Bryce M. Barclay

Ph.D. Applied Mathematics

Postdoctoral Research Scientist · Arizona State University

Bryce.Barclay@asu.edu

Research Summary

Applied mathematician specializing in the analysis of quantum systems and electromagnetic waves and the development of signal processing and machine learning algorithms. Author of publications in top-tier journals on wave propagation in turbulent media, nonlinear Doppler theory in 4D spacetime, electromagnetic sensing in non-inertial reference frames, relativistic and quantum field models, and physics-informed machine learning, with several years of high-performance computing experience including as a scholar at Lawrence Livermore National Laboratory. Current interests: quantum information science, scientific and physics-informed machine learning, computational PDEs, and numerical simulation of quantum and relativistic systems.

Education

2018 – 2023	**Ph.D., Applied Mathematics**, Arizona State University, Tempe, AZ Co-advisors: Alex Mahalov and Eric J. Kostelich
2015 – 2018	**B.S., Mathematics**, Arizona State University, Tempe, AZ (*summa cum laude*)

Research Positions and Fellowships

2023 – present	**Postdoctoral Research Scientist**, Arizona State University
2020 – 2023	**Lawrence Livermore National Laboratory Scholar** Data Science Summer Institute (2020); Computing Scholar Program (2021)
2019 – 2020	Research Training Group Fellowship in Data-Oriented Mathematical and Statistical Sciences, ASU
2019	Block Grant Summer Research Award, University Graduate Fellowship, ASU Topic: Optimal Sensor Location in Wave Propagation
2019	Research Assistant, Arizona State University

Publications and Patents

1. B. M. Barclay and A. Mahalov. *Dynamic Doppler Effects on Dirac Spinor Fields*. arXiv:2606.14952 [math-ph], 2026.
2. B. M. Barclay, E. J. Kostelich, and A. Mahalov. *Optimal Sensor Observation Time for Solutions to the Stochastic Maxwell Vector Wave Equation*. AMS Contemporary Mathematics book series (invited), submitted 2026.
3. B. M. Barclay and A. Mahalov. *The Dynamic Doppler Spectrum Induced by Nonlinear Sensor Motion: Relativistic Kinematics and 4D Frenet–Serret Spacetime Geometry*. arXiv:2603.24870 [math-ph], submitted 2026.
4. B. M. Barclay and A. Mahalov. *Spectral Distortions of Signals Induced by Nonlinear Sensor Motion: Acceleration, Jolt, and Relativistic Effects*. IEEE 59th Asilomar Conference on Signals, Systems, and Computers, pp. 713–718, 2026.

5. B. M. Barclay and A. Mahalov. *Transmission Frequency Estimation and Sensor Signal Processing for Nonlinear Receiver Motion in Stratified Media*. USPTO Provisional Patent No. 63/863,327, filed August 13, 2025.

6. B. M. Barclay, E. J. Kostelich, and A. Mahalov. *Doppler Effects of Nonlinear Sensor Motion in 3D Space: Curvature, Torsion, Jolts, and Directional Wave Propagation*. IEEE Transactions on Antennas and Propagation, 73(3):1840–1845, 2025.

7. B. M. Barclay, E. J. Kostelich, and A. Mahalov. *Physics-Informed Signal Processing for Time Series Data from Accelerating Sensors*. IEEE Transactions on Antennas and Propagation, 73(1):528–538, 2025.

8. M. Moustaoui, B. M. Barclay, and E. J. Kostelich. *Semi-Implicit Computation of Fast Modes in a Scheme Integrating Slow Modes by a Leapfrog Method Based on a Selective Implicit Time Filter*. Monthly Weather Review, 151(12):3133–3149, 2023.

9. B. M. Barclay, E. J. Kostelich, and A. Mahalov. *Vectorial EM Propagation Governed by the 3D Stochastic Maxwell Vector Wave Equation in Stratified Layers*. Atmosphere (special issue), 14(9):1451, 2023.

10. B. M. Barclay, E. J. Kostelich, and A. Mahalov. *Sensor Placement Sensitivity and Robust Reconstruction of Wave Dynamics from Multiple Sensors*. SIAM Journal on Applied Dynamical Systems, 21(4):2297–2313, 2022.

Selected Talks and Presentations

Jan 2026	*The Dynamic Doppler Effects of Nonlinear Sensor Motion: 4-D Geometry and the Frenet–Serret Framework*. Dynamics Days Conference, University of Arizona (**invited**).
Nov 2025	*Dynamic Doppler Effects: Spectral Distortions of Signals Induced by Nonlinear Motion in a Relativistic Framework*. Seminar, University of Washington (**invited**).
Oct 2025	*Spectral Distortions of Signals Induced by Nonlinear Sensor Motion: Acceleration, Jolt, and Relativistic Effects*. IEEE Asilomar Conference on Signals, Systems, and Computers.
Feb 2025	*Vectorial EM Wave Propagation Governed by 3D Stochastic Maxwell in Inhomogeneous Shear Layers*. AFOSR Mini-Conference, Air Force Research Laboratory (**invited**).
Dec 2024	*Dynamic Doppler Effects in 3D Space: Acceleration and Sensor Path Geometry*. Analysis, Dynamics, and Applications seminar, University of Arizona (**invited**).
Oct 2023	*Vectorial EM signal reconstruction in stochastic, inhomogeneous media and optimal observation times*. Kavli Institute for Theoretical Physics Conference (**invited**). doi:10.26081/K6QH5F.
May 2023	*Stochastic Maxwell's Equations: Reconstruction of Waves from Time Series Data using Optimal Observation Time*. SIAM Conference on Applications of Dynamical Systems.
Jan 2023	*Stochastic Maxwell's Equations: Robust Reconstruction of Wave Dynamics from Multiple Sensors and Optimal Observation Time*. AMS Joint Mathematics Meetings.

Teaching and Mentoring

2024 – 2025	Honors thesis committee member, Ashton Mitchell. Thesis: *Inverse Kinematics for Serial Linked Mechanisms*.
2023 – 2024	Undergraduate research mentor, Zachary Turner (NSF Graduate Research Fellowship recipient). Project: acoustic wave propagation, sensing, and signal reconstruction.
2018 – 2023	Graduate Teaching Assistant, Arizona State University. *Instructor of record:* MAT 170 Precalculus; MAT 265 Calculus I for Engineers; MAT 266 Calculus II for Engineers. *TA:* APM 502 Partial Differential Equations; APM 525 / MAE 598 High-Performance Computing.

Technical Skills

Programming	Python (NumPy, SciPy, PyTorch), C++, MATLAB
HPC	OpenMP, MPI; GPU-accelerated and distributed-memory computing on national-lab and university clusters
Methods	spectral methods, stochastic and physics-informed modeling, data assimilation, scientific machine learning, signal processing
Tools	LaTeX, Beamer, Git

Professional References

1. Alex Mahalov, Wilhoit Foundation Distinguished Professor, Arizona State University, email: `mahalov@asu.edu`
2. Eric J. Kostelich, President's Professor, Arizona State University, email: `kostelich@asu.edu`
3. Russell Whitesides, Staff Scientist, Lawrence Livermore National Laboratory, DOE, email: `whitesides1@llnl.gov`