

Douglas P. Finkbeiner

Professor, Harvard University

ADDRESS Harvard-Smithsonian Center for Astrophysics September, 2022
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PERSONAL Born 31 March, 1971, US citizen, married

EDUCATION Ph.D., Physics, University of California at Berkeley, 1999 (Uhl Thesis Award)
M.A., Physics, University of California at Berkeley, 1996
B.S., Physics and German, University of Michigan, 1994 (with highest honors)

EMPLOYMENT

Harvard University (joint appointment in Astronomy and Physics Departments)
Full Professor July, 2013 – present
Associate Professor July, 2010 – June, 2013
Assistant Professor July, 2006 – June, 2010

Princeton University, Dept. Astrophysical Sciences; July, 2001 – June, 2006
Hubble Fellow (through June, 2003), Russell-Cotsen Fellow (starting July, 2003)

University of California, Berkeley; May, 1999 – June, 2001
Postdoc (NASA ADP); Hubble Fellow, July, 2000 - June, 2001

RESEARCH INTERESTS

- Galactic structure in 2D and 3D; interstellar dust and ionized gas as CMB foregrounds
- Applied ML in astronomy: neural networks, wavelet scattering transform
- Inference problems involving large surveys; transdimensional inference
- Observable consequences of dark matter annihilation in γ -rays, cosmic rays, and microwaves
- High-energy astrophysics, AGN feedback, e.g. the “Fermi bubbles”

OBSERVING EXPERIENCE

- PI of DECam Plane Survey (5-band photometry of 3.34 billion stars)
- Extensive experience with satellite data from *Fermi*, WISE, WMAP, COBE and IRAS
- Optical photometry and spectroscopy (DECam, Keck/DEIMOS, SDSS, PS1)
- Radio continuum observations (Green Bank, VLA)
- Member of DESI, DECam Legacy Survey, Pan-STARRS1, DEEP2, and SDSS-V

AWARDS and FELLOWSHIPS

- 2020 Legacy Fellow, American Astronomical Society
- 2016 Fellow, American Physical Society
- 2014 Bruno Rossi Prize for High Energy Astrophysics (American Astronomical Society),
shared with former students Meng Su and Tracy R. Slatyer
- 2003-06 Cotsen Fellowship, Princeton Society of Fellows
- 2003-06 Henry Norris Russell Fellowship
- 2000-03 NASA Hubble Postdoctoral Fellowship
- 1999 Uhl Award – UC Berkeley – for Ph.D. Thesis Research
- 1994-97 NSF Graduate Fellowship

PROFESSIONAL ACTIVITIES

- Inaugural Director of Harvard Scientific Image Analysis Group (SIAG)
- NSF AI Institute for Artificial Intelligence and Fundamental Interactions (IAIFI), member
- Co-author of Maximizing Science in the Era of LSST report, 2016
- Co-organizer of Radcliffe workshop on Dark Matter, Harvard, 2016
- Co-organizer of Sackler Symposium on Dark Matter, Harvard, 2014
- Astro2010 Decadal Survey: Program Prioritization Panel on Particle Astrophysics and Gravitation
- Review panels for NASA and the National Science Foundation (many)
- Co-organizer of “Direct, Indirect and Collider Signals of Dark Matter,” Kavli Institute of Theoretical Physics (KITP) Santa Barbara, 2009 (with Arkani-Hamed & Weiner)
- Co-organizer of “Searching for Dark Matter: A Unified Approach,” Radcliffe, 2009 (with Stubbs, Gaitskell, & Fisher)

RESEARCH GRANTS

- 3/2021 - 2/2024 “Knitting Together the Milky Way: An Integrated Model of the Galaxy’s Stars, Gas, and Dust”
NASA/ADAP (Co-I w A. Goodman): \$461,785
- 9/2016 - 8/2021 “Exploring the Galaxy: 3-Dimensional Structure and Stellar Streams”
NSF/AST (PI): \$434,500
- 9/2013 - 8/2017 “Mapping Dust in 3-D with Pan-STARRS”
NSF/AST (PI): \$316,900
- 1/2012 - 1/2016 “A higher resolution Galactic Dust Map: Mapping Galactic Dust with WISE”
NASA/ADAP (PI): \$289,000
- 8/2011 - 7/2012 “Fermi Bubbles: Improved Spectral and Morphological Measurements”
Fermi Cycle 4 GI (PI): \$88,000
- 1/2010 - 12/2013 “A New Galactic Dust Map”
NASA/ADAP (PI): \$288,000
- 1/2010 - 12/2014 “Astrophysical Consequences of a New Force in the Dark Sector”
NASA/Theory (PI): \$288,000
- 7/2003 - 2/2009 “Exploring the ISM with MAP: The Microwave Emission from Spinning Dust”
NASA/LTSA 02-0058-0036 (PI): \$480,000

