Ryan Keeley

Academic Positions

Current Position

2025–Present **UC Irvine**, *Lecturer*.

Former Positions

2021–2025 **UC Merced**, *Postdoctoral Researcher*, Anna Nierenberg, Supervisor.

2018–2021 **Korea Astronomy Space Science Institute**, *Postdoctoral Researcher*, Arman Shafieloo, Supervisor.

2014–2018 **University of California, Irvine**, *Graduate Research Assistant*, Prof. Kevork N. Abazajian, PI.

Education

2008–2012 **B.S. Physics**, *California Institute of Technology*, Pasadena, CA.
Summer Undergraduate Research Fellow, Advisor: Marc Kamionkowski and Fabian Schmidt

2008–2012 **B.S. History**, *California Institute of Technology*, Pasadena, CA.

2012–2016 **Masters Physics**, *University of California, Irvine*, Irvine, CA.

2012–2018 **PhD Physics**, *University of California, Irvine*, Irvine, CA, Advisor: Professor Kevork Abazajian.
Thesis Title: Cosmology and Astroparticle Physics: What is Dark Matter and What is Dark Energy?; Funding: Fermi GI grant: Empirical Multiwavelength Analyses of the Milky Way's Galactic Center

Research Interests

Dark matter, *What is it? How does it interact?*.

Dark energy, *Understanding the late-time acceleration of the Universe*.

Inflation, *What is the physics of the early Universe*.

Small Scale Structure, *Does novel dark matter physics explain small scale anomalies*.

Large Scale Structure, *How do dark matter haloes grow in the presence of beyond-ΛCDM physics*.

Cosmological and Astroparticle phenomenology, *Working at the interface between theory and observations*.

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Statistics/Machine Learning, *Developing and implementing model-independent/data-driven methods*.

International Collaborations

Vera C. Rubin Observatory, *(LSST)*, Junior Member, `https://www.lsst.org`.

LSST Dark Energy Science Collaboration, *(LSST-DESC)*, Junior Member, `https://www.lsstdesc.org`.

Dark Energy Spectroscopic Instrument, *(DESI)*, Junior Member (former), `https://www.desi.lbl.gov/`.

Sloan Digital Sky Survey, *(SDSS)*, Junior Member (former), `https://www.sdss.org`.

Publications

NASA/ADS **`https://ui.adsabs.harvard.edu/search/q=author%3A%22Keeley%2C%20Ryan%22&sort=date%20desc%2C%20bibcode%20desc&p_=0`**.

Publications

[1] Ryan E. Keeley, Arman Shafieloo, and William L. Matthewson. Could We Be Fooled about Phantom Crossing? *arXiv*, 2506.15091, 6 2025.

[2] Ryan E. Keeley, Kevork N. Abazajian, Manoj Kaplinghat, and Arman Shafieloo. Preference for evolving dark energy from cosmological distance measurements and possible signatures in the growth rate of perturbations. *Phys. Rev. D*, 112(4):043501, 2025.

[3] Charles Gannon, Anna Nierenberg, Andrew Benson, Ryan Keeley, Xiaolong Du, and Daniel Gilman. Dark matter substructure: A lensing perspective. *Physical Review D*, 112(2):023532, July 2025.

[4] Elahe Khalouei, Arman Shafieloo, Alex G. Kim, Ryan E. Keeley, William Sheu, Gregory S. H. Paek, Myungshin Im, Xiaosheng Huang, and Hyung Mok Lee. Detection of unresolved strongly lensed supernovae with the 7-Dimensional Telescope. *Astron. Astrophys.*, 698:A266, 2025.

[5] Xiaolei Li, Ryan E. Keeley, and Arman Shafieloo. Redshift Evolution of the X-Ray and Ultraviolet Luminosity Relation of Quasars: Calibrated Results from SNe Ia. *Astrophys. J.*, 983(2):141, 2025.

[6] Benjamin L'Huillier, Ayan Mitra, Arman Shafieloo, Ryan E. Keeley, and

* Lead Author (Alphabetical ordering)
** Mentored Student/Colleague

Hanwool Koo. Litmus tests of the flat ΛCDM model and model-independent measurement of H $_0$ r $_d$ with LSST and DESI. *JCAP*, 05:030, 2025.

