Hayley J. Macpherson

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Employment

Herchel Smith Fellow October 2019 - present
Department of Applied Maths and Theoretical Physics (DAMTP)
University of Cambridge

Teaching Associate, Physics & Astronomy 2015 - 2019
Monash University, Clayton, Victoria, Australia
I worked as a teaching associate during my PhD for the following units offered as part of an Astrophysics major

- *ASP2011 - Astronomy.*
- *ASP2062 - Introduction to astrophysics.*
- *ASP3051 - Relativity and cosmology.*
- *ASP3162 - Computational astrophysics and the extreme universe.*

For all of these I took control of the weekly tutorial/laboratory classes, helping students with questions regarding content, marking weekly question sheets and exam marking.

Education

PhD in Astrophysics, March 2016 - September 2019
Monash University, Clayton, Victoria, Australia
Thesis: Inhomogeneous cosmology in an anisotropic universe

Bachelor of Science (Honours), 2015
Monash University, Clayton, Victoria, Australia
Thesis: Inhomogeneous cosmology in an anisotropic universe

Bachelor of Science, 2012 - 2014
Monash University, Clayton, Victoria, Australia
Major: Astrophysics

Publications

- Adamek, J., Barrera-Hinojosa, C., Bruni, M., Li, B., **Macpherson, H. J.**, and Mertens, J. B., *Numerical solutions to Einstein's equations in a shearing-dust Universe: a code comparison*, 2020, *ArXiv e-prints* 2003.08014 (accepted to CQG)
- **Macpherson H. J.**, Price D. J., Lasky P. D., *Einstein's Universe: Cosmological structure formation in numerical relativity*, 2019, Phys. Rev. D., 99, 063522
- **Macpherson H. J.**, Lasky P. D., Price D. J., *The trouble with Hubble: Local versus Global Expansion Rates in Inhomogeneous Cosmological Simulations with Numerical Relativity*, 2018, ApJ, 865, L4
- **Macpherson H. J.**, Lasky P. D., Price D. J., *Inhomogeneous cosmology with numerical relativity*, 2017, Phys. Rev. D, 95, 064028
- De Silva G. M., Carraro G., D'Orazi V., Efremova V., **Macpherson H.**, Martell S., Rizzo L., *Binary open clusters in the Milky Way: photometric and spectroscopic analysis of NGC 5617 and Trumpler 22*, 2015, MNRAS, 453, 106

Awards

- Charlene Heisler Prize from the Astronomical Society of Australia (ASA) for the most outstanding PhD thesis in astronomy (2020)
- Robert Street Doctoral Prize in Physics for the best PhD thesis in the School of Physics & Astronomy at Monash University (2020)
- Mollie Holman Medal for the best PhD thesis in the Faculty of Science, Monash University (2020)
- Research Associateship, Fitzwilliam College, Cambridge (2020)
- Herchel Smith Postdoctoral Fellowship (2019-2021)
- Monash University's Faculty of Science Young Science Leader Award (2018)
- Best student talk at the 9th ACGRG conference (2017)
- Best student talk at the 10th ANITA Theory Workshop (2016)
- Australian Postgraduate Award PhD scholarship (2016-2019)
- J.L William scholarship from the School of Physics & Astronomy (2016-2019)
- Monash Centre for Astrophysics top honours student prize (2015)

Grants

My project *Inhomogeneous cosmology in an anisotropic Universe (INCA)* was awarded the following allocations in the National Computational Merit Allocation Scheme (NCMAS):

- 1 million CPU hours on the Magnus machine at the Pawsey Supercomputing centre in Perth, Western Australia (December 2016 and 2017 round)
- 100 thousand CPU hours on Multi-modal Australian ScienceS Imaging and Visualisation Environment (MASSIVE) M2 machine in Melbourne (December 2016 round)

Invited Talks

- *"Cosmological simulations of large-scale structure with numerical relativity"* at the "From Dark Energy to Bright Synergies" workshop, Sexten Centre for Astrophysics, Sesto-Sexten, Italy, July 23-27 2018
- *"Cosmological simulations of large-scale structure with numerical relativity"* at the "General relativistic effects in cosmological large-scale structure" workshop, Sexten Centre for Astrophysics, Sesto-Sexten, Italy, July 16-20 2018
- *"General Relativistic cosmological structure formation"* at the 9th Australasian Conference on General Relativity and Gravitation, Gingin, Perth, November 27-30 2017
- *"Einstein's Universe: Cosmological structure formation in numerical relativity"* DAMTP Cosmology Seminar, University of Cambridge, February 24th, 2020
- *"Einstein's Universe: Cosmological structure formation in numerical relativity"* Kenyon College, Columbus, OH, USA, February 21st, 2020
- *"Einstein's Universe: Cosmological structure formation in numerical relativity"* DAMTP General Relativity Seminar, University of Cambridge, November 29th, 2019
- *"Einstein's Universe: Cosmological structure formation in numerical relativity"* School of Physics & Astronomy, Queen Mary University of London, November 20th, 2019
- *"The trouble with H_0: a general relativistic point of view"* Centre for Astrophysics & Supercomputing, Swinburne University of Technology, Melbourne, May 16th 2018

