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Performance of a Pixel Time Projection Chamber

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A Time Projection Chamber (TPC) module with 32 GridPix chips was constructed and the performance was measured using data taken in a testbeam at DESY in 2021.

The GridPix chips each consist of a Timepix3 chip with integrated amplification grid and have a high efficiency to detect single ionisation electrons.

In the testbeam setup, the module was placed in between two sets of Mimosas26 silicon detector planes that provided external high precision tracking and the whole detector setup was slid into the PCMag magnet at DESY.

The analysed data were taken at electron beam momenta of 5 and 6 GeV/c and at magnetic fields of 0 and 1 Tesla(T).

The transverse and longitudinal diffusion coefficients were measured with high precision.

The tracking systematical uncertainties in xy (pixel plane) were measured to be smaller than 13 microns.

The dE/dx or dN/dx resolution for electrons in the 1 T data was measured.

The projected particle identification performance of a GridPix Pixel TPC in ILD at ILC was evaluated.

The expected pion-kaon separation for momenta in the range of 2.5-45.0 GeV/c is more than 4.5 sigma.

Other Pixel TPC analysis results will be presented: the single electron efficiency at high hit rates, the characterisation of hit bursts and the resolution in the precision plane as a function of the incident track angle.

The results demonstrate the tracking and particle identification capabilities of a GridPix Time Projection Chamber and its potential at future colliders such as ILC (CLIC), CEPC, FCCee or EIC.

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