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STRASSE: a new silicon tracker for quasi-free scattering measurements at RIBF

In-beam γ-ray spectroscopy and invariant/missing mass studies from quasi-free scattering or knockout reactions on secondary fragmentation beams are often the preferable techniques to give access to the most exotic nuclei and perform their first spectroscopy. Illustratively, such studies have recently enabled to quantify the magic character of 54Ca [1,2], 78Ni[3], but as importantly to characterize the increase of collectivity when departing from shell or subshell closures (ex: 28F[4], 52Ar[5], 66Cr,70-72Fe[6]) sometimes leading to islands of inversion.
The technical challenge of these experiments is to maintain the best energy resolution possible while maximizing the luminosity and by consequence the target thickness. The above-mentioned results with beams down to a few particles per second have been obtained with the MINOS setup [7] allowing the use of a thick LH2 target (up to 15 cm long) via its combination with a TPC for vertex tracking of (p,2p)-like reactions. While pioneering in several aspects, the overall energy resolution using the MINOS device (either for doppler-correction of γ-ray energies or from recoil protons for missing mass) was limited by its vertex resolution (~5 mm FWHM) and its combination with scintillator arrays (high efficiency but limited resolving power).

In this presentation, we will present a new system in development called STRASSE to go above these performances and enable: (i) high-resolution γ-spectroscopy from an optimal coupling with state-of-the-art germanium tracking detectors and (ii) missing mass measurements with a moderate resolution sufficient to determine the absolute energy of the states populated (σ~ 2 MeV). The STRASSE system consists of a compact silicon tracker (Fig.1) placed in vacuum and a thick LH2 target (up to 150 mm long) with a small diameter of 30 mm to minimize the angular straggling of recoil protons. With about seventeen thousand strips and associated electronics channels in a cylinder of only 36 cm, the tracker aims at reaching a vertex resolution of about 0.5 mm (FWHM).
More precisely, this contribution will focus on the description of this new detection system (principle, electronics, integration) including simulations, first tests and perspectives of physics cases at the RIBF.

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