High-Resolution Electronic Particle Detectors

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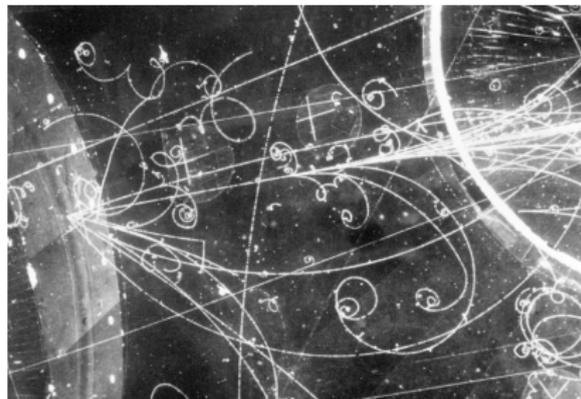April 25, 2018

Outline

Introduction

Experimental methods to detect
charged particles

- Bubble chamber
- Streamer chamber
- Holographic method

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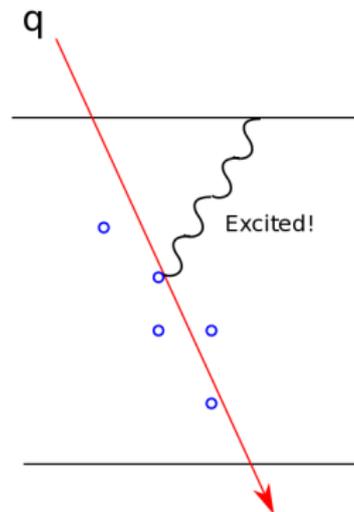
Ionization

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Ionization of the atoms within the detector is used in order to detect incident charged particles.
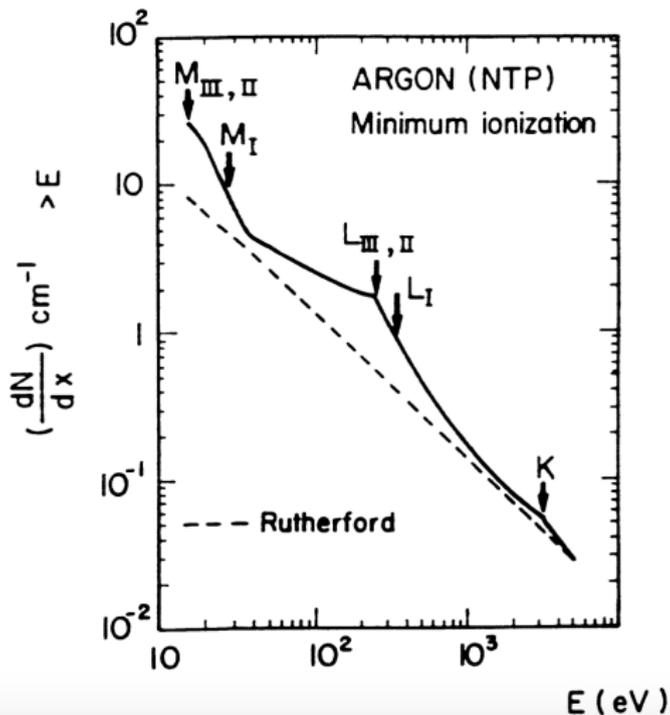
Energy loss

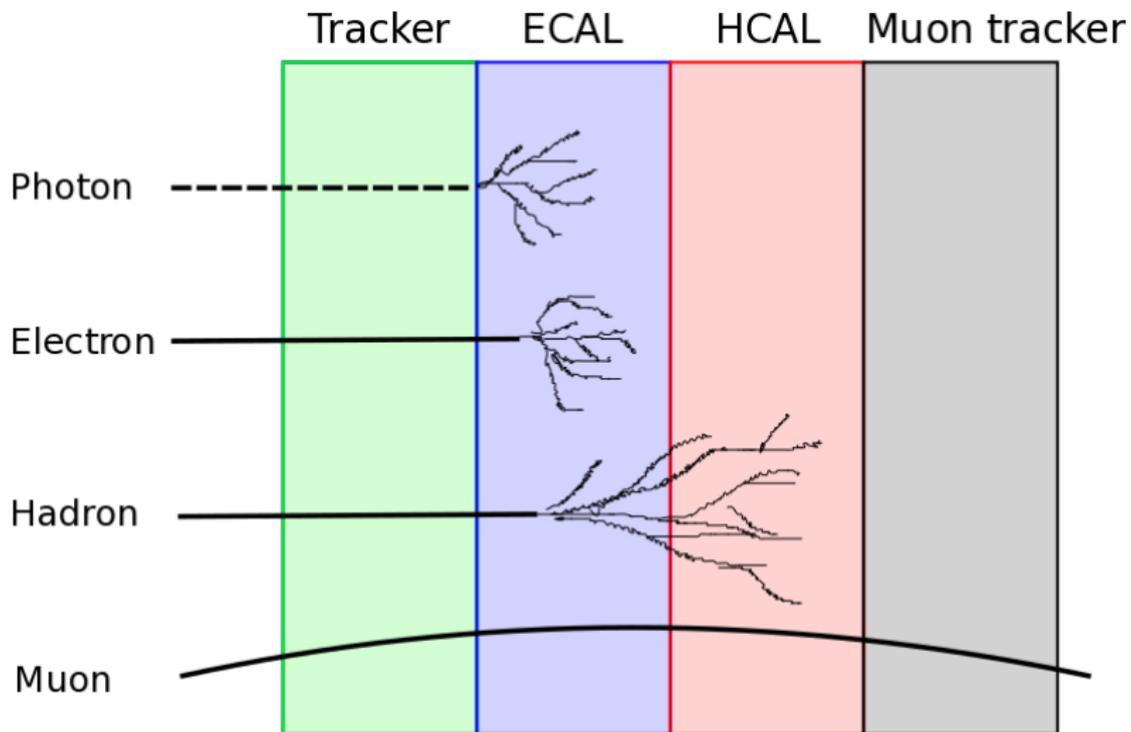Upon ionization, incident particle will lose its energy from it.

