

Adrian E. Fraser

Postdoctoral Scholar at University of California, Santa Cruz, Applied Math

Contact Information, Links

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Interests at a Glance

I study a variety of fluid and plasma instabilities, particularly how they saturate, drive turbulence, and affect mixing, and I work to capture these details in reduced models that I check against numerical simulations. This involves code development, running massively parallelizable simulations and analyzing the results, and applying a variety of mathematical methods to model complex physical systems.

Affiliations and Education

Fall 2022– <i>(anticipated start: 9/1)</i>	Hale Postdoctoral Fellow NSO & LASP, University of Colorado Boulder
2020–Present	University of California, Santa Cruz Postdoc, Applied Mathematics PI: Pascale Garaud
2014–2020	University of Wisconsin-Madison Ph.D., Physics (Plasma) Advisors: Paul W. Terry, Ellen G. Zweibel Graduation date: Aug 23, 2020
2010–2014	University of Oregon B.S., Physics (with honors), Mathematics

Honors, Awards, and Scholarships

- 2022 **George Ellery Hale Postdoctoral Fellowship in Solar, Stellar, and Space Physics**, CU Boulder and the National Solar Observatory
Competitive two-year postdoctoral fellowship to conduct independent research
(http://halefellows.org/postdoc_about.html)
- 2022 **Marie Skłodowska-Curie Postdoctoral Fellowship Seal of Excellence**
Submitted a proposal that “was recognised as a high-quality project proposal in a highly competitive evaluation process”, and could not be funded due to budgetary constraints
(https://afraser3.github.io/files/Seal_of_Excellence.pdf) ([link](#))
- 2021 **Outstanding Postdoc Spotlight**, UCSC press release
(<https://engineering.ucsc.edu/news/outstanding-postdoc-adrian-fraser>)
- 2019 **Karl Guthe Jansky & Alice Knapp Jansky Fellowship for Physics & Astronomy**, University of Wisconsin-Madison, Department of Physics
Annual award given to outstanding graduate student in Physics or Astronomy
(<http://www.physics.wisc.edu/awards>)
- 2018 **Exceptional Service Award**, University of Wisconsin-Madison
Campus-wide TA award, nominated by the Physics department
(<https://grad.wisc.edu/teaching-assistant-awards/>)
- 2017 **Student Poster Prize**, Sherwood Fusion Theory Conference
(http://www.sherwoodtheory.org/sw2018/poster_awards.php)
- 2015 **Piore Award**, University of Wisconsin-Madison, Department of Physics
Annual award given for academic achievement in early stage of the Ph.D. program
(<http://www.physics.wisc.edu/awards>)
- 2014 **Van Vleck Fellowship**, University of Wisconsin-Madison, Department of Physics
Awarded to incoming Ph.D. students with outstanding undergraduate records
(<http://www.physics.wisc.edu/awards>)
- 2013 **Weiser Undergraduate Teaching Award**, University of Oregon, Physics
- 2013 **Science Literacy Program Scholar**, University of Oregon
Co-instructed PHYS 155, a special topics elective for non-physics majors
(<https://scilit.uoregon.edu/>)
- 2011 **Dean’s List**, University of Oregon
(<https://advising.uoregon.edu/content/academic-honors>)
- 2010-2013 **Scholarships for Oregon Scientists**, University of Oregon
(<https://sciencescholars.uoregon.edu/>)

Successful Computing Allocation Requests (Co-) Authored

2021	Momentum transport by shear-flow-driven turbulence in stars , XSEDE computing resources, NSF (education allocation) Resources awarded: approx. 200,000 CPU-hours PI: A.E. Fraser
2018-2019	Role of Stable Eigenmodes in Shear-flow MHD Turbulence , XSEDE computing resources, NSF (start-up allocation) Lead author on proposal , but not listed as PI due to XSEDE policy Resources awarded: approx. 200,000 CPU-hours PI: P.W. Terry, Co-PIs: A.E. Fraser , M.J. Pueschel, E.G. Zweibel
2017-2018 & 2018-2019	Gyrokinetic Plasma Microturbulence Simulation in Fusion and Basic Plasmas , XSEDE computing resources, NSF (research allocation) Contributed to proposal, but the lead author was the PI Resources awarded: approx. 6,750,000 (2018-2019) & 11,300,000 (2017-2018) CPU-hours PI: M.J. Pueschel, Co-PIs: A.E. Fraser , P.W. Terry, Z.R. Williams, S.-W. Tsao

