

Keir K. Rogers

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Research interests: theoretical and observational cosmology, dark matter, fundamental physics, machine learning, astrostatistics, cosmological simulations, emulators

Research employment

Oct 2020 – present	<i>Dunlap Fellow</i> Dunlap Institute, University of Toronto, Canada
Oct 2017 – Sep 2020	<i>Oskar Klein Centre Fellow</i> Oskar Klein Centre, Stockholm University, Sweden
Jul 2013 – Sep 2013	<i>Research intern</i> STFC Rutherford Appleton Laboratory, Oxfordshire, UK

Education

Oct 2014 – Oct 2017	<i>PhD in Physics and Astronomy</i> University College London, University of London, UK <i>PhD thesis:</i> A clear view of the primordial universe <i>Supervisors:</i> Prof. Hiranya Peiris & Prof. Andrew Pontzen
Oct 2010 – Oct 2014	<i>MPhys in Physics</i> Lady Margaret Hall, University of Oxford, UK <i>MPhys thesis:</i> Axisymmetric models of boxy galaxies (first class) <i>Supervisors:</i> Prof. James Binney & Prof. Martin Bureau

Awards

Professional & academic awards

2021 - 23	Student funding, University of Toronto/Canada Research Council (CA\$54,000)
2020 - 24	Dunlap Fellowship (CA\$364,091)
2018	Travel funding, CASPEN exchange network (SEK 9000)
2017 - 20	Oskar Klein Centre Fellowship (SEK 1,318,800)
2014 - 17	Travel funding, Royal Astronomical Society, UCL graduate school (£1500)
2014 - 17	UK Science & Technology Facilities Council PhD studentship (£68,770)
2013	University of Oxford Commendation for Practical Work in Physics
2010 - 14	University of Oxford Bursary for climate change specialism (£4000)
2010 - 14	University of Oxford Scholar for first class examination results (£1400)

Computing award

2019 - 20	<i>Constraining inflation & neutrino masses with the Dark Energy Spectroscopic Instrument</i> , DiRAC (UK STFC supercomputing facility), 4.5M CPU-hours, co-I
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Supervision and mentoring

PhD student supervision

- 2023 - Harrison Winch, University of Toronto, 1 journal paper in prep
 2023 - Margaret Ikape, University of Toronto
 2020 - 22 Alex Laguë, University of Toronto, 1 journal paper; *Next: Postdoc, UPenn*
 2017 - 21 Christian Pedersen, UCL, 2 journal papers; *Next: Postdoc, New York University*

Undergraduate students as primary supervisor

- 1 = astronomy theory project, 2 = Milky Way simulation project, 3 = machine learning project**
- 2023 - 24 ¹ Alexander Spencer London, *Galaxy voids as new probes of dark matter signatures*
^{2,3} Peter Ma, *Simulation-based inference for stellar stream dark matter constraints*
- 2023 ³ Ian Chow, *Using ML to understand the robustness of cosmological inference*
 Winner, U of T Astronomy Summer Undergraduate Research competition
- 2022 - 23 ² Julian Meunier, *Modelling the nature of dark matter in stellar stream simulations*
- 2022 ² Ruth Huang, *Simulating stellar streams in non-cold dark matter cosmologies*
- ¹ Alexander Spencer London, *Modelling axion dark matter in cosmic void clustering*
 Honourable mention, Richards Award for Excellence in Undergraduate Research
- ³ Anran Xu, *Neural network emulators of axion Einstein-Boltzmann solvers*
- 2021 - 22 ¹ Zara Zaman, *Searching for axion dark matter in cosmic voids*
- 2021 ³ Utkarsh Mali, *Machine learning visible counterparts to gravitational-wave events*
 Winner, U of T Astronomy Summer Undergraduate Research competition
- ¹ TonyLouis Fondzenyuy Verberi, *A clear view of the primordial Universe*
 Winner, National Society of Black Physicists poster competition

