# ADAM FRANK

The Helen F. and Fred H. Gowen Professor in the Dept of Physics and Astronomy
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## EDUCATION

University of Washington, Seattle, WA
**Ph.D. in Physics** 1988-1992
Thesis: "The Radiation Gasdynamics of Planetary Nebulae"
Advisor: Professor Bruce Balick

University of Washington, Seattle, WA
**M.S. in Physics** 1988-1988

University of Colorado, Boulder, CO
**B.S. in Physics** (cum laude) 1980-1984

## APPOINTMENTS

**Helen F. and Fred H. Gowen Professor in The Department of Physics and Astronomy**, University of Rochester, Rochester, NY 2019-

**Professor** Physics and Astronomy, University of Rochester, Rochester, NY 2004-2019

**Associate Professor** Physics and Astronomy, University of Rochester, Rochester, NY 2000-2004

**Assistant Professor** Physics and Astronomy, University of Rochester, Rochester, NY 1996 - 2000

**Scientist**, Laboratory for Laser Energetics, University of Rochester, Rochester, NY 1996-Present

**Hubble Fellow** 1995-1996

**Postdoctoral Research Associate**, Minnesota Supercomputer Institute, Minneapolis, MN 1992-1995

**Research Scholar**, Minnesota Supercomputer Institute, Minneapolis, MN 1992-1996

**Visiting Scientist**, NSF Program for Research at Foreign Centers of Excellence, Leiden University, Leiden, Netherlands 1993

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| **Research Assistant**, Leiden University, The Netherlands 1992 | 1988- |
| **Research Assistant**, University of Washington, Seattle, WA | 1987-1991 |
| **Teaching Assistant**, University of Washington, Seattle, WA | 1986-1992 |
| **Scientific Assistant**, NASA Goddard Institute for Space Studies, New York, NY | 1985-1986 |

## RELATED EXPERIENCE

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| *Co-founder: Big Think.com 13. Blog* | *2021-Present* |
| *On-air Commentator: CNN, NBC and others* | *2021-Present* |
| *Contributor: New York Times, CNN, NBC, Washington Post, Atlantic and others* | *2012-Present* |
| *On-air Commentator: NPR All Things Considered* | *2011-2019* |
| *Co-founder: 13.7 Orbiter Blog* | *2019-2020* |
| *Co-founder: National Public Radio 13.7 Cosmos and Culture Blog* | *2009-2018* |
| President, Truth-N-Beauty Software, LLC | 2000-2004 |
| Editorial Advisory Board, ASTRONOMY Magazine | 1999-Present |
| Astronomy, Advisor, McGraw-Hill Publishing | 1998-2002 |
| Contributor, DISCOVER Magazine | 1994- Present |
| Contributor, ASTRONOMY Magazine | 1994-Present |
| Consultant, NASA High Performance Computing Program | 1997-2002 |

## HONORS AND AWARDS

- American Astronomical Society: Carl Sagan Medal, 2021
- American Physical Society Joseph A Burton Forum Award 2020
- The National Honor Society Phi Beta Kappa Award for Science 2019
- Top Ten Science Books, Forbes, 2018
- Selected for Best American Science and Nature Writing 2009.
- Selected Best Book Picks of the Year, SEED Magazine, 2009.
- American Astronomical Society Solar Physics Division: Popular Science Writing Award for a Scientist, 1999
- Nominated for Professor of the Year, 1999
- National Science Foundation Early Career Development Award, 1997-2002
- Hubble Space Telescope Fellowship, 1995-1998 (last two years declined)
- NSF Fellowship, Program for Research at Foreign Centers of Excellence
- Graduate Merit Fellowship, Dept. of Physics, University of Washington, 1986-87
- Isabelle Tour Scholarship in Physics, University of Colorado, 1983.

## GRANTS

### Currently and Recently Funded

- Templeton Foundation, Semantic Information and the Origin of Agency, ~ $700,000, end date 2025
- NASA, Categorizing Atmospheric Technosignatures, PI, ~ $700,000, end date 2024
- National Science Foundation, Common Envelope Interactions, University of Rochester, PI, $400,000, end date 2022
- National Science Foundation and Department of Energy, Colliding Magnetized Plasma Flows DEDP Laboratory Studies", University of Rochester, PI, $700,000, end date 2022

## PUBLICATIONS AND PAPERS

### Books

- Frank, A., ***The Little Book of Aliens. Everything You Need To Know About Life In The Universe,*** Harper-Collins 2023.

