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4D Pixel Detector Demonstrator Project

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High spatial and temporal resolution detectors will be critical to operate in the conditions created by future colliders. Based on the input from the 4D Tracking detector workshop at SLAC in September 2024 we have derived a proposal for a 4D Pixel detector demonstrator project. The project aims to coalesce multiple current R&D efforts in the US, better understand high precision timing systems holistically, and build a foundation for future targeted R&D to fork off from. The proposal outlines multiple work packages like sensors, front-end readout chip, and data acquisition among others, that when brought together enable the creation of a small scale 4D Pixel detector demonstrator system with the intention to operate as a telescope in a testbeam environment. The component specifications for the first stage are chosen such that the project can deliver a working prototype within the next 3-4 years, heavily leveraging already existing R&D in this area or using current ATLAS and CMS HL-LHC upgrades as a starting point. Initially the project will lean towards requirements set by the Muon collider detector environment, as they have a particular emphasis on 4D tracking, but the second stage of the proposal will encourage more specialized R&D thrusts to emerge from the foundation build during the first stage. A center piece of the project will be the front-end read out ASIC design in 28nm CMOS, for which a design framework shall be established that simplifies integration of new circuits in subsequent design iterations, such as reconfigurable data processing units, AI/ML enabled feature identification, or neuromorphic front-end designs. This presentation will outline the main points of our proposal in an effort to broadcast it to the community and potentially attract further collaborators.

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