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RIPTIDE: a proton-recoil track imaging detector for fast neutrons

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Fast neutron detection is often based on the neutron-proton elastic scattering reaction: the ionization caused by recoil protons in a hydrogenous material constitutes the basic information for the design and development of a class of neutron detectors. Although experimental techniques have continuously improved, proton-recoil track imaging remains still at the frontier of n-detection systems, due to the high photon sensitivity required. More in detail, several state-of-the-art approaches for neutron tracking by using n-p single and double scattering –referred to as Recoil Proton Track Imaging (RPTI) –can be found in the literature. So far, they have showed limits in terms of detection efficiency, complexity, cost, and implementation. In order to address some of these deficiencies, we have proposed RIPTIDE a novel recoil-proton track imaging detector in which the light output produced by a fast scintillator is used to perform a complete reconstruction in space and time of the interaction events. The proposed idea is viable thanks to the dramatic advances in low noise and single photon counting achieved in the last decade by new scientific CMOS cameras as well as pixel sensors, like Timepix or MIMOSIS.
In this contribution, we report the advances on the RIPTIDE concept: Geant4 Monte Carlo simulations, light collection tests as well as state-of-the-art approach to image readout, processing and fast analysis.

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