

Open Topics in Accelerator Physics at GSI / FAIR



TECHNISCHE
UNIVERSITÄT
DARMSTADT

Bachelor / Master Thesis
Accelerator Physics
July 22, 2025

The **GSI Helmholtzzentrum für Schwerionenforschung** in Darmstadt operates a world-wide leading accelerator facility for research purposes.

At GSI, **FAIR** is currently being built. It will be one of the largest and most complex accelerator facilities in the world. The FAIR accelerator facility will have the unique ability to provide **particle beams of all the chemical elements** (or their ions), as well as **antiprotons** accelerated to almost the speed of light for scientific experiments. The FAIR facility consists of a superconducting ring accelerator **SIS100** with a circumference of 1,100 meters, storage rings and experiment sites with several kilometers of beam line in total.

The existing accelerator facility of the GSI Helmholtzzentrum für Schwerionenforschung including the linear accelerator **UNILAC**, which is 120 meters long, and the **SIS18** ring accelerator, which has a circumference of 216 meters, will serve as the injector for the new FAIR facility.

At such a large accelerator facility, a lot of **accelerator physics challenges** have to be solved. Thus, there are also very interesting open topics for a bachelor or master thesis:

- **Department Accelerator Physics:**

- Beam Line and Particle Source Optimization using Bayesian Optimization and other algorithms
- Development of Fast Evaluating Surrogate Models for Beam Dynamics Simulations

- **Division Super-FRS:**

- Bayesian Optimization of Beam Injection Efficiency from the Fragment Separator in the Experimental Storage Ring ESR

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Fachgebiet



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Figure 1: Visualization of FAIR ©GSI/FAIR, Zeitrausch

