Lee M Gunderson

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I am a physicist working on ideas related to complex networks, causality, and information.

Education

Princeton University

Princeton, NJ, USA

PhD in Astrophysics --- Plasma Physics

June 2020

- *Dissertation*: ``Solar Equilibrium à la Grad--Shafranov''
- *Select courses (hyperlinked):* Analytical techniques & differential equations, Differential geometry in plasma physics, Computational complexity, Mathematical physics, Plasma waves & instabilities, Nonlinear processes in fluids & plasmas, Irreversible processes in plasmas, Computational methods in plasma physics, Arithmetic of elliptic curves, Quantum field theory, Matroid theory

University of Michigan

Ann Arbor, MI, USA

B.S.E. in Nuclear Engineering and Radiological Sciences Minor in Mathematics

Spring 2012

- *GPA*: 3.99/4.00
- *Select courses:* Partial differential equations, Dynamical systems, Thermodynamics, Real analysis, Complex analysis, Abstract algebra, Music theory

Academic appointments

Department of Statistical Science - UCL

London, UK

Research Fellow

2025 - present

- Estimating Causal Effects with Fewer Assumptions (with Ricardo Silva):
  Partial causal identifiability using imperfect instrumental variables.

Gatsby Computational Neuroscience Unit - UCL

London, UK

Research Fellow

2021 - 2024

- Inferring Stochastic Block Models from Subgraph Counts (with Peter Orbanz):
  Devised a clever way to convert subgraph densities into stochastic block models.

Simons Institute For the Theory of Computing

Berkeley, CA, USA

Visiting Postdoc

Fall 2022

- Program: Graph Limits and Processes on Networks: From Epidemics to Misinformation *(link)*

Publications

BudgetIV: Optimal Partial Identification of Causal Effects with Mostly Invalid Instruments *(link)*
J Penn, G Bravo-Hermsdorff, LM Gunderson, R Silva, DS Watson. *AISTATS, 2025* *(code)*

Bounding Causal Effects with Leaky Instruments.
DS Watson, J Penn, LM Gunderson, G Bravo-Hermsdorff, R Silva. *UAI, 2024* *(code)*

The Graph Pencil Method: Mapping Subgraph Densities to Stochastic Block Models. *(link)*
LM Gunderson, G Bravo-Hermsdorff, P Orbanz. *NeurIPS, 2023*

Quantifying Network Similarity using Graph Cumulants. *(link)*
LM Gunderson*, G Bravo-Hermsdorff*, PA Maugis, CE Priebe. *JMLR, 2023*

Statistical Anonymity: Quantifying Reidentification Risks Without Reidentifying Users. *(link)*
G Bravo-Hermsdorff, R Busa-Fekete, LM Gunderson, A Muños Medina, U Syed. *arXiv, 2022*

Computation of the Biot-Savart line integral with higher-order convergence [...] *(link)*
N McGreivy, C Zhu, LM Gunderson, SR Hudson. *Physics of Plasmas, 2021*

Introducing Graph Cumulants: What is the Variance of your Social Network? *(link)*
LM Gunderson* & G Bravo-Hermsdorff*. *arXiv, 2020 (video, code)*

A Unifying Framework for Spectrum-Preserving Graph Sparsification and Coarsening. *(link)*
G Bravo-Hermsdorff* & LM Gunderson*. *NeurIPS, 2019 (video, demos, code*

Gender and Collaboration Patterns in a Temporal Scientific Authorship Network. *(link)*
G Bravo-Hermsdorff, V Felso, E Ray, LM Gunderson, ME Helander, J Maria, Y Niv. *Appl. Network Sci., 2019*

A model of solar equilibrium: The hydrodynamic limit. *(link)*
LM Gunderson & A Bhattacharjee. *The Astrophysical Journal, 2019*

Non-planar elasticae as optimal curves for the magnetic axis of stellarators. *(link)*
D Pfefferlé, LM Gunderson, SR Hudson, L Noakes. *Physics of Plasmas, 2018*

Differentiating the shape of stellarator coils with respect to the plasma boundary. *(link)*
SR Hudson, C Zhu, D Pfefferlé, LM Gunderson. *Physics of Plasmas, 2018*

Aerodynamic focusing of high-density aerosols. *(link)*
DE Ruiz, LM Gunderson, MJ Hay, E Merino, EJ Valeo, SJ Zweben, NJ Fisch. *Journal of Aerosol Science, 2014*

**denotes equal contribution*

Awards and fellowships

- Henry Ford II Prize: College-wide award to a third-year engineering student ($10,000) *2011*
- Undergraduate American Nuclear Society (ANS) Scholarship *2010 & 2011*
- Nuclear Energy University Programs (NEUP) Scholarship *2009 & 2010*
- Kikuchi Scholarship: Award to a second-year nuclear engineering student ($3,000) *2009*
- Arthur B. Singleton Prize: College-wide award to a first-year engineering student ($3,500) *2009*
- Mandlebaum Simon Scholar: Scholarship from the University of Michigan ($11,000/yr) *2008*
- General Motors Community Relations Scholarship and Internship *2008*
- Silver award (7^{th} place) in Michigan Math Prize Competition *2007*

Teaching, mentoring, and academic service

Tutorial sessions for Probability and Statistics (UCL) *(link)* *Fall 2024*

- Ran tutorial sessions for bachelors and masters students in the Statistical Science Department, lectures given by Kayvan Sadeghi.
- Topics included: transformation of random variables, relations between standard distributions, statistical estimation, consistency, method of moments, Bayesian inference, conjugate priors, asymptotic guarantees.
- I held two one-hour tutorial sessions per week covering the students' homework and questions.

