

ASHLEY BRANS GROVE

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RESEARCH SUMMARY

I study the extreme physics of compact objects, combining first-principles numerical simulations with analytical theory to understand how magnetic fields evolve, reconnect, and dissipate energy in neutron stars and black holes. My research bridges microscopic processes, including kinetic plasma dynamics and microphysics of crustal yielding, with global phenomena such as magnetar giant flares, fast radio bursts, rotational glitches, and black hole flux eruptions. I develop large-scale computational models using particle-in-cell, molecular dynamics, and magnetohydrodynamics simulations.

RESEARCH INTERESTS

Theoretical Astrophysics

Magnetospheres of neutron stars and black holes; plasma physics, emission mechanisms, and magnetospheric transients. Neutron star interiors: magnetic field evolution, quantum fluid dynamics, crustal failures, glitches, and magnetar flares.

Computational Physics

Particle-in-cell (PIC) plasma simulations, computational magnetohydrodynamics (MHD), magnetoelastic-dynamics, molecular dynamics, and force-free electrodynamics. Numerical algorithms and large-scale parallel computing.

EMPLOYMENT

Princeton University

Lyman Spitzer Jr. Postdoctoral Fellow	2023 - 2028
PCTS Postdoctoral Fellow	2023 - 2026

Curtin University

Visiting Faculty at the Curtin Institute for Radio Astronomy (CIRA)	2026-
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EDUCATION

Columbia University

PhD (Physics)	2017 - 2023
Master of Arts (Physics)	2017 - 2019
Master of Philosophy (Physics)	2017 - 2019

Monash University

Master of Science (Physics)	2016 - 2017
Bachelor of Science Advanced (Honours), First Class Honours	2012 - 2015

HONOURS AND AWARDS

Competitive Fellowship Offers

NASA Hubble Fellowship Program, Einstein Fellow (declined)	2023
CITA Fellowship (declined)	2023
PCTS Fellowship, Princeton University	2023
Lyman Spitzer Jr. Fellowship, Princeton University	2023

PUBLICATIONS

15 refereed publications, including 6 first-author papers; 450+ citations; h-index = 9 (NASA ADS, July 2026)

* denotes student-led publications

Selected Publications

Bransgrove, A., Beloborodov, A.M., Levin, Y.

Hyperactive Magnetar Eruptions: Giant Flares, Baryon Ejections, and FRBs
The Astrophysical Journal Letters, 1001, L13 (2026).

Bransgrove, A., Levin, Y., Beloborodov, A.M.

Giant Hall Waves Launched by Superconducting Phase Transition in Pulsars
The Astrophysical Journal, 979, 144, (2024).

Bransgrove, A., Beloborodov, A.M., Levin, Y.

Radio Emission and Electric Gaps in Pulsar Magnetospheres
The Astrophysical Journal Letters, 958, L9, (2023).

Bransgrove, A., Ripperda, B., Philippov, A.

Magnetic Hair and Reconnection in Black Hole Magnetospheres
Physical Review Letters, 127, 055101, (2021).

Complete Publication List

Caplan, M., Smith, N., **Bransgrove, A.**, Horowitz, C.

Plasticity of Neutron Star Crusts
submitted, (2026).

Caplan, M., **Bransgrove, A.**

Revisiting the Rheology of Neutron Star Crusts with Molecular Dynamics
RNAAS, Volume 10, Issue 5, id.107 (2026).

*Dai, D., **Bransgrove, A.**, Prabhu, A., Mahlmann, J.

Linear Mode Conversion in Ultramagnetized Pair Plasmas: Single-Parameter Scaling
submitted, (2025).

Ripperda, B., Moran, A., Selvi, S., Grehan, M., Sironi, L., Philippov, A., **Bransgrove, A.**, Porth, O.

Magnetic reconnection with a 0.1 rate: Effective resistivity in general relativistic magnetohydrodynamics
submitted, (2025).

Caplan, M., Smith, N., Yaacoub, D., Serrano, F., Taira, E., **Bransgrove, A.**

Grain Boundary Diffusion in Yukawa Crystals
Physical Review E submitted, (2025).

*Burnaz, L., Most, E., **Bransgrove, A.**

Crustal Quakes Spark Magnetospheric Blasts: Imprints of Realistic Magnetar Crust Oscillations on the Fast Radio Burst Signal
The Astrophysical Journal Letters, 995, L57, (2025).

*Qu, Y., **Bransgrove, A.**

3D Numerical Simulations of Magnetar Crustquakes
The Astrophysical Journal, 998, 190 (2025).

