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Cluster Counting Drift Chambers for Collider Experiments

To optimize resolutions, both spatial and dE/dx, in a large gas drift chamber or in a system of stacked drift tubes, the gas mixture used is such that the ionization clusters are densely created along the charged track, thus resulting in a signal well defined in time and dominated in amplitude by Landau fluctuations only. Spatial resolution is limited by the primary ionization statistics at small impact parameters and by electron diffusion at large drift distances. Here, instead, it will be shown that, by collecting on the sense wire all primary ionization and recording the drift times and amplitudes of all individual ionization electrons, spatial resolution and particle identification can be pushed to their theoretical limits of accuracy. Devices built in such a way will prove to be ideal for colliders like SuperB, where accuracies of the order of a few percent in dE/dx are required for particle identification, or like the International Linear Collider, where the momentum resolution is needed at the level of a tenth of a percent for 100 GeV/c momenta particles. The status of the VLSI chip, designed to readout and store the cluster counting waveforms will also be reported.

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