Daniel Alejandro Gilman

CONTACT INFORMATION

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RESEARCH

Dark matter phenomenology, strong gravitational lensing

POSITIONS HELD

Brinson Prize Fellow (Aug. 2023 - present)
University of Chicago

Schmidt AI in Science Fellow (Jan. 2023 - Aug. 2023)
University of Toronto

Postdoctoral Researcher (2020-2023)
University of Toronto
Supervisor: Jo Bovy

Graduate Student Researcher (2016-2020)
University of California, Los Angeles
Supervisor: Tommaso Treu

NASA Undergraduate Research Program (2013, 2014)
NASA Jet Propulsion Laboratory
Supervisors: Leonidas Moustakas, Francis-Yan Cyr-Racine

EDUCATION

Ph.D. Physics (2020)
University of California, Los Angeles
Advisor: Tommaso Treu
Dissertation: *Investigating the Nature of Dark Matter with Strong Gravitational Lensing*

M.S. Physics (2015)
University of California, Los Angeles

B.S. Physics (2014), *cum laude*
James Madison University

AWARDS AND HONORS

Co-investigator JWST GO-2046, *A definitive test of the dark matter paradigm* (PI Anna Nierenberg)

CGS/ProQuest Distinguished Dissertation Award in Physical Sciences, UCLA's single nominee, honorable mention nationwide in USA (2021)

Allocation on the Niagara computing cluster (University of Toronto); 630 core years (2021)

Outstanding Undergraduate Research Award, James Madison University, (2014)

Phi Beta Kappa, James Madison University (2014)

PUBLICATION STATISTICS

10 first author; 8 second author, significant contribution, or student-led project
h-index 23 (ADS)

LEAD AUTHOR

Daniel Gilman, Simon Birrer, Anna Nierenberg, Maverick H. S. Oh, Turbocharging constraints on dark matter substructure through a synthesis of strong lensing flux ratios and extended lensed arcs, MNRAS, submitted (2024)

Daniel Gilman, Yi-Ming Zhong, Jo Bovy, Constraining resonant dark matter self-interactions with strong gravitational lenses, Phys Rev. D 107, 103008 (2023)

Daniel Gilman, Andrew Benson, Jo Bovy, Simon Birrer, Tommaso Treu, Anna Nierenberg, The primordial matter power spectrum on sub-galactic scales, MNRAS 512, 3163-3188 (2022)

Daniel Gilman, Jo Bovy, Tommaso Treu, Anna Nierenberg, Simon Birrer, Andrew Benson, Omid Sameie, Strong lensing signatures of self-interacting dark matter in low-mass halos, MNRAS 507, 2432-2447 (2021)

Daniel Gilman, Simon Birrer, Tommaso Treu, TDCOSMO III: Dark matter substructure meets dark energy - the effects of (sub)halos on strong-lensing measurements of H_0, Astronomy & Astrophysics 642, A194 (2020)

Daniel Gilman, Xiaolong Du, Andrew Benson, Simon Birrer, Anna Nierenberg, Tommaso Treu, Constraints on the mass-concentration relation of cold dark matter halos with 11 strong gravitational lenses, MNRAS 492, L12-L16 (2020)

Daniel Gilman, Simon Birrer, Anna Nierenberg, Tommaso Treu, Xiaolong Du, Andrew Benson, Warm dark matter chills out: constraints on the halo mass function and the free-streaming length of dark matter with 8 quadruple-image strong gravitational lenses, MNRAS 491, 6077-6101 (2020)

Daniel Gilman, Simon Birrer, Tommaso Treu, Anna Nierenberg, and Andrew Benson, Probing dark matter structure down to 10^7 solar masses: flux ratio statistics in gravitational lenses with line of sight halos, MNRAS 487, 5721-5738 (2019)

Daniel Gilman, Simon Birrer, Tommaso Treu, Charles R. Keeton, Anna Nierenberg, Probing the nature of dark matter by forward modelling flux ratios in strong gravitational lenses, MNRAS 481, 819-834 (2018)

Daniel Gilman, Adriano Agnello, Tommaso Treu, Charles R. Keeton, Anna Nierenberg, Strong lensing signatures of luminous structure and substructure in early-type galaxies, MNRAS 467, 3970-3992 (2017)

SECOND AUTHOR / MAJOR CONTRIBUTION
† INDICATES STUDENT-LED PROJECT

†Vinh Tran, **Daniel Gilman**, Mark Vogelsberger, Xuejian Shen, Stephanie O'Neil, Xinyue Zhang Gravothermal catastrophe in resonant self-interaction models, Physical Review D, submitted (2024)

Ryan Keeley, Anna Nierenberg, **Daniel Gilman**, et al. JWST Lensed quasar dark matter survey II: Strongest gravitational lensing limit on the dark matter free streaming length to date, MNRAS (2024)

†Veronica Dike, **Daniel Gilman**, Tommaso Treu, Strong lensing constraints on primordial black holes as a dark matter candidate, MNRAS in press (2023)