- Frank, A, Gleiser, M. and Thompson. ***The Blind Spot. Experience, Science, and the Search for Truth*****,** MIT Press 2022

- Frank, ***Light of the Stars: Alien Worlds and the Fate of the Earth***, WW Norton, 2018

- Frank, ***At Play in The Cosmos: An Introduction to Astronomy***, WW Norton, 2015

- Frank, ***About Time. Cosmology and Culture at the Twilight of the Big Bang***, Free Press, 2011

- Frank, ***The Constant Fire: Beyond the Science vs. Religion Debate***, University of California Press, 2009

### Selected Recent Popular Science Publications

### Recent contributions to National News Media

- Example 1: Scientists Found Ripples in Space and Time. And You Have to Buy Groceries
  - The Atlantic.
- Example 2: Is Earth Smart
  - The Atlantic: Planetary-scale operation of cognition. Based on a paper I wrote for IJAstrobiology.
- Example 2: UFOs Don't Impress Me
  - NYTimes: On UFOs and the lack of evidence for alien life
- Example 3: A new frontier is opening in the search for extraterrestrial life
  - Washington Post: On the new search for life in the Universe
- Example 4: American Science Shows What Unity Looks Likers
  - NBC American Science Triumphed in the Pandemic

### Selected OpEds/Book Reviews

- Frank, "Our Story of the Universe May Be Starting to Unravel", 9/2/23
- Frank, "A Quantum Life", NPR, 6/22/21
- Frank, "Heligoland", NPR, 5/27/21
- Frank, "The Anthropocene Reviewed", NPR, 5/18/21
- Frank, "Under A White Sky", NPR, 2/8,21

- Frank, "New Directions in the Search for Life", Washington Post, 12/31/20
- Frank, "A Different Story for Climate Change", Washington Post, 10/15/19
- Frank, "The Earth Will Survive We May Not", NY Times, 6/12/18
- Frank, "Is There Anyone Out There", Globe and Mail, 2/8/2019
- Frank, "How do Aliens Solve Climate Change", The Atlantic, 5/30/2018
- Frank, "Was There a Civilization On Earth Before Humans?", The Atlantic, 4/13/2018
- Frank, "Looking for Solar Panels on Distant Planets", The Atlantic, 12/27/2018
- Frank, "Earth the Final Frontier", NY Times 12/2/2016
- Frank, "Yes There Where Aliens ", NY Times, 6/18/2015
- Frank, "A Crisis At The Edge Of Physics, NY Times, 6/5/2015
- Frank, "Is A Climate Disaster Inevitable, NY Times, 1/27/2015
- Frank, "Evan Thompson's 'Waking, Dreaming, Being'", NY Times, 12/19/25
- Frank, "I was Promised Flying Cars", NY Times, 6/6/2014
- Frank, "Dreaming in Code, Michio Kaku's 'Future of the Mind'", NY Times, 3/7/2014
- Frank, "Welcome to the Age of Denial", NY Times, 8/21/2013
- Frank, "Cracking the Quantum Safe", NY Times, 10/13/2012
- Frank, "Alone in the Void", NY Times, 7/24/2012
- Frank, "Is Earth Smart", The Atlantic, 2/14/2021
- Frank, "A Scientists Guide to Finding Alien Life", Discover, May, 2009, (included in book *Best Science and Nature Writing* 2009),
- Frank, "Time and Again", Tricycle, Winter, 2008 (included in *Best Buddhist Writing* 2009, volume)

**Selected Television Appearences**

- "Alien Worlds" Netflix
- "Into the Night", PBS
- "Mars. Season 2", National Geographic
- "The Drake Equation", The Curiosity Channel
- "Nebula", The Universe, History Channel
- "Stonehenge", The Universe, History Channel
- "Pulsars", The Universe, History Channel

**Professional Publications**

1. Roulston, B. and 8 colleagues 2023. Probing Accretion Spin-Up in Binary Main-Sequence Carbon Stars. AAS/High Energy Astrophysics Division.
2. Balbi, A., Frank, A. 2023. The Oxygen Bottleneck for Technospheres. arXiv e-prints. doi:10.48550/arXiv.2308.01160
3. Lingam, M., Frank, A., Balbi, A. 2023. Planetary Scale Information Transmission in the Biosphere and Technosphere: Limits and Evolution. Life 13, 1850. doi:10.3390/life13091850
4. Chamandy, L. and 7 colleagues 2023. How negative feedback and the ambient environment limit the influence of recombination in common envelope evolution. arXiv e-prints. doi:10.48550/arXiv.2304.14840

