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Data Compression and LVL1 track triggering by means of Digital Signal Processing in GridPix/Gossip FE pixel chips

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The GridPix detector is a gaseous Time Projection Chamber with an active pixel chip as readout plane. See ATLAS Note: ATL-UPGRADE-SLIDE-2009-141; ATL-COM UPGRADE-2009-005.- Geneva : CERN, 2009 for detailed information.

Thanks to its fine granularity, the individual electrons along a particle track, are registered in three dimensions. Each GridPix layer measures therefore a track segment. The Gossip detector is a GridPix with a drift gap of only 1 mm. Here, the gas layer replaces a Si sensor layer of Si pixel or strip detectors. One of the advantages of Gossip/GridPix with respect to Si pixel or strip detectors is the extreme low source capacitance at the (pixel) preamp input pads. This limits the requirements concerning power, and physical space, needed for the preamp in the pixel. As a consequence, space is available for data processing.

With a drift gap of 20 mm, and placed in a specific angle of rotation, the projected tracks, appearing on the pixel plane, have a specific length for infinite high momentum tracks. Deviations from this length are a measure for the track momentum and for the charge sign of the particle's track. The projected track length is therefore a criterion for a LV1 trigger. In the pixel chip, an algorithm of neighbour-pixel-active could operate, in parallel to all pixels. The projected track could be fitted within ~ 100 ns, and its length could be established well within the trigger latency (the electron drift time of 200 ns included). This principle could also be used to provide a 1 - 20 GeV cut on 'valid' track data, reducing the data rate.

The present Si-strip trackers could be replaced by Gossip strixel detectors with its lower costs as main advantage. With a strixel width of ~ 50 μm and a strixel length of ~ 5 mm, the strixel surface is for the largest part available for digital signal processing. The raw data can be converted in 2D track position data, and could be communicated to 'common sector' detection layers at smaller and larger radii.

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