

# LUIA LUCIE-SMITH

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## RESEARCH INTERESTS

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- Cosmology: Cosmological structure formation, dark matter haloes, cosmic voids, galaxy formation.
- Computation: Numerical simulations, machine learning, Bayesian statistics.

## EDUCATION

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*STFC PhD 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.  
PhD defense date: 22nd Nov. 2019.

*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: 1<sup>st</sup> Class Honours.

## EMPLOYMENT

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*Research Fellow in Cosmological Structure Formation. University College London, UK* *Nov 2019 – present*  
ERC Consolidator Grant: “Understanding the diversity of galaxy morphology in the era of large spectroscopic surveys”. PI: Andrew Pontzen.

## GRANTS AND AWARDS

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- **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). *Mar 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). *Jul 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.*

## PUBLICATIONS

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1. **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>
2. **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](https://doi.org/10.1093/mnras/sty1719).
3. Nord, B. et al. (including **Lucie-Smith L.**), “Algorithms and Statistical Models for Scientific Discovery in the Petabyte Era”, arXiv:1911.02479, 2019.

## PROFESSIONAL PRESENTATIONS

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Most relevant professional presentations about my research:

- University of Oxford, UK. *Cosmology Seminar*, invited talk. *Feb 2020.*
- University of Cambridge, UK. *Cavendish mini-seminar series*, 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 Center for Computational Astrophysics, New York. *Cosmology X Data Science Meeting*, talk. *Jun 2019.*

- Fermi National Accelerator Laboratory, USA. *New Perspectives 2019*, talk. *Jun 2019*.
- Switzerland. *International Biomedical and Astronomical Signal Processing 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*.

## ACADEMIC AND PROFESSIONAL DEVELOPMENT

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- 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

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**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.

## DUTIES, TEACHING & MENTORING

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- Cosmology seminar organizer, University College London. *Nov 2019* – present.
- Lecture on *An Introduction to Decision Trees and Random Forests*, University College London. *Mar 2018*.
- Led workshop on *Clean code: guidelines for elegant and efficient code*, University College London. *Nov 2017*.
- Lecture on *An Introduction to Machine Learning*, University College London. *Oct 2016, Oct 2017*.
- Lecture on *Feature Importances in Random Forests*, Oskar Klein Centre, Stockholm, Sweden. *Nov 2016*.
- Peer-mentoring for incoming PhD students, 2017.

## PUBLIC ENGAGEMENT

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- Presented my work at the 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*.

## REFERENCES

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1. **Prof. Hiranya V. Peiris**, Department of Physics and Astronomy, University College London, U.K.
2. **Prof. Andrew Pontzen**, Department of Physics and Astronomy, University College London, U.K.
3. **Dr. Brian Nord**, Machine Intelligence Group, Fermi National Accelerator Laboratory, USA.