[7] Ryan E. Keeley, A. M. Nierenberg, D. Gilman, C. Gannon, S. Birrer, T. Treu, A. J. Benson, X. Du, K. N. Abazajian, T. Anguita, V. N. Bennert, S. G. Djorgovski, K. K. Gupta, S. F. Hoenig, A. Kusenko, C. Lemon, M. Malkan, V. Motta, L. A. Moustakas, Maverick S. H. Oh, D. Sluse, D. Stern, and R. H. Wechsler. JWST lensed quasar dark matter survey - II. Strongest gravitational lensing limit on the dark matter free streaming length to date. *Monthly Notices of the Royal Astronomical Society*, 535(2):1652–1671, December 2024.

[8] A. M. Nierenberg, R. E. Keeley, D. Sluse, D. Gilman, S. Birrer, T. Treu, K. N. Abazajian, T. Anguita, A. J. Benson, V. N. Bennert, S. G. Djorgovski, X. Du, C. D. Fassnacht, S. F. Hoenig, A. Kusenko, C. Lemon, M. Malkan, V. Motta, L. A. Moustakas, D. Stern, and R. H. Wechsler. JWST lensed quasar dark matter survey - I. Description and first results. *Monthly Notices of the Royal Astronomical Society*, 530(3):2960–2971, May 2024.

[9] Xiaolei Li, Ryan E. Keeley, Arman Shafieloo, and Kai Liao. A Model-independent Method to Determine H $_0$ Using Time-delay Lensing, Quasars, and Type Ia Supernovae. *Astrophys. J.*, 960(2):103, 2024.

[10] Ryan E. Keeley, Anna M. Nierenberg, Daniel Gilman, Simon Birrer, Andrew Benson, and Tommaso Treu. Pushing the limits of detectability: mixed dark matter from strong gravitational lenses. *Mon. Not. Roy. Astron. Soc.*, 524(4):6159–6166, 2023.

[11] Ryan E. Keeley, Arman Shafieloo, and Benjamin L'Huillier. An Analysis of Variance of the Pantheon+ Dataset: Systematics in the Covariance Matrix? *Universe*, 10(12):439, 2024.

[12] Helena García Escudero, Jui-Lin Kuo, Ryan E. Keeley, and Kevork N. Abazajian. Early or phantom dark energy, self-interacting, extra, or massive neutrinos, primordial magnetic fields, or a curved universe: An exploration of possible solutions to the H0 and σ8 problems. *Phys. Rev. D*, 106(10):103517, 2022.

[13] **Seung-gyu Hwang, Benjamin L'Huillier, Ryan E. Keeley, M. James Jee, and Arman Shafieloo. How to use GP: effects of the mean function and hyperparameter selection on Gaussian process regression. *JCAP*, 02:014, 2023.

[14] Ryan E. Keeley and Arman Shafieloo. Ruling out new physics at low redshift as a solution to the h_0 tension. *PRL*, 9 2023.

[15] Elcio Abdalla, Ryan E. Keeley, et al. Cosmology intertwined: A review of the particle physics, astrophysics, and cosmology associated with the cosmological tensions and anomalies. *JHEAp*, 34:49–211, 2022.

[16] Ryan E. Keeley and Arman Shafieloo. On the distribution of Bayesian evidence. *Mon. Not. Roy. Astron. Soc.*, 515(1):293–301, 2022.

[17] **Hanwool Koo, Ryan E. Keeley, Arman Shafieloo, and Benjamin L'Huillier. Bayesian vs frequentist: comparing Bayesian model selection with a frequentist approach using the iterative smoothing method. *JCAP*, 03(03):047, 2022.

[18] **Xiaolei Li, Ryan E. Keeley, Arman Shafieloo, Xiaogang Zheng, Shuo Cao, Marek Biesiada, and Zong-Hong Zhu. Hubble diagram at higher redshifts: model independent calibration of quasars. *Mon. Not. Roy. Astron. Soc.*, 507(1):919–926, 2021.

[19] Ryan E. Keeley, Arman Shafieloo, Gong-Bo Zhao, Jose Alberto Vazquez, and Hanwool Koo. Reconstructing the Universe: Testing the Mutual Consistency of the Pantheon and SDSS/eBOSS BAO Data Sets with Gaussian Processes. *Astron. J.*, 161(3):151, 2021.