5. Balick, B. and 6 colleagues 2023. NGC 6302: The Tempestuous Life of a Butterfly. arXiv e-prints. doi:10.48550/arXiv.2303.16439
6. Haqq-Misra, J., Kopparapu, R., Fauchez, T.J., Frank, A., Wright, J.T., Lingam1, M. 2022. Detectability of Chlorofluorocarbons in the Atmospheres of Habitable M-dwarf Planets. arXiv e-prints.
7. Zou, Y., Chamandy, L., Carroll-Nellenback, J., Blackman, E.G., Frank, A. 2022. Jets from main sequence and white dwarf companions during common envelope evolution. arXiv e-prints.
8. Roulston, B.R. and 8 colleagues 2022. New Clues to the Evolution of Dwarf Carbon Stars From Their Variability and X-Ray Emission. The Astrophysical Journal 926. doi:10.3847/1538-4357/ac4706
9. Debrecht, A. and 6 colleagues 2022. Effects of charge exchange on the evaporative wind of HD 209458b. Monthly Notices of the Royal Astronomical Society. doi:10.1093/mnras/stac112
10. Miklavivic, P.M. and 6 colleagues 2022. Habitat Bennu: Design Concepts for Spinning Habitats Constructed from Rubble Pile Near-Earth Asteroids. Frontiers in Astronomy and Space Sciences 8. doi:10.3389/fspas.2021.645363
11. Markwick, R.N. and 6 colleagues 2021. Cooling and instabilities in colliding flows. Monthly Notices of the Royal Astronomical Society 508, 2266–2278. doi:10.1093/mnras/stab2577
12. Williamson, K., Berryhill, K., Charlton, J., Frank, A. 2021. Gamifying Your Astronomy Class. Astronomical Society of the Pacific Conference Series 531, 54.
13. Savitch, E., Frank, A., Carroll-Nellenback, J., Haqq-Misra, J., Kleidon, A., Alberti, M. 2021. Triggering a Climate Change Dominated ``Anthropocene'': Is It Common among Exocivilizations?. The Astronomical Journal 162. doi:10.3847/1538-3881/ac1a71
14. Roulston, B.R. and 8 colleagues 2021. New Clues to the Evolution of Dwarf Carbon Stars From Their Variability and X-ray Emission. arXiv e-prints.
15. Wright, J.T., Carroll-Nellenback, J., Frank, A., Scharf, C. 2021. The Dynamics of the Transition from Kardashev Type II to Type III Galaxies Favor Technosignature Searches in the Central Regions of Galaxies. Research Notes of the American Astronomical Society 5. doi:10.3847/2515-5172/ac0910
16. Kastner, J.H. and 6 colleagues 2021. Panchromatic HST/WFC3 Imaging Studies of Young, Rapidly Evolving Planetary Nebulae. I. NGC 6302. arXiv e-prints.
17. Guidarelli, G., Nordhaus, J., Carroll-Nellenback, J., Chamandy, L., Blackman, E.G., Frank, A. 2021. The Formation of Discs in the Interior of AGB Stars from the Tidal Disruption of Planets and Brown Dwarfs. arXiv e-prints.
18. Chamandy, L., Blackman, E.G., Frank, A., Carroll-Nellenback, J., Tu, Y. 2020. Common envelope evolution on the asymptotic giant branch: unbinding within a decade?. Monthly Notices of the Royal Astronomical Society 495, 4028–4039
19. Debrecht, A. and 6 colleagues 2020. Effects of radiation pressure on the evaporative wind of HD 209458b. Monthly Notices of the Royal Astronomical Society 493, 1292–1305.
20. Chamandy, L., Blackman, E.G., Frank, A., Carroll-Nellenback, J., Zou, Y., Tu, Y. 2019. How drag force evolves in global common envelope simulations. Monthly Notices of the Royal Astronomical Society 490, 3727–3739.
21. Chamandy, L. and 8 colleagues 2018. Accretion in common envelope evolution. Monthly Notices of the Royal Astronomical Society 480, 1898–1911.