ADVISEES

- **Graduate students:**
 - Tracy R. Slatyer (2010) Professor, MIT
 - Sui Ann Mao (2011) Group Leader, Max Planck Institute for Radio Astronomy, Bonn
 - Edward F. Schlafly (2012) Asst. Astronomer, Space Telescope Science Institute, Baltimore
 - Tongyan Lin (2012) Assoc. Professor, UC San Diego
 - Meng Su (2012) Assoc. Professor, Hong Kong University
 - Aaron Meisner (2015) Staff Astronomer, NSF NOIRLab, Tucson
 - Gregory Green (2016) Research Group Leader, Max Planck Institute of Astronomy, Heidelberg
 - Stephen K. N. Portillo (2018) Asst. Professor, Concordia University of Edmonton
 - Tansu Daylan (2018) Asst. Professor, Washington U., St. Louis
 - Albert Lee (2018) Research Scientist, Institute for Disease Modeling, Seattle
 - Catherine S. Zucker (2020) Hubble Fellow, STScI, Baltimore
 - Joshua S. Speagle (2020) Asst. Professor, University of Toronto
 - Ioana Zelko (2021) CITA postdoc, University of Toronto
 - Jun Yin (2021) Jump Trading, Chicago
 - Justina Yang
 - Nayantara Mudur
 - Andrew Saydjari

- **Postdocs:**

- Gregory Dobler (Data scientist, Asst. Professor, U. Delaware)
- Mario Jurić (Professor, U. Washington)
- Molly Swanson (Resident Astrophysicist, Acera School)
- Blakesley Burkhart (Asst. Professor, Rutgers / Flatiron CCA)

- **Undergraduates:** Kim DeRose (EPO Coordinator, UCLA), Sarah Satinover (Stanford Business School), Dan D’Orazio (Einstein Fellow, Harvard), Lauren Weiss (Asst. Prof. Notre Dame), David Rosengarten (Princeton), William Hawley, Duncan Watts, Caroline Huang (postdoc, Harvard), Ben Lee (U. Washington Computer Science), Richard Feder (Caltech)

TEACHING

- 2022 Spring - GenEd 1024: Pride, Prejudice, and p-values: Scientific Critical Thinking
- 2021 Spring - GenEd 1024: Pride, Prejudice, and p-values: Scientific Critical Thinking
- 2020 Fall - Freshman Seminar 51Z: The Path to a Low-Carbon Future
- 2020 Spring - Ast. 100, Methods of Observational Astronomy
- 2019 *sabbatical*, *MPIA Heidelberg*
- 2018 Spring - Ast. 130, Cosmology
- 2017 Spring - Ast. 100, Methods of Observational Astronomy
- 2016 Spring - Ast. 130, Cosmology
- 2015 *sabbatical*
- 2014 Spring - Ast. 130, Cosmology
- 2013 Fall - Ast. 98, Junior tutorial
- 2013 Spring - Ast. 98, Junior tutorial
- 2012 Spring - Ast. 130, Cosmology
- 2011 Spring - Ast. 16, Introduction to Stellar and Planetary Astronomy
- 2010 Spring - Ast. 130, Cosmology
- 2009 Spring - Ast. 201b, Interstellar Medium (graduate)
- 2008 Spring - Ast. 192, Principles of Astronomical Measurement
- 2007 Spring - Ast. 16, Introduction to Stellar and Planetary Astronomy
- 2004 Fall - Ast. 302, Stellar Structure and Evolution (Princeton, assisting Goodman)
- 2003 Fall - Ast. 205, The Search for Planets (Princeton, assisting Turner, Spergel, & Knapp)
- 2000 Fall - Astronomical Data Analysis (UC Berkeley, jointly with Heiles)
- Led undergrad trips to Chile, Arizona, and Wyoming (2017 Solar Eclipse), Austria, England.

EDUCATION / OUTREACH

- Prominently featured in Unit 10 (dark matter) of *Physics for the 21st Century*, an 11-unit video course in modern physics for high school and college students. Produced in 2010 by Annenberg Learner, part of the Annenberg Foundation. ([here](#))

