ROBERT CADDY

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Research Interest: Computational Methods in Astrophysics & Scientific Software Best Practices

EDUCATION

University of Pittsburgh, Pittsburgh, PA 2018-2024
Ph.D. - Physics
Dissertation Title: *Cholla-MHD: An Exascale-Capable Magnetohydrodynamic Extension to the Cholla Astrophysical Simulation Code*
Advisor: Dr. Evan Schneider

Bowling Green State University, Bowling Green, OH 2016-2018
M.S. - Physics
Thesis Title: *Time Series Photometery of the Symbiot Star V1835 Aql and New Variable Stars in Aquila*
Advisor: Dr. Andrew Layden

Purdue University, West Lafayette, IN 2012-2016
B.A. - Honors Physics, Astronomy minor

EMPLOYMENT & RESEARCH EXPERIENCE

Research Software Engineer II, Princeton University, Princeton, NJ 2024-Present

- Developed and optimized scientific codes in collaboration with Astrophysics research groups, specializing GPU accelerate codes in computational Astrophysics.
- Worked with researches to expand the capabilities of Iseult, a visualization code for Particle-in-Cell simulations. Added several key new features and updated the code to comply with best practices.

Ph.D. Candidate, University of Pittsburgh, Pittsburgh, PA 2018-2024

- Expanded Cholla, a massively parallel GPU-accelerated code for simulating astrophysical fluid dynamics to include magnetic fields (magnetohydrodynamics/MHD) using state of the art methods.
- Conducted research with Professor Evan Schneider into numerical modeling of galactic winds using the GPGPU code Cholla
- Collaborated with the Frontier Center for Accelerated Application Readiness (CAAR) program to optimize Cholla to run on exascale supercomputers, namely Frontier.
- Established and executed a robust testing framework for Cholla, employing GoogleTest with custom extensions to ensure software reliability and quality.
- Led multiple initiatives to promote scientific software best practices within the Cholla development team, fostering excellence in software engineering standards.

Masters Student, Bowling Green, OH 2016-2018

- Conducted original thesis research into the properties of symbiotic star V1835 Aql with Professor Andrew Layden as advisor.
- Determined the general properties and causes of variability of a symbiotic star system through image and data analysis in Python.

Undergraduate Research Assistant, Purdue University, West Lafayette, IN 2015-2016

- Built an experimental two-channel dynamic digital holography system to investigate the time dependent effects of chemotherapy drugs on cancer tumors via biodynamic imaging.
- Improved efficiency & quality of large-scale (tens of terabytes) off-site data storage using HSI. Improved efficiency by a factor of 12.

Fellowships and Awards

Learning Beyond the Classroom Certificate, 2016
Presidential Scholarship, Purdue University, 2012-2016
Ascarelli Fellowship, Department of Physics and Astronomy, Purdue University, 2012
Eagle Scout, 2012

Conferences and Presentations

- *Getting Scientist buy-in on best practices: A Case Study.*, 2nd Annual Conference of the US Research Software Engineer Association (US-RSE'24), October 2024, Rapid Access Microtalk (RAM)
- *Exascale MHD Simulations with Cholla*, Santa Cruz Organization for Outreach in Physics (SCOOP) No Jargon Talk, University of California Santa Cruz, *Invited Talk*, November 2023
- *Exascale MHD Simulations with Cholla*, Seminar, NASA Goddard, *Invited Talk*, November 2023
- *Exascale MHD Simulations with Cholla*, Center for Theory and Computation (CTC) Seminar, University of Maryland, *Invited Talk*, November 2023
- *Exascale MHD Simulations with Cholla*, Joint Space Institute Workshop: Winds Throughout the Universe, *Contributed Talk*, October 2023
- *GPU Accelerated Magnetohydrodynamics for Astrophysics & Testing for Exascale Codes*, Fall Meeting of the Mid-Atlantic Section of the APS, *Poster Presentation*, December 2022
- *GPU Accelerated Magnetohydrodynamics for Astrophysics & Testing for Exascale Codes*, International High Performance Computing Summer School (IHPCSS), *Poster Presentation*, June 2022
- *Time Series Photometry of the Symbiotic Binary V1835 Aql*, Ohio Academy of Sciences (OAS) Meeting, *Poster Presentation*, April 2018
- *Time Series Photometry of the Symbiotic Binary NSV 11749*, Canadian-American-Mexican (CAM) Graduate Student Conference, *Poster Presentation*, August 2017

