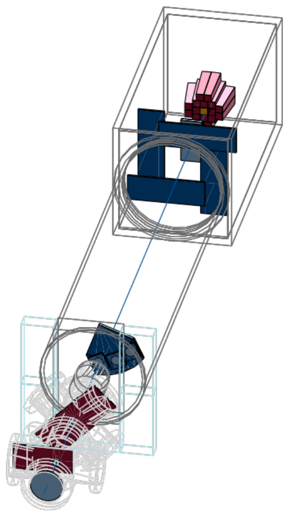
Master's Theses in Radiation Therapy

Spectrometer

Our group develops a detector system to measure nuclear cross sections which are relevant for particle therapy. The reactions of a carbon beam hitting a proton-rich plastic target are investigated. For each nuclear fragment, the time of flight, the $\frac{\mathrm{d}E}{\mathrm{d}x}$ and the kinetic energy are measured with scintillation detectors. With these three quantities, the charge and the mass of the fragments are calculated and the reaction is reconstructed. First test measurements with a demonstrator set-up have been performed at the Ion Therapy Center in Heidelberg.

Geant4 Simulation of a Time-of-Flight Spectrometer and Data Analysis using a Reconstruction Algorithm



One fundamental part of each particle physics experiment is the simulation. Therefore, our spectrometer is simulated using the C++-based Monte-Carlo toolkit Geant4. During your thesis you will work with this simulation and implement new features of our detectors. For example the light produced in the scintillating material is not yet correctly reproduced and needs further investigations.

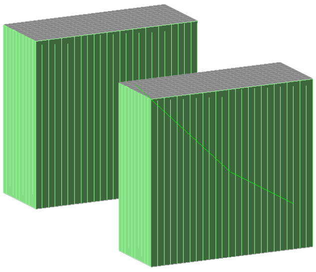
Your second task is the analysis of the measured data. We already have a reconstruction algorithm to combine the energy and time-of-flight data measured in our detectors to tracks and assign a particle ID to them, but further optimization is needed. You will identify the primary reactions and take the relevant uncertainties into account. With this you can calculate the nuclear cross sections whose measurement is the aim of this project. To be able to calculate the nuclear cross sections the primary reactions have to be identified and the uncertainties have to be taken into account.

Programming experience is required for this project.

Bragg Peak Live Monitoring

Ion therapy is a very precise tool in cancer treatment because of its characteristic longitudinal dose profile (Bragg peak). To optimize the precision of ion therapy, a real-time monitoring of the longitudinal Bragg peak position is needed. A promising approach towards online range verification in ion therapy is the analysis of prompt gamma radiation emitted by several nuclear processes.

A FPGA-based read-out system for a Compton Camera



Our group develops a detector to record the prompt-gamma emission: A Compton Camera based on heavy scintillating fibers. In the first stage of the project a demonstrator containing a few layers of fibers will be build. Each end of a fiber is attached to a SiPM. Your task is to build a FPGA-based read-out. You will work together with our colleagues from Cracow and take part in the development process of the demonstrator. Knowledge in electronics is useful here as well as programming experience in C++.

Contact

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It is also possible to work on slightly different topics. Please contact us if you are interested in this.

On the day of physics you can find us in room 28 A 110.