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The cluster counting/timing techniques in drift chambers

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The cluster counting technique represents a very promising alternative to the traditional ways of integrating the ionization charge for particle identification in drift chambers. It takes advantage of the Poisson nature of the primary ionization process and offers a more statistically robust method to infer mass information. Simulation studies prove that cluster counting allows reaching a resolution two times better than the traditional energy loss-based method over a wide momentum range in the use case of a helium-based drift chamber. It consists in singling out, in every recorded detector signal, the electron peak structures related to the arrival time of the electrons belonging to a single primary ionization act (cluster) on the anode wire. However, the search for hundreds of electron peaks and cluster recognition in real data-driven waveform signals is extremely challenging because of their superimposition in the time scale. The state-of-the-art open-source algorithms fail to reach theoretical expectations even in low-noise conditions. In this talk, we present cutting-edge methods to search for electron peaks in actual waveform time spectra and identify ionization clusters showing their application to beam test datasets collected at CERN facilities using helium-based drift tubes.

Primary authors: CAPUTO, Claudio (UCLouvain); CHIARELLO, Gianluigi (INFN); CORVAGLIA, Alessandro (Istituto Nazionale di Fisica Nucleare); CUNA, Federica (Istituto Nazionale di Fisica Nucleare); Ms D'ANZI, Brunella (INFN - Bari); DE FILIPPIS, Nicola (BA); ELMETENAWEE, Walaa (Istituto Nazionale di Fisica Nucleare); GORINI, Edoardo (Istituto Nazionale di Fisica Nucleare); GRANCAGNOLO, Francesco (Istituto Nazionale di Fisica Nucleare); GRECO, Matteo (Istituto Nazionale di Fisica Nucleare); JOHNSON, Kurtis (Florida State University); MICCOLI, Alessandro (Istituto Nazionale di Fisica Nucleare); MONGELLI, Maurizio (Istituto Nazionale di Fisica Nucleare); PANAREO, Marco (Istituto Nazionale di Fisica Nucleare); PASTORE, Cosimo (Istituto Nazionale di Fisica Nucleare); PRIMAVERA, Margherita (Istituto Nazionale di Fisica Nucleare); TALIERCIO, Angela (Nortwestern University); TASSIELLI, Giovanni Francesco (Istituto Nazionale di Fisica Nucleare); VENTURA, Andrea (Istituto Nazionale di Fisica Nucleare)

Co-authors: DE SANTIS, Francesco (Istituto Nazionale di Fisica Nucleare); XIN, Shuiting (IHEP); CAPUTO, Claudio (Universite Catholique de Louvain); POPOV, Alexander; GRIBANOV, Sergei; SHUAIYI, Liu (Institute of High Energy Physics); GUO, Fangyi (Institute of High Energy Physics, CAS)

Presenter: CUNA, Federica (Istituto Nazionale di Fisica Nucleare)

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