†Alex Laroche, **Daniel Gilman**, Xinyu Li, Jo Bovy, Xiaolong Du, Quantum fluctuations masquerade as halos: Bounds on ultra-light dark matter from quadruply-imaged quasars, MNRAS 517, 1867-1883 (2022)

Ethan Nadler. Simon Birrer, **Daniel Gilman**, Risa Wechsler, Xiaolong Du, Andrew Benson, Anna Nierenberg, Tommaso Treu, Dark Matter Constraints from a Unified Analysis of Strong Gravitational Lenses and Milky Way Satellite Galaxies, ApJ 917, 7 (2021)

Anna Nierenberg, **Daniel Gilman**, Tommaso Treu, Gabriel Brammer, Simon Birrer, Leonidas Moustakas, Adriano Agnello, Timo Anguita, Chris Fassnacht, Veronica Motta, Annika Peter, Dominique Sluse, Double dark matter vision: twice the number of compact-source lenses with narrow-line lensing and the WFC3 Grism, MNRAS 492, 5314-5335 (2020)

ADDITIONAL PUBLICATIONS

Maverick S. H. Oh, Anna Nierenberg, **Daniel Gilman**, Simon Birrer, Improving flux ratio anomaly precision by measuring lens multipole moments with extended arcs, JCAP submitted (2024)

Jose M. Diego, Sung Kei Li, ..., **Daniel Gilman**, et al. Imaging dark matter at the smallest scales

with lensed stars, Astronomy and Astrophysics submitted (2024)

Xiaolong Du, Andrew Benson, ..., **Daniel Gilman**, et al. Tidal evolution of cored and cuspy dark matter halos, Physical Review D submitted (2024)

Anna Nierenberg, Ryan Keeley, Dominique Sluse, **Daniel Gilman**, et al. JWST lensed quasar dark matter survey I: Description and first results, MNRAS in press (2024)

Patrick Kelly, Steven Rodney, ..., **Daniel Gilman**, et al.,Constraints on the Hubble constant from Supernova Refsdal's reappearance, Science Magazine (2023)

Patrick Kelly, Steven Rodney, ..., **Daniel Gilman**, et al., The Magninficent Five Images of Supernova Refsdal: Time Delay and Magnification Measurements, ApJ 948 93 (2023)

Ryan Keeley, Anna Nierenberg, **Daniel Gilman**, et al., Pushing the Limits of Detectability: Mixed Dark Matter from Strong Gravitational Lenses, MNRAS submitted (2023)

Alex Drlica-Wagner, Chanda Prescod-Weinstein, ..., **Daniel Gilman**, et al., Report of the Topical Group on Cosmic Probes of Dark Matter for Snowmass 2021, white paper (2022)

Birendra Dhanasingham, Francis-Yan Cyr-Racine, Annika H.G. Peter, Andrew Benson, **Daniel Gilman**, Interlopers speak out: Studying the dark universe using small-scale lensing anisotropies, arxiv:2203.13775, MNRAS in press (2022)

Ioana A. Zelko, Tommaso Treu, Kevork N. Abazajian, **Daniel Gilman**, et al., Constraints on sterile neutrino models from strong gravitational lensing, Milky Way satellites, and Lyman-α forest, PRL 129 191301 (2022)

Keith Betchtol, Simon Birrer, ..., **Daniel Gilman**, et al., Snowmass2021 Cosmic Frontier White Paper: Dark Matter Physics from Halo Measurements, white paper (2021)

Simon Birrer, Anowar Shajib, **Daniel Gilman**, et al., lenstronomy II: A gravitational lensing software ecosystem, JOSS, vol. 6, issue 62, id. 3283 (2021)

Xuheng Ding, ..., **Daniel Gilman**, et al., Time Delay Lens modelling Challenge: II. Results, MNRAS 503, 1096-1123 (2021)

Martin Millon, ..., **Daniel Gilman**, et al.
TDCOSMO II: 6 new time delays in lensed quasars from high-cadence monitoring at the MPIA 2.2m telescope, Astronomy & Astrophysics 642 A193 (2021)

Anowar Shajib, ..., **Daniel Gilman**, et al., STRIDES: A 3.9 per cent measurement of the Hubble constant from the strongly lensed system DES J0408−5354, MNRAS 494, 6072-6102 (2020)

Josh Simon, ..., **Daniel Gilman**, et al., Testing the Nature of Dark Matter with Extremely Large Telescopes, Bulletin of the American Astronomical Society 51, 152 (2019)

Vivian Bonvin, ... , **Daniel Gilman**, et al.
COSMOGRAIL. XVIII. time delays of the quadruply lensed quasar WFI2033-4723, Astronomy and Astrophysics 629, A97 (2019)

Vivian Bonvin, ... , **Daniel Gilman**, et al.
COSMOGRAIL. XVII. Time delays for the quadruply imaged quasar PG 1115+080, Astronomy and Astrophysics 616, A183 (2018)

Frederic Courbin, ... , **Daniel Gilman**, et al.
COSMOGRAIL: the COSmological MOnitoring of GRAvItational Lenses. XVI. Time delays for the quadruply imaged quasar DES J0408-5354 with high-cadence photometric monitoring, Astronomy

and Astrophysics 609, A71 (2018)

