## Thesis Projects in the Astroparticle Physics Working Group (Prof. Dr. Markus Risse)

Research in our group focuses on the **analysis of data from the Pierre Auger Observatory** and **phenomenological studies** of cosmic rays and air showers using Monte Carlo simulations. In particular, we are working on the following topics:

- Search for the highest-energy photons
- Multimessenger astronomy

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- Mass composition of cosmic rays
- Studies related to violations of Lorentz invariance in air showers

Center for Particle

In these research areas - but also beyond! - we always have interesting topics for Bachelor's and Master's theses.

Possible topics (which can and should be individually adjusted) are for example:

- Detailed studies of individual measured air showers
- Simulation studies of air-shower properties
- Investigation of observables with the aid of simulations and development of new observables
- Application of machine-learning methods (e.g., neural networks) to simulations and measured data
- Investigating properties of our detector (e.g., measuring rate, measurement uncertainties)
- Compilation of astronomical catalogs and comparison with data

## Examples for past thesis projects:

- Studies of air shower observables for the search for ultra-high-energy photons
- Identification of clouds in the field of view of the fluorescence detectors of the Pierre Auger Observatory
- Differentiation of primary protons and iron nuclei in air showers using the  $F_{\gamma}$  parameter
- Studying the shower front curvature of extensive air showers with the Pierre Auger Observatory
- Possible sources of UHECRs: characteristics, predictions and observational consequences
- Study of "below-ground" air showers to search for ultra-high-energy Photons
- Study of the differentiation of signal curves with the help of neural networks

## Contact

Are you interested in writing your thesis in our working group or would you like more information? Please contact us! We will be happy to invite you to a personal meeting.

- Prof. Dr. Markus Risse, risse@hep.physik.uni-siegen.de, EN-A 105
- Dr. Marcus Niechciol, niechciol@physik.uni-siegen.de, EN-A 106