[20] **Hanwool Koo, Arman Shafieloo, Ryan E. Keeley, and Benjamin L'Huillier. Model selection and parameter estimation using the iterative smoothing method. *JCAP*, 03:034, 2021.

[21] Ryan E. Keeley, Arman Shafieloo, Dhiraj Kumar Hazra, and Tarun Souradeep. Inflation Wars: A New Hope. *JCAP*, 09:055, 2020.

[22] Kevork N. Abazajian, Shunsaku Horiuchi, Manoj Kaplinghat, *Ryan E. Keeley, and Oscar Macias. Strong constraints on thermal relic dark matter from fermi-lat observations of the galactic center. *Phys. Rev. D*, 102(4):043012, 2020.

[23] **Kai Liao, Arman Shafieloo, Ryan E. Keeley, and Eric V. Linder. Determining Model-independent H0 and Consistency Tests. *Astrophys. J. Lett.*, 895(2):L29, 2020.

[24] **Hanwool Koo, Arman Shafieloo, Ryan E. Keeley, and Benjamin L'Huillier. Model-independent Constraints on Type Ia Supernova Light-curve Hyper-parameters and Reconstructions of the Expansion History of the Universe. *Astrophys. J.*, 899(1):9, 2020.

[25] **Kai Liao, Arman Shafieloo, Ryan E. Keeley, and Eric V. Linder. A model-independent determination of the Hubble constant from lensed quasars and supernovae using Gaussian process regression. *Astrophys. J. Lett.*, 886(1):L23, 2019.

[26] Ryan E. Keeley, Arman Shafieloo, Benjamin L'Huillier, and Eric V. Linder. Debiasing Cosmic Gravitational Wave Sirens. *Mon. Not. Roy. Astron. Soc.*, 491(3):3983–3989, 2020.

[27] Ryan E. Keeley, Shahab Joudaki, Manoj Kaplinghat, and David Kirkby. Implications of a transition in the dark energy equation of state for the h_0 and σ_8 tensions. *JCAP*, 12:035, 2019.

[28] Arman Shafieloo, *Ryan E. Keeley, and Eric V. Linder. Will cosmic gravitational wave sirens determine the Hubble constant? *JCAP*, 03:019, 2020.

[29] Shahab Joudaki, Manoj Kaplinghat, *Ryan E. Keeley, and David Kirkby. Model independent inference of the expansion history and implications for the growth of structure. *Phys. Rev. D*, 97(12):123501, 2018.

[30] Ryan E. Keeley, Kevork Abazajian, Anna Kwa, Nicholas Rodd, and Benjamin Safdi. What the Milky Way's dwarfs tell us about the Galactic Center extended gamma-ray excess. *Phys. Rev. D*, 97(10):103007, 2018.

[31] Kevork N. Abazajian and *Ryan E. Keeley. Bright gamma-ray Galactic Center excess and dark dwarfs: Strong tension for dark matter annihilation despite Milky Way halo profile and diffuse emission uncertainties. *Phys. Rev. D*, 93(8):083514, 2016.

[32] Manoj Kaplinghat, Ryan E. Keeley, Tim Linden, and Hai-Bo Yu. Tying Dark Matter to Baryons with Self-interactions. *Phys. Rev. Lett.*, 113:021302, 2014.

White Papers and Letters of Interest

NANCY: Next-generation All-sky Near-infrared Community surveY, *arxiv:2306.11784*.

Report of the Topical Group on Cosmic Probes of Fundamental Physics for for Snowmass 2021, *arxiv:2209.11726*.

Inflation and Dark Energy from spectroscopy at z $>$ 2, *arxiv:1903.09208*.

The Next Generation of Cosmological Measurements with Type Ia Supernovae, *arxiv:1903.05128*.

Messengers from the Early Universe: Cosmic Neutrinos and Other Light Relics, *arxiv:1903.04763*.

Gravitational wave cosmology and astrophysics with large spectroscopic galaxy surveys, *arxiv:1903.04730*.

Dark Matter Science in the Era of LSST, *arxiv:1903.04425*.