- *"Inhomogeneous cosmology in an anisotropic Universe"* Institute of Cosmology and Gravitation, University of Portsmouth, United Kingdom, July 12th 2017
- *"Inhomogeneous cosmology in an anisotropic Universe"* Department de Physique Theorique, Universite de Geneve, Switzerland, June 30th 2017
- *"Inhomogeneous cosmology with the Einstein Toolkit"* Department of Physics, University of Trento, Italy, June 20th 2016

Conference Presentations

- *"The trouble with Hubble: a general relativistic point of view"* at the 30th Texas Symposium on Relativistic Astrophysics, Portsmouth, United Kingdom, December 16-20 2019
- *"Cosmological structure formation with numerical relativity"* at the 13th ANITA Theory Workshop, Swinburne University of Technology, Melbourne, February 4-8 2019
- *"Inhomogeneous cosmological simulations with numerical relativity"* at the Inhomogeneous Cosmologies III workshop, Jagiellonian University, Kraków, Poland, September 16-21 2018
- *"Inhomogeneous cosmology in an anisotropic Universe"* at the Inhomogeneous Cosmologies workshop, Nicolaus Copernicus University, Torun, Poland, July 1-7 2017
- *"Inhomogeneous cosmology with numerical relativity"* at the 11th ANITA Theory Workshop, University of Tasmania, February 9-10 2017
- *"Formation of structures in the Universe: A full General-Relativistic treatment"* at CAASTRO Diving into the Dark: Bridging Cosmological Theory & Observation, Cairns, July 18-22 2016
- *"Cosmology with the Einstein Toolkit"* at the Einstein Toolkit EU School and Workshop, University of Trento, Italy, June 13-17 2016
- *"Formation of structures in the Universe: A full General-Relativistic treatment"* at the 10th ANITA Theory Workshop, Monash University, February 11-12 2016
- *"Formation of structures in the Universe: A full General-Relativistic treatment"* at the Eighth Australasian Conference on General Relativity and Gravitation (ACGRG8), Monash University, December 2-4 2015

Professional Activities

- Local organising committee member for the 13th Australian National Institute for Theoretical Astrophysics (ANITA) annual science workshop in Melbourne, February 4th-8th (2019)
- Delivered a tutorial (4 hours total) on using the Einstein Toolkit numerical relativity code at the Inhomogeneous Cosmologies III workshop in Kraków, Poland (2018)
- Scientific organising committee member for the Inhomogeneous Cosmologies III workshop in Kraków, Poland (2018)
- Local organising committee member for the 1st Phantom Users Workshop in Melbourne, February 19-23 (2018)
- Member of the Postgraduate Committee (PGC) and representative for students within the School of Physics & Astronomy (2017)
- Steering committee member for the Monash University Graduate Research Conference in Melbourne, November 17 (2017)
- Local organising committee member for the ADACS Data Intensive Astronomy Workshop in Melbourne, August 7-9 (2017)

- Scientific organising committee member for the 1st Inhomogeneous Cosmologies workshop in Torun, Poland (2017)

Skills

- Extensive use of the Einstein Toolkit numerical relativity code based on the Cactus infrastructure
- Proficient in Fortran 90 and Python programming
- Basic usage of Mathematica including the Riemannian Geometry and Tensor Calculus (RGTC) package
- Over 1 million CPU hour usage of supercomputer resources

Outreach

- Co-founder of the School of Physics and Astronomy Women in Physics & Astronomy mentoring program
  - Organised many social events to encourage engagement between undergraduate women in physics and higher-level researchers
  - Allocated mentoring pairs / groups based on common interests and goals for the program
  - Managed and monitored the success and progress of the program through 2018 and 2019
  - Mentored my own pair of undergraduate women in physics for 2018 and 2019
- *"Newton vs Einstein: battle of the brains"* kids talk online YouTube stream for the IoA Cambridge, June 30th, 2020
- *"How to make a Universe"* talk at Astronomy on Tap, Cambridge, February 27th, 2020
- Organiser for "*Astronomy on Tap*" Cambridge (2019 - present)
- Panel member for Science Week Q&A session at "The Academy" Catholic Girls Secondary School, Melbourne, August 14th (2019)
- Live science demonstrations for "Science Night" at Overport Primary School, Melbourne (2017 & 2019)
- Participant in running the Monash Centre for Astrophysics outreach stand at the Astrolight Festival at Scienceworks, Melbourne (2017)
- Skype discussion with primary school students in Tawa, New Zealand about space and Astronomy (2016)
- Monash University open day talk to high school students encouraging Physics & Astronomy (2015)

References

Professor Paul Shellard
Current Research Group Lead
DAMTP
University of Cambridge, UK
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Professor Daniel Price
Ph.D primary supervisor
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Dr. Paul Lasky
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