# Elizabeth Gould

*Curriculum Vitae*

*School of Physics and Astronomy, University of Southampton*
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## Research Interests

- Early Universe Cosmology
- Quantum Foundations
  - Defining Quantum vs Classicality
  - Various Interpretations of Quantum Mechanics to Resolve the Measurement Problem
- Non-Causal Structures: Retrocausal Quantum Mechanics and Closed Timelike Curves
- Gravity
  - Black Holes, Wormholes, Exotic Geometries
  - Quantum Gravity

## Summary of Qualifications

- 6.5 years of research experience in Physics
- 4 publications and 1 more submitted to a journal
- Highly proficient in various programming software
- Advised other graduate students on how to conduct cosmological data analysis

## Education

**Ph.D. in Physics – Cosmology**, *Department of Physics & Astronomy, University of Waterloo (UW)*, Waterloo, Ontario, Canada, Sep 2011 – Sep 2017.

- *Thesis Title:* New Views on Cosmological Big Bang
  Thesis Supervisor: Dr. Niayesh Afshordi (Perimeter Institute and UW)

**M.Sc. in Physics – Perimeter Scholars International program**, *University of Waterloo (UW)*, Waterloo, Ontario, Canada, Aug 2010 – Jun 2011.

- *Project Title:* Searching for Noncovariant Symmetric Informationally Complete Quantum Measurements
  Project Supervisor: Dr. Christopher A. Fuchs (previously: Perimeter Institute and UW)

**B.Sc. in Physics, with high distinction**, *Worcester Polytechnic Institute (WPI)*, Worcester, MA, USA, Sep 2005 – May 2010.

- *Major Qualifying Project:* Proofs of the Kochen-Specker Theorem in 3 Dimensions
  Project Supervisor: Prof. P. K. Aravind (Department of Physics, WPI)
- *Interactive Qualifying Project:* Education in a Technological Society
  Project Supervisor: Neil Heffernan (Department of Computer Science, WPI)
- *Sufficiency Project:* The Role of the Observer in Modern Physics (subject: philosophy)
  Project Supervisor: Prof. Ruth Smith (Department of Humanities & Arts, WPI)

## Research Experience

**Research Fellow**, *School of Physics and Astronomy, University of Southampton*, Southampton, United Kingdom, Nov 2017 – present.

- Developing Holographic Cosmology and Periodic Time Cosmology.

**Doctoral Student**, *Perimeter Institute for Theoretical Physics*, Waterloo, Ontario, Canada, Sep 2011 – Sep 2017.

- Developed non-equilibrium model for Lee Smolin's real ensemble quantum mechanics.
- Compared various models, one of my own design, to $\Lambda CDM$ using CosmoMC.

**Master's Student**, *Perimeter Institute for Theoretical Physics*, Waterlo, Ontario, Canada, Apr 2011 – Jun 2011.

- Wrote computer code in Fortran to search for non group covariant SICs.

**Research Assistant**, *Department of Computer Science, Worcester Polytechnic Institute*, Worcester, MA, USA, Sep 2009 – Apr 2010.

- Developed problems for ASSISTments educational computer software.
- Compared performance of students for different problem presentations.

**Research Experience for Undergraduates Student**, *Department of Physics, Lehigh University*, Bethlehem, PA, USA, Jun 2009 – Aug 2009.

- Wrote C++ code to model collisions between NaK and Ar and compared to experiment.

**Undergraduate Researcher**, *Department of Physics, Worcester Polytechnic Institute*, Worcester, MA, USA, Sep 2008 – Apr 2009.

- Examined properties of various proofs of the Bell-Kochen-Specker theorem.

**Research Assistant**, *Department of Physics, Worcester Polytechnic Institute*, Worcester, MA, USA, Jun 2007 – Jul 2007.

- Created Matlab program to integrate Van der Waals potential.

**Undergraduate Researcher**, *Department of Humanities & Arts, Worcester Polytechnic Institute*, Worcester, MA, USA, Mar 2007 – Dec 2007.

- Wrote a philosophy paper relating the themes in modern physics to previous conceptions.

**Research Assistant**, *Harvard Smithsonian Center for Astrophysics*, Cambridge, MA, USA, Jun 2005 – Aug 2005 and May 2006 – Aug 2006.

- Programmed computer interface for data acquisition card and Advanced Frequency Counter.

