Calibration of time of flight detector for accelerator-based studies of plasma-modified wall materials

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Under the conditions that apply on earth (gravity, air pressure etc.), the hot fusion plasmas needed for an electricity plant must be surrounded by the walls of a vacuum vessel and confined by strong external forces. This poses severe requirements on the selection of the materials and the interaction of the plasma with surrounding materials in the vacuum vessel constitutes one of the main remaining engineering problems. Therefore, comprehensive research programs are being carried out at many fusion science and material research laboratories worldwide. The work will be of interdisciplinary character, encompassing detector design, material science, data processing, electronics etc. For this project the main goal is to measure the efficiency and of a time-of-flight detector used for a technique called time of flight heavy ion elastic recoil detection analysis (ToF-HIERDA), a general material analysis method well suited to study some of the main question regarding material erosion and deposition for plasma facing surfaces.

Figur 1 One of the two existing ToF HIERDA systems showing parts of the target chamber at the right followed by two thin foil particle detectors that make up the time of flight detector and finally the energy detector at the left.

**Main Tasks**

1. Measurement of the efficiency of the time-of-flight system for HIERDA
2. Compare the two existing setups two investigate the differences in efficiency
   This could include tests of forward and backward geometry for the detector, simulating the electric fields inside of the detector and the investigating the effect of different foils.
3. Compare theoretical models with the measured efficiency curves to find the best fits
4. Participation in surface studies of plasma facing components with ToF HIERDA at the Tandem Accelerator Laboratory.

The exact project will be developed along with the candidate and could also include work such as constructing upgrades to the samples manipulation system or developments in software used for analyzing the results. It is also possible to combine the upgrades to the detector with material analysis of plasma facing components or materials tested for fusion devices depending on the interest and background of the candidate. The outcome of the work will be a calibration curve to be used for future measurement and could also result in a publication describing the results as well as other upgrades to the system.
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The candidate should have an interest in practical work with vacuum systems, ideally have some experience with detector system systems and electronics, experience with matlab, python and/or LabVIEW programing is also an advantage.