

# Adam Bauer

Graduate Research Assistant

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Champaign, IL, USA

## RESEARCH INTERESTS

Nonlinear Dynamical Systems

Extreme Weather Events

Climate Science

Atmospheric Fluid Dynamics

Social Cost of Carbon

Numerical 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  $\text{CO}_2$  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 accepted into *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. Bauer**, A. Cárdenas-Avendaño, C. F. Gammie, N. Yunes. Spherical accretion in alternative theories of gravity. *Accepted in The Astrophysical Journal on 11/12/2021*. [arXiv Link](#).

M. Pascale, B. L. Frye, L. Dai, N. Foo, Y. Qin, R. Leimbach, **A. Bauer**, E. Merlin, D. Coe, J. Diego, H. Yan, A. Zitrin, S. H. Cohen, C. Conselice, H. Dole, K. Harrington, R. A. Jansen, P. Kamiński, R. A. Windhorst, M. Yun. Multiband photometry and photometric redshift estimation 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/Herschel. *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 – present 📍 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 Dickinson, who performed my spring 2020 duties, in the spring 2021 semester.

## TALKS AND PRESENTATIONS

### (Upcoming) Updating Calculations of Optimal CO<sub>2</sub> Price Paths Using a State-of-the-Art Climate Emulator

American Geophysical Union Fall Meeting 📅 Dec 2021 📍 New Orleans, LA

### 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

### Grogan Scholarship

UArizona Department of Mathematics, 2019 – 2020

### Gregson Award

UArizona Department of Physics, 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*

### Grad On-Call

*University of Illinois Urbana Champaign*

### Undergraduate Peer Mentor

*University of Arizona*

### Physics Discovery Team Member & Project Developer

*University of Arizona*