Bachelorarbeit

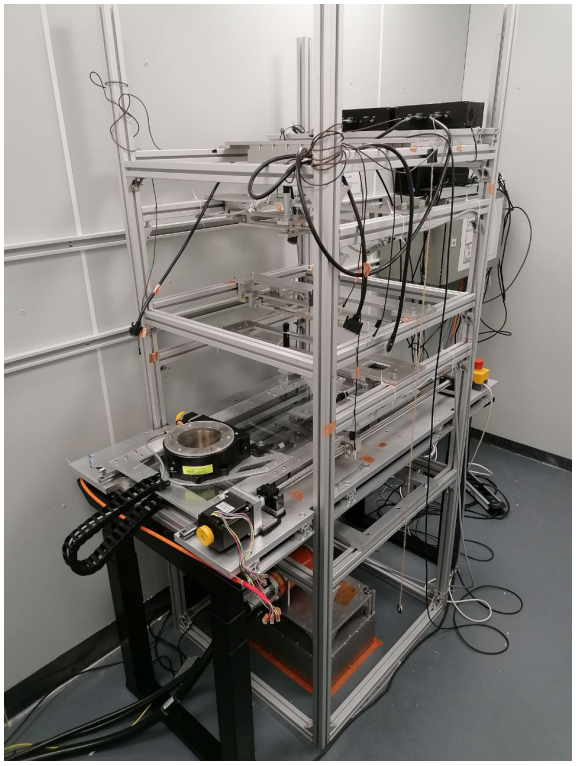
Frühjahr 2026

LA+PCI
Laboratory astrophysics
& Phase contrast imaging

Durch die gitterbasierte Phasenkontrast-Röntgenbildgebung können neben dem herkömmlichen Absorptionsbild zwei weitere Bildmodalitäten rekonstruiert werden: Das differentielle Phasenbild und das Dunkelfeldbild. Dafür wird ein Talbot-Lau-Interferometer verwendet. Das differentialle Phasenbild basiert auf den Phasenschub, den Röntgenstrahlung beim Durchdringen von Material erfährt. Somit können kleine Dichteunterschiede, im Verleich zum herkömmlichen Absorptionsbild, besser detektiert werden. Das Dunkelfeldbild entsteht durch Kleinwinkelstreuungen an mikrometergroßen Fasern oder granularen Strukturen. Durch das Dunkelfeldbild können beispielsweise Inhomogenitäten, Lufteinschlüsse oder Defekte im Material festgestellt werden.

Untersuchung von Proben mittels eines Zwei-Zeilen-Scanners

In unserer Arbeitsgruppe wird zurzeit ein Zwei-Zeilen-Röntgenscanner entwickelt, welcher eine quantitative Strukturgrößenanalyse ermöglicht. Dieser Scanner kann für die zerstörungsfreie Materialprüfung verwendet werden, um Inhomogenitäten und Defekte in Materialien feststellen zu können. In dieser Arbeit sollen verschiedene Proben mittels des Zwei-Zeilen-Scanners untersucht werden, um Unregelmäßigkeiten in diesen zu detektieren.



Was dich erwartet:

- Laborarbeit
- Datenauswertung mit Python
- Röntgenphysik und Detektoren
- Digitale Bildverarbeitung (Python/Matlab)

Interesse? Bitte eine kurze Mail an:

- Markus Schneider, markus.ms.schneider@fau.de
  Constantin Rauch, constantin.rauch@fau.de
  Büro 02.035, Nikolaus-Fiebiger Str. 2
- Dr. Veronika Ludwig, veronika.ludwig@fau.de
  Büro 02.034, Nikolaus-Fiebiger Str. 2
- Dr. Martin Rongen, martin.rongen@fau.de
  Büro 01.031, Nikolaus-Fiebiger Str. 2
- Prof. Dr. Stefan Funk, s.funk@fau.de
  Büro 02.036, Nikolaus-Fiebiger Str. 2

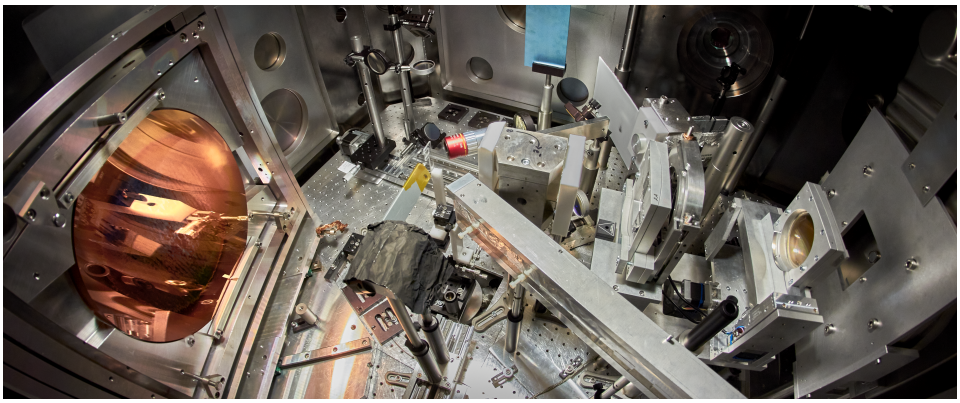
ecap Erlangen Centre for Astroparticle Physics

Master's Thesis

Spring 2026

LA+PCI
Laboratory astrophysics
& Phase contrast imaging

The aim of **high-energy-density physics** is to prepare, control and investigate systems in extreme states of matter. One example of such systems are laser-induced inertial confinement experiments and **imaging** of these systems using **X-ray phase-contrast imaging**.



