# Gavin S. Hartnett

Machine Learning Researcher/Theoretical Physicist

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## Education

### University of California, Santa Barbara
*Santa Barbara, CA*

PHD and MA in Physics — *Aug. 2009 - May 2015*

- Adviser: Prof. Gary Horowitz
- Dissertation: Aspects of Black Holes in Higher Dimensions

### Syracuse University
*Syracuse, NY*

BSC in Physics and Mathematics — *Sept. 2005 - May 2009*

- Summa Cum Laude
- Honors Thesis: Spiral Patterns in Liquid Crystals

## Research Experience

### The RAND Corporation (Current Position)
*Santa Monica, CA*

Information Scientist — *Aug. 2017 - present*

- AI/ML Lablet Lead at the Tech and Narrative Lab
- Organizer of company-wide AI seminar series and study group
- Co-PI for project on generative modeling for networks
- Investigated the vulnerability of autonomous agents to adversarial examples
- Investigated domain adaptation for object detection using synthetic data sets

### University of Southampton
*Southampton, United Kingdom*

Postdoctoral Research Fellow — *Sept. 2015 - Aug. 2017*

- Studied theoretical properties of black holes and quantum field theories
- Worked on multiple projects as part of an international collaboration
- Co-organized 3 seminar series
- Traveled extensively to present research and facilitate collaborations

### University of California, Santa Barbara
*Santa Barbara, CA*

Graduate Student Researcher — *May 2010 - Aug 2015*

- Researched black holes, string theory, and quantum field theory
- Played active role in department, serving as head TA and as the organizer of a weekly journal club

### Syracuse University
*Syracuse, NY*

Undergraduate Research Assistant — *June 2006 - May 2009*

- Senior Thesis Project in Condensed Matter, with Prof.'s Mark Bowick and Cristina Marchetti
- Laser Interferometer Gravitational-Wave Observatory (LIGO) research, with Prof. Peter Saulson
- Cosmology research, with Prof.'s Mark Trodden and Christian Armendariz-Picon

### Cornell University
*Ithaca, NY*

REU Summer Research Assistant — *Summer 2008*

- Investigated Modified Source Gravity Models, with Prof. Rachel Bean
- Studied cosmic string dynamics in expanding universe, with Prof. David Chernoff

# Teaching

### Pardee RAND Graduate School

*Santa Monica, CA*

Core Faculty Member — *2018-2019 Academic Year*

- Introduction to Blockchain Technology

### University of Southampton

*Southampton, UK*

Lecturer — *Sept. 2015 - May 2015*

- MATH1052 Differential Equations
- MATH1008 Mathematical Methods
- MATH3071 Light and Waves

### University of California, Santa Barbara

*Santa Barbara, CA*

Head Teaching Assistant — *Aug. 2010 - Aug. 2012*

- Managed team of 40+ TA's for the entire Physics Department
- Worked with faculty and staff to assign TA's to courses

Teaching Assistant — *Sept. 2009 - May 2015*

- PHYS6L Introductory Physics (3 quarters)
- PHYS21 General Physics
- PHYS105 Classical Mechanics
- PHYS115 Quantum Mechanics (2 quarters)
- PHYS219 Statistical Mechanics (graduate level)

# Professional Activities

Organizer of the company-wide AI seminar series and study group at the RAND Corporation — *2018 - present*

Organizer of Graduate Student High-Energy Journal Club — *2012 - 2014*

Referee for

- *ACM Conference on Fairness, Accountability, and Transparency (FAccT) 2020*
- *NeurIPS 2019 Workshop: Machine Learning and the Physical Sciences*
- *Journal of High Energy Physics (JHEP)*
- *Physical Letters B*
- *Classical and Quantum Gravity*
- *General Relativity and Gravitation*

