

Aaron F. Wienkers

CONTACT INFORMATION

Trinity College – University of Cambridge
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(Note hyperlinks on each item.)

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RESEARCH INTERESTS

Computational Fluid Dynamics on Geophysical & Astrophysical Scales

Mathematical interests: Nonlinear dynamical systems, pattern formation, asymptotics

Numerical interests: Adaptive mesh & pseudo-spectral methods, Navier–Stokes equations, task-based parallel algorithms, high-performance computing

Physical interests: Rotating, shearing, & stratified flows, hydrodynamic instability, oceanography, nonlinear saturation & evolution, turbulence, internal waves

EDUCATION

University of Cambridge – Trinity College Cambridge, UK

PhD, Applied Mathematics & Theoretical Physics (2022, *expected*)

- Topic: Submesoscale frontal instability in the turbulent stratified ocean
- Research Supervisor: Professor John R. Taylor
- Advisor: Professor Peter Haynes

Stanford University Stanford, USA

MS, Flow Physics (Mechanical Engineering) (2018)

- Focus: Flow instability and transition to turbulence
- Research Advisor: Professor Sanjiva K. Lele

University of Cambridge – Trinity College Cambridge, UK

MPhil, Scientific Computing & Astrophysics, with Distinction (2016)

- Thesis: Nonlinear hydrodynamic instability and turbulence in eccentric astrophysical discs with vertical structure
- Research Supervisor: Professor Gordon I. Ogilvie

University of California, Berkeley Berkeley, USA

BS, Fluid Dynamics (Mechanical Engineering), with Highest Honours (2014)

- Area of Study: Astrophysical and Computational Fluid Dynamics
- Research Advisors: Professors Philip S. Marcus and Christopher F. McKee

FELLOWSHIPS

Cambridge International Trust Scholarship (2018 to 2021)

EPSRC DTP International Doctoral Scholar (2018 to 2022)

Trinity College Honorary Graduate Studentship (2018)

Fletcher Jones Foundation Stanford Graduate Fellowship (2016 to 2020)

Stanford Engineering Fellowship (2015 to 2018)

National Science Foundation Graduate Research Fellowship (2015 to 2018)

Fannie & John Hertz Foundation Graduate Fellowship Finalist (2015)

Offered MIT Computational Engineering Graduate Fellowship (2015)

Offered Caltech Engineering Graduate Fellowship (2015)

US Department of Energy Science Undergraduate Research Fellowship (2013)

Qualcomm Scholars Research Fellowship (2013 and 2014)

RESEARCH EXPERIENCE	<p>Postgraduate Researcher 2018 to present Atmosphere-Ocean Dynamics Group, DAMTP, University of Cambridge</p> <ul style="list-style-type: none"> • Supervisor: John R. Taylor • Symmetric Instability (SI) and turbulent mixing mediating the nonlinear evolution of the submesoscales at finite frontal regions in the upper ocean <p>Graduate Research Fellow 2017 to 2018 Flow Physics and Aeroacoustics Laboratory, Stanford University</p> <ul style="list-style-type: none"> • Supervisor: Professor Sanjiva K. Lele • Spatio-temporal stability and nonlinear pattern formation in variably-stratified Ekman layers representing planetary and oceanic boundary layers <p>Graduate Research Fellow 2016 to 2017 Flow Physics and Computational Engineering, Stanford University</p> <ul style="list-style-type: none"> • Supervisor: Professor Parviz Moin • Nonlinear instability at the edge of turbulent boundary layer transition <p>Postgraduate Researcher 2015 to 2016 ¹Department of Applied Mathematics & Theoretical Physics and ²Cavendish Laboratory, Department of Physics, University of Cambridge</p> <ul style="list-style-type: none"> • Supervisors: Professor Gordon Ogilvie¹ and Professor Nikos Nikiforakis² • Inertial wave parametric instability and nonlinear evolution in elliptical accretion discs using a local finite volume eccentric geometry model <p>Visiting Research Scholar 2015 Laboratoire de Physique, École Normale Supérieure</p> <ul style="list-style-type: none"> • Supervisor: Professeur Thierry Dauxois • Finite-size effects on the internal gravity wave parametric subharmonic instability with enhanced transport in the atmosphere & ocean using a spectral method <p>Qualcomm Research Fellow 2011 to 2015 Computational Fluid Dynamics & Theoretical Astrophysics Centre, UC Berkeley</p> <ul style="list-style-type: none"> • Supervisor: Professor Philip S. Marcus • Baroclinic instability in protoplanetary discs using pseudo-spectral simulations <p>Livermore Research Fellow 2013 to 2015 ¹Astrophysical Fluid Dynamics Laboratory, UC Berkeley ²Institute for Scientific Computing, Lawrence Livermore National Lab</p> <ul style="list-style-type: none"> • Supervisors: Professor Christopher McKee¹ and Professor Richard Klein^{1,2} • Isentropic core accretion as a mode of turbulence driving and eccentricity growth in accretion discs using adaptive mesh finite volume simulations <p>Co-Director of Computational Microfluidics 2013 to 2015 M³B Microfluidics Laboratory, UC Berkeley</p> <ul style="list-style-type: none"> • Supervisors: Dr. Ryan Sochol and Professor Liwei Lin • Numerical model development of microfluidic circuit components
AWARD GRANTS	<p>XSEDE Startup Grant (PI) — 100k CPU-hrs Archer UK Supercomputing Grant — 200k CPU-hrs</p>
JOURNAL PUBLICATIONS	<p>[1] Wienkers, A. F. & Ogilvie, G. I., <i>Nonlinear hydrodynamic instability and turbulence in eccentric astrophysical discs with vertical structure</i>, Monthly Notices of the Royal Astronomical Society, 2018.</p> <p>[2] Wienkers, A. F., <i>Nonlinear hydrodynamic instability and turbulence in eccentric astrophysical discs</i>, M.Phil. Thesis, University of Cambridge, 2016.</p> <p>[3] Sochol, R. D., Wienkers, A. F., & Lin, L. <i>et al.</i>, <i>3D Printed Microfluidic Circuitry via Multijet-Based Additive Manufacturing</i>, Lab on a Chip, 2016.</p> <p>[4] Wienkers, A. F., Cunningham, A. J., Klein, R. I., Marcus, P. S., & McKee, C. F. <i>Development of an Efficient Baroclinic Cooling Prescription for Global Core</i></p>