22. Debrecht, A., Carroll-Nellenback, J., Frank, A., Fossati, L., Blackman, E.G., Dobbs-Dixon, I. 2018. Generation of a circumstellar gas disc by hot Jupiter WASP-12b. Monthly Notices of the Royal Astronomical Society 478, 2592–2598.
23. Frank, A., Chen, Z., Reichardt, T., De Marco, O., Blackman, E., Nordhaus, J. 2018. Planetary Nebulae Shaped by Common Envelope Evolution. Galaxies 6, 113
24. Balick, B., Frank, A., Liu, B., Corradi, R. 2018. Models of the Mass-ejection Histories of Pre-planetary Nebulae. II. The Formation of Minkowski{rsquo}s Butterfly and its Proboscis in M2-9. The Astrophysical Journal 853, 168
25. Chen, Z., Frank, A., Blackman, E.G., Nordhaus, J., Carroll-Nellenback, J. 2017. Mass transfer and disc formation in AGB binary systems. Monthly Notices of the Royal Astronomical Society 468, 4465-4477
26. Hansen, E.C., Frank, A., Hartigan, P., Lebedev, S.V. 2017. The Shock Dynamics of Heterogeneous YSO Jets: 3D Simulations Meet Multi-epoch Observations. The Astrophysical Journal 837, 143
27. Carroll-Nellenback, J., Frank, A., Lui, B., Quillen, A. C., Blackman, E. G., Kasting, J., Dobbs-Dixon, I. 2016. *Hot planetary winds near a star: dynamics, wind-wind interactions, and observational signatures*, MNRAS in press http://lanl.arxiv.org/abs/1604.08532
28. Hansen, E. C., Frank, A., Hartigan, P., Lebedev, S. V. 2016. The Shock Dynamics Heterogeneous YSO Jets: 3-D Simulations Meet Multi-Epoch Observations. ArXiv e-prints arXiv:1602.03804
29. Fogerty, E., Frank, A., Heitsch, F., Carroll-Nellenback, J., Haig, C., Adams, M. 2016. Molecular cloud formation in high-shear, magnetized colliding flows. ArXiv e-prints arXiv:1602.01417.
30. Hansen, E. C., Frank, A., Hartigan, P., Yirak, K. 2015. Numerical simulations of Mach stem formation via intersecting bow shocks. High Energy Density Physics 17, 135-139.
31. Frank, A., Lui, B., Carroll-Nellenback, J., Quillen, A. C., Blackman, E. G., Kasting, J., Dobbs-Dixon, I. 2015. Planetary Evaporation and the Dynamics of Planet Wind/Stellar Wind Bow Shocks. Young Stars { amp} Planets Near the Sun 314, 237-240.
32. Frank, A., Sullivan, W. T., III 2015. A New Empirical Constraint on the Prevalence of Technological Species in the Universe. ArXiv e-prints arXiv:1510.08837.
33. Chen, Z., Frank, A., Blackman, E., Nordhaus, J. 2015. The Creation of AGB Fallback Shells. ArXiv e-prints arXiv:1505.02969.
34. Hansen, E. C., A. Frank, and P. Hartigan. 2015. Magnetohydrodynamic Effects on Pulsed Young Stellar Object Jets. I. 2.5D Simulations. The Astrophysical Journal 800, 41.
35. Montez, R., Jr., J. H. Kastner, B. Balick, E. Behar, E. Blackman, V. Bujarrabal, Y.-H. Chu, R. L. M.Corradi, O. De Marco, A. Frank, M. Freeman, D. J. Frew, M. A. Guerrero, D. Jones, J. A. Lopez, B.Miszalski, J. Nordhaus, Q. A. Parker, R. Sahai, C. Sandin, D. Schonberner, N. Soker, J. L. Sokoloski, M. Steffen, J. A. Toala, T. Ueta, E. Villaver, and A. Zijlstra. 2015. The Chandra Planetary Nebula Survey (ChanPlaNS). III. X-Ray Emission from the Central Stars of Planetary Nebulae. The Astrophysical Journal 800, 8.
36. Li, S., A. Frank, and E. G. Blackman. 2014. Triggered star formation and its consequences. Monthly Notices of the Royal Astronomical Society 444, 2884-2892.
37. Albertazzi, B., A. Ciardi, M. Nakatsutsumi, T. Vinci, J. Beard, R. Bonito, J. Billette, M. Borghesi, Z. Burkley, S. N. Chen, T. E. Cowan, T. Herrmannsdorfer, D. P. Higginson, F. Kroll, S. A. Pikuz, K. Naughton, L. Romagnani, C. Riconda, G. Revet, R. Riquier, H.-P. Schlenvoigt, I. Y.

Skobelev, A. Y. Faenov, A. Soloviev, M. Huarte-Espinosa, A. Frank, O. Portugall, H. Pepin, and J. Fuchs. 2014. Laboratory formation of a scaled protostellar jet by coaligned poloidal magnetic field. Science 346, 325-328.