Teaching

Lecturer

- 2021 - 23 *Cosmology*, Summer Undergraduate Research Program, University of Toronto/CITA
 Guest lectures, *active learning activity: think, pair, share*
- 2021 *Epoch of reionisation*, postgraduate course, University of Toronto
 Guest lecture, *active learning activity: collaborative cloud computing exercise*
- 2021 *Introduction to research*, 4th year undergraduate, University of Toronto
 Guest lecture, *developed syllabus, flexible curricula*
- 2021 *Cosmic microwave background*, 3rd year undergraduate, University of Toronto
 Guest lecture, *active learning activity: reflective discussion*

Teaching assistant

- 2016 - 17 *Advanced physical cosmology*, 4th year undergraduate, University College London
 Teaching assistant, *delivered three seminars, coursework assessment*
- 2015 - 16 *Environmental physics*, 2nd year undergraduate, University College London
 Teaching assistant, *coursework assessment*
- 2014 - 17 University College London Observatory, multiple undergraduate courses
 Supervisor, *teaching telescope operation, data reduction, data analysis*

Professional service and membership

Collaboration and professional association

- 2023 - Rubin Observatory, Dark Energy Science Collaboration, Dark Matter working group
Liaison between Dark Matter and Modelling & Combined Probes working groups
PI, collaboration project to prepare for dark matter studies with galaxy survey data
Co-I, stellar streams sub-working group: simulations, models, machine learning
- 2023 - Simons Observatory collaboration: dark matter emulator, GPU likelihood
- 2022 - Atacama Cosmology Telescope collaboration: leading DR6 dark matter paper
- 2014 - Fellow of the Royal Astronomical Society

Leadership and organisation

- 2022 - Community climate committee, U of T Astronomy
Leading equality, diversity and inclusion actions, student - advisor code of conduct
Lead, 2023 U of T Astronomy community climate survey
- 2021 - 22 Anti-racism meeting organisation and presenting committee, U of T Astronomy/CITA
Weekly meeting, alternating between action and learning activities
- 2020 - 22 Summer Undergraduate Research Program 2021 & 2022 committees, U of T/CITA
Programme (forty students) with research internship, professional development
course, lectures, networking programme
Lead, oral presentation mini-conference, poster competition, end-of-program reports
- 2020 - 22 Snowmass 2021, US particle physics community planning exercise
Lead author, *Astrophysical probes of dark matter*, *Ultralight dark matter* white paper
Co-author, *Axion dark matter & CMB-S4 dark matter* white papers
Lead author, *Cosmic probes of ultralight dark matter* letter of interest (LOI)
- 2019 - 20 Organiser, Cosmology & Gravity group meetings, Stockholm University
Fortnightly meeting, hosting external speakers, journal club
- 2015 - 17 Organiser, cosmology graduate seminars, University College London
Monthly meeting, hosting internal speakers

Referee and review panels

- 2023 Invited grant review panelist, US Department of Energy HEP Cosmic Frontier
Invited grant review panelist, US National Science Foundation Astronomy panel
- 2019 - Referee, DiRAC (UK STFC supercomputing facility) grants
- 2017 - Referee, Phys. Rev. Lett., Phys. Rev. D, ApJ, MNRAS, JCAP

Press and public engagement

- 2023 News article on JCAP article (U of T website): [New link between DM & clumpiness](#)
Science press: e.g., [New Scientist \(front page\)](#), [MSN news](#),
[Popular Mechanics \(interview\)](#), The Globe & Mail (interview),
Universe Today (YouTube interview)
- 2023 Invited outreach talk at Royal Astronomical Society of Canada, Dunlap Observatory
- 2022 - Skype a Scientist, online engagements with school students across USA & Canada
- 2021 News article on Phys. Rev. Lett. article (SU website): [Dark matter is not “fuzzy”](#)
- 2018 Blog post: [earlyuniverse.org/a-clear-view-of-the-primordial-universe](#)
- 2010 - Outreach events, e.g., UCL Your Universe festival, astronomy open days

Conference and seminar presentations

> 100 invited & contributed cosmology / physics / data science / statistics seminars and conference talks since 2015.