Professional Experience

Computional:

Langues: C++, Python, Fortran, Bash

Packages & API's: MPI, CUDA, HIP, OpenMP, GoogleTest, Numpy, Pandas, Scipy, Matplotlib, Astropy

Software Tools: git, GitHub Actions, Clang Tools, LaTeX, GCC, Make, HDF5, HSI, PBS/Slurm/LSF, DAOPHOT, IRAF, GoogleTest, Docker

HPC Resources Used: Supercomputer clusters at Purdue University, the University of Pittsburgh, Argonne National Lab Leadership Computing Facility Theta supercomputer, Oak Ridge National Lab Leadership Computing Facility systems including Summit, Spock, Crusher, Andes, and Frontier.

Observing

PROMPT C1 & C5 at the Cerro Tololo Inter-American Observatory (*remote*) many nights observing the symbiotic star V1835 Aql

Service:

Member, Women and Minorities in Physics, University of Pittsburgh 2019-Current
President, Purdue Society of Physics Students (SPS), 2016
Member, Women in Physics, Purdue 2014-2016
APS - Conference for Undergraduate Women in Physics (Purdue University, 2015) - Volunteer

Professional Development:

- 2024 US Research Software Engineer Association 2nd Annual Conference (US-RSE'24)
- 2023 Supercomputing Conference & Tutorials
- 2023 US Research Software Engineer Association 1st Annual Conference (US-RSE'23)
- 2023 Practice and Experience in Advanced Research Computing Conference (PEARC)

- 2023 Platform for Advanced Scientific Computing Conference (PASC)
- 2022 Argonne Training Program for Extreme Scale Computing (ATPESC)
- 2022 International High Performance Computing Summer School (IHPCSS), Second place in the programming challenge
- 2021 Advanced Cyberinfrastructure Training for Modeling Physical Systems at Rensselaer Polytechnic Institute
- 2021 XSEDE Webinar: Performance Tuning and Single Processor Optimization
- 2020 Intel Developer Tools Workshop
- 2020 Frontier Center of Excellence (COE) Workshop, *invite only*
- 2020 OLCF User Meeting
- XSEDE HPC Workshop Series: Attended the MPI, OpenMP,Python & Performance, OpenACC, and Big Data & Machine Learning workshops

Membership: AAS Member, APS Member

Teaching & Tutorials

Tutorials

- *Introduction to Python Data Types*, University of Pittsburgh, 2023
- *Introduction to Git, GitHub, and Git Workflows*, University of Pittsburgh, 2022
- *Scientific Software Best Practices*, University of Pittsburgh 2022, 2023
- *Organizing Your Dotfiles*, University of Pittsburgh, 2021

Teaching

- University of Pittsburgh, 2018-2020:
  - Graduate Teaching Assistant for introductory physics and astronomy courses
  - Led 2-5 recitations per week with 20-50 students each. Sometimes wrote my own recitation assignments/problems depending on what the professor required
  - Grading recitation assignments, exams, labs, etc.
- Bowling Green State University, 2016-2018:
  - Graduate Teaching Assistant for introductory physics courses
  - Led 2-3 two hour labs per week of 20-30 students each
- Purdue University, 2013-2016:
  - Undergraduate Teaching Assistant for introductory physics courses. Helped graduate TAs teach 2-4 recitation and/or labs per week of 20-30 students each

Submitted and Refereed Publications

⋆ - First or Second Author

2. ⋆ *Cholla-MHD: An Exascale-capable Magnetohydrodynamic Extension to the Cholla Astrophysical Simulation Code*
Caddy, R & Schneider, E., 2024, The Astrophysical Journal, Volume 970
DOI: 10.3847/1538-4357/ad464a, arXiv:2402.05240

1. ⋆ *Optical Time-series Photometry of the Symbiotic Nova V1835 Aquilae*
Caddy, Robert V., Layden,Andrew C., Reichart, Daniel E., Haislip, Joshua B., Kouprianov, Vladimir V., Ivarsen, Kevin M., Moore, Justin P., LaCluyze, Aaron P., Linder, Tyler R., and Nysewander Melissa C., 2022 Publications of the Astronomical Society of the Pacific, Volume 134, Number 1039
DOI: 10.1088/1538-3873/ac8f6f, arXiv:2209.11251