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Particle identification with the cluster counting technique for the IDEA drift chamber

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IDEA (Innovative Detector for an Electron-positron Accelerator) is an innovative general-purpose detector concept, designed to study electron-positron collisions in a wide energy range provided by a very large circular leptonic collider. The IDEA drift chamber is designed to provide an efficient tracking, a high precision momentum measurement and an excellent particle identification by exploiting the application of the cluster counting technique. To investigate the potential of the cluster counting techniques on physics events a simulation of the ionization clusters generation is needed, so we developed an algorithm which can use the energy deposit information provided by Geant4 toolkit to reproduce, in a fast and convenient way, the clusters number distribution and the cluster size distribution. The results obtained confirm that the cluster counting technique allows to reach a resolution 2 times better than the traditional dE/dx method. A beam test has been performed during November 2021 at CERN on the H8 to validate the simulations results, to establish the most efficient cluster counting algorithms, to define the limiting effects for a fully efficient cluster counting, to demonstrate the ability to count the number of electron clusters released by an ionizing track at a fixed $\beta\gamma$ as a function of the operative parameters and to establish the limiting conditions for an efficient cluster counting. Once a set of parameters optimizing the cluster counting efficiency has been defined, the setup will undergo a new test in a muon beam of momenta in the relativistic rise range, in order to define the particle identification capabilities of the cluster counting approach over the full range of interest for all future lepton machines. We will present a detailed description of the simulations analysis and the beam test results.

Collaboration

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