Invited Talks

Mar 2021	“Capturing negative turbulent viscosity in reduced models of unstable shear flows” - ‘Staircase21’ KITP meeting
Oct 2019	“Saturation of Shear-flow Turbulence in Magnetized Plasmas” - American Physical Society Division of Plasma Physics Meeting, Fort Lauderdale, Florida
Apr 2019	“Role of Stable Modes in the Saturation and Transport Properties of Shear Flow Turbulence” - Sherwood Fusion Theory Conference, Princeton, New Jersey

Seminars

Nov 2021	“Fingering convection in MHD: problems with parasites, and speculative solutions” - University of Leeds, Fluids and MHD Seminar (Youtube link)
Jun 2021	“MHD effects on thermohaline mixing in stars: the problem with parasites” - UW-Madison Astronomy, Monday Science Seminar series
Jun 2021	“MHD effects on thermohaline mixing in stars: the problem with parasites” - Kavli Summer Program in Astrophysics
Apr 2021	“MHD effects on thermohaline mixing in stars: the problem with parasites” - Flatiron Institute CCA, Stars & Compact Objects group meeting
Oct 2020	“Momentum transport, dissipation, and models built from linear modes in MHD shear flows” - Astronomy Seminar, Stony Brook University
Mar 2019	“Role of Stable Modes in Shear-Flow Turbulence” - Plasma Physics Seminar, University of Maryland
Oct 2018	“Role of Stable Eigenmodes in Kelvin-Helmholtz Turbulence” - Plasma Seminar, IFS, University of Texas at Austin

Contributed Presentations

Nov 2021	KITP Conference: Transport in Stellar Interiors, Santa Barbara, CA – contributed oral (link)
Nov 2021	American Physical Society Division of Fluid Dynamics Meeting, Phoenix, AZ – contributed oral
Nov 2021	American Physical Society Division of Plasma Physics Meeting, Pittsburg, PA – poster presentation
Nov 2020	American Physical Society Division of Plasma Physics Meeting, remote – poster presentation
Apr 2020	Sherwood Fusion Theory Conference, Santa Rosa, CA – poster presentation (<i>meeting canceled</i>)
Nov 2018	American Physical Society Division of Plasma Physics Meeting, Portland, Oregon – poster presentation
Apr 2018	Sherwood Fusion Theory Conference, Auburn, Alabama – poster presentation
Oct 2017	American Physical Society Division of Plasma Physics Meeting, Milwaukee, Wisconsin – poster presentation
May 2017	Sherwood Fusion Theory Conference, Annapolis, Maryland – poster presentation
Oct 2016	American Physical Society Division of Plasma Physics Meeting, San Jose, California – poster presentation
Apr 2016	Sherwood Fusion Theory Conference, Madison, Wisconsin – poster presentation

Teaching Experience

2014-2017	Teaching Assistant, Introductory Physics I & II for Life Sciences, UW <i>Taught four semesters total; granted ratings of “Excellent” three times and “Very Good” once by TA coordinator; granted campus-wide TA award in 2018</i>
2010-2014	Co-instructor, instructional lab manager, Undergraduate Teaching Assistant, tutor, mentor, and peer advisor at UO and a local high school <i>The teaching activities I was involved in at UO were broad and occurred over the span of my time there; I am happy to discuss them in greater detail if asked</i>

