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TPC Development for the ILD Detector at ILC (On behalf of the LCTPC Collaboration)

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A large, worldwide community of physicists is working to realize an exceptional physics program of energy-frontier, electron-positron collisions with the International Linear Collider (ILC) and other collider projects (summarized and evaluated in https://arXiv.org/abs/2208.06030).
The International Large Detector (ILD) is one of the proposed detector concepts at the next electron-positron linear collider (ILC). The ILD tracking system consists of a Si vertex detector, forward tracking disks, and a large volume Time Projection Chamber (TPC), all embedded in a 3.5 T solenoidal field. The TPC is designed to provide up to 220 three dimensional points for continuous tracking with a single-hit resolution better than 100 μm in rφ, and about 1 mm in z. An extensive research and development program for a TPC has been carried out within the framework of the LCTPC collaboration. A Large Prototype TPC in a 1 T magnetic field, which allows to accommodate up to seven identical Micropattern Gaseous Detector (MPGD) readout modules of the near-final proposed TPC-design, has been built as a demonstrator at the 5 GeV electron test-beam at DESY. Three MPGD concepts are being developed for the TPC: Gas Electron Multiplier, Micromegas and Pixel, also known as GridPix (MicroMegas integrated on a Timepix chip). Successful test beam campaigns with the different technologies have been carried out during the last decade. Fundamental parameters such as transverse and longitudinal spatial resolution and drift velocity have been measured. In parallel, a new gating device based on large-aperture GEMs has been successfully developed. Recent R&D also led to a design of a Micromegas module with monolithic cooling plate in 3D printing and 2-phase CO2 cooling. In this talk, we will review the track reconstruction performance results and summarize the next steps towards the TPC construction for the ILD detector. The TPC with pad (pixel) readout electronics is designed to have about 10e6 pads (10e9 pixels) per endcap for continuous tracking and a momentum resolution of delta(1/pT) ~ 1x10e-4/GeV (TPC only) (delta(1/pT)~0.8x10e-4}/GeV (60% coverage, TPC only)), and the dE/dx resolution is ~5 % (~4 %). The momentum resolution including all tracking subdetectors is 2x10e-5/GeV.

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