

Rui An | Curriculum Vitae

University of Southern California, Los Angeles, CA 90089, USA

✉ anrui@usc.edu 🏠 <https://ruian1320.github.io>

RESEARCH

Theoretical Cosmology

- Searching for physics beyond the standard cosmology, including dark matter, neutrino self-interaction, dark energy and modified gravity, and investigating the impact of them on the cosmic history
- Measuring new physics from cosmological and astrophysical observations, including big bang nucleosynthesis, cosmic microwave background, reionization process, large scale structure and near-field measurements

Computational Cosmology

- Using N-body simulations to explore the nonlinear evolution of our universe in non-standard cosmology
- Studying the impact of dark matter microphysics on small-scale structure using zoom-in simulations of Milky Way-like systems

POSITION

University of Southern California
Postdoctoral Research Fellow

2021 — Present

EDUCATION

Shanghai Jiao Tong University

Ph.D., Physics

Thesis: *Non-standard cosmology: modified gravity and dark energy model*

2014 — 2020

Hubei University

B.S., Physics

2010 — 2014

SCIENTIFIC COLLABORATIONS

CMB-S4 Collaboration, Member

2022 — Present

Simons Observatory Collaboration, Member

2022 — Present

Atacama Cosmology Telescope Collaboration, Member

2021 — Present

FUNDING

NASA Astrophysics Theory Program, awarded \$545,084.00, Co-PI

Award Number: 21-ATP21-0135

Award period: 06/2022-07/2025

Title: *Cosmological Signals of Light Dark Matter: New Predictions and Connections*

PUBLICATIONS

Publications in Peer-Reviewed Journals — Below is a list of peer-reviewed publications on which R.A. was the first author, or to which R.A. made major contributions. Publications that are currently under review but available online are marked as “submitted for publication”.

- **Rui An**, Vera Gluscevic, *Reconstructing the early-universe expansion and thermal history*, [arXiv:2310.17195](https://arxiv.org/abs/2310.17195), submitted for publication.
- Adam He, **Rui An**, Mikhail M. Ivanov, and Vera Gluscevic, *Self-Interacting Neutrinos in Light of Large-Scale Structure Data*, [arXiv:2309.03956](https://arxiv.org/abs/2309.03956), submitted for publication.
- Adam He, Mikhail M. Ivanov, **Rui An**, Vera Gluscevic, *S8 Tension in the Context of Dark Matter-Baryon Scattering*, [ApJL 954, L8 \(2023\)](https://arxiv.org/abs/2308.15418), [highlighted by AAS](#).
- **Rui An**, Vera Gluscevic, Ethan O. Nadler, Yue Zhang, *Can Neutrino Self-interactions Save Sterile Neutrino Dark Matter?*, [ApJL 954, L18 \(2023\)](https://arxiv.org/abs/2308.15418).
- Trey Driskell, Ethan O. Nadler, Jordan Mirocha, Andrew Benson, Kimberly K. Boddy, Tim Morton, Jack Lashner, **Rui An**, Vera Gluscevic, *Structure Formation and the Global 21-cm Signal in the Presence of*

Coulomb-like Dark Matter-Baryon Interactions, [PRD 106 \(2022\) 103525](#).

