

# James Wurster

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## Employment

- 2016 – present    **Research Fellow**  
Astrophysics Group  
School of Physics  
University of Exeter  
Exeter, England
- 2013 – 2016    **Research Fellow**  
Monash Centre for Astrophysics (MoCA)  
School of Physics and Astronomy  
Monash University  
Melbourne, Australia

## Education

- 2008 – 2013    **Ph. D. Astronomy**  
Saint Mary's University (SMU)  
Halifax, Nova Scotia, Canada  
Title: *Feedback from AGN: A Study of its Impact and Numerical Implementations*  
Advisor: Dr. Robert J. Thacker
- 2006 – 2008    **M. Sc. Astronomy**  
Queen's University  
Kingston, Ontario, Canada  
Title: *Defining Gravitational Singularities in General Relativity*  
Advisor: Dr. Kayll Lake
- 2002 – 2004    **B. Sc. (Honours) Mathematics and Physics**  
The University of Western Ontario (UWO)  
London, Ontario, Canada  
Honours Thesis Title: *Simulating the Hydrodynamic Collapse of a 3D Molecular Cloud*  
Honours Thesis Advisor: Dr. Shantanu Basu

## Publications

### Refereed journal publications

- J. Wurster**, D. J. Price, and M. R. Bate. Can non-ideal magnetohydrodynamics solve the magnetic braking catastrophe? *MNRAS*, 457:1037–1061, March 2016.
- J. Wurster**, D. Price, and B. Ayliffe. Ambipolar diffusion in smoothed particle magnetohydrodynamics. *MNRAS*, 444:1104–1112, October 2014.
- R. J. Thacker, C. MacMackin, **J. Wurster**, and A. Hobbs. AGN feedback models: correlations with star formation and observational implications of time evolution. *MNRAS*, 443:1125–1141, September 2014.
- D. J. Williamson, R. J. Thacker, **J. Wurster**, and B. K. Gibson. Cloud angular momentum and effective viscosity in global SPH simulations with feedback. *MNRAS*, 442:3674–3685, August 2014.

**J. Wurster** and R. J. Thacker. A comparative study of AGN feedback algorithms. *MNRAS*, 431:2513–2534, May 2013.

**J. Wurster** and R. J. Thacker. Accretion disc particle accretion in major merger simulations. *MNRAS*, 431:539–553, May 2013.

S. Basu, G. E. Ciolek, W. B. Dapp, and **J. Wurster**. Magnetically-regulated fragmentation induced by nonlinear flows and ambipolar diffusion. *New A*, 14:483–495, July 2009.

S. Basu, G. E. Ciolek, and **J. Wurster**. Nonlinear evolution of gravitational fragmentation regulated by magnetic fields and ambipolar diffusion. *New A*, 14:221–237, April 2009.

### Submitted papers

**J. Wurster**. NICIL: A stand alone library to self-consistently calculate non-ideal magnetohydrodynamic coefficients in molecular clouds.

### Conferences

- February 2016 *Australian National Institute for Theoretical Astrophysics*, Melbourne, VIC, Australia.  
Contributed Talk: To Be or Not to Be: That is the Hall Effect.  
**J. Wurster**, D. Price & M. Bate.
- Sept. 2015 *Protoplanetary Disk Dynamics and Planet Formation*, Yokohama, Japan.  
Contributed Talk: Disc Formation using Non-Ideal Magnetohydrodynamics  
**J. Wurster**, D. Price & M. Bate
- June 2015 *Disc dynamics & Planet formation*, Larnaka, Cyprus.  
Contributed Poster: Bring back the disc!  
**J. Wurster**, D. Price & M. Bate
- February 2015 *Australian National Institute for Theoretical Astrophysics*, Canberra, ACT, Australia.  
Contributed Talk:  
When Ideal Gas is Not Enough: Collapsing a Cloud to form a Protostar.  
**J. Wurster** & D. Price.
- July 2014 *AGN vs Star Formation: The Fate of the Gas in Galaxies*, Durham, England.  
Contributed Poster:  
Influence of real vs numerical bulge mass on star formation rates during major mergers.  
**J. Wurster** & R.J. Thacker.
- February 2014 *Australian National Institute for Theoretical Astrophysics*, Sydney, NSW, Australia.  
Contributed Talk: AGN feedback: A comparative study.  
**J. Wurster**.
- March 2012 *Turbulence in Cosmic Structure Formation*, Tempe, Arizona, United States.  
Contributed Poster: A comparative study of AGN feedback implementations.  
**J. Wurster** & R. J. Thacker.

### Colloquia

- February 2016 *Swinburne University*, Melbourne, Victoria, Australia.  
On the formation of proto-stellar discs using non-ideal magnetohydrodynamics.
- February 2016 *Monash University (MoCA)*, Melbourne, Victoria, Australia.  
On the formation of discs using non-ideal magnetohydrodynamics.
- August 2015 *Monash University (Fluids Seminar Series)*, Melbourne, Victoria, Australia.  
Magnetohydrodynamics in the star formation process.
- June 2015 *University of Exeter*, Exeter, England.  
Finding the disc around pre-stellar objects.
- April 2015 *University of Melbourne*, Melbourne, Victoria, Australia.  
The Challenges of Numerical Star Formation.
- August 2014 *University of Central Lancashire*, Preston, England.  
Angels and Demons: AGN sub-grid models.
- June 2014 *Monash University (MoCA)*, Melbourne, Victoria, Australia.  
Angels and Demons: AGN sub-grid models.

Sept. 2012      *Saint Mary's University*, Halifax, Nova Scotia, Canada.  
A comparative study of AGN feedback implementations.