38. Freeman, M., R. Montez Jr., J. H. Kastner, B. Balick, D. J. Frew, D. Jones, B. Miszalski, R. Sahai, E. Blackman, Y.-H. Chu, O. De Marco, A. Frank, M. A. Guerrero, J. A. Lopez, A. Zijlstra, V. Bujarrabal, R. L. M. Corradi, J. Nordhaus, Q. A. Parker, C. Sandin, D. Schonberner, N. Soker, J. L. Sokoloski, M. Steffen, J. A. Toala, T. Ueta, and E. Villaver. 2014. The Chandra Planetary Nebula Survey (CHANPLANS). II. X-Ray Emission from Compact Planetary Nebulae. The Astrophysical Journal 794, 99.
39. Kaminski, E., A. Frank, J. Carroll, and P. Myers. 2014. On the Role of Ambient Environments in the Collapse of Bonnor-Ebert Spheres. The Astrophysical Journal 790, 70.
40. Carroll-Nellenback, J. J., A. Frank, and F. Heitsch. 2014. The Effects of Flow-inhomogeneities on Molecular Cloud Formation: Local versus Global Collapse. The Astrophysical Journal 790, 37.
41. Frank, A., T. P. Ray, S. Cabrit, P. Hartigan, H. G. Arce, F. Bacciotti, J. Bally, M. Benisty, J. Eisloffel, M. Gudel, S. Lebedev, B. Nisini, and A. Raga. 2014. Jets and Outflows from Star to Cloud: Observations Confront Theory. Protostars and Planets VI 451-474.
42. Blackman, E. G., J. J. Carroll-Nellenback, A. Frank, M. Huarte-Espinosa, and J. Nordhaus. 2013. Size of discs formed by wind accretion in binaries can be underestimated if the role of wind-driving force is ignored. Monthly Notices of the Royal Astronomical Society 436, 904-909.
43. Li, S., A. Frank, and E. G. Blackman. 2013. Magnetohydrodynamic Shock-Clump Evolution with Selfcontained Magnetic Fields. The Astrophysical Journal 774, 133.
44. Huarte-Espinosa, M., J. Carroll-Nellenback, J. Nordhaus, A. Frank, and E. G. Blackman. 2013. The formation and evolution of wind-capture discs in binary systems. Monthly Notices of the Royal Astronomical Society 433, 295-306.
45. Balick, B., M. Huarte-Espinosa, A. Frank, T. Gomez, J. Alcolea, R. L. M. Corradi, and D. Vinkovic, 2013. Outflows from Evolved Stars: The Rapidly Changing Fingers of CRL 618. The Astrophysical Journal 772, 20.
46. Frank, A., J. Carroll, E. G. Blackman, F. Heitsch, and S. Lebedev. 2013. Molecular clouds, colliding flows and HEDLA experiments: Star formation with the AstroBEAR AMR code. High Energy Density Physics 9, 341-346.
47. Yirak, K., J. M. Foster, P. Hartigan, B. H. Wilde, M. R. Douglas, R. Paguio, B. E. Blue, D. Martinez, D. Farley, P. A. Rosen, and A. Frank. 2013. Mach stem hysteresis: Experiments addressing a novel explanation of clumpy astrophysical jet emission. High Energy Density Physics 9, 251-257.
48. Bocchi, M., B. Ummels, J. P. Chittenden, S. V. Lebedev, A. Frank, and E. G. Blackman. 2013. Numerical Simulations of Z-pinch Experiments to Create Supersonic Differentially Rotating Plasma Flows. The Astrophysical Journal 767, 84.
49. Suzuki-Vidal, F., S. V. Lebedev, M. Krishnan, J. Skidmore, G. F. Swadling, M. Bocchi, A. J. Harvey-Thompson, S. Patankar, G. C. Burdiak, P. de Grouchy, L. Pickworth, S. J. P. Stafford, L. Suttle, M. Bennett, S. N. Bland, J. P. Chittenden, G. N. Hall, E. Khoory, R. A. Smith, A. Ciardi, A. Frank, R. E. Madden, K. Wilson-Elliot, and P. Coleman. 2013. Interaction of radiatively

cooled plasma jets with neutral gases for laboratory astrophysics studies. High Energy Density Physics 9, 141-147.

