Ronan Hix

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Education

Princeton University, Princeton, NJ — *Expected May 2028*
Ph.D in Astrophysics

University of Maryland, College Park, MD — *May 2023*
Bachelor of Science in Physics
Bachelor of Science in Astronomy
Minor in Germanic Studies
GPA: 4.0/4.0

Research

Alfvén Wave Propogation in Pre-Stellar Cores — *June 2024—Present*
Advisor: Dr. Matt Kunz
Institution: Princeton University, Princeton, NJ

- Simulate magnetized pre-stellar cores under non-ideal MHD using the GPU-compatible Kokkos code IDEFIX.
- Investigate how magnetic wave penetration couples pre-stellar envioronments to the turbulent structure of their natal molecular clouds.

Simulating Cosmic Ray Transport in Diverse Environments — *August 2023—Present*
Advisor: Dr. Lucia Armilotta, Dr. Chang-Goo Kim, and Prof. Eve Ostriker
Institution: Princeton University, Princeton, NJ

- Simulate the propagation of cosmic rays using a multi-mechanism, self-consistent transport scheme built on Athena++ and the TIGRESS simulation suite.
- Study the strong variability in CR transport characteristics between ISM phases.
- Develop straightforward parametrizations that accurately capture the cosmic ray distributions across a diverse range of galactic environments.

Simulating Giant Molecular Clouds with RAMSES-RT — *February 2021—June 2023*
Advisor: Dr. Massimo Ricotti
Institution: University of Maryland, College Park, MD

- Ran HPC simulations of Giant Molecular Clouds (GMCs) under local universe conditions using RAMSES-RT, an AMR MHD code with realistic radiation transport and photochemistry.
- Study the impact of variations in GMC metallicity and galactic magnetic field strength on the resulting star formation histories and stellar populations.

Probing the LSS with N-Point Correlation Functions — *May 2022—May 2023*
Advisor: Dr. Jiamin Hou and Dr. Zachary Slepian
Institution: University of Florida, Gainesville, FL

- Developed software in Python and CUDA to calculate 3- and 4-PCFs using an innovative basis decomposition method and GPU parallelization on UF's HiPerGator supercomputer.
- Accelerated code execution by factors exceeding 3,500,000, allowing feasible analysis of large population galaxy samples, from both simulation and observation.

Simulating Air Shower Geometry in HAWC *November 2019—February 2021*

Advisor: Dr. Andy Smith
Institution: University of Maryland, College Park, MD

- Developed tools in C/ROOT to derive shower-front curvature from Monte Carlo simulations of cosmic air-shower detections by the High Altitude Water Cherenkov Observatory (HAWC).
- Created new models of air-shower-front geometry for use in the reconstruction of collected data, in order to improve the angular resolution of the detector.

Event Reconstruction with the CMS Detector *September 2019—December 2020*

Advisor: Dr. Müge Karagöz
Institution: University of Maryland, College Park, MD

- Developed and utilized ROOT-based tools to investigate simulated performance of the Compact Muon Solenoid experiment at the Large Hadron Collider, to improve energy reconstruction.

Analyzing CHIMERA Type-II Supernova Simulations *May 2018—August 2019*

Advisor: Dr. Bronson Messer
Institution: Oak Ridge National Laboratory, Oak Ridge, TN

- Developed tools in Python for analysis and visualization of simulation outputs, enabling investigations of the early-stage progression of Type-II Core-Collapse Supernovae, including nucleosynthesis, neutrino-driven shock revival, and proto-neutron-star development.
- Created a frontend to enable compatibility between the astrophysical visualization python package "yt" and raw Chimera simulation outputs, which is now included in the public yt distribution.

