Igor Z. Palubski

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https://github.com/ipalubski

Education

University of California, Irvine — **Irvine, CA**
Ph.D in Physics (Computational/Theoretical) — *September 2024*

Iowa State University — **Ames, IA**
B.S in Physics (with minors in Math and Astronomy) — *Awarded 2017*

Programming Languages: Python • C • Matlab • Java • JavaScript • HTML
Familiar with: High-Performance Computing • React • MPI • PyTorch • Linux Systems • SQL • Git • Docker
Natural Languages: English (fluent) • Polish (fluent)
Related Coursework: Three graduate level courses in Machine Learning

Software and Data Analysis Experience

University of California, Irvine - Graduate Student Researcher — **Irvine, CA**
Astrophysics Theory — *November 2020 - September 2024*
Develop and analyze cosmological, hydrodynamical simulations for Dark Matter studies.

• Developed Monte Carlo simulations for dark matter interactions in galaxies, enhancing an existing hydrodynamical simulation code in C, GIZMO, by implementing new features and addressing critical limitations in massively-parallelized N-body simulations. Improvements include new physics routines: a variety of scattering models, an evolving baryon gravitational potential, and model verification tools.
• Discovered an empirical relation that predicts the evolution of dark matter halos under any particle physics model.
• Engineered analysis tools in Python to process and verify large-scale hydrodynamical datasets from galaxy simulations, optimizing data handling and interpretation.

Shields Center for Exoplanet Climate and Interdisciplinary Education — **Irvine, CA**
Atmospheric Physics — *August 2018 - November 2020*
Extrasolar planet climate studies using a hierarchy of numerical models of varying complexity.

• Investigated the effects of orbital dynamics on planetary habitability by creating a parallelized 1-Dimensional Energy Balance Model (EBM) in MATLAB for extensive parameter scans on supercomputers. The EBM can accurately model the inner boundary of the habitable zone at a fraction of the computational cost compared to other models. My work revealed significant habitable zones on extreme planetary orbits. However, retaining water on such planets may prove a challenge due to increased levels of high-energy radiation.
• Designed a Fortran tool that generates initial climatic conditions for synchronously rotating planets with desired spatial resolution, contributing to the development of sophisticated 3D Global Circulation Models (GCMs) for climate simulation on extrasolar planets.

Personal Projects

• Built a modern game of snake in React/JavaScript, where the player can compete for survival against an AI trained snake. Training is done using a deep Q-learn, a reinforcement learning algorithm, and a websocket-based training server. AI Training is in progress; app to be published on the App store in early 2025.

Select Publications and Talks

Publications

- A General Evolution Model of Self-Interacting Dark Matter Halos with velocity-dependent cross sections. (in-prep)
- Numerical Challenges in Modeling Gravothermal Collapse in Self-Interacting Dark Matter Halos link
- Terminator Habitability: the Case for Limited Water Availability on M-dwarf Planets link
- The Eccentric Habitable Zone: Habitability and Water Loss Limits on Eccentric Planets link
- Global Energy Budgets for Terrestrial Extrasolar Planets link

Talks and Poster Presentations

- Habitability and Water Loss Limits on Eccentric Planets Orbiting Main-Sequence Stars, ExSoCal 2020 and American Astronomical Society/Division for Planetary Sciences Meeting October 2020 (**Talks**)
- Temporal Habitability and Water Loss Limits on Eccentric Planets, Exoclimes V, August 2019 and Sagan Exoplanet Summer Workshop, July 2019. (**Posters**)