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# Simulation of particle identification with cluster counting technique

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Particle identification is one of the most important and difficult goal for high energy physics.
Ionization of matter by charged particles is the primary mechanism used for particle identification (dE/dx), but the large and inherent uncertainties in total energy deposition represent a limit to the particle separation capabilities: even in the most favorable momentum region (relativistic rise), the typical separation between energy loss curves relating to different particles is smaller than the spread around the relative mean values.
Cluster counting technique takes advantage from the primary ionization Poissonian nature and offers a more statistically significant way to infer mass information. The method consists in singling out, in ever recorded detector signal, the isolated structures related to the arrival on the anode wire of the electrons belonging to a single ionization act (dN/dx).
Tracking devices, like drift chambers, provide measurements of the energy loss along the particle track, which, if combined with a measurement of momentum, allow to infer the mass of the ionizing particle.
We investigate the potential of cluster counting technique for He based drift chamber, developing different algorithms to simulate the ionization cluster generation in Geant4.
Indeed, Geant4 is a powerful software, that can simulate a full detector and collider events, but cannot investigate the fundamental properties and performances of the sensible elements (drift cells), which are studied in more details by Garfield++ .
We simulate, with both software, 2 m long tracks of five particles at different momenta passing through 1 cm long side box filled with 90% He and 10% iC4H10.
Different algorithms to achieve reasonable results are developed, but the common key for all the ways explored is a model for the kinetic energy of cluster containing single electron and cluster containing more than one electron, built using Garfield++ simulations.
The algorithms reproduce the number of cluster distribution which follow the expected Poissonian shape and the cluster size distribution whose shape is similar to the one expected, moreover the results obtained confirm that cluster counting allows to reach a resolution 2 times better than traditional dE/dx method.
A full Geant4 simulation of the IDEA tracking system is developed to test the tracking performance and the reconstruction algorithms will be implemented in the drift chamber hit creation.

## Time Zone

Europe/Africa/Middle East

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