Mateusz Kapusta

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https://github.com/Wesenheit

PROFILE

I am a Master's student currently studying at the Faculty of Physics, University of Warsaw. I completed my Bachelor's thesis under supervision of dr Przemysław Mróz at the Warsaw University Observatory. I mainly specialize in numerical aspect of the Physics/Astronomy, working both with numerical simulations and machine learning technics. In my free time, I work on various machine learning models applied to the field of Natural Sciences but also to more mainstream areas such as vision and generative modeling.

EDUCATION

Master of Science, ***2023-2025*** *(expected)*
Master of Science in Astronomy
Warsaw University Observatory, Faculty of Physics

Bachelor of Science, ***2020-2023***
Inter-faculty Individual Studies in Mathematics and Natural Sciences, University of Warsaw, Poland
Grade: 4.96/5 (2-5 scale, 5 is the best), graduated with distinctions
Major: Astronomy, Physics
Minor: Mathematics

High School, ***2017-2020***
IIIrd Secondary School, Wroclaw, Poland
grade: 5.00 (1-6) scale
graduated with distinctions

EXPERIENCE

Student stipendist at Astronomical Observatory November 2022 - present
Student stipendist position in grant 2021/41/B/ST9/00252, working under the supervision of dr Przemysław Mróz.

- Performing MCMC modelling of microlensing events discovered as the part of 4th phase of the OGLE project.

Bachelor's Thesis at Warsaw University Astronomical Observatory July 2022 - July 2023
Working under the supervision of dr Przemysław Mróz on the data analysis from the OGLE survey to search for Dormant BH candidates.

- Analysing OGLE data using the method introduced in Gomel et al. 2021
- Designing Python based MCMC code to assemble spectral energy distribution (SED) for candidate objects.
- Inference of the parameters of binaries using the OGLE and Gaia DR3 data, searching for compact companion stars.

Intern at Nicolaus Copernicus Astronomical Center July 2022 - October 2022
Project: "Measuring the structure of relativistic jets in numerical simulation results" under the supervision of prof. Krzysztof Nalewajko (NCAC) and prof. Agnieszka Janiuk (CFT PAN).

- Worked with results from HARM MHD code to study the structure of magnetically arrested discs.
- Developed a few Python routines to search for magnetic reconnection and other interesting magnetic phenomena.

Intern at Nicolaus Copernicus Astronomical Center July 2021 - October 2023
Project: "Energy of a Strange Quark Star" under the supervision of Fatemeh Kayanikhoo and dr M. Cemeljic

- Worked with LORENE library to study the structure of relativistic strange quark stars, ported part of functions to work with C++17 standard and MPI multithread environment.
- Developed Python code to calculate the external energy of a star contained in a magnetic field.
- Developed multi-threaded C++ code to calculate the equation of state of the magnetized strange matter.

PUBLICATIONS & POSTERS

- **M. Kapusta**, P. Mróz. "The search for Dormant Black Holes in the OGLE data"
  Submitted to Acta Astronomica
- K. Nalewajko, **M. Kapusta**, A. Janiuk. "Initialization of magnetic flux eruptions at accreting black holes"
  European Astronomical Society meeting 2023 (poster)
- F. Kayanikhoo, **M. Kapusta**, M. Cemeljic. "The maximum mass and deformation of rotating strange quark stars with strong magnetic fields"
  Submitted to Physical Review D (#Arxiv 2305.03055)
- F. Kayanikhoo, **M. Kapusta**, M. Cemeljic. "The maximum gravitational mass and deformation of magnetized rotating strange quark stars"
  European Astronomical Society meeting 2023 (poster)

AWARDS & SCHOLARSHIPS

- Gold medal at 2021 University Physics Competition (as part of the team representing Faculty of Physics)
- Silver medal at 1st Global e-Competition on Astronomy and Astrophysics (in place of 14th International Olympiad on Astronomy and Astrophysics), 2020
- Bronze medal at 13th International Olympiad on Astronomy and Astrophysics, 2019 Hungary
- Winner of 62th and 63th Polish Astronomy Olympiad
- Finalist of 67th and 69th (11th place) Polish Physics Olympiad
- Finalist of 70th Polish Mathematical Olympiad
- Minister of Education's scholarship in the year 2018/2019, 2019/2020
- Rector scholarship in the academic year 2020/2021, 2021/2022, and 2022/2023

TALKS & OUTREACH

- Judge at 16th International Olympiad on Astronomy and Astrophysics

COMPUTER SKILLS

Languages & Software:

Computer languages:

- Python - advanced
- C/C++ - advanced
- Julia - advanced
- R - intermediate
- Fortran - intermediate
- Rust - intermediate

Additional computer-related skills:

- Bayesian modeling using emcee, Pyro, NumPyro, PyMC, and Tensorflow Probability
- Parallel programming using MPI/OMP
- Low-level programming using Python C API
- Deep learning experience using PyTorch, Tensorflow, Jax
- Grain level parallelism using SIMD
- Experience with astronomical Python libraries like Astropy, Astroquery, PyVO

Operating Systems: Advanced knowledge of Linux OS

Language

- English - B2/C1
- Polish - native speaker
- German - A2/B1