

# Alexander Mead

*curriculum vitae*

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## Academic appointments

- 2015 – 2017 **CITA national fellowship**, *Weak lensing*, University of British Columbia, Ludo van Waerbeke.
- 2014 – 2015 **Post-doctoral research**, *Baryonic feedback, matter clustering, weak lensing*, University of Edinburgh, Catherine Heymans.

## Education

- 2010 – 2014 **PhD**, *Cosmological structure formation*, University of Edinburgh, John Peacock.
- 2005 – 2010 **MPhys**, *University of Oxford, 1<sup>st</sup> class, Millard Exhibition, Trinity scholarship*.

## Awards

- 2015 **CITA national fellowship**, *Fellowship to work at UBC*.
- 2010 **STFC funded PhD position**, *PhD in Edinburgh*.
- 2010 **Peter Fisher prize**, *top results in college*.
- 2009 **Trinity College Scholarship**, *1<sup>st</sup> class results in exams*.
- 2008 **Millard Exhibition**, *general high standard of work*.

## PhD thesis

- title *Demographics of dark-matter haloes in standard and non-standard cosmologies*
- supervisors John Peacock, Alan Heavens, Sylvain de la Torre, Lucas Lombriser
- description (1) Tuning the halo model of structure formation to accurately predict the full non-linear matter power spectrum as a function of cosmological parameters. (2) Rescaling cosmological simulations, in terms of both matter distributions and halo catalogues, between cosmological models. (3) Rescaling simulations from standard to modified gravity models.

## Research interests

- Cosmology I have a strong background in fundamental cosmology with particular knowledge of the theory of structure formation including both the perturbative and non-linear regime via the halo model. I am interested in how the halo model can be extended to better model the statistical properties of the density field when considering dark energy (DE) and modified gravity (MG) scenarios and accounting for baryons.

**Simulations** As well as having written my own cosmological simulation code (PM) I am experienced in using GADGET-2 to perform cutting-edge, multi-core simulations. I have modified GADGET-2 to include a dark energy component and I am interested in simulations of both DE and MG models, but particularly in how to *avoid* running large numbers of simulations by applying better theoretical modelling to simulation output, particularly by rescaling between different cosmological models. Over the course of my PhD I developed a large library of software to analyse the output of simulations and to generate and analyse halo catalogues produced by simulations.

**Orbits** I enjoy the theory behind celestial mechanics. I find it particularly fascinating how orbits can be modified over secular timescales by the accumulation of small perturbations and also how day-night cycles and climate would vary on planets with orbital parameters different from that of the earth. To this end I have written a direct particle-particle  $n$ -body code to perform accurate calculations of orbital motions. I have used this to investigate how flux patterns would vary on planets in non-standard orbital configurations including spin-orbit resonance, Lagrange point orbits and planets orbiting a binary.

## Publications

I am an author of 8 papers that mainly deal with theoretical topics. I am first author of 4 of these papers and either second or third author on 3 of the remaining 4 papers. This final paper is the only one that I have worked on as part of a large collaboration. I have an  $h$ -index of 3 and am only one year out of my PhD:

