

KEATON J. BURNS

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RESEARCH INTERESTS

I am broadly interested in computational physics and particularly in applications to astrophysical, geophysical, and biological fluid dynamics. My current work focuses on nonlinear waves and turbulence in stars, the ocean, and active fluids. I am the lead developer of Dedalus, an open-source framework for solving PDEs using spectral methods (dedalus-project.org).

EDUCATION

Doctor of Philosophy in Physics (<i>in progress</i>)	Expected 2018
Massachusetts Institute of Technology	
Master of Advanced Study in Mathematics (Part III)	2013
Churchill College, University of Cambridge	
Bachelor of Arts in Applied Mathematics, Physics, and Astrophysics	2012
University of California Berkeley	
Highest Honors in Applied Mathematics, Physics	
Highest Distinction in General Scholarship	

FELLOWSHIPS & APPOINTMENTS

NSF Graduate Research Fellow – MIT Physics	2012 – 2017
Geophysical Fluid Dynamics Fellow – Woods Hole Oceanographic Institute	Summer 2016
Visiting Scholar – Univ. of Sydney Mathematics & Statistics	February 2016
Visiting Scholar – UC Berkeley Astronomy	May 2015
Kavli Graduate Fellow – MIT Kavli Institute	2013 – 2014

HONORS & AWARDS

Department Citation – UC Berkeley Astronomy	2012
Stewardship Science Graduate Fellowship (Declined) – DOE NNSA	2012
Peirce Fellowship (Declined) – Harvard Astronomy	2012
Ernest Coleman Award for Scholarship and Citizenship – SLAC SULI Program	2011
Chang Freshman Award for Academic Excellence – UMass Amherst Physics	2009

TEACHING

Astrophysics II (Physics 8.902) Teaching Assistant – MIT Physics	Fall 2017
Astrophysics I (Physics 8.901) Teaching Assistant – MIT Physics	Spring 2017
Radio Astronomy Laboratory (Astro 121) Teaching Assistant – UC Berkeley Astronomy	Spring 2011
Multivariate Calculus (Math 233) Supp. Instructor – UMass Amherst Mathematics	Spring 2009

SERVICE & OUTREACH

CFD Session Chair – APS Division of Fluid Dynamics Meeting #70	November 2017
STEM Teaching Assistant – MIT Warrior Scholar Project	Summer 2017
John Carlson Lecture Assistant – MIT & New England Aquarium	October 2016
Journal Club Coordinator – MIT Kavli Institute	2015 - 2018
Social Coordinator – MIT Physics Graduate Student Council	2014 - 2018

JOURNAL PUBLICATIONS

O. Mickelin, J. Słomka, **K. J. Burns**, D. Lecoanet, G. M. Vasil, L. M. Faria, and J. Dunkel, “Anomalous chained turbulence in actively driven flows on spheres.” Submitted to PRL.

K. J. Burns, N. J. Balmforth, and I. J. Hewitt, “Rolling resistance of shallow granular deformation.” Proc. R. Soc. A, vol. 473, no. 2207, p. 20170375, Nov. 2017.

D. Lecoanet, G. M. Vasil, J. Fuller, M. Cantiello, and **K. J. Burns**, “Conversion of internal gravity waves into magnetic waves.” MNRAS, vol. 466, no. 2, pp. 2181-2193, Apr. 2017.

D. Lecoanet, J. Schwab, E. Quataert, L. Bildsten, F. X. Timmes, **K. J. Burns**, G. M. Vasil, J. S. Oishi, and B. P. Brown, “Turbulent Chemical Diffusion in Convectively Bounded Carbon Flames.” ApJ, vol. 832, no. 1, p. 71, Nov. 2016.

G. M. Vasil, **K. J. Burns**, D. Lecoanet, S. Olver, B. P. Brown, and J. S. Oishi, “Tensor calculus in polar coordinates using Jacobi polynomials.” Journal of Computational Physics, vol. 325, pp. 53-73, Nov. 2016.

D. Lecoanet, M. McCourt, E. Quataert, **K. J. Burns**, G. M. Vasil, J. S. Oishi, B. P. Brown, J. M. Stone, and R. M. O’Leary, “A validated non-linear Kelvin-Helmholtz benchmark for numerical hydrodynamics.” MNRAS, vol. 455, no. 4, pp. 4274-4288, Feb. 2016.

D. Lecoanet, M. Le Bars, **K. J. Burns**, G. M. Vasil, B. P. Brown, E. Quataert, and J. S. Oishi, “Numerical simulations of internal wave generation by convection in water.” Phys. Rev. E, vol. 91, no. 6, p. 063016, Jun. 2015.

D. Lecoanet, B. P. Brown, E. G. Zweibel, **K. J. Burns**, J. S. Oishi, and G. M. Vasil, “Conduction in Low Mach Number Flows. I. Linear and Weakly Nonlinear Regimes.” ApJ, vol. 797, no. 2, p. 94, Dec. 2014.

E. Huby, G. Perrin, F. Marchis, S. Lacour, T. Kotani, G. Duchêne, E. Choquet, E. L. Gates, J. M. Woillez, O. Lai, P. Fédou, C. Collin, F. Chapron, V. Arslanyan, and **K. J. Burns**, “FIRST, a fibered aperture masking instrument. I. First on-sky test results.” Astronomy & Astrophysics, vol. 541, p. A55, May 2012.

INVITED PRESENTATIONS

“Dedalus: A flexible spectral solver for partial differential equations.”

Flatiron Seminar, Flatiron Institute, November 7 2017.

“Dedalus: A flexible spectral solver for fluid dynamics.”

Physical Mathematics Seminar, MIT Mathematics, October 3 2017.

“Flexible Spectral Methods for Geophysical Flows.”

Mathematical Geoscience Seminar, Oxford Mathematics, June 2 2017.

“Simulations of turbulent meltwater plumes.”

Physical Oceanography Group Meeting, Oxford Earth Sciences, May 31 2017.

“Rolling Resistance on Sand.”

GFD Fellow Presentations, Woods Hole Oceanographic Institute, August 24 2016.

“Multivariate Chebyshev Discretizations of Incompressible Hydrodynamics.”

Spectral Methods Workshop, Univ. of Sydney Mathematics & Statistics, February 25 2016.

CONTRIBUTED PRESENTATIONS

“Turbulent Heat Transfer from a Thermally Forced Boundary in a Stratified Fluid.”

American Geophysical Union Fall Meeting, December 2017.

“Dedalus: A spectral solver for PDEs with diverse applications to CFD.”

APS Division of Fluid Dynamics Meeting #70, November 2017.

“Sidewall-driven convection in a thermally and compositionally stratified fluid.”

APS Division of Fluid Dynamics Meeting #69, November 2016.

“Turbulent structures in convection from a heated sidewall in a stratified fluid.”

APS Division of Fluid Dynamics Meeting #68, November 2015.

“Numerical Simulations of Nonlinear Wall-Mode Convection.”

American Geophysical Union Fall Meeting, December 2014.

“Orbital Stability of Spacecraft Exploring Multiple Asteroid Systems.”

American Astronomical Society Meeting #218, May 2011.

THESES & ESSAYS

“Chebyshev Spectral Methods with Applications to Astrophysical Fluid Dynamics.”

Cambridge Part III Essay, advised by H. Latter, May 2013.

“Tidal Effects in Binary Star Systems.”

UC Berkeley Senior Thesis, advised by E. Quataert, June 2012.