Bachelor's/Master's Thesis

The **Cherenkov Telescope Array (CTA)** is the next-generation instrument for very-high-energy gamma-ray astronomy. It will consist of about 70 mirror telescopes of up to 20 m diameter, and will observe the sky at photon energies of about 30 GeV to 300 TeV.

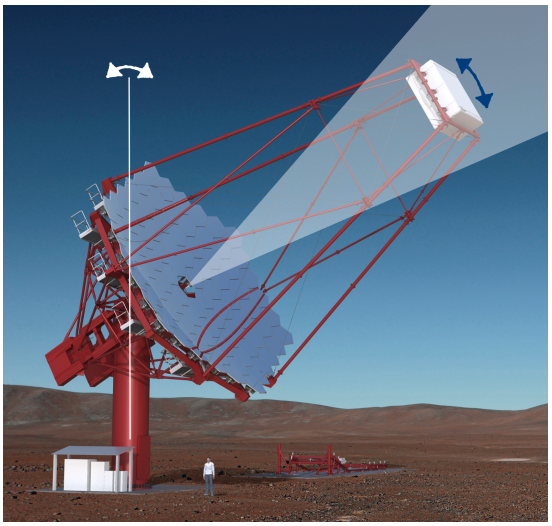
Obtaining the orientation of CTA telescopes through sky images

The alignment of a telescope to the sky is never perfect. Therefore, the sky orientation of the CTA telescopes is measured with CCD cameras monitoring stars during science observations.

In this thesis, camera images taken with a CCD camera on the roof of the ECAP building will be analysed, the aim being to optimise the precision with which the telescope orientation can be determined.

Physics topics related to this work:

- Precision astrometry with CCD cameras
- Reconstruction techniques for optical sky images



Skills acquired during this work:

- Efficient algorithms for solving sky images
- Programming in Python
- Working together in a motivated team

Interested? Please get in touch!

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ERLANGEN CENTRE FOR ASTROPARTICLE PHYSICS

Bachelor's/Master's Thesis

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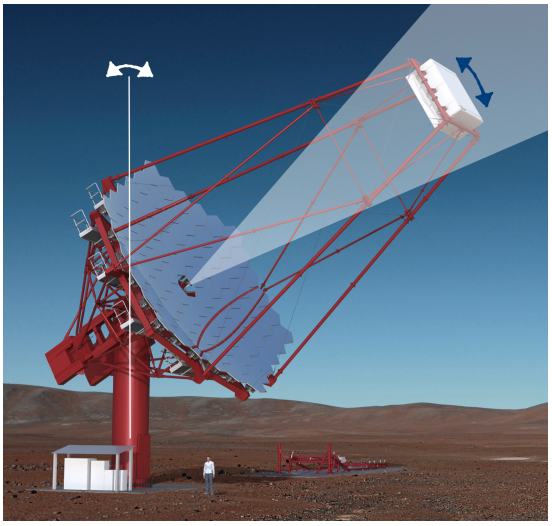
Testing the pointing accuracy of an astronomical camera

In this thesis, an astronomical mount equipped with an astronomincal camera will be used to take sky image on the roof of the ECAP building. From these images, a model will be derived which corrects the observation direction for mechanical deformations of the setup.

Physics topics related to this work:

- Using astronomical instrumentation
- Precision astrometry with CCD cameras



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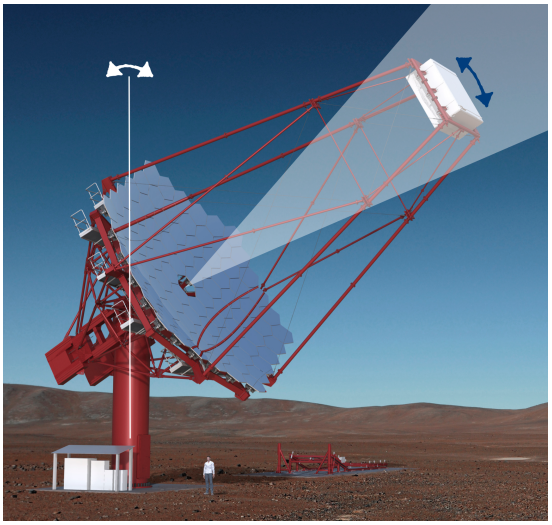

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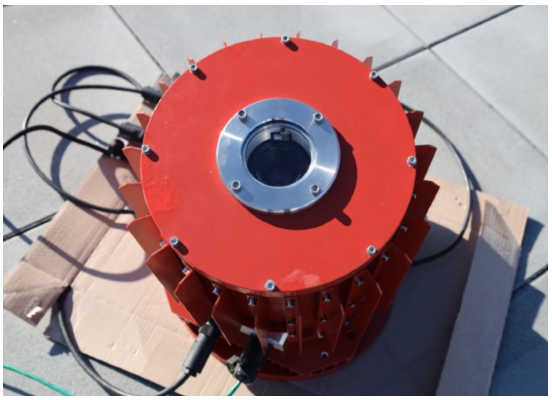
A test facility for astronomical cameras

In this thesis, a test facility will be set up that will enable various (long-term) tests on astronomical cameras such as temperature control, noise measurements and general communication. In this context, an astronomical camera will be fully characterised.

