


# Karol Fułat

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Besides the elegance of theory, the cleverness, and resourcefulness of experiment, I love how physics broadens our horizons and affects our world perception. On top of the scientific aspect, I believe physics facilities people's lives and showcases problems from a different point of view.

## EDUCATION

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### **PhD in Theoretical Astroparticle Physics** 07/2021 – 06/2024 (expected)

Institute of Physics and Astronomy, University of Potsdam, Potsdam, Germany

- Supervisor: Prof. Martin Pohl, funded by DFG German Research Foundation, collaboration with THAT group in DESY, Zeuthen
- Investigation of electron acceleration at non-relativistic oblique shocks using massively parallel particle-in-cell simulations
- Developed a novel method to study from first principles the influence of pre-existing turbulence on shock microphysics
- Awarded 5.5 million CPU hours per year at HLRN (proposal co-author)

### **M.Sc. in Technical Physics** 02/2020 – 06/2021

AGH University of Science and Technology, Krakow, Poland

- Dissertation: "Study of the Conditions for Effective Electron Acceleration in Low Mach Number Shocks", supervisor: Prof. Jacek Niemiec
- Best theoretical thesis at the Faculty of Physics and Applied Computer Science
- 1st award for a talk at the SKNS student conference

### **B.Sc. in Technical Physics** 10/2016 – 01/2020

AGH University of Science and Technology, Krakow, Poland

- Dissertation: "Shock Waves in Merging Galaxy Clusters", supervisor: Prof. Jacek Niemiec
- IUVENES Krakowskie Konsorcjum Naukowe scholarship for the best first-year students

## SCHOLARSHIPS AND INTERNSHIPS

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### **Research scholarship** 05/2019 – 11/2021

The Henryk Niewodniczanski Institute of Nuclear Physics, Krakow, Poland

- Studies of electron acceleration at shocks in galaxy clusters using fully kinetic simulations
- Funded by National Science Center Poland, supervisor: Prof. Jacek Niemiec

### **Internship** 06/2021 – 09/2021

European Space Agency ESAC, done remotely due to Covid-19

- Examination of electron populations at interplanetary shocks using the Cluster mission data, supervisor: Dr. Georgina Graham

## PROFESSIONAL TRAINING

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### **Potsdam Plasma Workshop** 11/2022

Leibniz-Institute for Astrophysics (AIP), Potsdam, Germany

Discussions with Prof. Christoph Pfrommer's group from AIP on the latest results of kinetic shock simulations, presentation of my current research work

**The International school of Cosmic Ray Astrophysics** 08/2022  
Ettore Majorana Center for Scientific Culture, Erice, Sicily, Italy  
Lectures on experimental astroparticle physics and multimessenger astronomy

**Foundations of Cosmic Ray Astrophysics** 06/2022  
Villa Monastero, Varenna, Italy  
Lectures on sources, acceleration and instabilities of cosmic rays

## SKILLS

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**Programming languages:** Python, Fortran, C++, IDL

**Technical and software:** 5 years of experience with a TRISTAN-based particle-in-cell code, High Performance Computing using MPI, scientific Python packages (NumPy, SciPy, Numba), machine learning basis (scikit-learn), Git, Matlab

**Foreign languages:** fluent English, basic French, native Polish

## TEACHING EXPERIENCE

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**Laboratory course supervisor** 02/2023 – Present  
University of Potsdam, Potsdam, Germany  
Supervision of the Muon Counter experiment: material preparation, assistance, evaluation

**Programming and maths teacher** 11/2018 – 07/2020  
EDU.EXE Ewelina Kurek, EUREKA Monika Wójcik, Krakow, Poland  
Extracurricular courses for children in primary school

## PEER-REVIEWED PUBLICATIONS

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**Kinetic simulations of nonrelativistic high-Mach-number perpendicular shocks propagating in a turbulent medium** 12/2023  
**Fułał, K., Bohdan, A., Torralba Paz, G. & Pohl, M.**  
Published in the Astrophysical Journal, contribution: design of the work, development of tools, performance of simulations, data analysis, drafting the manuscript

**Pre-acceleration in the Electron Foreshock. II. Oblique Whistler Waves** 01/2023  
Morris, P. J., Bohdan, A., Weidl, M. S., Tsirou, M., **Fułał, K.** & Pohl, M.  
Published in the Astrophysical Journal, contribution: consultation on the mechanism of electron acceleration

## CONFERENCE PROCEEDINGS

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**PIC simulations of SNRs shocks with a turbulent upstream medium** 07/2023  
**Fułał, K., Bohdan, A., Torralba Paz, G., Tsirou, M. & Pohl, M.**  
Published in Proceedings of Science (ICRC2023)

**Electron acceleration at oblique supernova remnant shocks** 07/2023  
Bohdan, A., **Fułał, K.**, Morris, P. J., Weidl, M. S., Tsirou, M. & Pohl, M.  
Published in Proceedings of Science (ICRC2023)

**PIC simulations of SNR's shock waves with a turbulent upstream medium** 09/2022  
**Fułał, K., Pohl, M., Bohdan, A., & Morris, P. J.**  
Published in Acta Physica Polonica B Proceedings Series

**Electron Pre-acceleration Through Stochastic Shock Drift Acceleration  
at Intracluster Shocks**

06/2021

Niemiec, J., Kobzar, O., **Fuřat, K.**, Pohl, M., Amano, T., Hoshino, M., Matsukiyo, S., & Matsumoto, Y.

Published in Proceedings of Science (ICRC2021)

FEATURED PRESENTATIONS

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Invited talk at the Astroplasmas Seminar Department of Astrophysical Sciences, Princeton University	2023
Poster presentations at the 38th International Cosmic Ray Conference, Nagoya, Japan	2023
Talk at the 13th International Conference on High Energy Density Laboratory Astrophysics, Lisbon, Portugal	2022
Poster presentation at the 7th Heidelberg International Symposium on High-Energy Gamma-Ray Astronomy, Barcelona, Spain	2022
Talk at XXVIII EIPHANY Conference on Recent Advances in Astroparticle Physics, online	2022