ASHLEY BRANSGROVE

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RESEARCH SUMMARY

Neutron stars are natural laboratories for physics that cannot be reproduced on earth: matter denser than an atomic nucleus, threaded by the strongest known magnetic fields. I study how the physics inside neutron stars drives what we observe from outside, including magnetar giant flares, fast radio bursts and pulsar glitches. I do this by developing global simulations of the star's evolving magnetic field, informed by first-principles calculations of the microphysics of its interior, crust and magnetosphere. By combining these approaches, I am building a direct connection between observations of compact objects and the physics of dense matter. I also apply the same methods to black hole magnetospheres.

RESEARCH INTERESTS

Theoretical Astrophysics
Magnetospheres of neutron stars and black holes: plasma physics, emission mechanisms, and magnetospheric transients. Neutron star interiors: magnetic fields, superconductivity, star quakes, pulsar glitches, quantum fluids, extreme solids.

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

Curtin University
Visiting faculty at the Curtin Institute for Radio Astronomy (CIRA) *2026-*

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 (Honors), First Class Honors *2012 - 2015*

HONORS 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*

Additional Honors
J.L. William Physics Honours Scholarship, Monash University *2015*

SELECTED PUBLICATIONS

15 total publications; 450+ citations; h-index = 9 (NASA ADS, July 2026)

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).

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

A Quake Quenching the Vela Pulsar

The Astrophysical Journal, 897, 173, (2020).

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 uGMRT Radio Telescope Observing Proposal *2025*
Proposed an observation to test Crab pulsar emission physics 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

International Symposium on Relativistic Astrophysics, Shanghai China (invited, scheduled) *2026*
Exotic Matter Magnetohydrodynamics in Neutron Star Interiors

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 *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

Perimeter Institute for Theoretical Physics, Strong Gravity Seminar Series (invited, scheduled) *2027*
Exotic Magnetohydrodynamics of Neutron Star Interiors

National Center for Radio Astrophysics, Pune, India (invited, scheduled) *2026*
Extreme Physics of Radio Pulsars

Illinois State University, Colloquium (invited, scheduled) *2026*
Extreme Physics of Neutron Stars

Oxford University, Plasma Physics Seminar *2026*
Exotic Magnetohydrodynamics of Neutron Star Interiors

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

University of Melbourne, Astrophysics Seminar *2024*
Extreme Plasma Physics 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 *2019*
Seismic Activity in the 2016 Vela Glitch

Max Planck Institute for Astrophysics Garching, Astrophysics Seminar *2018*
Magnetic Field Evolution of Neutron Stars

SELECTED RESEARCH PRESENTATIONS

Stanford University, Philippov Group Meeting *2026*
Physics of Neutron Star Interiors

Perimeter Institute for Theoretical Physics, Magnetic Fields of Compact Objects Conference *2025*
Magnetic Field Evolution of Superconducting Pulsars

Stanford, SLAC (KIPAC Tea Talk) *2025*
Hyperactive Magnetar Eruptions

Flatiron Institute, SCEECS Collaboration Annual Meeting (satellite) *2025*
Giant Hall Waves in Pulsar Crusts

Columbia University, Mal Ruderman Memorial Conference *2025*
Neutron Star Quakes, Glitches, and Superconducting Flux Tubes

SCEECS Simons Collaboration, Weekly Neutron Star Meeting *2024*
Giant Hall Waves in Pulsars

MPA Garching, MIAPbP High Energy Plasma Conference *2024*
Radio Pulsar Puzzles

MPA Garching, MIAPbP High Energy Plasma Workshop, Blackboard Talk *2024*
Physics of Neutron Star Interiors

Australasian Pulsar Meeting *2024*
Radio Pulsar Puzzles

Flatiron Institute, SCEECS Collaboration Annual Meeting (satellite) *2024*
Radio Pulsar Puzzles

Caltech, Numerical Relativity Group Meeting *2023*
First-Principles Modelling of Pulsar Magnetospheres

Institute for Advanced Study (IAS), Astrophysics Coffee Talk *2022*
Magnetic Activity of Neutron Stars and Black Holes

Harvard University Black Hole Initiative, Narayan Group Meeting *2021*
Magnetic Hair and Reconnection in Black Hole Magnetospheres

MPA Garching, Munich Institute for Astro-Particle Physics (MIAPP) Conference *2021*
(i) Black Hole Magnetospheres and the No-Hair Theorem
(ii) Vela Radio Emission Affected by a Glitch

OzGrav Weekly Telecon Meeting *2020*
A Quake Quenching the Vela Pulsar

Monash University, High Energy Astrophysics Group Meeting *2020*
What Happened in the 2016 Vela Glitch?

Flatiron Institute, Compact Objects Group Meeting, Blackboard Talk *2019*
Vela Magnetosphere Affected by a Glitch

PHAROS/CoCoNuT meeting on magnetic fields of neutron stars, CEA Saclay, France *2018*
Internal Dynamics of Neutron Star Magnetic Fields

CLASSROOM TEACHING

SCEECS Summer School, UNAM, Ensenada Mexico *2026*
Prepared and taught graduate level lectures on pulsar magnetospheres and nebulae.

Princeton University, Undergraduate Course Instructor *2025*
Independently taught an undergraduate General Physics I section three times per week for one full semester; responsible for lesson planning, office hours, exam writing, supervision, and grading.

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.), ApJ (2025).

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*
Proposed, organized and ran a 3 day workshop with approx. 70 local and international scientists.

Meeting Organization *2026-*
Organized weekly meetings for the Simons Collaboration for Extreme Electrodynamics of Compact Sources (SCEECS); responsible for inviting speakers, hosting virtual meetings, and maintaining the SCEECS YouTube channel.

Proposal Review
NSF Astronomy and Astrophysics Research Grants (AAG) panel reviewer. *2026*

Refereeing
Referee for *Nature Astronomy, PRL, New Astronomy, ApJL, ApJL, MNRAS, MNRAS Letters, PRD.* *2017-*

Outreach and Guest Lectures

- *Physics of Compact Objects*, STAR Space School (high school students, scheduled). *2026*
- *Magnetic Fields of Black Holes*, Columbia Society of Physics Students (undergraduates). *2021*

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.

COMPLETE PUBLICATION LIST

15 total publications; 450+ citations; h-index = 9 (NASA ADS, July 2026)

* denotes student-led publications

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

Hyperactive Magnetar Eruptions: Giant Flares, Baryon Ejections, and FRBs

The Astrophysical Journal Letters, 1001, L13 (2026).

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, (2026).

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).

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).

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).