Designing a grating interferometer for imaging ultrafast changes of inertial confinement fusion targets

We develop **cutting edge imaging setups** deployed at large-scale research facilities, an example is shown above, and corresponding image reconstruction algorithms and data analysis. The key element of any grating-based phase-contrast imaging setup is the **grating interferometer**. During this work, you will contribute to the design of a new grating interferometer for deployment at an XFel facilties based on the year long experience of the group with grating-based phase-contrast systems at high-power laser facilities.

What you can expect:

- Simulation with a customizable simulation framework
- Analysis of large simulated datasets
- Data evaluation with Python
- Running software on HPC systems
- X-ray physics

Interested? Please get in Touch:

- Constantin Rauch, constantin.rauch@fau.de
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Master's Thesis

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& Phase contrast imaging

Grating-based X-ray imaging, also called X-ray Talbot-(Lau) imaging, adds two further images to the conventional attenuation image: The differential phase-contrast and the dark-field image. For that purpose a Talbot-Lau interferometer is used. The contrast in the differential phase image is based on the diffraction of X-rays by an object. Small density variations are better detectable, in particular for light materials (C, H, O). The dark-field image covers signals generated by small angle scattering off micrometer sized fibers or granular structures. Therefore, it is sensitive to material transitions, as they occur for cracks, air inclusions or structural defects for example.

AI supported dark-field data analysis for a novel dual energy interferometer

We are currently designing and implementing a novel dual interferometer setup for nondestructive testing. As a part of this project, this thesis aims to implement machine learning-based algorithms to classify for example defects or determine particle and fibre sizes using artificial intelligence (AI).

A variety of objects are chosen and then the resulting images for both interferomters are evaluated for a large amount of samples. Statistical data analysis methods support the following AI analysis.

What you can expect:

- Laboratory work and Data analysis (Python)
- Conceptualisation and implementation of simulated setups and samples
- Development of machine learning algorithms with Python
- X-ray physics
- Digital image processing (Python/Matlab)

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Master's Thesis

Spring 2026

FLASH radiation therapy is a next-generation approach to cancer treatment, in which ultra-high dose rates are applied to tumor tissues in a very short amount of time. While the tumor control is unaffected by this, the sparing of the healthy tissue around the cancerous region has been shown to be significantly better for such high dose rates, opening the parameter space of cancer treatment. However, there are currently no online beam monitoring devices that are capable of dealing with such extreme dose rate environments while not compromising the beam in the measurement process.

Simulations and Measurements of the Nitrogen Fluorescence Output of Ultra-High Dose Rate Electron Beams in Air

Our group is currently developing a beam monitoring device for electron beams by making use of the nitrogen fluorescence photons that are emitted by the electron beam as it traverses the air between the accelerator exit window and the patient. This light is imaged by a UV-sensitive camera to gain information about the beam position, width, and intensity.

What you can expect:

- Simulations of fluorescence photon output
- Python-based Raytracing
- Participation in measurement campaigns at linear electron accelerators
- Data analysis and digital image processing (Python)

Interested? Please get in Touch:

- Florian Beißer, florian.beisser@fau.de
  Leonie Ullmann, leonie.ullmann@fau.de
  Büro 02.035, Nikolaus-Fiebiger Str. 2
- Dr. Martin Rongen, martin.rongen@fau.de
  Büro 01.031, Nikolaus-Fiebiger Str. 2
- Prof. Dr. Stefan Funk, s.funk@fau.de
  Büro 02.036, Nikolaus-Fiebiger Str. 2

Erlangen Centre for Astroparticle Physics

Bachelor & Master theses

Spring 2026

LA+PCI
Laboratory astrophysics
& Phase contrast imaging

The aim of **laboratory astrophysics** is to prepare, control and investigate systems which behave similar to those of astrophysical origin. One example of such laboratory experiments is the production of laser-induced shock fronts and the **imaging and reconstruction** of the resulting **density distribution** with **X-ray phase-contrast imaging**.

We are working on the development of **experimental imaging setups** and image reconstruction. We are developing a **phase-contrast-scanner** for quantitative structure analysis to detect defects in the field of **non-destructive testing**.

FLASH radiation therapy is gaining interest as a novel alternative to conventional radiotherapy for cancer, due to shorter treatment times and improved preservation of healthy tissue. We are developing a **beam monitoring and dosimetry system** to contribute to a precise treatment.

We offer the following **Bachelor** theses:

- Untersuchung von Proben mittels eines Zwei-Zeilen-Scanners

Master theses:

- Designing a grating interferometer for imaging ultrafast changes of inertial confinement fusion targets
- AI supported dark-field data analysis for a novel dual energy interferometer
- Simulations and Measurements of the Nitrogen Fluorescence Output of Ultra-High Dose Rate Electron Beams in Air

Interested? For more details on the topics feel free to simply drop in the office or get in touch via mail that we can arrange a personal (Zoom) Meeting.

- Constantin Rauch,
  constantin.rauch@fau.de
  Büro 02.035, Nikolaus-Fiebiger Str. 2
- Florian Beißer,
  florian.beisser@fau.de
  Büro 02.035, Nikolaus-Fiebiger Str. 2
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  leonie.ullmann@fau.de
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