Invited talks

Jan 2024	Department of Physics, University of Texas, Austin, USA
Dec 2023	Kavli IPMU, University of Tokyo, Japan
Dec 2023	Cosmology Talks (YouTube interview)
Nov 2023	Multi-probe approach to wavy dark matter workshop, Korea University, Seoul, Korea
Nov 2023	New physics from galaxy clustering workshop, IFFU, SISSA, Trieste, Italy
Oct 2023	Department of Physics & Astronomy, Queen's University, Kingston, Canada
Aug 2023	Rencontres de Vietnam 2023 conference, Quy Nhon, Vietnam (invited review)
Jul 2023	DM working group, Rubin DESC collaboration meeting, SLAC, Menlo Park, USA
May 2023	Montpellier Universe and Particles Laboratory, University of Montpellier, France
Feb 2023	Cosmo Talks mini-workshop on ultra-light axions & cosmological tensions
Jan 2023	Kavli Institute for Cosmological Physics, University of Chicago, USA
Jan 2023	Cosmology Talks (YouTube interview)
Oct 2022	Atacama Cosmology Telescope working group telecon
Oct 2022	School of Mathematics, Statistics and Physics, Newcastle University, UK
Sep 2022	Canadian Institute for Theoretical Astrophysics, Toronto, Canada
May 2022	Rencontres de Blois 2022 conference, France (invited review/plenary)
Mar 2022	Institute of Theoretical Astrophysics, University of Oslo, Norway
Feb 2022	Max Planck Institute for Astrophysics, Garching, Germany
Nov 2021	Canadian Virtual Astronomy Seminars, Canadian Astronomical Society (CASCA)
Nov 2021	Nature of dark matter on small scales seminar, Yale University, New Haven, USA
Feb 2021	Carnegie Observatories, Pasadena, USA
Nov 2020	Department of Physics and Astronomy, Queen Mary University of London, UK
Nov 2020	Dark Energy Spectroscopic Instrument Lyman-alpha forest working group telecon
Nov 2019	Oskar Klein Centre for Cosmoparticle Physics, Stockholm University, Sweden
Apr 2019	Institute for Computational Science, Zurich University, Switzerland
Sep 2018	Stockholm Data Science Forum, Sweden
Feb 2018	Department of Physics, Stockholm University, Sweden
Dec 2017	Oskar Klein Centre for Cosmoparticle Physics, Stockholm University, Sweden

Referees

Prof. Hiranya Peiris
University of Cambridge
Institute of Astronomy
United Kingdom
hiranya.peiris@ast.cam.ac.uk

Prof. George Efstathiou FRS
University of Cambridge
Institute of Astronomy
United Kingdom
gpe@ast.cam.ac.uk

Prof. Renée Hložek
University of Toronto
Dunlap Institute for Astronomy & Astrophysics
Canada
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Prof. Cora Dvorkin
Harvard University
Department of Physics
United States of America
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List of publications | Keir K. Rogers

Journal papers

Link to up-to-date paper repository: <https://inspirehep.net/authors/1958912>.

A preceding asterisk indicates a student-led publication where I mentored.