Yuan, Y., Levin, Y., **Bransgrove, A.**, Philippov, A.

Alfvén Wave Mode Conversion in Pulsar Magnetospheres
The Astrophysical Journal, 908, 176, (2021).

Bransgrove, A., Beloborodov, A.M., Levin, Y.

A Quake Quenching the Vela Pulsar
The Astrophysical Journal, 897, 173, (2020).

Levin, Y., Beloborodov, A., **Bransgrove, A.**

Precessing Flaring Magnetar as a Source of Repeating FRB 180916.J0158+65
The Astrophysical Journal Letters, 895, L30, (2020).

Bransgrove, A., Levin, Y., Beloborodov, A. M.

Magnetic Field Evolution of Neutron Stars I: Basic formalism, numerical techniques, and first results
Monthly Notices of the Royal Astronomical Society, 423, 2771 (2018).

RESEARCH FUNDING AND LEADERSHIP

- PI of Approved NSF ACCESS Supercomputer Allocation** 2025
11,000 node-hours on TACC Stampede 3 supercomputer.
- Co-I of Approved GMRT Radio Telescope Observing Proposal** 2025
Proposed an observation to test Crab pulsar emission mechanisms at 400 – 600 MHz.
- High Performance Computing Leadership** 2017-
Technical experience in writing and running specialized numerical codes in various languages (Fortran 90, python, C++), and performing large scale parallel computations on supercomputers, (e.g. up to 14,500 CPU cores, 140 TB of RAM on NASA Pleiades - the highest resolution pulsar PIC simulation in the world to date).

INVITED CONFERENCE TALKS

- APS DPP Plasma Meeting, Chicago (invited, scheduled)** 2026
Magnetohydrodynamics of Exotic Matter in Neutron Star Interiors
- Pulsars as Multi-wavelength EM Emitters, University of Oxford (invited, scheduled)** 2026
Radio Pulsar Variability: The Interior-Magnetosphere Connection
- AAPPS DPP Plasma Meeting, Fukuoka Japan** 2025
Extreme Plasma Physics of Neutron Stars
- International Pulsar Symposium, Guiyang China** 2024
Extreme Physics of Radio Pulsars
- Improving Black Hole Accretion with Plasma Theory Workshop, Princeton PCTS** 2023
Magnetic Reconnection and Flux Eruptions in Black Hole Magnetospheres
- Midwest Magnetic Field Meeting, University of Wisconsin, Madison** 2021
Alfvén Waves Inside and Outside Neutron Stars

INVITED SEMINARS AND RESEARCH TALKS

- Curtin Institute for Radio Astronomy (CIRA), Colloquium** 2026
Extreme Physics of Neutron Stars
- KITP Extreme Plasma Program, (Blackboard Talk)** 2025
Physics of Neutron Star Interiors
- Stanford, SLAC (KIPAC Tea Talk)** 2025
Hyperactive Magnetar Eruptions
- University of Melbourne, Astrophysics Seminar** 2024
Extreme Plasma Physics of Neutron Stars and Black Holes
- Institute for Advanced Study (IAS), Astrophysics Coffee Talk** 2022
Magnetic Activity of Neutron Stars and Black Holes
- Princeton Department of Astrophysical Sciences, Astro-Plasma Seminar** 2022
Magnetic Activity of Neutron Stars and Black Holes
- University of Maryland Center for Theory and Computations, Seminar** 2022
Magnetic Activity of Neutron Stars and Black Holes
- Canadian Institute for Theoretical Astrophysics (CITA), Theory Seminar** 2022
Magnetic Activity of Neutron Stars and Black Holes

Institute for Advanced Study (IAS), Astrophysics Coffee Talk <i>Seismic Activity in the 2016 Vela Glitch</i>	2019
Max Planck Institute for Astrophysics Garching, Astrophysics Seminar <i>Magnetic Field Evolution of Neutron Stars</i>	2018