Volunteer teacher for the In2STEM-In2ScienceUK outreach initiative *(link)* *August 2024*

- Designed and taught three 2-hour classes to nine high-school students:
  The mathematics of card magic tricks --- based on the wonderful book "Magical Mathematics" by Diaconis and Graham *(link)*;
  Optimal betting --- derive the Kelly criterion *(link)* using hands-on simulations and a story about exploiting a broken arcade game;
  The mathematics of cooperation --- a introduction to evolutionary game theory via the repeated Prisoner's Dilemma game *(link)*.
- Thanks to nominations from our students, our placement (hosted by Alex Watson) was awarded "host of the week" *(link)*.

Mentoring *2023 --- 2024*

- Helped supervise a master student (Emma Graham)
- Helped supervise a PhD student (Jordan Penn)

Instructional assistant *Fall 2011*

- First-year nuclear engineering course, ``Understanding Radiation''
- Ran weekly lab session, helped students with material, and graded homework and presentations
- Alexander Thomas --- Nuclear Engineering and Radiological Sciences, University of Michigan

Tutor *2009 --- 2012*

- Private tutor for upper-level courses in nuclear engineering, mathematics, and physics
- Pamela Derry --- Nuclear Engineering and Radiological Sciences, University of Michigan

Outreach Teaching (DAPCEP) *2010 --- 2011*

- In 2010, volunteered for DAPCEP (Detroit Area Pre-College Engineering Program)
- In 2011, planned and ran the 6 weekend sessions of math and physics lessons *(link)*

Reviewer

- LoG Learning on Graphs Conference (2023), AISTATS (2023), NeurIPS (2022)

Other research experiences

Design of a novel vacuum tube device *Summer 2011*

- Research intern at L3 Communications, Electron Devices Division, San Carlos, CA. *Advisor:* Mark Kirshner
- Conducted simulations to demonstrate the feasibility of a hybrid traveling wave tube concept.

Simulation of relativistic laser-plasma interactions *Fall 2010*

- Research assistant at the Center for Ultrafast Optical Sciences, University of Michigan. *Advisor:* Alexander Thomas
- Conducted particle-in-cell simulations of photon interactions with relativistic electron beams.

Characterization of gas jets for use in laser wakefield acceleration *Summer 2010*

- Research intern at the Laboratoire d'Optique Appliquée, Palaiseau, France. *Advisor:* Victor Malka
- Constructed an interferometer and used tomographical techniques to reconstruct the density of a supersonic gas jet.

Asymptotic analysis of coarsening/nucleation dynamics *Summer 2009*

- Undergraduate researcher at the Department of Mathematics, University of Michigan. *Advisor:* Peter Smereka
- Research paper: *Long Time Behavior of a Modified Becker-Döring System: Initial Conditions Without Compact Support*

Reconstruction of capacitor banks for pulsed power experiments *2009 --- 2010*

- Research intern at the Plasma, Pulsed Power, and Microwave Lab, University of Michigan. *Advisor:* Ronald Gilgenbach
- Rebuilt specialized power supplies and vacuum chambers for extreme plasma experiments.

Selected talks

- **Cumulants for Networks** *Algebraic and Combinatorial Perspectives in the Mathematical Sciences (ACPMS), 2022 (link)*
- **Graph reduction by edge deletion and edge contraction.** *Ninth International Conference on Complex Systems*, *2018 (link)*
- **Graph reduction by edge deletion and edge contraction.** *Society for Industrial and Applied Mathematics Annual Meeting*, *2018*
- **A Grad--Shafranov model of solar equilibrium.** *Waves, Turbulence, and Large-Scale Structures in Rotating Magnetic Fluids*, *2018*
- **A Grad--Shafranov model of equilibrium solar behavior.** *Max Planck Princeton Center (MPPC) Workshop on Plasma Processes in Astrophysics and Fusion Energy*, *2018*

Extracurricular

Eagle Scout

Spring 2008

- Organized construction of reinforcing steps on an eroding path in Nichols Arboretum (Ann Arbor, MI)

A Cappella

2006 --- 2019

- Member of *Jersey Transit (2013 --- 2019)* *(link)*
- Member of *Compulsive Lyres* at the University of Michigan *(2009 --- 2012)* *(link)*
- Member of *The Pioneers* at Pioneer High School *(2007 --- 2008)*
- Member of *Desperate Measures* at Pioneer High School *(2006 --- 2007)*