Primordial Non-Gaussianity, *arxiv:1903.04409*.

Invited Talks and Conferences

* Lead Author (Alphabetical ordering)
** Mentored Student/Colleague

September 2025 **CGWU: Future of Multi-Messenger Astronomy and Gravitational Wave Research**, *Cosmology with Dark Sirens: Model-independent constraints on the expansion history*, Seoul National University.

September 2025 **The End of Lambda?**, *Preference for Evolving Dark Energy: Signatures in the Growth Rate of Perturbations*, Korea Astronomy Space Science Institute.

July 2024 **Marcel Grossman 2024**, *New physics at low redshift cannot be the sole explanation for the H0 tension*, Pescara, Italy.

May-July 2024 **KITP Dark Matter Theory, Simulation, and Analysis in the Era of Large Surveys**, *Strongest WDM Constraints from JWST observations of Strong Lenses*, UCSB.

December 2023 **UC Merced Colloquium**, *Strongest WDM Constraints from JWST observations of Strong Lenses*.

June 2023 **PASCOS 2023**, *New physics at low redshift cannot be the sole explanation for the H0 tension*, University of California, Irvine.

June 2023 **Polica SIDM workshop**, *Pushing the Limits of Detectability: Mixed Dark Matter from Strong Gravitational Lenses*, Polica, Italy.

July 2022 **Center for the Gravitational-Wave Universe Workshop**, *Cosmology with Gravitational Waves and 3D Surveys*, Online.

April 2021 **Korea Astronomy Machine Learning Meeting 2021**, *Gaussian Process Regression in Cosmology*, Seoul National University.

February 2021 **Tehran Meeting on Cosmology at the Crossroads 2021**, *Inflation Wars: A New Hope*, Online.

June 2020 **Korea Astronomy and Space Science Institute Colloquium**, *Strong constraints on thermal relic dark matter from Fermi-LAT observations of the Galactic Center*, KASI, Daejeon, Korea.

October 2019 **Korea Astronomical Society Fall Meeting 2019**, *Pillars of the standard model of cosmology: dark energy and the cosmological constant*, KIAS, Seoul, Korea.

June 2018 **Conference on the Intersection of Particle and Nuclear Physics**, *Dark Matter Interpretation of the Galactic Center Gamma Ray Excess*, Palm Springs, CA, US.

February 2018 **Texas A&M High Energy seminar**, *What the Milky Ways Dwarfs tell us about the Galactic Center extended excess*, College Station, TX, US.

Talks and Conferences

June 2025 **Cosmology From Home 2025**, *The Preference for Evolving Dark Energy*, online.

March 2025 **APS Global Physics Conference**, *Strongest WDM Constraints from JWST observations of Strong Lenses*, National Harbor, Maryland.

January 2025 **AAS245**, *Strongest WDM Constraints from JWST observations of Strong Lenses*, National Harbor, Maryland.

October 2024 **Cosmo24**, *Strongest WDM Constraints from JWST observations of Strong Lenses*, Kyoto University.

August 2024 **TeV Particle Astrophysics**, *Strongest WDM Constraints from JWST observations of Strong Lenses*, U Chicago.

June 2024 **Cosmology from Home**, *Strongest WDM Constraints from JWST observations of Strong Lenses*, Online.

June 2024 **KITP Cosmic Signals of Dark Matter Physics: New Synergies**, *UCSB*.

February 2024 **Lensathon 2024**, *Pushing the Limits of Detectability: Mixed Dark Matter from Strong Gravitational Lenses*, UCLA.

December 2023 **DESC DM Working Group Telecon**, *Strongest WDM Constraints from JWST observations of Strong Lenses*.

September 2023 **Cosmo 23**, *Pushing the Limits of Detectability: Mixed Dark Matter from Strong Gravitational Lenses*, IFT, Madrid.

July 2023 **Lensing at Different Scales: Strong, Weak and the Synergies between the two**, *Pushing the Limits of Detectability: Mixed Dark Matter from Strong Gravitational Lenses*, University of Chicago / KICP.

July 2023 **DESC collaboration meeting**, *attended*, online.

July 2023 **Cosmology from Home**, *Pushing the Limits of Detectability: Mixed Dark Matter from Strong Gravitational Lenses*, Online.

