol. 671, pp. 201-204 (2007)
36. Frazin, R.A., Butala, M.D., Kemball, A., Kamalabadi, F., “Time-Dependent Reconstruction of Non-Stationary Objects with Tomographic or Interferometric Measurements,” *The Astrophysical Journal Letters*, vol. 635, pp. 197-200 (2005)
37. Frazin, R.A. & Kamalabadi, F. “Rotational Tomography for 3D Reconstruction of the White-Light and EUV Corona in the post-SOHO Era,” *Solar Physics*, vol. 228, pp. 221-239 (2005)
38. Frazin, R.A., Kamalabadi, F. & Weber, M.A., “On the Combination of Differential Emission Measure Analysis and Rotational Tomography for 3D Solar EUV Imaging,” *The Astrophysical Journal*, vol. 628, pp. 1070-1080 (2005)
39. Butala, M.D., Frazin, R.A. & Kamalabadi, F. “Three-Dimensional Estimates of the Coronal Electron Density at Times of Extreme Solar Activity,” *Journal of Geophysical Research*, 110, DOI: 10.1029/2004JA010938 (2005)
40. Frazin, R.A. & Kamalabadi, F. “On the Use of Total Brightness Measurements for Tomography of the Solar Corona,” *The Astrophysical Journal*, vol. 628, pp. 1061-1069 (2005)
41. Frazin, R.A., Cranmer, S.R. & Kohl, J.L., “Empirically Determined Anisotropic Velocity Distributions and Outflows of O5+ Ions in a Coronal Streamer at Solar Minimum,” *The Astrophysical Journal*, vol. 597, pp. 1145-1157 (2003)
42. Frazin, R.A. & Janzen, P., “Tomography of the Solar Corona: II. Robust, Regularized, Positive Estimation of the Three-Dimensional Electron Density from LASCO-C2 Polarized White-Light Images,” *The Astrophysical Journal*, vol. 570, pp. 408-422 (2002)
43. Frazin, R.A., “Tomography of the Solar Corona: I. A Robust, Regularized, Positive Estimation Method,” *The Astrophysical Journal*, vol. 530, pp. 1026-1035 (2000)
44. Suleiman, R.M., Kohl, J.L., Panasyuk, A.V., Ciaravella, A., Cranmer, S.R., Gardner, L.D., Frazin, R., Hauck, R., Smith, P.L., Noci, G., “UVCS/SOHO Observations of H I Lyman Alpha Line Profiles in Coronal Holes at Heliocentric Heights Above $3.0 R_{\odot}$,” *Space Science Reviews*, v. 87, pp. 327-330 (1999)

45. Kohl, J.L., Esser, R., Cranmer, S.R., Fineschi, S., Gardner, L.D., Panasyuk, A.V., Strachan, L., Suleiman, R.M., Frazin, R.A., Noci, G., “EUV Spectral Line Profiles in Polar Coronal Holes from 1.3 to 3.0 R_{\odot} ,” *The Astrophysical Journal*, vol. 510, pp. L59-L62 (1999)
46. Frazin, R.A., Ciaravella, A., Dennis, E., Fineschi, S., Gardner, L.D., Michels, J., O’Neal, R.; Raymond, J.C., Wu, C.-R., Kohl, J.L., Modigliani, A., Noci, G. “UVCS/SOHO Ion Kinetics in Coronal Streamers,” *Space Science Reviews*, v. 87, pp. 189-192 (1999)

Book Chapters:

1. Frazin, R.A., et al., “White Light Inter-calibrations of UVCS, LASCO-C2, and Spartan 201/WLC”, in *The Radiometric Calibration of SOHO*, ISSI Scientific Report SR-002, eds. A Pauluhn, M.C.E. Huber, & R. von Steiger (Noordwijk: ESA Publications) (2002)
2. Romoli, M., Frazin, R.A., Kohl, J.L., Gardner, L.D., Cranmer, S.R., Reardon, K., & Fineschi, S. , “In-flight Calibration of the UVCS White Light Channel,” in *The Radiometric Calibration of SOHO*, ISSI Scientific Report SR-002, eds. A Pauluhn, M.C.E. Huber, & R. von Steiger (Noordwijk: ESA Publications) (2002)

Ph.D. Thesis:

Frazin, R.A., “Empirical Constraints on O5+ Outflows and Velocity Distributions in a Solar-Minimum Coronal Streamer,” University of Illinois at Urbana-Champaign (2002)

Talks (partial listing):

- “Millisecond Imaging and Wavefront Control for Direct Imaging of Exoplanets,” UV-Vis NASA/NSF PI Program Review Meeting, Oct. 1, 2019
- “The Real-Time Frazin Algorithm: Fixing Quasi-static coronagraphic NCPA (and Finding Exoplanets, Too),” Alexander Rodack (presenter), Richard Frazin, Jared Males. Center for Adaptive Optics Fall Science Retreat, Nov. 8-11, 2019
- “Millisecond Imaging and Wavefront Control for Direct Imaging of Exoplanets,” Steward Observatory (University of Arizona) on Oct. 29, 2018
- “Millisecond Imaging and Wavefront Control for Direct Imaging of Exoplanets,” Richard Frazin, UV-Vis NASA/NSF PI Program Review Meeting, Sept. 11-12, 2018
- “Tomographic Reconstruction from WISPR Data,” Richard Frazin, Alberto Vásquez. WISPR/SoLoHi Consortium Meeting, Feb. 20-21, 2018
- “Millisecond Exposures in Ground-Based Exoplanet Imaging,” Prof. Jeremy Kasdin’s group at Princeton University on July 19, 2017

- “Direct Imaging of Exoplanets *sans* Background Subtraction,” **Colloquium** given to Laboratoire d’Astrophysique de Marseille on July 8, 2016
- “Multimodal Differential Emission Measure in the Solar Corona,” Science Seminar given at the Laboratory for Atmospheric and Space Physics (LaSP) at the University of Colorado Boulder on March 26, 2015
- “Space Weather Modeling Framework Simulation for Solar Orbiter Science,” Frazin, R.A. (presenter), van der Holst B., Manchester, W.B. IV, Landi, E., Lepri, S., Gruesbeck, J., Jin, M. & Oran, R., Fourth Solar Orbiter Workshop, 2011
- “3D Imaging of the Sun’s Corona with Satellite Images,” **Colloquium** at Albion College Department of Physics (Albion, MI), March 26, 2010
- “Coronal Tomography and Solar Simulations,” Frazin, R.A. (presenter), Vásquez, A.M., Manchester, W.B. & Kamalabadi, F., CCHM/CWMM Pre-Review Project Meeting, 2009
- “The Sun, Its Corona and 3D Imaging,” Univ. of Michigan Undergraduate Research Opportunities Program (UROP), November 4, 2009
- “Dynamic Tomography of the Solar Corona with the localized Ensemble Kalman Filter,” Richard Frazin (presenter), Yuguo Chen, Mark Butala, Farzad Kamalabadi, **Invited Talk** at the Joint Statistical Meeting, Denver, CO, Aug. 3-8, 2008
- “Combined Magnetic and Tomographic Analysis of the 5/13/05 Event Period,” Frazin, R.A. (presenter), Vásquez, A.M., Hayashi, K., Butala, M.D. & Kamalabadi, K., NSF SHINE workshop, Aug. 2007
- “3D Tomographic Plasma Diagnostics for the Solar Corona,” presented at the Monday Physics Meeting at the Princeton Plasma Physics Laboratory on June 12, 2006