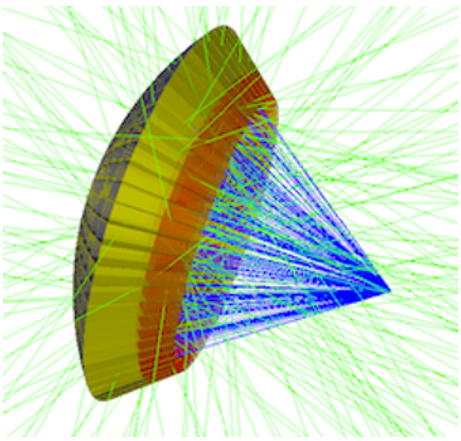
# CALIFA Forward Endcap

## Subatomic physics thesis project



Modern experimental physics is based on cutting-edge technology. Detecting subatomic particles with high efficiency, as well as high energy and time resolution is the goal of this project. For this purpose we employ an array of phoswich detectors, composed of two crystals ($LaBr_3$ and $LaCl_3$), which are read-out by a single photomultiplier tube. Those crystals have a superb energy and time resolution. We want to use them to detect, primarily, high-energy protons and gamma-rays. This requires in addition a large dynamic range, as the energy the particles deposit in the crystals varies by a factor of 500, which poses a challenge to read-out electronics.

## Background: Large-scale experiments

The $R^3B$ experiment (Reactions with Relativistic Radioactive Beams) investigates collisions of radioactive beams with stable targets at relativistic energies. The purpose is to identify all particles emerging from a nuclear collision and to measure their momenta, which allows to reconstruct the collision. This allows to answer a whole array of physics questions on atomic nuclei, their structure and how they influence astrophysical processes. Nuclei are the heaviest systems bound due to the strong interaction but only in a very delicate way. Nevertheless, our world would not exist if it were not for the existence of stable nuclei.

The entire $R^3B$ set-up is currently under construction and the experimental subatomic physics group at Chalmers is responsible for the CEPA detector (CALIFA Endcap Phoswich Array), which will consist of 8 sectors, each with 12 phoswich detectors. CEPA is also the focus of this project.

## Project description

The first sector of CEPA has been delivered to Chalmers at the end of October 2018. This project aims at characterizing this state-of-the-art device to find out if it matches the design criteria and if it is suitable for the experiments planned with it. This means to study its response to cosmic radiation as well as to gamma-radiation. The measured data need to be analyzed and interpreted, so we can decide if we proceed with the construction of the remaining sectors or if the manufacturer needs to modify the production for forthcoming sectors. This project involves hands-on engineering skills for the measurements, as well as data analysis using CERN-developed analysis tools. Measured data will be compared to simulations for interpretation.

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