Ryan Keeley

Academic Positions

Current Position

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

Former Positions

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 and 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?*.

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

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

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

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

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

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

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International Collaborations

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

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

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

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

Publications

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

Publications

[1] Ryan Keeley et al. Pushing the Limits of Detectability: Mixed Dark Matter from Strong Gravitational Lenses. *submitted*.

[2] **Helena Garcia Escudero, Jui-Lin Kuo, Ryan E. Keeley, and Kevork N. Abazajian. Early versus Phantom Dark Energy, Self-Interacting, Extra, or Massive Neutrinos, Primordial Magnetic Fields, or a Curved Universe: An Exploration of Possible Solutions to the H_0 and σ_8 Problems. *arXiv e-prints*, page arXiv:2208.14435, August 2022.

[3] 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. *arXiv e-prints*, page arXiv:2206.15081, June 2022.

[4] *Ryan E. Keeley and Arman Shafieloo. Ruling Out New Physics at Low Redshift as a solution to the H_0 Tension. *arXiv e-prints*, page arXiv:2206.08440, June 2022.

[5] Elcio Abdalla, et al., and Ryan Keeley. Cosmology intertwined: A review of the particle physics, astrophysics, and cosmology associated with the cosmological tensions and anomalies. *Journal of High Energy Astrophysics*, 34:49–211, June 2022.

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* Lead Author
** Mentored Student
* Note the numerous alphabetically ordered author lists

[6] *Ryan E. Keeley and Arman Shafieloo. On the distribution of Bayesian evidence. *Monthly Notices of the Royal Astronomical Society*, 515(1):293–301, September 2022.

[7] 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. *arXiv e-prints*, page arXiv:2110.10977, October 2021.

[8] 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. *Monthly Notices of the Royal Astronomical Society*, 507(1):919–926, October 2021.

[9] *Ryan E. Keeley, Arman Shafieloo, Gong-Bo Zhao, Jose Alberto Vazquez, and Hanwool Koo. Reconstructing the Universe. *arXiv e-prints*, page arXiv:2010.03234, October 2020.

[10] Hanwool **Koo, Arman Shafieloo, Ryan E. Keeley, and Benjamin L'Huillier. Model selection and parameter estimation using the iterative smoothing method. *arXiv e-prints*, page arXiv:2009.12045, September 2020.

[11] *Ryan E. Keeley, Arman Shafieloo, Dhiraj Kumar Hazra, and Tarun Souradeep. Inflation Wars: A New Hope. *Journal of Cosmology and Astroparticle Physics*, June 2020.

[12] 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. *Physical Review D*, 102(4):043012, August 2020.

[13] Kai Liao, Arman Shafieloo, *Ryan E. Keeley, and Eric V. Linder. Determining Model-independent H_0 and Consistency Tests. *Astrophysical Journal, Letters*, 895(2):L29, June 2020.

[14] 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. *Astrophysical Journal*, 899(1):9, August 2020.

[15] 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. *Astrophysical Journal, Letters*, 886(1):L23, November 2019.

[16] *Ryan E. Keeley, Arman Shafieloo, Benjamin L'Huillier, and Eric V. Linder. Debiasing cosmic gravitational wave sirens. *Monthly Notices of the Royal Astronomical Society*, 491(3):3983–3989, January 2020.

[17] *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. *Journal of Cosmology and Astroparticle Physics*, 2019(12):035, December 2019.

[18] Arman Shafieloo, *Ryan E. Keeley, and Eric V. Linder. Will cosmic gravitational wave sirens determine the Hubble constant? *Journal of Cosmology and Astroparticle Physics*, 2020(3):019, March 2020.

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

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

[21] 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. *Physical Review D*, 93(8):083514, Apr 2016.

[22] Manoj Kaplinghat, Ryan E. Keeley, Tim Linden, and Hai-Bo Yu. Tying Dark Matter to Baryons with Self-Interactions. *Physical Review Letters*, 113(2):021302, Jul 2014.

White Papers and Letters of Interest

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*.

* Lead Author
** Mentored Student

Invited Talks and Conferences

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

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

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

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

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

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

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

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

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.

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.

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

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.

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.

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 Experience

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

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

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 Afilliations and Service

Local Outreach

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

2021 **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

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 [7], [10], [14])

2021–Present **UC Merced group**.
I have begun 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 begun 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 begun 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

Organizing Conferences

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

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

Refereed Journals

Physical Review Letters.

Physical Review D.

Monthly Notices of the Royal Astronomical Society.

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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