Mentoring

2022-	Co-mentoring UCSC undergraduate student Henry Olling, alongside Prof. Patrick Chuang, on research project on water droplet accumulation in turbulent clouds
2021-	As a senior participant at the Kavli Summer Program in Astrophysics 2021 (link), directly supervised Kavli student fellow Imogen Cresswell's research project on shear-flow turbulence in MHD, motivated by small-scale dynamics in stellar interiors <ul style="list-style-type: none">- <i>Met daily for five weeks, and weekly thereafter, to discuss research progress and review concepts involving shear-flow instabilities and turbulence</i>- <i>Simulations performed using XSEDE resources I procured</i>
2021-	Mentoring UCSC undergraduate student Amishi Sanghi on research project, publication in prep.
2019-2020	Peer mentor to Bindesh Tripathi, UW-Madison (<i>I continue to mentor Bindesh on research</i>)
2019-2020	Supervised an undergraduate research project: Jack Schroeder, studying how magnetic fields affect coupling to large-scale stable modes in shear flow instabilities <ul style="list-style-type: none">- <i>Met weekly to discuss progress in his calculation and review underlying concepts</i>

Professional Service

2018-2019	Co-founder and President, Physics Graduate Student Council (PGSC) <ul style="list-style-type: none">- <i>Led department-wide town halls to collaboratively form PGSC, served as president for its first year</i>- <i>Worked with department administrators and peers on two \$1,000 professional development grants awarded by the university with which we hosted seminar speakers; secured additional \$4,000 in support from the department for our first year</i>- <i>Worked with department and peers to: restructure graduate student recruitment and orientation; address major concerns regarding the graduate program; secure graduate student representatives on relevant faculty committees; implement peer mentoring</i> (https://pgsc.physics.wisc.edu/)
2018-2019	Graduate Program Committee Member, UW-Madison Department of Physics <i>Served as student representative on faculty committee</i> (https://www.physics.wisc.edu/resources/committee)

Peer reviews: J. Plasma Phys. (2020-present), Phys. Rev. Fluids (2022-present); NSF ad-hoc proposal review (plasma physics, 2022)

Session chair: KITP “transtar21” conference ([link](#))

Open-source software contributions: contributed to Dedalus (1 PR, 1 issue) and Eigentools (1 issue), see [my GitHub](#)

Ongoing External Collaborations

(Red text highlights undergraduate and/or graduate students I mentor on these projects.)

- 2021- **A.E. Fraser**, J.S. Oishi, and A.K. Kaminski, *Nonmodal growth of MHD shear flows with stabilizing magnetic fields*, contributed poster to APS DPP 2021; progress shared openly on [GitHub](#)
- 2021- **I.G. Cresswell**, **A.E. Fraser**, and E.H. Anders, *Propagating fronts of thermohaline mixing*, project started from our participation in the *Transtar21* KITP meeting
- 2021- **I.G. Cresswell**, **A.E. Fraser**, and P. Garaud, *Mixing in unstable shear flows with strong magnetic fields and high resistivity*, KSPA report [available online](#), journal publication next step
- 2020- **B. Tripathi**, **A.E. Fraser**, P.W. Terry, E.G. Zweibel, and M.J. Pueschel, *Stable-mode-mediated turbulence saturation and small-scale dissipation in MHD Kelvin-Helmholtz-unstable flows*, contributed abstracts to [Sherwood Fusion Theory 2021](#) & 2022 and APS DPP 2020 & 2021
- 2022- **B. Tripathi**, **A.E. Fraser**, P.W. Terry, E.G. Zweibel, M.J. Pueschel, and E.H. Anders, *MHD shear-flow turbulence and stable mode excitation in the generalized quasi-linear approximation*
- 2021- Z.R. Williams, J.C. Timperman, M.S. Dickerson, and **A.E. Fraser**, *Investigating the role of stable eigenmodes in the nonlinear dynamics of resistive tearing instabilities*, contributed abstract to APS DPP 2021