- *5 σ tension between Planck cosmic microwave background and eBOSS Lyman-alpha forest and constraints on physics beyond Λ CDM*
K. Rogers, V. Poulin, arXiv:2311.16733
- *Extreme axions unveiled: a novel fluid approach for cosmological modeling*
H. Winch, R. Hložek, D. J. E. Marsh, D. Grin, **K. Rogers**, Phys. Rev. D, submitted, 2023, arXiv:2311.02052
- *Cosmological simulations of mixed ultralight dark matter*
A. Laguë, B. Schwabe, R. Hložek, D. J. E. Marsh, **K. Rogers**, Phys. Rev. D, submitted, 2023, arXiv:2310.20000
- *Ultra-light axions and the S₈ tension: joint constraints from the cosmic microwave background and galaxy clustering*
K. Rogers, R. Hložek, A. Laguë, M. Ivanov, O. Philcox, G. Cabass, K. Akitsu, D. J. E. Marsh, JCAP, 06, 023, 2023
- * *Constraining ultralight axions with galaxy surveys*
A. Laguë, J. R. Bond, R. Hložek, **K. Rogers**, D. J. E. Marsh, D. Grin, JCAP, 01, 049, 2022
- *Fuzzy dark matter and the Dark Energy Survey year 1 data*
M. Dentler, D. J. E. Marsh, R. Hložek, A. Laguë, **K. Rogers**, D. Grin, MNRAS, 515, 5646, 2022
- *Non-linearities in the Lyman-alpha forest and in its cross-correlation with dark matter halos*
J. Givans, A. Font-Ribera, A. Slosar, L. Seeyave, C. Pedersen, **K. Rogers**, M. Garny, D. Blas, V. Iršič, JCAP, 09, 070, 2022
- *Limits on light dark matter - proton cross section from the cosmic large-scale structure*
K. Rogers, C. Dvorkin, H. Peiris, Phys. Rev. Lett., 128, 171301, 2022
- * *An emulator for the Lyman- α forest in beyond- Λ CDM cosmologies*
C. Pedersen, A. Font-Ribera, **K. Rogers**, P. McDonald, H. Peiris, A. Pontzen, A. Slosar, JCAP, 05, 033, 2021
- *Strong bound on canonical ultralight axion dark matter from the Lyman-alpha forest*
K. Rogers, H. Peiris, Phys. Rev. Lett., 126, 071302, 2021
- *General framework for cosmological dark matter bounds using N-body simulations*
K. Rogers, H. Peiris, Phys. Rev. D, 103, 043526, 2021
- * *Massive neutrinos and degeneracies in Lyman-alpha forest simulations*
C. Pedersen, A. Font-Ribera, T. Kitching, P. McDonald, S. Bird, A. Slosar, **K. Rogers**, A. Pontzen, JCAP, 04, 025, 2020

- *Bayesian emulator optimisation for cosmology: application to the Lyman-alpha forest*
K. Rogers, H. Peiris, A. Pontzen, S. Bird, L. Verde, A. Font-Ribera, JCAP, 02, 031, 2019
- *An emulator for the Lyman-alpha forest*
S. Bird, **K. Rogers**, H. Peiris, L. Verde, A. Font-Ribera, A. Pontzen, JCAP, 02, 050, 2019
- *Cosmological hydrodynamic simulations with suppressed variance in the Lyman- α forest power spectrum*
L. Anderson, A. Pontzen, A. Font-Ribera, F. Villaescusa-Navarro, **K. Rogers**, S. Genel, ApJ, 871, 144, 2019
- *Correlations in the three-dimensional Lyman-alpha forest contaminated by high column density absorbers*
K. Rogers, S. Bird, H. Peiris, A. Pontzen, A. Font-Ribera, B. Leistedt, MNRAS, 476, 3716, 2018
- *Simulating the effect of high column density absorbers on the one-dimensional Lyman-alpha forest flux power spectrum*
K. Rogers, S. Bird, H. Peiris, A. Pontzen, A. Font-Ribera, B. Leistedt, MNRAS, 474, 3032, 2018
- *Spin-SILC: CMB polarisation component separation with spin wavelets*
K. Rogers, H. Peiris, B. Leistedt, J. McEwen, A. Pontzen, MNRAS, 463, 2310, 2016
- *SILC: a new Planck internal linear combination CMB temperature map using directional wavelets*
K. Rogers, H. Peiris, B. Leistedt, J. McEwen, A. Pontzen, MNRAS, 460, 3014, 2016

White papers

A preceding asterisk indicates that I made a significant contribution to that white paper.

- * *Snowmass 2021 CF2: New horizons: scalar and vector ultralight dark matter*
D. Antypas, et al., inc. **K. Rogers** [arXiv:2203.14915]
- *Snowmass 2021 CF2: Axion dark matter*
J. Jaeckel, et al., inc. **K. Rogers** [arXiv:2203.14923]
- * *Snowmass 2021 CF3: Dark matter physics from the CMB-S4 experiment*
C. Dvorkin, et al., inc. **K. Rogers** [arXiv:2203.07064]

Conference proceedings

- *Learning reionization history from quasars with simulation-based inference*
H. Chen, J. Speagle, **K. Rogers**, 37th Conference on Neural Information Processing Systems (NeurIPS), 2023
- *Spin-SILC: CMB polarisation component separation for next-generation experiments*
K. Rogers, H. Peiris, B. Leistedt, J. McEwen, A. Pontzen, International BASP Frontiers proceedings, 2017