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Large Area Coverage of a TPC Endcap with GridPix Detectors

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The Linear Collider is a future accelerator colliding electrons and positrons at center of mass energies of 250-500 GeV. One of the detector concepts under study foresees a large volume TPC as a main tracking device. The LCTPC collaboration studies several different MPGD technologies which could fulfill the requirements of the ILC physics program. To test and compare the readout technologies, a test setup with a fully operational TPC prototype (called Large Prototype, LP) in a B = 1 T magnetic field and an E = 6 GeV electron test beam was set up at DESY, Hamburg, by the collaboration. The LP can be equipped with up to 7 readout modules of about 400 cm^2 each.

One of the technology options is the GridPix detector, which consists of a Micromegas gas amplification stage on top of the highly pixelized Timepix readout ASIC. The pillars and grid of the Micromegas can be fabricated in photolithographic processes ensuring a very good alignment of each grid hole with a pixel of the ASIC. Therefore, single primary electrons entering in a grid hole are amplified in the gap and the charge is collected completely on one pixel. This has significant advantages in energy determination, since counting the number of pixels gives a direct measure of the energy deposited along the track without gas amplification fluctuations. Also, the track reconstruction profits from the detailed information on each electron, since for example effects of delta electrons, multiple-scattering kinks can be corrected. In addition, the track reconstruction is also free from the angular pad effect.

Covering a large area of about 10 m^2 per endcap with GridPix detectors of 2 cm^2 is, however, challenging and the feasibility has to be demonstrated. For this reason we have built 3 modules for the Large Prototype setup with a total of 160 GridPix detectors corresponding to 10.5 million pixels. A central module with 96 GridPix detectors and two outer modules with 32 GridPixes each give a lever arm of about 60 cm for each track. The construction of the modules including the production of the GridPixes, the specifically developed readout system based on the Scalable Readout System of RD51, the LV and cooling system
will be described in this presentation. Also, experience of operating a 160 GridPix detectors and analyses concerning the data quality and TPC performance will be shown.

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