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High spatial resolution of Time Projection Chamber R&D at high luminosity Tera-Z on CEPC

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The Circular Electron Positron Collider (CEPC) was been proposed as a Higgs and high luminosity Z factory in last few years. The detector conceptual design of a updated detector consists of a tracking system, which is a high precision (about $100\mu\text{m}$) spatial resolution Time Projection Chamber (TPC) detector as the main track device in very large 3D volume. The tracking system required the high precision performance requirements, but without power-pulsing not likely as the International Linear Collider (ILC), which leads to additional constraints on detector specifications, especially for the case of the machine operating at the high luminosity Z pole (Tera Z). TPC detection technology requires longitudinal time resolution of about 100ns and the physics goals require Particle Identification Detection (PID) resolution of very good separation power with cluster counting to be considered. A number of critical issues are still remaining regarding the TPC research. The simulation and PID resolution show TPC technology potential to extend Tera Z at the future e+e- collider. In this talk, I will present the feasibility and status of high precision TPC as the main track detector for e+e- collider. The traditional pad readout is designed about $1\text{mm} \times 6\text{mm}$ and the pixelated readout is designed about $55\mu\text{m} \times 5\mu\text{m}$ or bigger size. Compared with the pad readout, the pixelated readout option will obtain the better spatial resolution of single electrons, the very high detection efficiency in excellent tracking and good dE/dx performance. A smaller prototype TPC has been developed with a drift length of 500 mm, gaseous chamber, 20000V field-cage, the low power consumption FEE electronics and DAQ have been commissioned and some studies have been finished. Some updated experimental results including the spatial resolution, the gas gain, the laser track reconstruction and dE/dx will be reported. The track performance results and summarize the next steps of the pad/pixelated TPC technology for e+e- collider will presented in this talk.

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