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Triplet Track Trigger for Future Hadron Collider Experiments

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For the post High Luminosity LHC era several accelerator projects are under study with the aim to increase the discovery potential for new physics at both the high energy and intensity frontier. The hadron-hadron based Future Circular Collider(FCC-hh) is one such project with the goal to collide proton-proton beams at $\sqrt{s} \sim$ 100TeV with a bunch crossing rate of 25ns. Some of the major challenges that the FCC-experiments have to tackle are the very large number of pileup events ($\sim$ 1000) and the data processing, namely the reduction of the huge data rate of 1 - 2PBytes/s whilst keeping the signal efficiencies high. The required processing power will be extremely challenging even in 20 years time from now. Therefore, we need smart triggering concepts that not only allow for a significant reduction of pileup and rate but also provide high signal acceptance and purity. One such concept is the triplet track trigger(TTT) based on monolithic pixel sensors.
In the poster, the concept of triplet track trigger using High Voltage Monolithic Active Pixel Sensors(HV-MAPS) is introduced for a generic detector geometry. Based on the tracker layout of the FCC-hh reference detector design, a full Geant4 simulation is done with the TTT placed at a radius of 85cm. Tracking performance studies are presented for a full-scale triplet pixel detector, i.e. three closely spaced pixel layers at sufficiently large radius in a FCC like detector environment. It is demonstrated that the TTT allows for a very simple and fast track reconstruction, providing excellent track reconstruction efficiencies and very high purity at the same time.
It is shown that the TTT can be used to trigger efficiently multi-jet signals using track-jets. A significant pileup, and thus data rate reduction is achieved by reconstructing the z-vertex positions of the jet constituents already at the first trigger level. Results obtained for different triplet layer design parameters are compared.

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