March 2023 **Dark Matter 2023**, *Pushing the Limits of Detectability: Mixed Dark Matter from Strong Gravitational Lenses*, University of California, Los Angeles.

March 2023 **Public Talk: Mariposa Rotary Club**, *Distances in Astronomy*, Mariposa, CA.

February 2023 **UC Merced Postdoctoral Spotlight**, *Revealing Dark Matter With Strong Gravitational Lenses*, University of California, Merced.

August 2022 **CMB-S4 Meeting**, *New physics at low redshift cannot be the sole explanation for the H0 tension*, University of Chicago.

August 2022 **International Astronomical Union General Assembly**, *On the Distribution of Bayesian Evidences*, Busan, South Korea.

July 2022 **Korea Astronomy Space sceince Institute seminar**, *Pushing the Limits of Detectability: Mixed Dark Matter from Strong Gravitational Lenses*, Daejeon, South Korea.

July 2022 **Cosmology from Home**, *New physics at low redshift cannot be the sole explanation for the H0 tension*, Online.

June 2022 **UCI cosmology seminar**, *New physics at low redshift cannot be the sole explanation for the H0 tension*, Online.

December 2021 **Focused Workshop on Cosmology with Gravitational Waves**, *Cosmology With Lensed Quasars*, Online.

July 2021 **American Physical Society DPF**, *Strong constraints on thermal relic dark matter from Fermi-LAT observations of the Galactic Center*, Online.

July 2021 **Marcel Grossman 2021**, *Strong constraints on thermal relic dark matter from Fermi-LAT observations of the Galactic Center*, Online.

July 2021 **Marcel Grossman 2021**, *Testing LCDM with eBOSS / SDSS*, Online.

June 2021 **PASCOS 2021**, *Testing LCDM with eBOSS / SDSS*, Online.

April 2021 **Korea Astronomical Society Spring Meeting 2021**, *Testing LCDM with eBOSS / SDSS*, Online.

December 2020 **7th Korea-Japan Workshop on Dark Energy**, *Inflation Wars: A New Hope*, Online.

October 2020 **Korea Astronomical Society Fall Meeting 2020**, *Model Independent Methods in Cosmology*, Online.

September 2020 **Cosmology From Home**, *Model Independent Methods in Cosmology*, Online.

January 2020 **Dark Odyssey**, *Debiasing Gravitational Waves*, Seoul National University.

December 2019 **6th Korea-Japan Workshop on Dark Energy**, *Transitional Dark Energy: A solution to the H0 tension*, Nagoya, Japan.

September 2019 **CosKASI-ICG-NAOC-YITP Workshop 2019**, *Transitional Dark Energy: A solution to the H0 tension*.

August 2019 **COSMO19**, *Transitional Dark Energy: A solution to the H0 tension*, Aachen, Germany.

July 2019 **KITP UCSB Tensions between Early and Late Universe**, *Transitional Dark Energy: A solution to the H0 tension*, Santa Barbara, CA, US.

July 2019 **DESI Collaboration Meeting**, *Model independent methods in cosmology*, LBNL, Berkeley, CA, US.

April 2019 **COSKASI 19**, *Transitional Dark Energy: A solution to the H0 tension*, Jeju, Korea.

February 2019 **Korea Astronomical Society Spring Meeting**, *Model independent inference of the expansion history and implications for the growth of structure*, Busan, Korea.

November 2018 **KIAS structure formation workshop**, *Model independent inference of the expansion history and implications for the growth of structure*, KIAS, Seoul, Korea.

October 2018 **CosKASI-ICG-NAOC-YITP Workshop 2018**, *Model independent inference of the expansion history and implications for the growth of structure*, NAOC, Beijing, China.

August 2018 **5th Korea-Japan Workshop on Dark Energy**, *Model independent inference of the expansion history and implications for the growth of structure*, KASI, Daejeon, Korea.

August 2017 **TeV Particle Astrophysics conference**, *What the Milky Way's Dwarfs tell us about the Galactic Center extended excess*, OSU, Columbus, OH, US.

July 2017 **Summer Institute for Neutrino Theory**, *Summer School*, Virginia Tech, Blacksburg, VA, US.