# Awards

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|---|---|---|
| 2020 | **RAND Bronze Medal Award**, company-wide annual award, awarded for "vision, integrity, and leadership" in the course of a project on adversarial machine learning for cyber defense systems. | *Santa Monica, CA* |
| 2019 | **RAND Spotlight Award**, awarded for "developing a new game theoretic approach with Machine Learning techniques to assess cyber defense capabilities." | *Santa Monica, CA* |
| 2019 | **RAND Project Air Force Team Innovation Award**, awarded for our team's "high-risk/high-reward approach to solving a complex technical problem – understanding how machine learning-based algorithms might be vulnerable to cyber attack" | *Santa Monica, CA* |
| 2014 | **Dean's Fellowship**, Competitive University-wide fellowship | *Santa Barbara, CA* |
| 2013 | **James Hartle Award**, Best graduate student talk | *Warsaw, Poland* |
| 2011 | **Chairs Certificate of Appreciation**, Outstanding service as Head TA | *Santa Barbara, CA* |
| 2009 | **Syracuse University Scholar**, Highest undergraduate academic honor | *Syracuse, NY* |
| 2008 | **Barry Goldwater Scholarship**, Most prestigious undergraduate national science award | *Syracuse, NY* |

# Publications

1 **Deep Generative Modeling in Network Science with Applications to Public Policy Research**
G. S. Hartnett, R. Vardavas, L. Baker, M. Chaykowski, C. B. Gibson, F. Girosi, D. P. Kenedy, O. A. Osoba.
arXiv:2010.07870 [cs.LG]
RAND Working Paper WRA843-1

2 **Self-Supervised Learning of Generative Spin-Glasses with Normalizing Flows**
G. S. Hartnett, M. Mohseni.
arXiv:2001.00585 [cs.LG]
Preprint

3 **A Probability Density Theory for Spin-Glass Systems**
G. S. Hartnett, M. Mohseni.
arXiv:2001.00927 [cond-mat.dis-nn]
Preprint

4 **Operationally Relevant Artificial Training for Machine Learning: Improving the Performance of Automated Target Recognition Systems**
G. S. Hartnett, L. Menthe, J. Léveillé, D. Baveye, L. Zhang, D. Gold, J. Hagen, J. Xu.
RAND Report RRA683-1 (2020)

5 **Covariant Noether charges for type IIB and 11-dimensional supergravities**
O. J. C. Dias, G. S. Hartnett, J. E. Santos.
arXiv:1912.01030 [hep-th]
Accepted to Class. Quant. Grav.

6 **Adversarial Examples for Cost-Sensitive Classifiers**
G. S. Hartnett, A. J. Lohn, A. P. Sedlack.
arXiv:1910.02095 [stat-ML]
Accepted to the Workshop on Safety and Robustness in Decision Making, NeurIPS 2019

7 **Holographic dual of hot Polchinski-Strassler quark-gluon plasma**
I. Bena, O. J. C. Dias, G. S. Hartnett, Benjamin. E. Niehoff, J. E. Santos.
arXiv:1805.06463 [hep-th]
JHEP 9, 33 2019

8 **Replica Symmetry Breaking in Bipartite Spin Glasses and Neural Networks**
G. S. Hartnett, E. Parker, E. Geist.
arXiv:1803.06442 [cond-mat.dis-nn; cs.LG]
Phys. Rev. E 98, issue 2, 022116 (2018)

9 **Constraining the mass of dark photons and axion-like particles through black-hole superradiance**
V. Cardoso, O. J. C. Dias, G. S. Hartnett, M. Middleton, P. Pani, J. E. Santos.
arXiv:1801.01420 [gr-qc]
JCAP 1803, no.03, 043 (2018)

10 **Mass-deformed M2 branes in Stenzel space**
O. J. C. Dias, G. S. Hartnett, B. E. Niehoff, J. E. Santos
arXiv:1704.02323 [hep-th]
JHEP 1711, 105 (2017)

