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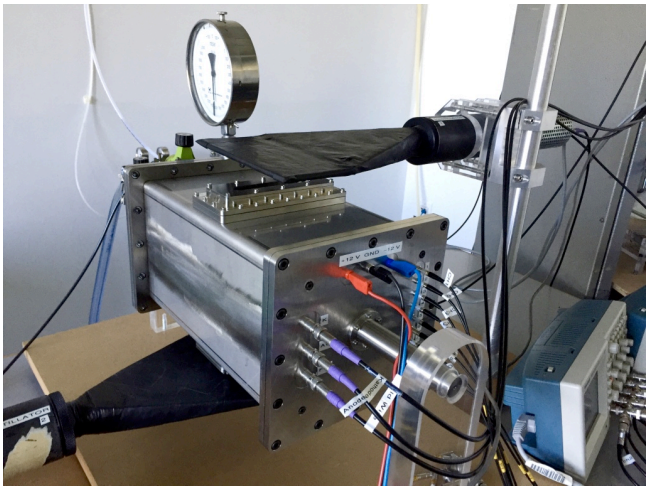
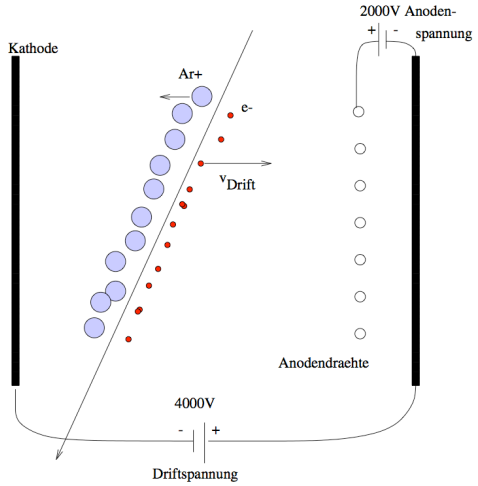
Drift Chamber

Abstract

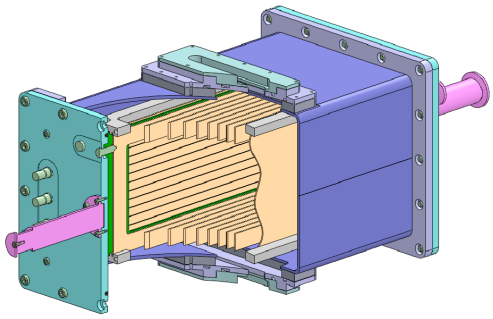
The experiment is designed to give a student an introduction to the detection of relativistic charged particles (cosmic muons) using a proportional drift chamber. The main concepts introduced in the lab are: gas ionization, electron and ion drift, and signal amplification through controlled avalanche process, and particle tracking. In addition the lab teaches the student the basic ideas of particle physics experiment, such as signal discrimination, coincidence logic, trigger logic, scintillators, photomultipliers, NIM standards, and signal aquisition.



The data acquisition proceeds in the following order. The cosmic muon, passing both scintillators, generates a fast signal, which then is amplified and discriminated. The discriminated signal is then sent to the coincidence unit, which determines the coincidence in time of the signals. The output of the coincidence is then sent to the trigger input of the DRS4 digitizer, where the signal is digitized and stored to disk. The recorded waveforms are then ready to be analyzed. Analyzing waveforms one extracts the pulse height and the time of the arrival, which in turn can used to determine the track of the particle as well as the dependance of the amplification coefficient on the parameters of the chamber.



The particle detection and tracking in a drift chamber is based on the following principle. The charged particle passing trough gas ionizes it. The positive ions then drift toward cathode, while the negative electrons drift towards anode. From the drift time the position of the hit is determined by using the drift velocity. Upon reaching the anode electrons undergo avalanche multiplication and get collected on the anode wires.



Results:

In the lab the students will determine the plato region of the scintillators by varying the bias voltage of photomultipliers and the thresholds of discriminators. They will the measure the dependence of the drift velocity on the cathode voltage and dependence of signal multiplication on the anode voltage and gas pressure. In the process they will determine the optimal conditions for the wire chamber, such as the gas pressure and the anode voltage. Finally, using the determined optimal conditions, they will record and reconstruct the tracks of the muons passing through the chamber.

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