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P2.4: RIPTIDE, a proton-recoil track imaging detector for fast neutrons

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RIPTIDE is a new detector concept aiming to track fast neutrons. It is based on neutron-proton elastic collisions inside a plastic scintillator, where the neutron momentum can be measured by imaging the scintillation light [1-3]. More in detail, by stereoscopically imaging the recoil-proton tracks, the proposed apparatus provides neutron spectrometry capability, and enable the online analysis of the specific energy loss along the track (see Fig. 1). In principle, the spatial and topological event reconstruction enables particle discrimination, which is a crucial property for neutron detectors.

In this contribution, we report the advances on the RIPTIDE detector concept. In particular, we have developed a Geant4 optical simulation to demonstrate the possibility of reconstructing with sufficient precision the tracks and the vertices of neutron interactions inside a plastic scintillator. To realistically model the optics of the scintillation detector, monoenergetic protons were generated inside a 6x6x6 cm³ cubic BC408 scintillator, and the ensuing optical photons were recorded on a scoring plane corresponding to the surfaces of the cube. The photons were then transported through an optical system to a 2x2 cm² photo sensitive area with 1 Megapixel. The first panel of Fig. 1 show an example of one of the 6 projections of a track on a pixellated photosensor.

Moreover, we have developed 2 different analysis procedures to reconstruct 3D tracks: one based on least square fitting and one on Principal Component Analysis. The main results of this study will be presented with a particular focus on the role of the optic system and the attainable spatial/energy resolution.

[1] A. Musumarra et al 2021 JINST 16 C12013

[2] C. Massimi et al 2022 JINST 17 C09026

[3] P. Console Camprini et al 2023 JINST 18 C01054

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