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Drift chamber with cluster counting techniques for CEPC

The Circular Electron Positron Collider (CEPC) is designed to operate at center-of-mass energies of 240 GeV as a Higgs factory, as well as at the Z-pole and the WW production threshold for electroweak precision measurements and study of flavor physics. A good identification of charged kaons is essential for the flavor physics and benefits the determination of jet flavor and jet charge. To achieve these physics goals, a design of tracking system combining a silicon tracker and a drift chamber is proposed. The silicon tracker provides excellent spatial resolution and granularity to cope with track separation in dense jets. The drift chamber could provide excellent particle identification (PID) performance with cluster counting technique. The cluster counting, which measures the number of primary ionizations (dN/dx) instead of the energy loss (dE/dx) along the particle trajectory in a gaseous detector, represents the most promising breakthrough in PID. The Poissonian nature of the dN/dx offers a more statistically significant way of ionization measurement, which makes the dN/dx potentially has a resolution two times better than the dE/dx.
In this presentation, detailed PID study of the CEPC drift chamber will be discussed. The sophisticated full-simulation model, which includes the detector and electronics responses as well as the reconstruction algorithm, is used to optimize the drift chamber design and to provide the PID performance. A preliminary CEPC drift chamber design is proposed. The PID performance in terms of the kaon and pion separation power with one meter track for 20 GeV/c momentum can reach 2σ level, which satisfies the preliminary physics requirements of CEPC. Furthermore, we will focus on some major updates since the previews talks, including the updated PID performance with the machine learning reconstruction algorithm, the domain adaptation algorithm for test beam data and PID performance of physics channels with Delphes.

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