Technical Experience

Programming Languages:
C, CUDA, Matlab, Python, ROOT

Software:
Git, Jupyter, LaTeX, Unix shell, Vim

Software Packages:
CuPy, Matplotlib, Numpy, Pandas, Scipy, yt

HPC Experience:
Parallelization, Supercomputing, SLURM

General:
Computational Simulation, Data Processing, Data Analysis and Visualization, Software Development and Optimization

Presentations and Publications

Publications:

- "Bimodal Star Formation in Simulations of Strongly Magnetized Giant Molecular Cloud", Hix R., He C.-C., Ricotti M., 2022, arXiv e-prints, arXiv: 2212.04411

Presentations:

- "Simulating Star Formation under the Influence of Strong Magnetic Fields", Oral presentation, 2024 Ramses User Meeting, 24 April 2024, Flatiron Institute, New York City, NY
- "Bimodal Star Formation in Simulations of Strongly Magnetized Giant Molecular Cloud", iPoster, 243st Meeting of the AAS, 12 January 2024, New Orleans, LA - **Chambliss Awardee**
- "Calculating N-Point Correlation Functions using Isotropic Basis Projection and GPU Computing", iPoster, 241st Meeting of the AAS, 12 January 2023, Seattle, WA
- "Simulating Star Formation in Giant Molecular Clouds under the influence of Magnetic Fields", Physics Undergraduate Committee (PUC) Colloquium, 15 November 2022, College Park, MD
- "Studying N-Point Correlation Functions using GPU Accelerated Computing", Oral presentation, 4 August 2022, Gainesville, FL

  Link to Recording of Presentation
- "A New Method for Producing Curvature Corrections from Monte Carlo Data", HAWC Data and Algorithms Meeting, Virtual meeting, 20 October 2020
- "Refining HGCAL Energy Reconstruction with Timing Data" - First-Year Innovation and Research Experience Summit, Poster session, 14 November 2020, College Park, MD

Honors and Awards

- Chambliss Astronomy Student Achievement Award (2024)
- SPS/SSAI Academic Scholarship Awardee (2022)
- NSF REU Recipient (2022)
- University of Maryland President's Scholarship (2019 - 2023)
- UMD Dean's List (2019 - 2023)
- Sigma Pi Sigma (Physics Honors Society) Inductee (2021)
- Honors Citation - University Honors (2020)
- National Merit Scholarship Awardee (2019)
- Eagle Scout (2019)

Extracurriculars

- **Society of Physics Students (SPS): (2019 - present)**
  - Supports the academic and personal pursuits of physics students in the department. Organizes a wide range of activities, including lectures by professors, skill development workshops, town halls, social events, peer mentoring, a breakfast stand, and even a free tutoring clinic.
  - SPS Treasurer: (2021-2022)
  - **SPS Vice President**: (2022 - Present)
- **AstroTerps - Undergraduate Astronomy Club: (2019 - present)**
  - Undergraduate astronomy club featuring guest lectures, social events, and career development activities in astronomy.
- **Physics Undergraduate Committee (PUC): (2019 - present)**
  - Provides peer support for students, showcases undergraduate research achievement, and champions student causes to university and physics department leaders.

Volunteer and Outreach Experience

- **SPS Tutoring: (2020-present)**
  - Volunteer several hours a week for the free physics tutoring service organized by the UMD SPS chapter.
  - Provide assistance and guidance to undergraduate students enrolled in a variety of introductory and upper-level physics courses.
- **2022 Physics Congress Volunteer Co-Organizer (2022)**
  - Coordinated with AIP and the UMD physics department to serve as a local host University for the 2022 Congress, which was attended by almost 1000 students from across the country.
  - Helped organize and lead lab tours, academic panels, and social activities during the congress, as well as assisted with pre-conference logistics and planning.
- **Astronomy Department Peer Mentoring: (2022-present)**
  - Serve as a peer mentor for 2 first-year astronomy students.
  - Assist their transition into both astronomy and the university through advice, recommendations, and explanations on topics both academic and interpersonal.
- **SPS Peer Mentoring Co-Organizer: (2021-present)**

  - Matched underclassmen physics majors and transfer students with experienced upperclassmen and coached mentees on how to use their experience to help mentees succeed.
  - Serve as a mentor for a first-year physics student

- **Departmental Physics Outreach: (2019 - present)**
  - Co-organized a fundraising 5k in liaison with the physics department and national SPS organization and American Institute of Physics (AIP).
  - Volunteer and co-organize at a variety of events organized by the UMD physics department designed to engender physics interest in both grade school students and adults, especially among underrepresented groups.