Stamatis Vretinaris

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Summary

Computational physicist nearing completion of a PhD in Computational Physics, with expertise in numerical methods for simulations and modeling with a focus in high-performance computing. Strong background in machine learning and data analysis.

Computational Physics Experience

- Proved the non-viability of a black hole initial data method by modifying large community C/C++ simulation code and running simulations on high-performance computing (HPC) systems.
- Designed and implemented a simulation pipeline through a **Python library** to pre/post-process and automatically submit simulations at an HPC scale. This enabled me to run and process **over 100.000 simulations**.
- Developed new framework for calculating self-force numerically. Implemented **3D Finite Volume and Finite Difference simulations**. Optimized code to run **parallel on HPC** using **Julia**.
- Developed new summation by parts finite difference operators suitable for spherical coordinate systems using Mathematica, enabling spherically symmetric simulations with a **90% reduction in computational cost** and reduced complexity compared to multi-patch methods.
- Discovered novel system behavior by conducting simulations using large Fortran code and developing a data analysis pipeline in Python, as referenced in the community white paper.

Data Analysis Experience

- Proved hypothesis of black hole merger behavior by analyzing simulation data with Julia.
- Improved parameter estimation for timeseries models by **an order of magnitude** with respect to the state-of-the-art methods by develing new method that employs physics informed priors.
- Proved theoretical spectral classification by analyzing neutron star timeseries data with **machine learning algorithms** implemented in Python.

Coordination Experience

- **HPC System Administrator,** Physics Department - Aristotle University of Thessaloniki *2018-2020*
  Managed the compute nodes for the Master programs.
- **IT Lab Coordinator,** Physics Department - Aristotle University of Thessaloniki *2016-2020*
  Led a team of student volunteers for the IT lab.

Selected Publications `

Vretinaris, S., Schnetter E., Krishnan B. *Formulating self-force as an initial value problem*, to be submitted in PRD (2026)

Vretinaris, S., Schnetter E., Krishnan B. *Summation by parts operators for spherical coordinate systems.*, to be submitted in PRD (2026)

Kastha S., Vretinaris, S., Pook-Kolb D., Krishnan B. *Cusp Formation in Merging Black Hole Horizons*, to be submitted in PRD (2026)

Vretinaris, S., et.al. *Robust and fast parameter estimation for gravitational waves from binary neutron star merger remnants*, PRD (2026), DOI: 10.1103/g1qs-j74x

Vretinaris S., Stergioulas N., Bauswein Andreas. *Empirical relations for gravitational-wave asteroseismology of binary neutron star mergers*, PRD (2020). DOI: 10.1103/PhysRevD.101.084039

Supervision & Teaching

- Supervised 3 Master Thesis and 1 Bachelor Thesis
- Taught 3 courses for BSc and MSc at Radboud University for 3 years

Education

- **PhD Researcher** *2020-present*
  - Institute for Mathematics, Astrophysics and Particle Physics (IMAPP), Radboud Universiteit Nijmegen, Netherlands
  - Max Planck Institute for Gravitational Physics (Albert Einstein Institute) Hannover, Germany
  - Supervisors: Badri Krishnan (Radboud Universiteit, AEI), Erik Schnetter eschnett (Perimeter Institute)
- **Master of Science in Computational Physics** Aristotle University of Thessaloniki *2019*
- **Bachelor of Science in Physics** Aristotle University of Thessaloniki *2017*

Skills

- **Programming Languages:** Julia, Python, C/C++, Mathematica, Fortran
- **DevOps & Version Control:** Git, CI/CD, Testing, Docs
- **Specialized Area:** HPC, Parallelization, Performance optimizations for simulations, Bayesian Inference, Machine Learning, Monte Carlo, Finite Volumes, Finite Differences
- **Other Tools & Technologies:** Slurm, LIKWID, Bash, Linux, LaTeX, Office Suite, OpenMP
- **Languages:** English (Proficient), Greek (Native), German (Native), Spanish (A2), Chinese (A1)