POPULAR PRESS

- January 10, 2020: A giant wave of gas lurks near our solar system, [BBC](#), [CNN](#), [Newsweek](#), etc.
- April 3, 2014: Does dark matter make the excess gamma rays in the inner Milky Way?
Press release and March 10, 2014 [Astronomy Picture of the Day](#)
- January 18, 2013: Hunting for dark matter with Fermi: BBC News
- January 10, 2013: What keeps me awake at night? LA Times
- September 4, 2012: My thoughts on the microwave haze, posted at Cosmic Variance
- The “Fermi bubbles” press release (via NASA, 11/2010) was picked up by over 150 major newspapers around the world. It was featured on TV from CNN to CCTV (China). The 90 second [video](#) prepared by the press team at Goddard was viewed nearly 150,000 times at nasa.gov in the first week.
- *Is Fermi Seeing Dark Matter?* Sky & Telescope, 10/28/2009
- *Findings on Mysterious Haze at Galaxy’s Center*, The New York Times, 10/30/2009
- *Emission Impossible?: Is Dark Matter Behind the Hazy Radiation at the Milky Way’s Center?* Scientific American, 11/3/2009

ACADEMIC PUBLICATIONS

- 146 refereed papers, 56,500 citations, h index = 83 (ADS)
- A full list of publications is available on [ADS](#) and [Google Scholar](#).

SELECTED PAPERS

1. *The Dark Energy Camera Plane Survey 2 (DECaPS2): More Sky, Less Bias, Better Uncertainties*
A. K. Saydjari, **D. P. Finkbeiner**, & 11 co-authors ApJ, submitted, arXiv:2206.11909
This is the final data release of our DECam Galactic Plane Survey. We made 34 billion measurements of 3.34 billion stars in 5 colors (g,r,i,z,Y bands) over 6.5% of the sky, the largest such survey in history by object count. This will form the basis for a future 3-D dust map in the Galactic plane.
2. *Photometry on Structured Backgrounds: Local Pixel-wise Infilling by Regression*
A. K. Saydjari & **D. P. Finkbeiner** 2022, ApJ, 933, 155, arXiv:2201.07246
We introduce new methodology for computing a local covariance matrix of photometric residual around each star in an image, and marginalizing over the uncertain background “behind” a given star. This allows us to perform precise, unbiased photometry in complex images (e.g., structured backgrounds, extreme crowding), which is needed for the DECaPS2 survey.
3. *A Galactic-scale gas wave in the solar neighbourhood*
J. Alves, C. Zucker, A. Goodman, J. Speagle, ... & **D. P. Finkbeiner** 2020, Nature, 578, 7794, 237, arXiv:2001.08748
We describe the discovery of the *Radcliffe Wave*, the largest (nearly 9000 light-years long) nearby coherent gas structure in the Milky Way. This discovery was made possible by the 3-D dust mapping efforts of my group and our collaborators. The structure was so named because it was discovered during Prof. Alves’s sabbatical at Radcliffe.
4. *Giant Gamma-ray Bubbles from Fermi-LAT: AGN Activity or Bipolar Galactic Wind?*
Meng Su, T. R. Slatyer, & **D. P. Finkbeiner** 2010, ApJ, 724, 1044, arXiv:1005.5480
We describe the discovery of a bilobular structure extending ± 8 kpc above the Galactic center in the *Fermi* gamma-ray data at 1-100 GeV. These “bubbles” have a hard spectrum and sharp edges, and they are likely the relic of past AGN activity. This work was awarded the Bruno Rossi Prize.
5. *A Theory of Dark Matter*,
N. Arkani-Hamed, **D. P. Finkbeiner**, T. R. Slatyer, & Neal Weiner 2009, Phys. Rev. D , 79, 015014, arXiv:0810.0713
We propose that a new force in the dark sector causes WIMPs to have a high annihilation cross section (via “Sommerfeld enhancement”) to light leptons, providing a source for recent cosmic-ray and gamma-ray signals. This is the second-most cited paper of 2008 in theoretical physics (SPIRES) and spawned dozens of papers on Sommerfeld-enhanced dark matter in 2009.
6. *Microwave ISM Emission in the Green Bank Galactic Plane Survey: Evidence for Spinning Dust*,
D. P. Finkbeiner, G. I. Langston, & A. H. Minter 2004, ApJ, 617, 350, and astro-ph/0408292
Presents strong evidence for microwave dipole emission from spinning dust grains, ruling out the “dust-correlated synchrotron” hypothesis of the WMAP team. This was a key step in establishing a new continuum emission mechanism in the ISM.
7. *Microwave ISM Emission Observed by WMAP*,
D. P. Finkbeiner 2004, ApJ, 614, 186, and astro-ph/0311547
“WMAP haze” discovery paper, leading to later papers proposing synchrotron emission from dark matter annihilation products in the inner Galaxy as the source. This emission is now associated (mostly) with the Fermi bubbles.
8. *Maps of Dust IR Emission for Use in Estimation of Reddening and CMBR Foregrounds*,
D. J. Schlegel, **D. P. Finkbeiner**, & Marc Davis 1998, ApJ, 500, 525
The “SFD” dust map is the most widely used map of Galactic extinction and the most cited refereed article in astronomy (ADS).