11 **Localised Anti-Branes in Flux Backgrounds**
G. S. Hartnett.
arXiv:1501.06568 [hep-th]
JHEP 1506, 007 (2015)

12 **A No Black Hole Theorem**
G. S. Hartnett, G. T. Horowitz and K. Maeda.
arXiv:1410.1875 [hep-th]
Class. Quant. Grav. 32, no. 5, 055011 (2015)

13 **Quasinormal modes of asymptotically flat rotating black holes**
O. J. C. Dias, G. S. Hartnett and J. E. Santos.
arXiv:1402.7047 [hep-th]
Class. Quant. Grav. 31, no. 24, 245011 (2014)

14 **Holographic thermalization, quasinormal modes and superradiance in Kerr-AdS**
V. Cardoso, O. J. C. Dias, G. S. Hartnett, L. Lehner and J. E. Santos.
arXiv:1312.5323 [hep-th]
JHEP 1404, 183 (2014)

15 **Non-Axisymmetric Instability of Rotating Black Holes in Higher Dimensions**
G. S. Hartnett and J. E. Santos.
arXiv:1306.4318 [gr-qc]
Phys. Rev. D 88, 041505 (2013)

16 **Geons and Spin-2 Condensates in the AdS Soliton**
G. S. Hartnett and G. T. Horowitz
arXiv:1210.1606 [hep-th]
JHEP 1301, 010 (2013)

## Invited Talks

[Scheduled] Neural Networks for Networks

- LLNL Data Science Initiative Seminar Series
  Lawrence Livermore National Laboratory
  February 2, 2020

Replica Symmetry Breaking in Bipartite Spin Glasses and Neural Networks

- Theoretical Physics for Machine Learning, Aspen Winter Conference
  Aspen Center of Physics
  Aspen, Colorado
  January 2019

Machine Learning for Cybersecurity

- Project Air Force, Force Modernization and Employment Seminar
  RAND Corporation
  Santa Monica, California
  November 2017
  (joint talk with A. Shah, O. Osoba, M. Lee, and C. Steiner)

Deep Learning as Renormalization: Using tools from physics to better understand neural networks

- RAND Corporation
  Santa Monica, California
  April 2017

Thinking outside the truncation: new hair for holographic superconductors

- 21st International Conference on General Relativity and Gravitation
  Columbia University, New York City
  July 2016

Localised Anti-branes in Flux Backgrounds

- Weekly High Energy Seminar
  Institute for Theoretical Physics, Katholieke Universiteit Leuven, Belgium
  March 2016
- Friday Gravity Seminar
  Department of Applied Mathematics and Theoretical Physics, Cambridge University, United Kingdom
  February 2016
- Rencontres Théoriciennes Seminar: “Supergravité, théorie des cordes et théorie M”
  Institut Henri Poincaré, Paris, France
  December 2015

A No Black Hole Theorem

- High Energy Physics Seminar
  CEA Saclay, Paris, France
  December 2015
- High Energy Physics Seminar
  University of California at Santa Barbara
  November 2014

### Spinning Out of Control: Black Hole Instabilities in Higher Dimensions

- Gravity Seminar
  University of Southampton, United Kingdom
  October 2015

### Symmetry in String Theory

- Invited Guest Lecture: Undergraduate Course CS 10: Symmetry and Aesthetics in Contemporary Physics
  University of California, Santa Barbara
  March 2016

### How Horizons Saved the Landscape

- High Energy Physics Seminar
  University of Southern California
  February 2015

### Instabilities of Rotating Black Holes and Quasinormal Modes in the Large D Limit

- 30th Annual Pacific Coast Gravity Meeting
  University of California, San Diego
  March 2014

### Geons and Spin-2 Condensates in the AdS Soliton

- 20th International Conference on General Relativity and Gravitation/10th Edoardo Amaldi Conference on Gravitational Waves
  University of Warsaw, Warsaw, Poland
  July 2013 April
- APS Meeting
  Denver
  April 2013