- Zack Li, **Rui An**, Vera Gluscevic, Kimberly K. Boddy *et al.* (ACT Collaboration), *The Atacama Cosmology Telescope: limits on dark matter-baryon interactions from DR4 power spectra*, [JCAP 02 \(2023\) 046](#).
- **Rui An**, Vera Gluscevic, Erminia Calabrese, J. Colin Hill, *What does cosmology tell us about the mass of thermal-relic dark matter?*, [JCAP 07 \(2022\) 002](#).
- Yun Liu, Shihong Liao, Xiangkun Liu, Jiajun Zhang, **Rui An**, Zuhui Fan, *Dark Matter Halos in the N-body Simulations for Interacting Dark Energy Models: Formation History, Density Profile, Spin and Shape*, [MNRAS 511, 3076 \(2022\)](#).
- Linfeng Xiao, Le Zhang, **Rui An**, Chang Feng, Bin Wang, *Fractional Dark Matter decay: cosmological imprints and observational constraints*, [JCAP 01 \(2020\) 045](#).
- **Rui An**, André A. Costa, Linfeng Xiao, Jiajun Zhang, Bin Wang, *Testing a quintessence model with Yukawa interaction from cosmological observations and N-body simulations*, [MNRAS 489, 297 \(2019\)](#).
- Jiajun Zhang, **Rui An**, Wentao Luo, Zhaozhou Li, Shihong Liao, Bin Wang, *The First Constraint from SDSS Galaxy-Galaxy Weak Lensing Measurements on Interacting Dark Energy Models*, [ApJL 875, L11 \(2019\)](#).
- **Rui An**, Xiaodong Xu, Jun Zhang, Bin Wang, Bin Yue, *Signature of the interaction between dark sectors in the reionization process*, [JCAP 01 \(2019\) 034](#).
- Linfeng Xiao, **Rui An**, Le Zhang, Bin Yue, Yidong Xu, Bin Wang, *Can Conformal and Disformal Couplings Between Dark Sectors Explain the EDGES 21cm Anomaly?*, [PRD 99, 023528 \(2019\)](#).
- Jiajun Zhang, **Rui An**, Shihong Liao, Wentao Luo, Zhaozhou Li, Bin Wang, *A Fully Self-Consistent Cosmological Simulation Pipeline for Interacting Dark Energy Models*, [PRD 98, 103530 \(2018\)](#).
- Yen Chin Ong, S. Sedigheh Hashemi, **Rui An**, Bin Wang, *Stephani Cosmology: Entropically Viable But Observationally Challenged*, [EPJC 78 \(2018\) 405](#).
- **Rui An**, Chang Feng, Bin Wang, *Relieving the Tension between Weak Lensing and Cosmic Microwave Background with Interacting Dark Matter and Dark Energy Models*, [JCAP 02 \(2018\) 038](#).
- **Rui An**, Chang Feng, Bin Wang, *Constraints on the dark matter and dark energy interactions from weak lensing bispectrum tomography*, [JCAP 10 \(2017\) 049](#).
- **Rui An**, Xiaodong Xu, Bin Wang, Yungui Gong, *Dynamical analysis of modified gravity with nonminimal gravitational coupling to matter*, [PRD 103505 \(2016\)](#).

Large-Collaboration Publications — Below is a list of peer-reviewed publications to which R.A. made minor contributions as a member of a large collaboration.

- Dhayaa Anbajagane *et al.* (ACT Collaboration, incl. **Rui An**, DES Collaboration, SPT Collaboration), *Cosmological shocks around galaxy clusters: A coherent investigation with DES, SPT & ACT*, [arXiv:2310.00059](#), submitted for publication.
- Gerrit S. Farren *et al.* (ACT Collaboration, incl. **Rui An**), *The Atacama Cosmology Telescope: Cosmology from cross-correlations of unWISE galaxies and ACT DR6 CMB lensing*, [arXiv:2309.05659](#), submitted for publication.
- Shabbir Shaikh *et al.* (ACT Collaboration, incl. **Rui An**, DES Collaboration), *Cosmology from Cross-Correlation of ACT-DR4 CMB Lensing and DES-Y3 Cosmic Shear*, [arXiv:2309.04412](#), submitted for publication.
- William R. Coulton *et al.* (ACT Collaboration, incl. **Rui An**), *The Atacama Cosmology Telescope: High-resolution component-separated maps across one-third of the sky*, [arXiv:2307.01258](#), submitted for publication.
- Niall MacCrann *et al.* (ACT Collaboration, incl. **Rui An**), *The Atacama Cosmology Telescope: Mitigating the impact of extragalactic foregrounds for the DR6 CMB lensing analysis*, [arXiv:2304.05196](#), submitted for publication.
- Frank J. Qu *et al.* (ACT Collaboration, incl. **Rui An**), *The Atacama Cosmology Telescope: A Measurement of the DR6 CMB Lensing Power Spectrum and its Implications for Structure Growth*, [arXiv:2304.05202](#), submitted for publication.
- Mathew S. Madhavacheril *et al.* (ACT Collaboration, incl. **Rui An**), *The Atacama Cosmology Telescope: DR6 Gravitational Lensing Map and Cosmological Parameters*, [arXiv:2304.05203](#), submitted for publication.
- Yaqiong Li *et al.* (ACT Collaboration, incl. **Rui An**), *The Atacama Cosmology Telescope: Systematic Transient Search of 3-Day Maps*, [arXiv:2303.04767](#), submitted for publication.
- Christina D. Kreisch *et al.* (ACT Collaboration, incl. **Rui An**), *Atacama Cosmology Telescope: The Persistence of Neutrino Self-Interaction in Cosmological Measurements*, [arXiv:2207.03164](#), submitted for publication.
- Carlos A. Wuensche *et al.* (BINGO Collaboration, incl. **Rui An**), *Baryon Acoustic Oscillations from*