Collapse Simulations into Protoplanetary Disks, Lawrence Livermore National Laboratory, **ICRL** (LLNL Domain), 2013.

TALKS AND
UNREFEREED
PUBLICATIONS

- [5] **Wienkers, A. F.**, Thomas, L., & Taylor, J. R., *Equilibration of symmetric instability and inertial oscillations at a finite-width submesoscale front*, **American Geophysical Union: Ocean Sciences**, San Diego, CA, February 2020.
- [6] **Wienkers, A. F.**, Thomas, L., & Taylor, J. R., *Equilibration of symmetric instability and inertial oscillations at an idealised submesoscale front*, **American Physical Society: Division of Fluid Dynamics**, Seattle, WA, November 2019.
- [7] **Wienkers, A. F.** & Taylor, J. R., *The late-time evolution of an isolated symmetrically unstable front*, **UK Fluids Conference**, Cambridge, UK, August 2019.
- [8] **Wienkers, A. F.**, Thomas, L., & Taylor, J. R., *Transport and evolution of symmetric instability in an unstratified layer*, **American Meteorological Society: Atmospheric and Oceanic Fluid Dynamics**, Portland, ME, June 2019.
- [9] **Wienkers, A. F.** & Ogilvie, G. I., *Nonlinear oscillations and zonal flows in turbulent eccentric astrophysical discs with vertical structure*, **American Physical Society: Division of Fluid Dynamics**, Denver, CO, November 2017.
- [10] **Wienkers, A. F.**, *Exploring Protoplanetary Disc Turbulence in Order 10^7 Dynamic Range*, in Berkeley Engineering Fund Poster Session, Berkeley, CA, June 2014.
- [11] Jiang, C. H., Pei, S., Hassanzadeh, P., **Wienkers, A. F.**, Levy, C., & Marcus, P. S., *The role of interactions between waves and baroclinic critical layers in zombie vortex self-replication*, **American Physical Society: Division of Fluid Dynamics**, Pittsburgh, PA, 2013.
- [12] **Wienkers, A. F.**, *Turbulence and Baroclinic Instabilities in Protoplanetary Discs*, presented at **LLNL & Sandia**, November 2013.
- [13] **Wienkers, A. F.**, *Awakening Zombie Vortices: Complex Eikonal Ray Tracing Methods*, in Berkeley Engineering Poster Session, Berkeley, CA, September 2013.
- [14] *Development and equilibration of symmetric instability in an unstratified layer*, with L. Thomas and J. R. Taylor.
- [15] *Wave/Potential-Vortex dynamics within stratified shear layer turbulence*, with A. Ghate and S. K. Lele.
- [16] *Spatio-temporal stability of the stratified Ekman boundary layer*, with S. K. Lele.