1. A. Mead et al. "An accurate halo model for fitting non-linear cosmological power spectra and baryonic feedback models". In: *preprint (arXiv:e-prints 1505.07833)* (May 2015). arXiv: 1505.07833 (accepted to MNRAS; 2 citations)
2. A. J. Mead et al. "Rapid simulation rescaling from standard to modified gravity models". In: *MNRAS* 452 (Oct. 2015). DOI: 10.1093/mnras/stv1484. arXiv: 1412.5195 (3 citations)
3. A. J. Mead and J. A. Peacock. "Remapping simulated halo catalogues in redshift space". In: *MNRAS* 445 (Dec. 2014). DOI: 10.1093/mnras/stu1964. arXiv: 1408.1047 (2 citations)
4. A. J. Mead and J. A. Peacock. "Remapping dark matter halo catalogues between cosmological simulations". In: *MNRAS* 440 (May 2014). DOI: 10.1093/mnras/stu345. arXiv: 1308.5183 (10 citations)
5. L. Lombriser, F. Simpson, and A. Mead. "Unscreening Modified Gravity in the Matter Power Spectrum". In: *Physical Review Letters* 114.25, 251101 (June 2015). DOI: 10.1103/PhysRevLett.114.251101. arXiv: 1501.04961 (5 citations)
6. D. H. Forgan et al. "Surface flux patterns on planets in circumbinary systems and potential for photosynthesis". In: *International Journal of Astrobiology* 14 (July 2015). DOI: 10.1017/S147355041400041X. arXiv: 1408.5277 [astro-ph.EP] (0 citations)
7. S. P. Brown et al. "Photosynthetic potential of planets in 3:2 spin-orbit resonances". In: *International Journal of Astrobiology* 13 (Oct. 2014). DOI: 10.1017/S1473550414000068. arXiv: 1402.5044 [astro-ph.EP] (2 citations)
8. M. Nicholl et al. "Superluminous supernovae from PESSTO". in: *MNRAS* 444 (Nov. 2014). DOI: 10.1093/mnras/stu1579. arXiv: 1405.1325 [astro-ph.HE] (22 citations)

## Software

I currently maintain the following publicly available software:

1. A. Mead. *HMcode: Halo-model matter power spectrum computation*. Astrophysics Source Code Library. Aug. 2015. ascl: 1508.001

## Computer skills

- OS Linux
- Coding FORTRAN, C, gnuplot
- Simulations GADGET-2, N-GENIC, 2LPTIC, halo finding, simulation analysis tools, direct sum  $n$ -body calculations

## Academic talks

- 2015 Rescaling simulations from standard to modified gravity – *DEX meeting, ROE*
- 2014 Rescaling simulations from standard to modified gravity – *University of Oxford*
- 2014 Rescaling simulations from standard to modified gravity – *McGill University*
- 2014 Central configuration solutions to the  $n$ -body problem – *ROE short talk*
- 2014 Rescaling simulations from standard to modified gravity – *Benasque workshop*
- 2014 Rescaling in redshift space – *UCL cross correlations workshop*
- 2014 Rescaling simulations from standard to modified gravity – *Higgs workshop*
- 2013 Rescaling dark matter halo catalogues – *ROE internal seminar*
- 2013 Life in 3-2 spin-orbit resonance – *ROE short talk*
- 2012 Halofit 2 – *DEX meeting*
- 2012 Halofit 2 – *Benasque workshop*
- 2012 Halofit 2 – *Passo Tonale winter school*

## Outreach

- 2013–2015 The distant Universe – *Course of ten public lectures, given each year for three years*
- 2014 Dark energy – *Talk given to the Edinburgh astronomical society*
- 2012–2013 Progress in astronomy lectures – *Public talks given every month on new discoveries*
- 2013 Mass transfer in binary stars – *ROE public lecture*
- 2012 Large-scale structure formation – *ROE public lecture*

## Teaching

- 2015 The binary orbit menagerie – Summer project
- 2015 Planetary orbits in Lagrange points – Summer project
- 2014 – 2015 The effect of dark energy on cosmological structure formation – Masters project
- 2014 Planetary systems perturbed by passing neutron stars – Summer project
- 2013 – 2015 The distant Universe – Course of public lectures
- 2012 – 2013 General relativity – Undergraduate teaching
- 2010 – 2013 Cosmology – Undergraduate teaching
- 2010 – 2011 Mathematical physics – Undergraduate teaching

## Involvement in academic institutions

- 2012 – 2015 Organiser of the Edinburgh large-scale structure reading group



## Referees

- 1 Professor John Peacock – *jap@roe.ac.uk*
- 2 Dr Catherine Heymans – *cech@roe.ac.uk*
- 3 Professor Alan Heavens – *a.heavens@imperial.ac.uk*