Adam Michael Bauer

Graduate Research Assistant

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RESEARCH INTERESTS

Nonlinear Dynamical Systems | **Climate Science** | **Social Cost of Carbon**

Extreme Heating Events | **Soil Moisture Dynamics** | **Mathematical Modeling**

EDUCATION

Ph. D. Physics

University of Illinois Urbana Champaign | 2020 –

- Currently enrolled in the physics doctoral program.
- Cumulative GPA: 4.000

B.S. Physics & B.S. Mathematics

University of Arizona | 2016 – 2020

- Minor: Astronomy and Astrophysics
- Cumulative GPA: 3.972 (Summa Cum Laude)
- Thesis: *On the Behavior of Null Rays in Spherically Symmetric Spacetimes*

CURRENT RESEARCH PROJECTS

Building a Hasselmann-like model for soil moisture dynamics

Advisor: *Prof. Cristian Proistosescu*

University of Illinois Urbana Champaign | Jan 2021 – Present | Urbana, IL

- Built a numerical code to simulate the time-evolution of near-surface air energy and moisture budgets, forced by both observational data and synthetic data.
- Analytically derived a one-dimensional Hasselmann-like model for soil moisture dynamics.
- Analytically computed (and numerically verified) the central moments of the soil moisture in our 1D Hasselmann-like model when forced with stochastic forcing.
- *Outcome:* An in preparation publication.

Updating EZClimate using an enhanced climate emulator

Advisor: *Prof. Cristian Proistosescu & Prof. Gernot Wagner*

University of Illinois Urbana Champaign | May 2021 – Present | Urbana, IL

- Implemented a new climate module into EZClimate, an Integrated Assessment Model used to calculate the social cost of carbon.
- Module includes, among other things, a two-box Hasselmann-like model to accurately calculate the warming in response to a doubling of CO_2 and a physically consistent representation of the carbon cycle.
- *Outcome:* An in preparation publication.

PAST RESEARCH PROJECTS

Using accretion physics to test general relativity

Advisor: *Prof. Nicolás Yunes & Prof. Charles Gammie*

University of Illinois Urbana Champaign | Dec 2020 – Oct 2021 | Urbana, IL

- Performed analytic calculations of accretion disk flow properties in a modified theory of gravity.
- Built a ray tracing code to calculate the intensity profile of a black hole accretion disk in a modified theory of gravity.
- Investigated the feasibility of testing general relativity using the Event Horizon Telescope.
- *Outcome:* A first-author publication that's been published in *The Astrophysical Journal*.

Near-horizon null rays in stationary spherically symmetric spacetimes

Advisor: *Prof. Samuel Gralla*

University of Arizona | Aug 2019 – Sep 2019 | Tucson, AZ

- Utilized Penrose limit metrics and perturbation theory to further investigate the Aretakis instability of extremal black holes.
- *Outcome:* Senior thesis.

Transonic canards in the stellar wind problem

Advisor: *Prof. Paul Carter*

University of Arizona | Jan 2019 – Dec 2020 | Tucson, AZ

- NSF REU internship where we proved the existence of a canard-shock solution in the hydrodynamic equations governing gas surrounding a star, including the effects of heat conduction and viscosity using geometric singular perturbation theory results.

- *Outcome:* A first-author publication in *SIAM Journal on Applied Dynamical Systems*.

Data-driven investigation of massive galaxy cluster lensing properties

Advisor: *Prof. Brenda Frye*

University of Arizona | Sep 2016 – May 2019 | Tucson, AZ

- Developed a numerical algorithm to reduce and analyze observational data.
- Used observational data to measure the redshift of galaxy cluster members and calculated the total cluster mass.
- Fully funded by University of Arizona/NASA Space Grant from Aug 2018 – May 2019.
- *Outcomes:* Two publications in *The Astrophysical Journal* (1 in prep) and publication of an open-source user's manual.

REFEREED PUBLICATIONS

A. M. Bauer, A. Cárdenas-Avendaño, C. F. Gammie, N. Yunes. Spherical accretion in alternative theories of gravity. *The Astrophysical Journal*, 925:2, 2022.

M. Pascale, B. L. Frye, L. Dai, N. Foo, Y. Qin, R. Leimbach, **A. M. Bauer**, E. Merlin, D. Coe, J. Diego, H. Yan, A. Zitrin, S. H. Cohen, C. Conselice, H. Dole, K. Harrington, R. A. Jansen, P. Kamienski, R. A. Windhorst, M. Yun. Multiband photometry and photometric redshift estimatation in the field of PLCK G165+67.0. *In preparation*, 2021.

