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Front end intelligence for triggering and local track measurement in gaseous pixel detectors

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The TimePix3 chip, currently being designed, is a pixel read-out chip with precision tdc (< 2 ns) recording hit arrival times and time-over-threshold. The read-out architecture [1] allows for continuous and trigger-free readout of sparsely distributed data with the rate up to $20 \text{ Mhits cm}^{-2} \text{ s}^{-1}$. It is designed for both solid-state pixel sensors and gaseous detectors. When used with gaseous detectors 3D tracking on one chip becomes possible. We are investigating the addition of fast pattern recognition of tracks in gaseous detectors in a successor chip to TimePix3. This includes recognition, without external trigger, of the passage of a particle, filtering of tracks to select only those with the desired angles, and fast measurement of the track. For example, tracks with small tilt angle correspond to high momentum tracks in solenoid-field inner trackers. Being able to select these fast and without external input could have applications at the future upgrades of the LHC detectors.

I will discuss the initial results in terms of which algorithms look most promising, with estimates of requirements for the extra electronics in terms of power, data rates, latency, and chip area.

[1] V. Gromov et al, "Development and Applications of the Timepix3 Readout Chip", Proceedings of Science (PoS) of the 20th Anniversary International Workshop on Vertex Detectors (19-24 June 2011, Rust, Austria) http://pos.sissa.it/archive/conferences/137/046Vertex%202011_046.pdf

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