Xuheng, Ding, ... , **Daniel Gilman**, et al., Time Delay Lens Modeling Challenge: I. Experimental Design, preprint (2018)

Francis-Yan Cyr-Racine, Leonidas Moustakas, Charles R. Keeton, Kris Sigurdson, **Daniel Gilman** Dark census: Statistically detecting the satellite populations of distant galaxies, Phys. Rev. D. 94, 043505 (2016)

Invited Conference Presentations and Colloquia

PACIFIC 2024, UC Richard Gump Research Station, French Polynesia; August 2024

Syncretism 2024, Particle physicists dining with astrophysicists, Rethymno, Greece; June 2024

Astronomy Colloquium, Dominion Astrophysical Observatory at the Herzberg Astronomy and Astrophysics Research Centre; April 2024

Astrophysics Seminar, UC Merced; November 2023

Astrophysics Seminar, UC Riverside; November 2023

TeVPA 2023, Naples, Italy; September 2023 (plenary)

Self-interacting dark matter: models, simulations, and signals, Pollica, Italy; June 2023

Astrophysics Colloquium, FORTH & University of Crete, Heraklion, Greece; March 2023

Astronomy Seminar, Kavli IPMU, Tokyo, Japan; October 2022

Vulcano Astrophysics and Particle Physics Workshop, Elba Island, Italy; September 2022

Astrophysics seminar at Universite Libre de Bruxelles, Brussels, Belgium; September 2022

Syncretism 2022, Particle physicists dining with astrophysicists, Chania, Greece; June 2022

Astrophysics Colloquium, University of New Mexico, February 2022

Kavli Institute for Cosmological Physics Seminar, University of Chicago; January 2022

Astronomy and Astrophysics Colloquium, University of Toronto; January 2021

Identification of Dark Matter, Providence, USA; July 2018

Service and Public Engagement

The (Strong) Gravitational Lensing of Our Dark Universe; public lecture at the Santa Barbara Museum of Natural History (2023) (video)

Revealing the nature of dark matter with strong gravitational lensing; public Star Talk hosted by the Astronomy and Space Exploration Society at the University of Toronto (2021) (video)

Warm dark matter chills out; Dark matter halos smaller than previously known; press briefing at AAS 235 (2020) (video)

Referee for Monthly Notices of the Royal Astronomical Society, Astronomy & Astrophysics

Student Mentoring

Vinh Tran (MIT) undergraduate research, co-supervised with Prof. Mark Vogelsberger - Gravothermal Catastrophe in resonant self-interacting dark matter models

Birendra Dhanasignham (University of New Mexico) PhD research, co-supervised with Prof. Francis-Yan Cyr-Racine - machine learning applied to strongly-lensed galaxies

Charles Gannon (UC Merced) PhD research, co-supervised with Prof. Anna Nierenberg - use of semi-analytic models for substructure lensing predictions

Maverick Oh (UC Merced) PhD research, co-supervised with Prof. Anna Nierenberg - flux ratios in strong lens systems with multipole mass moments

Shibo Yu (University of Toronto) AST425 research project - tidal stripping of CDM subhalos

Erik Gillis (University of Toronto) SURP program, co-supervised with Profs. Jeremy Webb and Jo Bovy - N-body simulations of CDM structure in early-type galaxies

Hao Yang Yu (University of Toronto) AST425 research project - detecting core-collapsed halos in galaxy-galaxy strong lenses

Veronica Dike (UCLA) PhD thesis, co-supervised with Prof. Tommaso Treu - strong lensing constraints on primordial black holes

Alex Laroche (McGill, now PhD student at UofT) SURP program, co-supervised with Prof. Jo Bovy - strong lensing constraints on ultra-light dark matter

Alejandro Mendoza - Lamat Undergraduate Research Program, co-supervised with Prof. Anna Nierenberg (UC Merced)

Teaching and physics pedagogy training

Teaching Assistant; University of California, Los Angeles
- Physics 1A (Physics for Scientists and Engineers: Mechanics)
- Physics 6A (Physics for Life Science Majors)
- Astronomy 6 (Changing concepts of the Universe)
- Physics 12 (Physics of Renewable Energy)

Teaching Assistant; James Madison University
- Physics 140 (College Physics I)
- Physics 150 (College Physics II)

Pedagogy of Physics; completed training at James Madison University (2012)

Open-source Software

`pyHalo` (lead developer) : A python package for generating realizations of dark matter halos in cold, warm, self-interacting, and fuzzy dark matter for strong gravitational lensing simulations
`lenstronomy` (co-administrator) : A python package for gravitational lensing simulations
`quadmodel` (lead developer): A wrapper around lenstronomy and pyHalo for analyses of qudruply-imaged quasars

Languages

Fluent in English (native language) and Spanish
Python (advanced)
MATLAB (basic)
C++ (basic)

Professional References

1) Tommaso Treu: tt@astro.ucla.edu
2) Jo Bovy: bovy@astro.utoronto.ca
3) Andrew Benson: abenson@carnegiescience.edu