January 2017 **American Physical Society - April Meeting**, *Bright gamma-ray Galactic Center excess and dark dwarfs: Strong tension for dark matter annihilation despite Milky Way halo profile and diffuse emission uncertainties*, Washington DC, US.

Programming

Languages

Python

C

C++

C#

R

Software

October 2017 **Cosmological expansion history inference using Gaussian processes**, *DOI:10.5281/zenodo.999564*.

April 2019 **Cosmological expansion history inference with a 1% forecasted H0 measurement using Gaussian processes**, *DOI:10.5281/zenodo.3116772*.

Teaching

Trainings

2024 **Mobile Summer Institute of Scientific Teaching (MoSIST)**, *Week-long workshop on active learning strategies*.

2022 **Principles of Pedagogy: level 3**, *research-based teaching series*.

2021 **Principles of Pedagogy: level 2**, *research-based teaching series*.

Classroom Experience

2012–2018 **Physics Teaching Assistant**, *UC, Irvine*.
Taught various classes from the standard introductory labs and courses to the more specialized classes aimed at teaching physics and astronomy to non-science majors, to teaching upper division astronomy courses.

2016–2016 **Instructor of Record**, *UC, Irvine*.
Physics 7 - Calculus based introductory mechanics course.

Professional Afiliations and Service

Local Outreach

February 2025 **Public Talk: Mariposa Science on Tap**, *Investigating the Nature of the Universe*, Mariposa, CA.

March 2024 **Public Talk: Mariposa Science on Tap**, *Distances in Astronomy*, Mariposa, CA.

February 2024 **Judged Merced County School District Science Fair**.

March 2023 **Panelist at California Hispanic Serving Institution Conference**, *Cal State Fresno*.

March 2023 **Postdoc Panel at UC Merced Thesis Bootcamp**, *University of California, Merced*.

March 2023 **Public Talk: Mariposa Rotary Club**, *Distances in Astronomy*, Mariposa, CA.

February 2023 **Judged Merced County School District Science Fair**.

January 2023 **Conferences for Undergraduate Women in Physics**, *Local organizing committee*, University of California, Merced.

2021-2 **Judged Merced County School District Science Fair**.

2021-2 **Judged Merced City School District Science Fair**.

2016–2018 **Teaching through COSMOS program at UC, Irvine**.
Taught basic cosmology and particle physics to high school students, ran demonstrations for basic kinematics concepts, and designed a cloud chamber kit appropriate for the students to build themselves.

Mentoring

2021–Present **UC Merced group**.
I have been mentoring Charles Gannon, one of the graduate studnts in the Nierenberg group. His current project involves using semi-analytic software (Galacticus) to make precise predictions about the number, distribution, and profiles of subhalos for the purpose of understanding their impact on substructure lensing

2021–Present **UC Merced group**.
I have been mentoring Max Seibt, an undergraduates in the Niereberg group. Their project involves understanding the effects of the parameters of the main deflecting lens on dark matter inferences from substructure lensing

2021–Present **UC Merced group**.
I have been mentoring Emmanuel Rabago, an undergraduates in the Niereberg group. Their project involves understanding how much additional information is gained from using multiple source sizes when making dark matter inferences from substructure lensing

2018-2021 **CosKASI group**.
I mentored Hanwool Koo, a graduate student in the Physical Cosmology group at KASI, which lead to the student writing 3 first author papers so far. These project were on developing statistical tests for ΛCDM using Type Ia supernova (see entries [8], [11], [15])

Organizing Conferences

January 2023 **Conferences for Undergraduate Women in Physics**, *Local organizing committee*, University of California, Merced.

Spring 2021 – Fall 2021 **CosKASI Early Career Researcher Seminar Series**, *Chair of the organizing committee*, Online.

December 7-10 2020 **7th Korea-Japan Workshop on Dark Energy**, *Chair of the local organizing committee*, Online.

Refereed Journals

Physical Review Letters.

Physical Review D.

Monthly Notices of the Royal Astronomical Society.

Journal of Cosmology and Astroparticle Physics.

The Astrophyscal Journal.

European Physical Journal C.

Universe.

Societies

Member of American Physical Society, *(APS)*.

Member of Korea Astronomical Society, *(KAS)*.

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