50. Huarte-Espinosa, M., A. Frank, E. G. Blackman, A. Ciardi, P. Hartigan, S. V. Lebedev, and J. P. Chittenden, 2012. On the Structure and Stability of Magnetic Tower Jets. The Astrophysical Journal 757, 66.
51. Huarte-Espinosa, M., A. Frank, B. Balick, E. G. Blackman, O. De Marco, J. H. Kastner, and R. Sahai, 2012. From bipolar to elliptical: simulating the morphological evolution of planetary nebulae. Monthly Notices of the Royal Astronomical Society 424, 2055-2068.
52. Kastner, J. H., R. Montez Jr., B. Balick, D. J. Frew, B. Miszalski, R. Sahai, E. Blackman, Y.-H. Chu, O. De Marco, A. Frank, M. A. Guerrero, J. A. Lopez, V. Rapson, A. Zijlstra, E. Behar, V. Bujarrabal, R. L.M. Corradi, J. Nordhaus, Q. A. Parker, C. Sandin, D. Schonberner, N. Soker, J. L. Sokoloski, M. Steffen, T. Ueta, and E. Villaver. 2012. The Chandra X-Ray Survey of Planetary Nebulae (CHANPLANS): Probing Binarity, Magnetic Fields, and Wind Collisions. The Astronomical Journal 144, 58.
53. Suzuki-Vidal, F., S. V. Lebedev, M. Krishnan, M. Bocchi, J. Skidmore, G. Swadling, A. J. Harvey-Thompson, G. Burdiak, P. de Grouchy, L. Pickworth, L. Suttle, S. N. Bland, J. P. Chittenden, G. N. Hall, E. Khoory, K. Wilson-Elliot, R. E. Madden, A. Ciardi, and A. Frank. 2012. Laboratory astrophysics experiments studying hydrodynamic and magnetically-driven plasma jets. Journal of Physics Conference Series 370, 12002.
54. Savin, D. W., N. S. Brickhouse, J. J. Cowan, R. P. Drake, S. R. Federman, G. J. Ferland, A. Frank, M. S. Gudipati, W. C. Haxton, E. Herbst, S. Profumo, F. Salama, L. M. Ziurys, and E. G. Zweibel. 2012. The impact of recent advances in laboratory astrophysics on our understanding of the cosmos. Reports on Progress in Physics 75, 036901.
55. Li, S., A. Frank, and E. Blackman. 2012. Consequences of Magnetic Field Structure for Heat Transport in Magnetohydrodynamics. The Astrophysical Journal 748, 24.
56. Yirak, K., E. Schroeder, A. Frank, and A. J. Cunningham. 2012. The Evolution of Heterogeneous ”Clumpy Jets”: A Parameter Study. The Astrophysical Journal 746, 133
57. Balick, B., T. Gomez, D. Vinkovic, J. Alcolea, R. L. M. Corradi, and A. Frank. 2012. The Illumination and Growth of CRL 2688: An Analysis of New and Archival Hubble Space Telescope Observations. The Astrophysical Journal 745, 188.
58. Suzuki-Vidal, F., S. V. Lebedev, S. N. Bland, G. N. Hall, G. Swadling, A. J. Harvey-Thompson, G. Burdiak, P. de Grouchy, J. P. Chittenden, A. Marocchino, M. Bocchi, A. Ciardi, A. Frank, and S. C. Bott. 2011. Experimental Studies of Magnetically Driven Plasma Jets. Astrophysics and Space Science 336, 41-46.
59. Hartigan, P., A. Frank, J. M. Foster, B. H. Wilde, M. Douglas, P. A. Rosen, R. F. Coker, B. E. Blue, and J. F. Hansen. 2011. Fluid Dynamics of Stellar Jets in Real Time: Third Epoch Hubble Space Telescope Images of HH 1, HH 34, and HH 47. The Astrophysical Journal 736, 29.
60. Bally, J., N. J. Cunningham, N. Moeckel, M. G. Burton, N. Smith, A. Frank, and A. Nordlund. 2011. Explosive Outflows Powered by the Decay of Non-hierarchical Multiple Systems of Massive Stars: Orion BN/KL. The Astrophysical Journal 727, 113.
61. Carver, R. L., A. J. Cunningham, A. Frank, P. Hartigan, R. Coker, B. H. Wilde, J. Foster, and P. Rosen, 2010. Laboratory astrophysics and non-ideal equations of state: the next challenges for astrophysical MHD simulations. High Energy Density Physics 6, 381-390.

