LUISA LUCIE-SMITH

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RESEARCH INTERESTS

- Formation and evolution of cosmic structures in our Universe.
- The connection between dark and visible matter.
- Computational techniques: numerical simulations, machine learning, Bayesian statistics.

EMPLOYMENT

Research Fellowship   **Nov 2020 − present**
  Max-Planck-Institut für Astrophysik, Garching, Germany.

Postdoctoral Research Fellowship   **Nov 2019 − Oct 2020**
  University College London, UK.

EDUCATION

Ph.D. in Astrophysics. University College London, UK.   **Oct 2015 − Oct 2019**
  Thesis: "Insights into cosmological structure formation with machine learning"
  Supervisors: Prof. Hiranya Peiris, Prof. Andrew Pontzen.
  Examiners: Prof. Benjamin Wandelt, Prof. Ofer Lahav.

MSc Quantum Fields and Fundamental Forces. Imperial College London, UK.   **Sep 2013 − Sep 2014**
  Thesis: "Reheating of the Universe and Gravitational Wave Production' '
  Supervisor: Prof. Arttu Rajantie; Grade: Merit.

BSc Mathematical Physics. The University of Nottingham, UK.   **Sep 2010 − Jul 2013**
  Thesis: "Tunnelling in Quantum Field Theory"
  Supervisor: Dr. Clare Burrage; Grade: 1st Class Honours.

PUBLICATIONS

Selected works:

1. **Lucie-Smith L.**; Peiris H.V.; Pontzen A.; Nord B.; Thiyagalingam J., "Deep learning insights into cosmological structure formation". Submitted to *Nature Machine Intelligence*. Preprint at arXiv:2011.10577, 2020.
2. **Lucie-Smith L.**; Peiris H.V.; Pontzen A., "An interpretable machine learning framework for dark matter halo formation". *Monthly Notices of the Royal Astronomical Society*, Volume 490, Issue 1, November 2019, Pages 331–342. https://doi.org/10.1093/mnras/stz2599
3. **Lucie-Smith L.**; Peiris H.V.; Pontzen A.; Lochner M., "Machine learning dark matter halo formation". *Monthly Notices of the Royal Astronomical Society*, Volume 479, Issue 3, September 2018, Pages 3405–3414. doi:10.1093/mnras/sty1719.

GRANTS AND AWARDS

- **Universities Research Association Grant**. *Deep learning dark matter halo formation.* PI; $12,500; collaborators at the Fermi National Accelerator Laboratory (USA) and University College London (UK). *March 2019.*
- **Cosmology and Astroparticle Student and Postdoc Exchange Network Grant**. *Machine learning the density profile of dark matter halos.* PI; £2,600; collaborators at Stanford University (USA) and University College London (UK). *July 2018.*
- **Royal Astronomical Society Grant**. Travel support to present my research at 22nd annual International Conference on Particle Physics and Cosmology, South Korea. £1,014. *Nov 2015.*
- **George Green Prize**. Awarded by University of Nottingham for most outstanding student of the year in the BSc Mathematical Physics course. £400. *July 2013.*

Professional presentations

Presentations about my research to broad and specialized audiences in astrophysics and machine learning:

- Max-Planck-Institut for Astrophysics, Germany. *Institute Seminar*, **invited** talk. *April 2021.*
- LMU Munich, Gemany. *Machine learning meeting*, **invited** talk. *March 2021.*
- Origins Excellence Cluster, Munich. *Origins data science meeting*, **invited** talk. *Feb 2021.*
- Cambridge – LMU online cosmology workshop. *Connecting through the cosmic web*, talk. *Jan 2020.*
- GRAPPA (Gravitation Astroparticle Physics Amsterdam). *ML journal club*, **invited** talk. *Nov 2020.*
- Max-Planck-Institut for Astrophysics, Germany. *Cosmology Seminar*, **invited** talk. *Nov 2020.*
- The University of Amsterdam, Netherlands. *AI for Science Colloquium*, **invited** talk. *Nov 2020.*
- University of Oxford, UK. *Cosmology Seminar*, **invited** talk. *Feb 2020.*
- Max-Planck-Institut for Astrophysics, Germany. *Cosmology Seminar*, **invited** talk. *Jan 2020.*
- University of Cambridge, UK. *Cavendish mini-seminar series*, **invited** talk. *Jan 2020.*
- Ringberg Castle, Germany. *Machine learning in Astronomy*, **invited** talk. *Dec 2019.*
- Fermi National Accelerator Laboratory, USA. *Astrophysics Seminar*, **invited** talk. *Sep 2019.*
- Argonne National Laboratory, USA. *High Energy Physics Seminar*, **invited** talk. *Sep 2019.*
- Flatiron CCA, New York. *Cosmology X Data Science Meeting*, talk. *Jun 2019.*
- Fermi National Accelerator Laboratory, USA.*New Perspectives 2019*, talk. *Jun 2019.*
- Villars-sur-Ollon, Switzerland. *BASP Frontiers Workshop*, **invited** deluxe poster. *Mar 2019.*
- University of Sheffield, UK. *Astrophysics Seminar*, **invited** talk. *Mar 2019.*
- Stanford University, USA. *Cosmology Meeting*, talk. *Feb 2019.*
- Institute of Cosmology, London. *London Cosmology Discussion Meeting*, talk. *Oct 2018.*
- Institute for Basic Science, South Korea. *22nd annual International Conference on Particle Physics and Cosmology*, talk. *Aug 2018.*
- University of Oxford, UK. *Statistical Challenges for Large-scale Structure in the Era of LSST*, talk. *Apr 2018.*
- Oskar Klein Centre, Stockholm. *Astrophysics Seminar*, talk. *Mar 2018.*
- University Paris Diderot, France. *21st annual International Conference on Particle Physics and Cosmology*, talk. *Aug 2017.*
- Queen Mary University, London. *Machine Learning in Physics*, **invited** talk. *Dec 2016.*

Duties, Teaching & mentoring

Institutional roles

- Organizer of Women Encouragement Group, Max-Planck-Institut for Astrophysics. *Dec 2020 – present.*
- Organizer of Cosmology seminar, University College London. *Nov 2019 – Nov 2020.*

Teaching

- Presented my research at 1$^{\text{st}}$ year BSc Classical Mechanics lecture, University College London. *Dec 2020.*
- Lecture: *Machine learning in Physics.* Max-Planck-Institut for Astrophysics. *Nov 2020 (postponed).*
- Led workshop: *Effective remote presentations.* University College London. *Oct 2020.*
- Lecture: *An Introduction to Decision Trees and Random Forests.* University College London. *Mar 2018.*
- Led workshop: *Clean code: guidelines for elegant and efficient code.* University College London. *Nov 2017.*
- Lecture: *An Introduction to Machine Learning.* University College London. *Oct 2016, Oct 2017.*
- Lecture: *Feature Importances in Random Forest.* Oskar Klein Centre, Stockholm, Sweden. *Nov 2016.*

Supervision

- Co-supervising PhD student Lillian Guo at University College London. *Oct 2020 – present.*
- Peer-mentoring for incoming PhD students, *2017.*

Public engagement

- Presenter at Kathleen Lonsdale Building Opening, University College London, UK. *April 2018.*
- Presenter for science events, festivals and astronomy groups, including for *Highgate High School* (Nov 2017), *Blackheath High School* (May 2017), *International Federation of Business and Professional Women, Italy* (Mar 2017) and *Your Universe Festival* (Mar 2016).
- Led tour guides at the *University College London Observatory* to members of the public to introduce the field of Astrophysics and explain the workings of telescopes. *Oct 2015 – Oct 2016.*

Academic and professional development

- European Space Astronomy Centre, Madrid. *Data Analysis & Statistics Workshop.* Statistical inference, Bayesian statistics, computational Bayesian inference, Monte Carlo Markov Chain, machine learning. *Nov 2017.*
- Les Houches, France. Summer school on *Cosmology after Planck: what is next? Apr 2016.*
- NVIDIA, London. *Deep Learning and Neural Networks GPU. Feb 2016.*
- Imperial College, London.*Bayesian Data Analysis Workshop. Sep 2016.*
- University College, London. *Advanced Python course. Nov 2015.*
- University College, London. *Software Carpentry Workshop. Nov 2015.*
- Imperial College, London. *Introduction to High Performance and Throughput Computing. Oct 2015.*

Technical skills

Programming languages and tools: proficient with Python (`NumPy, SciPy, Pandas, scikit-learn, Keras, TensorFlow, LightGBM`), Git, slurm; basic ability with C++, Perl; HPC unix systems.
Cosmological simulations: `GADGET, SUBFIND, PYNBODY, ASTROPY, CAMB, AHF`.