Physics topics related to this work:

- Using astronomical instrumentation
- Characterisation of optical CMOS cameras



Skills acquired during this work:

- Programming in Python
- Working together in a motivated team

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ERLANGEN CENTRE FOR ASTROPARTICLE PHYSICS

Master's Thesis

The **High Energy Stereoscopic System (H.E.S.S.)** is the most successful telescope to detect highly energetic gamma radiation with energies above 100 GeV. At its location in Namibia, it has an optimum view onto the Milky Way, and has detected more than 100 galactic gamma-ray sources.

Modelling diffuse emission from the Galactic Centre

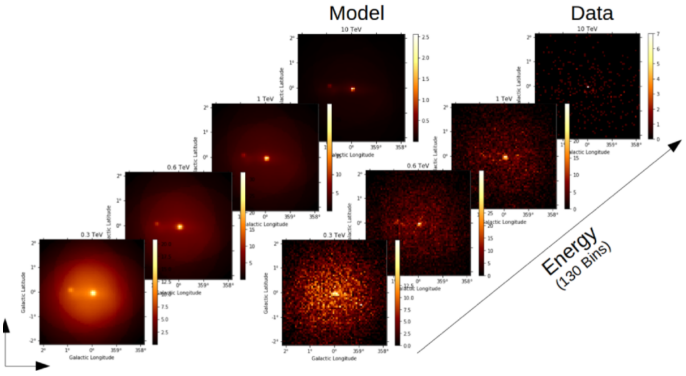
H.E.S.S. has detected a band of diffuse gamma-ray emission towards the Galactic Centre, possibly caused by relativistic protons in that region. The aim of this thesis is to help develop a simulation that models the diffusion of protons through that region and the subsequent production of gamma rays. The simulation will then be compared to data observed with H.E.S.S. using modern analysis software.

Physics topics related to this work:

- Particle acceleration and propagation in the Galactic Centre
- Astrophysical processes in the Galaxy

Skills acquired during this work:

- Large-scale simulation studies
- Working together in a motivated team
- Python for data analysis



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ERLANGEN CENTRE FOR ASTROPARTICLE PHYSICS

Master's Thesis

The **The Southern Wide-field Gamma-ray Observatory (SWGO)** is a next-generation gamma-ray telescope consisting of several thousands of water tanks installed in the Andes. The array is currently in its design phase.

Optimisation of the SWGO array trigger

Several different array layouts and detector technologies are proposed for the SWGO array. Depending on the array layout, the event trigger scheme must be optimised to cope with the expected high data rates.

In this thesis, simulated data of various SWGO array layouts are investigated to identify the best trigger scheme for each layout.

Physics topics related to this work:

- Simulation techniques in gamma-ray astronomy
- Detector optimisation

Skills acquired during this work:

- Methods of gamma-ray analysis
- Programming in Python
- Working together in a motivated team

Interested? Please get in touch!

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ERLANGEN CENTRE FOR ASTROPARTICLE PHYSICS

Master's Thesis

The **The Southern Wide-field Gamma-ray Observatory (SWGO)** is a next-generation gamma-ray telescope consisting of several thousands of water tanks installed in the Andes. The array is currently in its design phase.

Suppressing background using deep learning

Only very few of the air-shower events detected by the SWGO array will originate from high-energy gamma rays. Using deep learning methods, these gamma-ray events can be distinguished from background events due to cosmic rays.

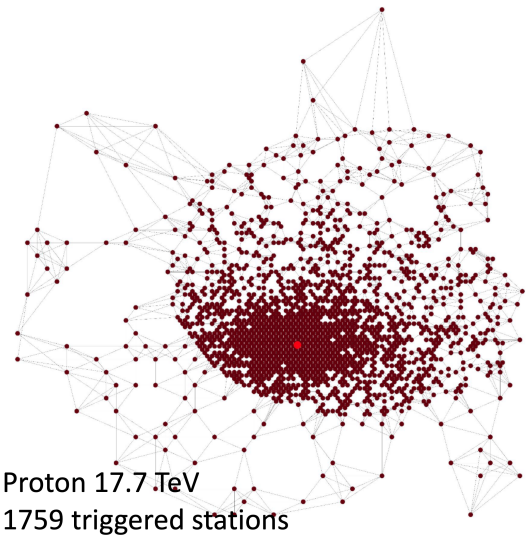
In this thesis, the background rejection performance of various SWGO candidate arrays will be explored using graph neural networks (GNNs).

Physics topics related to this work:

- Simulation techniques in gamma-ray astronomy
- Detector optimisation

Skills acquired during this work:

- Using deep learning in physics applications
- Programming in Python
- Working together in a motivated team



Proton 17.7 TeV
1759 triggered stations

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Master's Thesis

The **The Southern Wide-field Gamma-ray Observatory (SWGO)** is a next-generation gamma-ray telescope consisting of several thousands of water tanks installed in the Andes. The array is currently in its design phase.

Combined energy and direction reconstruction of gamma-ray air showers

A gamma-ray air shower hitting the SWGO detector produces signals in the water tanks of the array. Using the signal strength and arrival times, the energy and direction of the gamma ray can be reconstructed.

In this thesis, a combined reconstruction of energy and direction will be explored, based on an already existing solution where the energy and direction are still reconstructed separately.

Physics topics related to this work:

- Design of ground-based gamma-ray telescopes
- Reconstruction techniques in gamma-ray astronomy

Skills acquired during this work:

- Programming in Python
- Simulation-based reconstruction
- Working together in a motivated team

Interested? Please get in touch!

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