## Publications

### Refereed Publications

1. **"Constraining holographic cosmology using Planck data"**
   N. Afshordi, **E. Gould** and K. Skenderis.
   arXiv:1703.05385 [astro-ph.CO]
   DOI:10.1103/PhysRevD.95.123505
   Phys. Rev. D **95**, 123505 (2017)
2. **"From Planck data to Planck era: Observational tests of Holographic Cosmology"**
   N. Afshordi, C. Coriano, L. Delle Rose, **E. Gould** and K. Skenderis.
   arXiv:1607.04878 [astro-ph.CO]
   DOI:10.1103/PhysRevLett.118.041301
   Phys. Rev. Lett. **118**, 041301 (2017)
3. **"A Non-Local Reality: Is there a Phase Uncertainty in Quantum Mechanics?"**
   **E. Gould** and N. Afshordi.

arXiv:1407.4083 [quant-ph]
DOI:10.1007/s10701-015-9948-8
Found. Phys. **45**, no. 12, 1620 (2015)

4. **"Isomorphism between the Peres and Penrose proofs of the BKS theorem in three dimensions"**
**E. Gould** and P. K. Aravind.
arXiv:0909.4502 [quant-ph]
DOI:10.1007/s10701-010-9434-2
Found. Phys. **40**, no. 8, 1096 (2010)

### Submitted Manuscripts

1. **"Cosmological Perturbations in the 5D Holographic Big Bang Model"**
N. Altamirano, **E. Gould**, N. Afshordi and R. B. Mann.
arXiv:1703.00954 [astro-ph.CO]
Submitted to *PRD*.

## Conference Presentations

1. Presentation in Discussion Session 2 at Bounce Scenarios in Cosmology.
Perimeter Institute for Theoretical Physics, Waterloo, Ontario, Canada, Jun 2017.
2. **"Rethinking Time at the Big Bang"**
Parallel Talk at PASCOS 2017.
Instituto de Física Teórica, UAM-CSIC, Madrid, Spain, Jun 2017.
3. **"Rethinking Time at the Big Bang"**
Presentation at Theory Canada 12.
York University, Toronto, Ontario, Canada, May 2017.
4. **"Observational Constraints of Holographic Cosmology from Planck Data"**
Presentation at 2016 Midwest Relativity Meeting.
Perimeter Institute for Theoretical Physics, Waterloo, Ontario, Canada, Oct 2016.
5. **"From Planck data to Planck era: Observational tests of Holographic Cosmology"**
Poster presentation at Cosmo 16.
University of Michigan, Ann Arbor, Michigan, USA, Aug 2016.

## Programming Skills

- *Programming:* general experience, including: C/C++, Fortran, Java, Mathematica, Matlab, LaTeX, mixed C and Fortran code
- *Image Processing:* GIMP, Inkscape
- *Physics Specific Software:* CAMB, CosmoMC

## Scholarships and Awards

**UW Graduate Scholarship**, *University of Waterloo*, Sep 2016 – Aug 2017.

**Marie Curie Graduate Student Award**, *University of Waterloo*, Sep 2014 – Aug 2017.

**Perimeter Institute PhD Award**, *University of Waterloo*, Sep 2011 – Aug 2017.

**Graduate Research Studentship**, *University of Waterloo*, Sep 2011 – Aug 2017.

**Science Graduate Experience Award**, *University of Waterloo*, Jan 2013, Sep 2014, Sep 2015, Sep 2016.

**International Doctoral Student Award**, *University of Waterloo*, Sep 2011 – Aug 2016.

**Provost Doctoral Entrance Award for Women**, *University of Waterloo*, Sep 2011.

**Perimeter Scholars International Award**, *University of Waterloo*, Sep 2010 – Jun 2011.

**PSI Tuition Award**, *University of Waterloo*, Sep 2010 – Jun 2011.

**The Goddard Award**, *Worcester Polytechnic Institute*, Apr 2010.

**Provost MQP award**, *Worcester Polytechnic Institute*, Apr 2009.

## Teaching Experience

**Teaching Assistant**, *University of Waterloo*, Waterloo, Ontario, Canada, 2012–present.

- Grading student assignments and tests.
- Guiding students through sample problems as section instructor.
- *Courses:* Quantum Physics 1; Mechanics; Exploring the Universe; Fundamentals of Astrophysics; Electricity and Magnetism 3; Physics of Electrical Engineering 1

**Undergraduate Teaching Assistant**, *Department of Physics, Worcester Polytechnic Institute*, Worcester, MA, USA, Sep 2009 – Dec 2009.

- Graded student assignments.

## Service and Leadership

**Vice President**, *Society of Physics Students, Worcester Polytechnic Institute Chapter*, Sep 2009 – May 2010.

**Speaker Coordinator**, *Society of Physics Students, Worcester Polytechnic Institute Chapter*, Sep 2007 – May 2009.

## Professional Memberships

- Sigma Pi Sigma (physics honors society), 2008 – present
- American Physical Society, 2006 – 2015