A. Bauer, P. Carter. Existence of transonic solutions in the stellar wind problem with viscosity and heat conduction. *SIAM Journal on Applied Dynamical Systems*, 20:1, 2021.

B. L. Frye, M. Pascale, Y. Qin, A. Zitrin, J. Diego, G. Walth, H. Yan, C. J. Conselice, M. Alpaslan, **A. Bauer**, L. Busoni, D. Coe, S. H. Cohen, M. Dole, M. Donahue, I. Georgiev, R. A. Jansen, M. Limousin, R. Livermore, D. Norman, S. Rabien, R. A. Windhorst. PLCK G165.7+67.0: Analysis of a massive lensing cluster in a Hubble Space Telescope census of sub-millimeter giant arcs selected using Planck/Hershel. *The Astrophysical Journal*, 871:51, 2019.

UNREFEREED PUBLICATIONS

A. Bauer, B. Frye. THELI Reduction Software: A write up for inexperienced data reducers. Posted to THELI forums & Cloudynights.com, 2019. (Theli Link.) (Cloudynights Link.)

PEDAGOGICAL WORK

Analytic Formal Report Development and Implementation (PI)

Collaborators: *Prof. Shawn Jackson, Danielle Dickinson*

University of Arizona | Jan 2020 – May 2021 | Tucson, AZ

- Led the development of the Analytic Formal Report, a new assignment for upper division physics students.
- Graded AFRs and held office hours to help students with them in the 2020 spring semester.
- Mentored Danielle Dickenson, who performed my spring 2020 duties, in the spring 2021 semester.

TALKS AND PRESENTATIONS

Characterization and Analysis of Massive Space Telescopes

Arizona Space Grant Symposium | Apr 2019 | Tempe, AZ

Measuring the Dynamical Masses of Sub-millimeter Selected Gravitational Lenses

Steward Observatory Internal Symposium | Sep 2018 | Tucson, AZ

Measuring Masses of Galaxy Clusters

Galileo Circle Scholarship Banquet | Apr 2018 | Tucson, AZ

ACADEMIC HONORS AND ACHIEVEMENTS

NSF Graduate Research Fellowship Program
Honorable Mention – 2020

The Excellence in Undergraduate Research Award
UArizona College of Science – 2020

The Excellence in Undergraduate Research Award
UArizona Department of Physics – 2020

University of Arizona/NASA Space Grant Intern
2018 – 2019

Phi Beta Kappa Society
Alpha of Arizona Chapter – 2018

Galileo Circle Scholar
2018 – 2019

Weaver Research Award
UArizona Department of Physics, 2017 – 2018

Highest Academic Achievement
UArizona, 2016 – 2017, 2018 – 2019, & 2019 – 2020

SCHOLARSHIPS AWARDED

Glenn C. Purviance Scholarship
UArizona Department of Physics, 2019 – 2020

Gregson Award
UArizona Department of Physics, 2019 – 2020

Grogan Scholarship
UArizona Department of Mathematics, 2019 – 2020

Douglass/Langadas Scholarship
UArizona Department of Astronomy, 2018 – 2019

TEACHING EXPERIENCE

Graduate Teaching Assistant

Course: *PHYS 102 – College Physics: E&M and Modern*

University of Illinois Urbana Champaign Aug 2020 – Dec 2020 Urbana, IL

- Made the **List of Teachers Ranked as Excellent By Their Students**.
- Led discussion sections for introductory physics course designed for non-physics majors.
- Prepared small lectures and held extra exam review sessions.

Undergraduate Teaching Assistant

Course: *PHYS 103 – Introductory Physics II*

University of Arizona Aug 2019 – Dec 2019 Tucson, AZ

- Oversaw problem solving sessions bi-weekly where I walked students through exam level practice problems.

TECHNICAL STRENGTHS

Strong:
Python, Mathematica, LaTeX

Intermediate:
IRAF/PyRAF

Beginner:
C/C++, IDL

EXTRA-CIRRICULAR

Graduate Peer Mentor
University of Illinois Urbana Champaign

Undergraduate Peer Mentor
University of Arizona

Grad On-Call
University of Illinois Urbana Champaign

Physics Discovery Team Member & Project Developer
University of Arizona