### Technical Skills Summary

Computer Languages	Fortran, Python, GNUplot, $\LaTeX$ .
Numerical Codes	Smooth Particle Hydrodynamics: PHANTOM, SPHNG, HYDRA. Grid: ZEUS-3D.
Numerical Modelling	Run large simulations to analyse the physical evolution and final state. Run suites of simulations to perform systematic comparisons to determine the effects of the included terms and parameters. Use pre-written and self-written analysis programmes (Fortran, Python) to analyse and interpret numerical data.
Code Development	Extended existing astrophysical codes to include new physics. – Wrote and implemented an ionisation and non-ideal magnetohydrodynamic module (PHANTOM, SPHNG). – Wrote and implemented several AGN feedback sub-grid models (HYDRA). – Wrote and implemented an N-body solver to track stars created in shocks (ZEUS-3D). – Wrote and implemented an external force routine to model AGN winds (ZEUS-3D). Modified existing astronomical codes for enhanced realism. – Added physical checks to sink particle creation (PHANTOM). Modified existing astronomical codes for enhanced performance. – Incorporated super-timestepping to current timestepping algorithm (PHANTOM). – Incorporated the Saito-Makino timestep limiter in the independent timestep algorithm to wake inactive neighbours (PHANTOM). – Modified output to logfile to be less verbose yet more useful by summarising important quantities (PHANTOM). – Modified the star formation algorithm to obtain speed-ups of a few to a few dozen (HYDRA). Debug large astronomical codes.

### Supervision Summary

Summer 2015-2016	Ms. Madeline Marshall Third Year Summer Student (Monash; co-supervised with Dr. Paul Lasky) Project Title: <i>Simulating the largest explosions in the Universe: Equations of State in Neutron Star Mergers</i>
Summer 2015-2016	Mr. Bernard Field First Year Summer Student (Monash; co-supervised with Dr. Paul Lasky) Project Title: <i>Simulating the largest explosions in the Universe: Gravitational Wave Emission during Neutron Star Mergers</i>
2015	Mr. David Liptai Honours Thesis (Monash; co-supervised with Dr. Daniel Price) Project Title: <i>Star Formation: Determining the Initial Mass Function</i>

## Teaching Summary

Oct 2015	Lecturer: Stars and Galaxies (galaxy interactions and galaxy clusters modules; Monash: ASP 3012)
Sept 2011 – Apr 2013	Teaching Assistant Coordinator (SMU): oversaw all teaching assistants in the Department of Astronomy and Physics
Jan 2013 – Apr 2013	Instructor: University Physics laboratory sections (SMU: PHYS 1101)
Jan 2012 – Dec 2012	Instructor: Physics for Life Science laboratory sections (SMU: PHYS 1000/1001)
Sept 2011 – Apr 2012	Teaching Assistant: University Physics laboratory section (SMU: PHYS 1100/1101)
Sept 2008 – Apr 2009	Teaching Assistant: University Physics laboratory section (SMU: PHYS 1100/1101)
Sept 2008 – Apr 2009	Teaching Assistant: University Physics help desk (SMU: PHYS 1100/1101)
Jan 2007 – Dec 2008	Teaching Assistant: Practical Engineering Modules laboratory section (Queen's University: APSC 100)
Sept 2007 – Apr 2007	Tutor: First year physics for physicists (Queen's University: PHYS 104)
Sept 2006 – Dec 2006	Teaching Assistant: Second year dynamics laboratory section (Queen's University: PHYS 206)

## Scholarships and Awards

Dec 2014	Awarded 600000CPU hours from the Australian National Computational Merit Allocation Scheme (NCMAS)
Sept 2011 – Aug 2012	Faculty of Graduate Studies and Research Graduate Award (SMU)
Sept 2011 – Aug 2012	Faculty of Graduate Studies and Research Fellowship (SMU)
Sept 2009 – Aug 2011	National Science and Engineering Research Council of Canada (NSERC) Canada Graduate Scholarship - Ph. D. Level
Sept 2008 – Aug 2010	Faculty of Graduate Studies and Research Graduate Award (SMU)
Sept 2007 – Aug 2008	NSERC Post Graduate Scholarship - M. Sc. Level (Extension)
Sept 2006 – Aug 2007	NSERC Canada Graduate Scholarship - M. Sc. Level

### **Other activities – Memberships**

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|-----------|---|
| 2013–2016 | Astronomical Society of Australia (ASA; professional organization)                            |
| 2013–2016 | Australian National Institute for Theoretical Astrophysics (ANITA; professional organization) |
| 2008–2013 | Canadian Astronomical Society (CASCA; professional organization)                              |

### **Other activities – Volunteer positions**

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|-------------------------|--|
| 2015–present            | MoCA Public Talk Series: Co-coordinator  |
| 2014                    | MoCA Seminar Series: Coordinator   |
| Nov 2013                | MoCA PhD Day: Organised and ran critical writing workshop  |
| Spring 2010             | CASCA 2010: Graduate student representative on SMU's local organising committee, and organised the Graduate Student Workshop |
| 2010                    | International Year of Astronomy:<br>Various positions at events (e.g. public talks, public observing) hosted by SMU          |
| Sept 2008 –<br>Aug 2010 | SMU's Burke-Gaffney Observatory:<br>Periodically assisted the telescope operator at public tours                             |
| April 2008              | Frontenac, Lennox, and Addington Science Fair: Judge   |
| June 2007               | CASCA 2007: Served on the Royal Military College's local organising committee  |
| April 2007              | Frontenac, Lennox, and Addington Science Fair: Judge   |

### **References**

Available upon request

March 21, 2016