Stanford



Alec Shelley

Ph.D. Student in Applied Physics, admitted Autumn 2021

Bio

BIO

I am a PhD candidate in Applied Physics at Stanford University, advised by Daniel Tartakovsky. I did my undergrad in applied math and physics at UC Berkeley.

My research interests are broad, tied together by probability, geometry, and mathematical physics. I derived exact formulas for the n-point functions of the Poisson model of heterogeneous materials. I also developed a fast method for computing the area of a union of translates of a convex planar body, a key step in calculating n-point functions for planar Boolean models.

I am both an AI enthusiast and an AI safety enthusiast. With the help of AI, my collaborators and I recently proved that helium binds two or fewer electrons, while lithium binds four or fewer. The last time that an element had its ions characterized in this way was hydrogen in 1984!

HONORS AND AWARDS

- Best Student or Postdoc Paper, American Nuclear Society, Mathematics and Computation Conference (M&C 2025) (2025)
- Universities Research Association Sandia Graduate Fellowship, Universities Research Association and Sandia National Laboratories (2024)
- ARCS Foundation Scholar, Achievement Rewards for College Scientists (ARCS) Foundation (2023-2024)
- Olsen Memorial Fund Award for academic achievement in physics, University of California, Berkeley (2018)

PROFESSIONAL AFFILIATIONS AND ACTIVITIES

- President, Graduate Students of Applied Physics and Physics, Stanford University (2023 - 2024)

EDUCATION AND CERTIFICATIONS

- B.A., magna cum laude, University of California, Berkeley , Physics and Applied Mathematics (2021)

PERSONAL INTERESTS

I love card games, and I used to be a professional Magic: The Gathering player. Recently, I built a bot to play gin rummy, and to my knowledge it is the strongest such bot in the world!

I also enjoy rock climbing and cooking.

LINKS

- Press release for Poisson model paper: https://sustainability.stanford.edu/news/researchers-solve-model-can-improve-sustainable-design-groundwater-management-nuclear-waste.

- My Gin Rummy Bot: https://github.com/AlecShelley/gin-rummy-bot

Research & Scholarship

CURRENT RESEARCH AND SCHOLARLY INTERESTS

My research uses probability and geometry to solve problems in applied math and physics. I have published several results related to microstructure theory, including exactly solving for the n-point functions in the Poisson model, and proving a fast way to calculate the area of the union of translates of a planar convex body, a key step in finding the n-point functions of a Boolean model.

I have applied uncertainty quantification techniques, including multifidelity Monte Carlo, to problems in radiation transport.

I recently related the problem of bounding vertices in stationary geodesic nets to the problem of bounding the maximum number of collisions in a system of zero diameter billiard balls. This produced novel exponential bounds for both. Also, my colleagues and I solved the ionization problem for helium and lithium, showing that helium binds two electrons and lithium binds four.

Teaching

COURSES

2025-26

- Uncertainty Quantification in Data-Centric Simulations: ENERGY 160 (Spr)

Publications

PUBLICATIONS

- **Union of Translates of a Convex Body**
  Shelley, A., Tartakovsky, D. M.
  arXiv (under review at Discrete & Computational Geometry).
  2026
- **Multipoint Correlations in Poisson Media.** *Physical review letters*
  Shelley, A., Olson, A., Geraci, G., Tartakovsky, D. M.
  2025; 135 (15): 156101
- **Spatial Correlations of the Poisson Model for Radiation Transport** *NUCLEAR SCIENCE AND ENGINEERING*
  Shelley, A., Olson, A., Geraci, G.
  2026
- **Collision Systems, with Applications to Geodesic Networks and Point Billiards**
  Shelley, A., Bosch, H.
  Hexagon preprint.
  2026
- **Sharp Ionization Bounds for Helium and Lithium**
  Shelley, A., Yang, C., Tartakovsky, D. M.
  Hexagon preprint.
  2026
- **A Bound Helium Dianion Does Not Exist**
  Shelley, A., Tartakovsky, D. M.
  Hexagon preprint.
  2026

- **The Potential Inversion Theorem**
  Shelley, A., Hunt, H.
  arXiv.
  2023

PRESENTATIONS

- Multifidelity Ensembles for UQ in Monte Carlo Transport - SIAM Conference on Uncertainty Quantification (UQ26) (3/22/2026)
- Spatial Correlations of the Poisson Model for Radiation Transport - International Conference on Mathematics and Computational Methods Applied to Nuclear Science and Engineering (M&C 2025), American Nuclear Society (4/27/2025)