PAPERS IN
PREPARATION

University of Cambridge, Cambridge, UK

TEACHING AND
OUTREACH

- Committee Member** of the Trinity College BA Society 2019 to present
- Academic and post-graduate organiser for the Middle Combination Room
- Organiser** of the Trinity Forum 2019 to present
- Termly interdisciplinary symposium for graduates, post-docs, and faculty
- Convener & Seminar Organiser**
- Ocean-Atmosphere Dynamics meeting series 2020 to present
 - Geophysical Fluid Dynamics department seminar series 2018 to 2019
- Exhibitor**
- DAMTP Fluid Dynamics Open Day 2019
 - Cambridge Science Festival at the Cambridge Science Centre 2016

Stanford University, Stanford, CA

Instructor & Course Designer for school outreach programs 2017 to 2018

- Organised the seeME High School outreach event
- Taught for the RISE (Raising Interest in Science & Engineering) program

Volunteer for an ongoing NASA Ames ISS Human Factors Research Study 2017

University of California, Berkeley, Berkeley, CA

Instructor for Engineering 198:

Aeronautical Engineering – Private Pilot Ground Course 2011 to 2015

- Aerospace Engineering concepts introduced complementary with a Private Pilot Ground School curriculum per the Federal Aviation Regulations §141.
- Course Faculty Advisor: Jasenka Rakas

President & Co-founder of UC Berkeley Section of AIAA 2011 to 2014

- Young Professionals Committee Member, AIAA San Francisco Section

HONOURS AND AWARDS

University Medal Finalist — Awarded to Top University of California Student (2014)

Engineering Departmental Citation — Award for Top Graduating Student (2014)

College of Engineering Dean's Honour List (2010 to 2014)

NSF Summer Research Grant (Centre of Integrated Nanomechanical Systems) (2014)

Berkeley Leadership Award Scholarship (2013 to 2014)

Alexander Levens Research Design Award (2012)

Tau Beta Pi Engineering Honours Society (2011)

ACADEMIC MEMBERSHIP

Fellow of the Cambridge Philosophical Society

Engineering & Physical Sciences Research Council (EPSRC) Doctoral Training Centre

Cambridge Centre for Climate Science (CCfCS)

Natural Environment Research Council (NERC) Doctoral Training Centre (Honorary)

Trinity Mathematical Society

Trinity College Science Society

COMPUTER LANGUAGES

C/C++, FORTRAN, MPI, OpenMP, CUDA, Python, Lua, Regent (Legion), Terra, Mathematica, MATLAB, IDL, UNIX, JavaScript

RELEVANT
COURSEWORK

Mathematics: (Graduate (★) and Undergraduate (●) Courses)

- ★ Advanced Numerical Analysis (4 Course Series)
- ★ Numerical Linear Algebra
- ★ Numerical Solution of Hyperbolic PDEs
- ★ Spectral Methods in Computational Physics
- ★ Asymptotic Methods
- ★ Nonlinear Dynamical Systems
- ★ Probabilistic & Stochastic Dynamics
- ★ Partial Differential Equations for Scientists
- ★ Machine Learning Algorithms
- ★ Geometric Algebra

Computation:

- ★ Advanced Task-Oriented Parallel Computing
- ★ Advanced Software Development & Design
- ★ Programming for Power-Efficient Computing
- ★ High-Performance Computing on Modern Architectures
- ★ Computational Hardware
- ★ General Purpose GPUs
- ★ Mesh Generation & Adaptation for PDEs

Fluid Dynamics and Physics:

- ★ Advanced Fluid Dynamics (2 Course Series)
- ★ Advanced Turbulence (2 Course Series)
- ★ Compressible & Incompressible Computational Fluid Dynamics
- ★ Hydrodynamic Instability (2 Course Series)
- ★ Geophysical Fluid Dynamics
- ★ Ocean Circulation & Dynamics
- ★ Environmental Fluid Dynamics (Part III of Maths Tripos)
- ★ Fluid Dynamics of Climate (Part III of Maths Tripos)
- ★ Accretion Discs (Part III of Maths Tripos)
- ★ Astrophysical Fluid Dynamics (Part III of Maths Tripos)
- ★ Fluid Dynamics Experimental Laboratory (Part III of Maths Tripos)
- ★ Lagrangian & Hamiltonian Mechanics
- ★ Order of Magnitude Physics
- ★ Physical Gas Dynamics & Statistical Mechanics
- ★ Thermodynamics & Heat Transfer
- ★ Combustion
- Planetary Astrophysics
- Cosmology
- Microscale Fluid Mechanics

RELEVANT
INTERESTS

Private Pilot with Instrument Airplane Rating

- Certificated under FAR §141
- 250+ hours of pilot in command in single-engine aircraft

Recreational Gliding

- British Paragliding Association Certificated Pilot

SCUBA

- PADI Certificated Open Water Diver

Lawn and *Real* Tennis

- Cambridge University Real Tennis Varsity Team
- Captain of Trinity College Real Tennis Club