Integrated Neutral Gas Observations: an instrument to observe the 21cm hydrogen line in the redshift range $0.13 < z < 0.45$ —status update, [Anais da Academia Brasileira de Ciências 93 \(2021\)](#).

White Papers

- Cora Dvorkin, Renée Hlozek, **Rui An**, Kimberly K. Boddy, Francis-Yan Cyr-Racine, Gerrit S. Farren, Vera Gluscevic *et al.*, *Dark Matter Physics from the CMB-S4 Experiment*, [arXiv:2203.07064](#).

MENTORING

Graduate Student Project Advisor

2021 — Present

- Adam He, University of Southern California: *Self-Interacting Neutrinos in Light of Large-Scale Structure Data*, see [arXiv:2309.03956](#).
- Aryan Rahimieh, University of Southern California: *21cm forecast on dark matter-baryon scattering*, in preparation.
- Wendy Crumrine, University of Southern California: *Constraints on dark matter-radiation coupling from Milky Way satellite abundance*, in preparation.

Undergraduate Student Project Advisor

Summer 2022

- Israel Biniam, University of Maryland at College Park: *Constraints on dark matter and baryon interactions in the early universe*, recruited through the Simons-NSBP Scholars Program.

TEACHING

Leading Course Instructor

Fall 2016

— Experimental College Physics (Undergraduate course, Shanghai Jiao Tong University)

Teaching Assistant

Fall 2014, Fall 2015, Spring 2015

— College Physics (Undergraduate course, Shanghai Jiao Tong University)

Trainee Teacher

Fall 2013

— High School Physics (High school course, Hubei University Affiliated High School)

SERVICE

Journal Referee (PRD)

2021 — Present

TALKS

Mini-workshop at Shanghai Astronomical Observatory, Shanghai, China (Invited)	2023
Chicago Workshop on Dark Matter and Neutrino Physics, Loyola University Chicago, USA (Invited)	2023
Astro-seminar at KICP, University of Chicago, USA (Invited)	2022
Simons Observatory Summer 2022 F2F Meeting, University of California San Diego, USA	2022
XV International Conference on Interconnections between Particle Physics and Cosmology, Washington University in St. Louis, USA	2022
YITP Asian-Pacific Winter School and Workshop on Gravitation and Cosmology, Kyoto University, Japan	2019
Conference on Gravity and Relativistic Physics, Yangzhou, China	2018
International Symposium on Cosmology and Particle Astrophysics, Kyoto University, Japan	2017
Geometric Foundations of Gravity in Tartu, University of Tartu, Estonia	2017
Conference on Weak Lensing, Shanghai, China	2017

VISITS

University of Illinois at Urbana-Champaign, USA

Jun-Nov 2019

University of Tokyo, Japan

Dec 2017

University of Helsinki, Finland

Aug 2017

SCHOLARSHIPS & HONORS

GCL graduate scholarship, SJTU

2018, 2019

Guanghua graduate scholarship, SJTU

2016

Graduate scholarship for outstanding new PhD students, SJTU

2016

Graduate scholarship of IFSA Collaborative Innovation Center, SJTU	2016
Professional scholarship, HUBU	2014
Scientific research innovation scholarship, HUBU	2013
Outstanding undergraduate scholarship, HUBU	2011, 2012
Excellent academic performance scholarship, HUBU	2011, 2012

CODE

Languages: Python, C/C++, Fortran, Mathematica

Packages: CAMB, CLASS, CosmoMC, Cobaya, Monte Python, Gadget, AlterBBN

Github: <https://github.com/RuiAn1320>