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

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

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, Department of 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://scienceschola rs.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 *(meeting canceled)*
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 *Taught four semesters total; granted ratings of "Excellent" three times and "Very Good" once by TA coordinator; granted campus-wide TA award in 2018*
2010-2014	Co-instructor, instructional lab manager, Undergraduate Teaching Assistant, tutor, mentor, and peer advisor at UO and a local high school *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*

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 - *Met daily for five weeks, and weekly thereafter, to discuss research progress and review concepts involving shear-flow instabilities and turbulence* - *Simulations performed using XSEDE resources I procured*
2021-	Mentoring UCSC undergraduate student Amishi Sanghi on research project, publication in prep.
2019-2020	Peer mentor to Bindesh Tripathi, UW-Madison *(I continue to mentor Bindesh on research)*
2019-2020	Supervised an undergraduate research project: Jack Schroeder, studying how magnetic fields affect coupling to large-scale stable modes in shear flow instabilities - *Met weekly to discuss progress in his calculation and review underlying concepts*

Professional Service

2018-2019	Co-founder and President, Physics Graduate Student Council (PGSC) - *Led department-wide town halls to collaboratively form PGSC, served as president for its first year* - *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* - *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* (https://pgsc.physics.wisc.edu/)
2018-2019	Graduate Program Committee Member, UW-Madison Department of Physics *Served as student representative on faculty committee* (https://www.physics.wisc.edu/resources/committee)

Peer reviews: J. Plasma Phys. (2020-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

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 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.)

(In prep)	**A.E. Fraser** and P. Garaud, *MHD effects on fingering convection in stars: the problem with parasites*, Astrophys. J.
(In prep)	A. Sanghi, **A.E. Fraser**, E.R. Tian, and P. Garaud, *Magnetized semiconvection and density layers in stars*, Astrophys. J.
(In prep)	B. Tripathi, **A.E. Fraser**, P.W. Terry, E.G. Zweibel, and M.J. Pueschel, *Stable modes in coherent vortices and scaling laws of MHD shear flow turbulence*, Phys. Plasmas
(Under review)	B. Tripathi, **A.E. Fraser**, P.W. Terry, E.G. Zweibel, and M.J. Pueschel, *A New Mechanism for Sequestering Magnetic Energy at Large Scales in Shear-Flow Turbulence*, Phys. Rev. Lett.
(Under review)	**A.E. Fraser**, M. Joyce, E.H. Anders, J. Tayar, and M. Cantiello, *Observed Extra Mixing Trends in Red Giants are Reproduced by the Reduced Density Ratio in Thermohaline Zones*, Astrophys. J., arXiv
(Under review)	**A.E. Fraser**, I.G. Cresswell, and P. Garaud, *Resistive instabilities in sinusoidal shear flows with a streamwise magnetic field*, J. Fluid Mech.
Mar 2022	E.H. Anders, A.S. Jermyn, D. Lecoanet, **A.E. Fraser**, I.G. Cresswell, M. Joyce, and J.R. Fuentes, *Schwarzschild and Ledoux are equivalent on evolutionary timescales*, Astrophys. J. Lett., DOI ADS arXiv
Feb 2021	**A.E. Fraser**, P.W. Terry, E.G. Zweibel, M.J. Pueschel, and J.M. Schroeder, *The impact of magnetic fields on momentum transport and saturation of shear-flow instability by stable modes*, Physics of Plasmas 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, *Role of stable modes in driven shear-flow turbulence*, Physics of Plasmas 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, *Coupling of damped and growing modes in unstable shear flow*, Physics of Plasmas 24, 062304 DOI ADS → Designated as a Phys. Plasmas **Editor's Pick**