62. Suzuki-Vidal, F., S. V. Lebedev, S. N. Bland, G. N. Hall, G. Swadling, A. J. Harvey-Thompson, J. P. Chittenden, A. Marocchino, A. Ciardi, A. Frank, E. G. Blackman, and S. C. Bott. 2010. Generation of episodic magnetically driven plasma jets in a radial foil Z-pinch. Physics of Plasmas 17, 112708.
63. Yirak, K., A. Frank, and A. J. Cunningham. 2010. Self-convergence of Radiatively Cooling Clumps in the Interstellar Medium. The Astrophysical Journal 722, 412-424.
64. Carroll, J. J., A. Frank, and E. G. Blackman. 2010. Isotropically Driven Versus Outflow Driven Turbulence: Observational Consequences for Molecular Clouds. The Astrophysical Journal 722, 145-157.
65. Ampleford, D. J., C. A. Jennings, G. N. Hall, S. V. Lebedev, S. N. Bland, S. C. Bott, F. Suzuki-Vidal, J. B. A. Palmer, J. P. Chittenden, M. E. Cuneo, A. Frank, E. G. Blackman, and A. Ciardi. 2010. Bow shocks in ablated plasma streams for nested wire array z-pinches: A laboratory astrophysics testbed for radioactively cooled shocks. Physics of Plasmas 17, 056315.
66. Dennis, T. J., A. Frank, E. G. Blackman, O. De Marco, B. Balick, and S. Mitran. 2009. Magnetic Nested-Wind Scenarios for Bipolar Outflows: Preplanetary and YSO Nebular Shaping. The Astrophysical Journal 707, 1485-1494.
67. Hartigan, P., J. M. Foster, B. H.Wilde, R. F. Coker, P. A. Rosen, J. F. Hansen, B. E. Blue, R. J. R.Williams, R. Carver, and A. Frank. 2009. Laboratory Experiments, Numerical Simulations, and Astronomical Observations of Deflected Supersonic Jets: Application to HH 110. The Astrophysical Journal 705, 1073-1094.
68. Rosen, P. A., J. M. Foster, B. H. Wilde, P. Hartigan, B. E. Blue, J. F. Hansen, C. Sorce, R. J. R. Williams, R. Coker, and A. Frank. 2009. Laboratory experiments to study supersonic astrophysical flows interacting with clumpy environments. Astrophysics and Space Science 322, 101-105.
69. Suzuki-Vidal, F., S. V. Lebedev, A. Ciardi, S. N. Bland, J. P. Chittenden, G. N. Hall, A. Harvey-Thompson, A. Marocchino, C. Ning, C. Stehle, A. Frank, E. G. Blackman, S. C. Bott, and T. Ray. 2009. Formation of episodic magnetically driven radiatively cooled plasma jets in the laboratory. Astrophysics and Space Science 322, 19-23.
70. Cunningham, A. J., A. Frank, P. Varniere, S. Mitran, and T. W. Jones. 2009. Simulating Magnetohydrodynamical Flow with Constrained Transport and Adaptive Mesh Refinement: Algorithms and Tests of the AstroBEAR Code. The Astrophysical Journal Supplement Series 182, 519-542.
71. Bellan, P. M., M. Livio, Y. Kato, S. V. Lebedev, T. P. Ray, A. Ferrari, P. Hartigan, A. Frank, J. M. Foster, and P. Nicolai. 2009. Astrophysical jets: Observations, numerical simulations, and laboratory experiments. Physics of Plasmas 16, 041005.
72. Carroll, J. J., A. Frank, E. G. Blackman, A. J. Cunningham, and A. C. Quillen. 2009. Outflow-Driven Turbulence in Molecular Clouds. The Astrophysical Journal 695, 1376-1381.
73. Yirak, K., A. Frank, A. J. Cunningham, and S. Mitran. 2009. Hypersonic Buckshot: Astrophysical Jets as Heterogeneous Collimated Plasmoids. The Astrophysical Journal 695, 999-1005.
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**Selected Previously Funded Grants**

- NASA, Catagorizing Atmospheric Technosignatures, University of Rochester, PI, $200,000, end date 2023,
- STScI Space Telescope Science Institute, "HST Cycle 22: Triggered Star Formation From Shock to Disk", University of Rochester, Co-I, $81,843, 2015-2017
- STScI Space Telescope Science Institute, "HST Cycle 22: The Reel Deal in 3D: The Spatio-Temporal Evolution of YSO Jets", University of Rochester, PI, $73,569, 2015-2017
- Department of Energy, "Inertial Confinement Fusion Program, $130,000 (annually), 2013-2018
- STScI Space Telescope Science Institute, "HST Cycle 20: Climbing the Ladder of Star Formation Feedback, University of Rochester, PI, $82,088, 2012-2015
- STScI Space Telescope Science Institute, "Hubble Telescope Cycle 20-Climbing the Ladder of Start Formation Feedback", University of Rochester, $82,088, 2012-2015
- STScI Space Telescope Science Institute, "Hubble Telescope – The Reel Deal: Interpreting HST Multi-epoch Movies of YSO Jets, University of Rochester, PI, $95,000, 2010-2014
- National Science Foundation, "From Core to Outflow: Binaries, MDH and the Origin of Planetary/Pre-Planetary Nebulae", University of Rochester, PI, $406,000, 2011-2014
- Rice University, "Clumpy Environments & Interacting Shock Waves: Realistic Laboratory Analogs of Astrophysical Flows", University of Rochester, PI, $134,784, 2011-2014
- National Science Foundation, "From Core to Outflow: Binaries, MHD, and Origin of Nebulae", University of Rochester, PI, $368,684, 2008-2011
- National Science Foundation, "From Core to Outflow: Binaries, MHD and the Origin of Planetary/Pre-Planetary Nebulae", University of Rochester, PI, $16,300, 2009-2011
- National Science Foundation, "From Central Engine to Bipolar Outflow: Binaries, MHD and the Evolution of Planetary Nebulae", University of Rochester, PI, $477,518, 2010-2011
- Spitzer Space Telescope Science Institute, National Aeronautics and Space Administration, "Temporal Systematics of Planetary Nebulae", University of Rochester, PI, $45,000, 2007-2010
- Spitzer Space Telescope Science Institute, "Simulating 3D Disk with Planets", University of Rochester, CO-I, $39,510, 2007-2010
- STScI Space Telescope Science Institute, "Beyond the Textbook Temp System of Planetary Nebula", University of Rochester, PI, $42,380, 2007-2010
- Jet Propulsion Laboratory, National Aeronautics and Space Administration, "JPL Cycle 4 Spitzer YSO Outflows Feedback in Young Clusters", University of Rochester, PI, $89,317, 2007-2010

