Contribution ID: **63** Type: **ORAL**

Cluster counting algorithms for PID at future colliders

Wednesday, 11 October 2023 14:15 (15 minutes)

While the ionization process by charged particles (dE/dx) is commonly used for particle identification, uncertainties in total energy deposition limit particle separation capabilities. To overcome this limitation, the cluster counting technique (dN/dx) leverages the Poisson nature of primary ionization, providing a statistically robust method for inferring mass information. Simulation studies using Garfield++ and Geant4 indicate that the cluster counting technique can achieve twice the resolution of the traditional dE/dx method in helium-based drift chambers. However, in real experimental data, finding electron peaks and identifying ionization clusters is extremely challenging due to the superimposition of signals in the time domain. To address these challenges, this talk introduces cutting-edge algorithms and modern computing tools for electron peak identification and ionization cluster recognition in experimental data. The effectiveness of the algorithms is validated through three beam tests conducted at CERN/H8, involving different helium gas mixtures, varying gas gains, and various wire orientations relative to ionizing tracks. The tests employ a muon beam ranging from 1 GeV/c to 180 GeV/c, with drift tubes of different sizes and diameter sense wires. The data analysis results concerning the ascertainment of the Poisson nature of the cluster counting technique, the establishment of the most efficient cluster counting and electrons clustering algorithms among the various ones proposed, and the definition of the limiting effects for a fully efficient cluster counting, like the cluster dimensions, the space charge density around the sense wire and the dependence of the counting efficiency versus the beam particle impact parameter will be discussed.

Primary authors: ELMETENAWEE, Walaa (Istituto Nazionale di Fisica Nucleare); Ms D'ANZI, Brunella (INFN - Bari); DE FILIPPIS, Nicola (BA); GRANCAGNOLO, Francesco (Istituto Nazionale di Fisica Nucleare)

Co-authors: CHIARELLO, Gianluigi (INFN); CORVAGLIA, Alessandro (Istituto Nazionale di Fisica Nucleare); DE SANTIS, Francesco (Istituto Nazionale di Fisica Nucleare); GORINI, Edoardo (Istituto Nazionale di Fisica Nucleare); MAGGI, Marcello (Istituto Nazionale di Fisica Nucleare); MICCOLI, Alessandro (Istituto Nazionale di Fisica Nucleare); PANAREO, Marco (Istituto Nazionale di Fisica Nucleare); PRIMAVERA, Margherita (Istituto Nazionale di Fisica Nucleare); VENTURA, Andrea (Istituto Nazionale di Fisica Nucleare); XIN, Shuiting (IHEP, Beijing); LIU, Shuaiyi (Beijing, Inst. High Energy Phys.)

Presenter: ELMETENAWEE, Walaa (Istituto Nazionale di Fisica Nucleare)

Session Classification: Parallel - WG2