Other Experience

- Fall 2021 Participant in KITP Program: Probes of Transport in Stars
- Summer 2021 Participant in Kavli Summer Program in Astrophysics (KSPA): Fluid Dynamics of the Sun and Stars
- Spring 2021 Participant in KITP Program: Layering in Atmospheres, Oceans and Plasmas
- Summer 2017 Student in Summer School on Astrophysical Plasmas - Niels Bohr International Academy, Copenhagen, Denmark
- 2013–2014 Imamura Group, University of Oregon
Worked on analytical and numerical models of accretion disks, including global fluid simulations, linear stability analyses, and radiation transport models
- 2011–2013 Torrence Group, University of Oregon
Using Geant4, a Monte Carlo-based particle physics software package, developed and ran a model to test the performance of an electron energy spectrometer originally proposed for use in the International Linear Collider

Refereed Publications

(Red text highlights undergraduate and/or graduate students I mentored on these projects.)

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| (In prep) | A.E. Fraser and P. Garaud, <i>MHD effects on fingering convection in stars: the problem with parasites</i> , <i>Astrophys. J.</i> |
| (Submitted) | B. Tripathi , A.E. Fraser , P.W. Terry, E.G. Zweibel, and M.J. Pueschel, <i>Stable modes in coherent vortices and scaling laws of MHD shear flow turbulence</i> , <i>Phys. Plasmas</i> |
| (Submitted) | A.E. Fraser , M. Joyce, E.H. Anders, J. Tayar, and M. Cantiello, <i>Observed Extra Mixing Trends in Red Giants are Reproduced by the Reduced Density Ratio in Thermohaline Zones</i> , <i>Astrophys. J.</i> , arXiv |
| (Submitted) | A.E. Fraser , I.G. Cresswell , and P. Garaud, <i>Resistive instabilities in sinusoidal shear flows with a streamwise magnetic field</i> , <i>J. Fluid Mech.</i> , arXiv |
| (Accepted for publication) | A. Sanghi , A.E. Fraser , E.R. Tian, and P. Garaud, <i>Magnetized semiconvection and density layers in stars</i> , <i>Astrophys. J.</i> , arXiv |
| (Accepted for publication) | B. Tripathi , A.E. Fraser , P.W. Terry, E.G. Zweibel, and M.J. Pueschel, <i>Mechanism for Sequestering Magnetic Energy at Large Scales in Shear-Flow Turbulence</i> , <i>Phys. Plasmas</i> , arXiv |
| Mar 2022 | E.H. Anders, A.S. Jermyn, D. Lecoanet, A.E. Fraser , I.G. Cresswell , M. Joyce, and J.R. Fuentes, <i>Schwarzschild and Ledoux are equivalent on evolutionary timescales</i> , <i>Astrophys. J. Lett.</i> , DOI ADS arXiv |
| Feb 2021 | A.E. Fraser , P.W. Terry, E.G. Zweibel, M.J. Pueschel, and J.M. Schroeder , <i>The impact of magnetic fields on momentum transport and saturation of shear-flow instability by stable modes</i> , <i>Physics of Plasmas</i> 28, 022309 DOI ADS
→ Designated as a Phys. Plasmas Editor's Pick |
| Dec 2018 | A.E. Fraser , M.J. Pueschel, P.W. Terry, and E.G. Zweibel, <i>Role of stable modes in driven shear-flow turbulence</i> , <i>Physics of Plasmas</i> 25, 122303 DOI ADS
→ Designated as a Phys. Plasmas Featured Article
→ Selected for an AIP Scilight article (https://aip.scitation.org/doi/10.1063/1.5083843)
→ UW press release
(https://news.wisc.edu/taming-turbulence-seeking-to-make-complex-simulations-a-breeze/) |
| Jun 2017 | A.E. Fraser , P.W. Terry, E.G. Zweibel, and M.J. Pueschel, <i>Coupling of damped and growing modes in unstable shear flow</i> , <i>Physics of Plasmas</i> 24, 062304 DOI ADS
→ Designated as a Phys. Plasmas Editor's Pick |