- Department of Energy, Cooperative Agreement with Cornell University "Study of Pulsed-Power Driven High Energy Density",
  University of Rochester, Co-I, $259,430, 2002-2009
- STScI Space Telescope Science Institute, "Interaction of YSO Outflows in L2551", University of Rochester, PI, $62,772, 2007-2010
- National Science Foundation, "Core to Outflow: Understanding the Driving and Shaping of Asymmetric Planetary Nebulae", University of Rochester, PI, $336,966, 2005-2009
- Department of Energy, Cooperative Agreement with Cornell University, "Pulsed Power Driven High Energy Density Plasmas", University of Rochester, Co-I, $100,000, 2002-2008
- National Science Foundation, "The Magnetohydrodynamics of Planetary Nebulae: New Paradigm, New Tools", University of Rochester, PI,
  $406,000, 2005 –2008
- NASA, "Detection of Outer Extra Solar Plants", University of Rochester, Co-I, $265,000, 2004-2008
- Jet Propulsion Laboratory, National Aeronautics and Space Administration, "Jets, Outflows and Feedback in Young Clusters, University of
  Rochester, PI, $70,000, 2005-2008
- National Science Foundation, "From Central Engine to Bipolar Outflow: Binaries, MHD and the Evolution of Planetary Nebulae", University of Rochester, PI, $393,684, 2007-2008
- National Science Foundation, "Holding Footprints to the Fire, Protoplanetary Disk Structure in r, □ and z", University of Rochester, co-PI (with
  Alice Quillen), $480,000, 2004 – 2007
- STScI Space Telescope Science Institute, "The Astrophysics of Heterogeneous (Clumpy) Stellar Outflow", University of Rochester, PI, $47,992,
  2004-2006
- National Science Foundation, "Magnetic Shaping of Planetary Nebulae", University of Rochester, PI, $299,482, 2001-2005
- STScI Space Telescope Science Institute, "Outflow Collimation in bip9olar Symbiotic Nebulae", University of Rochester, PI, $25,127, 2001-2004
- NYSTAR, "Astronomy Visualization in Planetarium Domes", University of Rochester, PI, $10,000, 2003-2004
- NASA, "The Physics of Radiative MHD Jets", University of Rochester, PI, $284,000, 1999-2004
- NYSTAR, "Astronomy Visualization with E-textbooks", University of Rochester, PI, $10,000, 2002-2003
- Spitzer Space Telescope Institute, National Aeronautics and Space Administration, "Turbulence and YSO Jets", University of Rochester, PI, $75,000, 2001-2002
- National Aeronautics and Space Administration, "Bipolar Outflows", University of Rochester, Co-I, $25,000, 2001-2002
- National Science Foundation Faculty Early Career Development Award, "Career Understanding Stellar Outflows", University of Rochester, PI,
  $366,983, 1997-2003
- National Aeronautics and Space Administration, "The Propagation of Magnetized Jets", University of Rochester, PI, 1999-2002, $ 285,000

- NASA, Space Telescope Science Institute, Hubble Fellowship, “Outflows and Star Formation”, University of Minnesota,
  1995-1998, $ 150,000, National Science Foundation, Astronomy: Stars and Stellar Systems,
- NASA, Hubble Space Telescope Cycles 5,6, and 7, "A Multi-Faceted Study of Eta Car", University of Minnesota, Co-I
- National Science Foundation Program for Research at Foreign Centers of Excellence “Inertial Confinement and Collimation of Astrophysical
  Jets”, Leiden University, 1993, $ 38,000
- University of Washington Graduate School Research Fund, "Planetary Nebulae Haloes: Fossil Winds", Graduate PI, 1989-90, $60,000