SELECTED RESEARCH PRESENTATIONS

Magnetic Fields of Compact Objects Conference, Perimeter Institute <i>Magnetic Field Evolution of Superconducting Pulsars</i>	2025
SCEECS Collaboration Annual Meeting (satellite), Flatiron Institute <i>Giant Hall Waves in Pulsar Crusts</i>	2025
Mal Ruderman Memorial Conference, Columbia University <i>Neutron Star Quakes, Glitches, and Superconducting Flux Tubes</i>	2025
SCEECS Simons Collaboration, Weekly Neutron Star Meeting <i>Giant Hall Waves in Pulsars</i>	2024
MIAPbP High Energy Plasma Conference, MPA Garching <i>Radio Pulsar Puzzles</i>	2024
MIAPbP High Energy Plasma Workshop, MPA Garching, Blackboard Talk <i>Physics of Neutron Star Interiors</i>	2024
Australasian Pulsar Meeting <i>Radio Pulsar Puzzles</i>	2024
SCEECS Collaboration Annual Meeting (satellite), Flatiron Institute <i>Radio Pulsar Puzzles</i>	2024
Numerical Relativity Group Meeting, Caltech <i>First-Principles Modelling of Pulsar Magnetospheres</i>	2023
Harvard University Black Hole Initiative, Narayan Group Meeting <i>Magnetic Hair and Reconnection in Black Hole Magnetospheres</i>	2021
Munich Institute for Astro-Particle Physics (MIAPP) Conference (i) <i>Black Hole Magnetospheres and the No-Hair Theorem</i> (ii) <i>Vela Radio Emission Affected by a Glitch</i>	2021
OzGrav Weekly Telecon Meeting <i>A Quake Quenching the Vela Pulsar</i>	2020
Monash University, High Energy Astrophysics Group Meeting <i>What Happened in the 2016 Vela Glitch?</i>	2020
Flatiron Institute, Compact Objects Group Meeting, Blackboard Talk <i>Vela Magnetosphere Affected by a Glitch</i>	2019
PHAROS/CoCoNuT meeting on magnetic fields of neutron stars, CEA Saclay, France <i>Internal Dynamics of Neutron Star Magnetic Fields</i>	2018

CLASSROOM TEACHING

Princeton University, Undergraduate Course Instructor <i>Independently taught an undergraduate General Physics I section three times per week; responsible for lesson planning, office hours, exam preparation, supervision, and grading.</i>	2025
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Columbia University, Teaching Associate

2017-2023

Teaching and grading duties for undergraduate physics lab class and mathematical methods. Teaching and grading duties for graduate level classes including astrophysics I, classical fields and waves, general relativity, electromagnetic theory.

Monash University, Teaching Associate

2015-2017

Teaching and grading duties for undergraduate physics lab class.

SERVICE, LEADERSHIP, AND MENTORING**Research Mentoring**

2017-

Supervised undergraduate and graduate student research projects in computational astrophysics and plasma physics, resulting in peer-reviewed publications:

- **Smith, N.** (with Caplan, M., Bransgrove, A.), submitted (2026)
- **Dai, D.** (with Bransgrove, A., Prabhu, A., Mahlmann, J.), submitted (2026).
- **Burnaz, L.** (with Most, E., Bransgrove, A.), ApJL (2025).
- **Qu, Y.** (with Bransgrove, A.), ApJL (2025).

Physics Undergraduate Mentoring Program

2023-

Mentored undergraduate students through the Princeton Physics Undergraduate Mentoring Program.

Conference Organization

Primary Conference Organizer, "Extreme Physics of Neutron Star Interiors" at Princeton PCTS.

2025

Organized and ran a 3 day workshop with approx. 70 local and international scientists.

Refereeing

Referee for *Nature Astronomy*, *PRL*, *New Astronomy*, *ApJL*, *ApJL*, *MNRAS*, *MNRAS Letters*, *PRD*.

2017-

Proposal Review

NSF Astronomy and Astrophysics Research Grants (AAG) panel reviewer.

2026

MEDIA COVERAGE**Featured on the Postdoc Path Podcast**

2025

The Postdoc Path Podcast interviews postdoctoral researchers at the physics department at Princeton University.

Featured in AAS Nova Research Highlights

2024

"Discovering, Modeling, and Characterizing Pulsars" by K. Hensley, February 2024.

Physical Review Letters Editor's Suggestion

2021

"About 1 in 7 letters are highlighted as an Editor's Suggestion due to particular importance, innovation, and broad appeal."

Featured in New Scientist Magazine

2021

"Black holes with magnetic field 'hair' shed it in loops of hot plasma" by L. Crane, August 2021 Issue.

Featured in APS Physics Synopsis

2021

"Balding Black Holes Lose Their Magnetic Hair" by R. Berkowitz on physics.aps.org.

Featured on the cover of Physical Review Letters

2021

Simulation of a black hole magnetosphere selected for the cover image of Physical Review Letters Vol 127, Iss. 5.

Featured in New Scientist Magazine

2021

"Wobbly star may be radio burst culprit" by L. Crane, February 2020 Issue.