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*
Conduct cosmological and hydrodynamical simulations to investigate the nature of dark matter.

• Developed Monte Carlo simulations for dark matter interactions in galaxies, enhancing the GIZMO hydrodynamical simulation code (C language). Key contributions include new physics routines, scattering models, evolving baryon gravitational potentials, and model verification tools, improving the accuracy of massively parallelized N-body simulations. Improvements include new physics routines: a variety of scattering models, an evolving baryon gravitational potential, and model verification tools.
• Identified an empirical relation that accurately predicts dark matter halo evolution across diverse particle physics models.
• 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.

• Developed a parallelized 1D Energy Balance Model (EBM) in MATLAB, enabling extensive parameter scans on supercomputers to study the impact of orbital dynamics on planetary habitability. The EBM can accurately model the inner boundary of the habitable zone at a fraction of the computational cost compared to other models. Demonstrated significant habitable zones on extreme planetary orbits, but highlighting challenges in water retention due to high-energy radiation exposure.
• Developed a Fortran-based tool to generate initial climatic conditions for synchronously rotating planets, enhancing 3D Global Circulation Models (GCMs) for extrasolar planet climate simulations.

Personal Projects
• Built a modern snake game in React/JavaScript, integrating a websocket-based server for training an AI agent using a deep Q-learning algorithm. Currently optimizing the AI for competitive gameplay; app to be released 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**)