Interaction

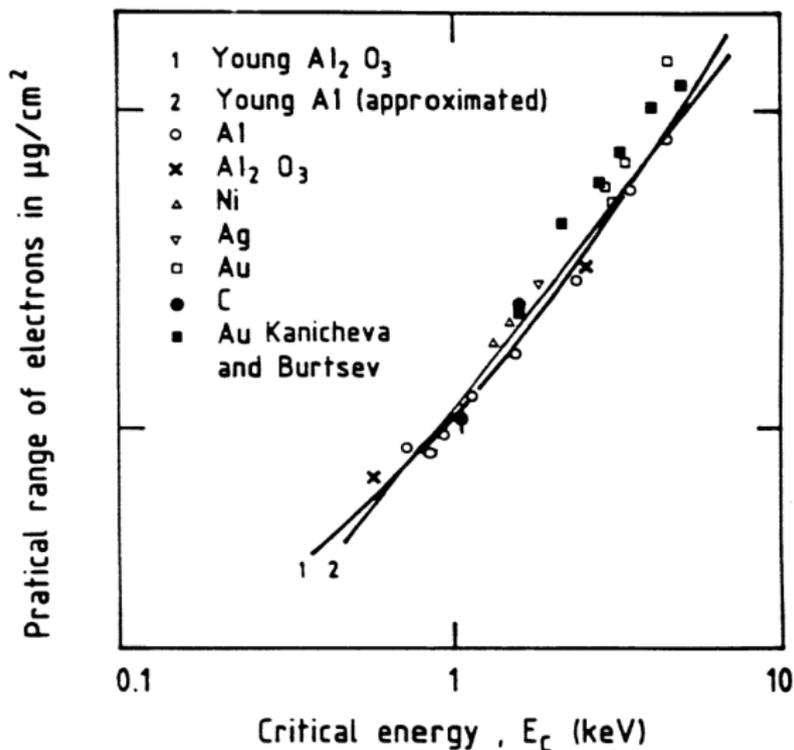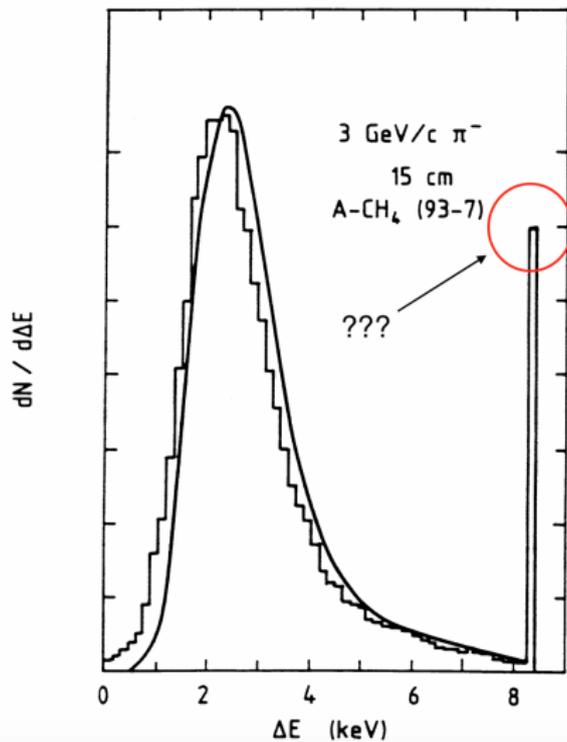Interactions between detector and incident particle can result transition of several eV.

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Excited!

Physical Message

Physical Message

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Introduction

Gaseous Detector

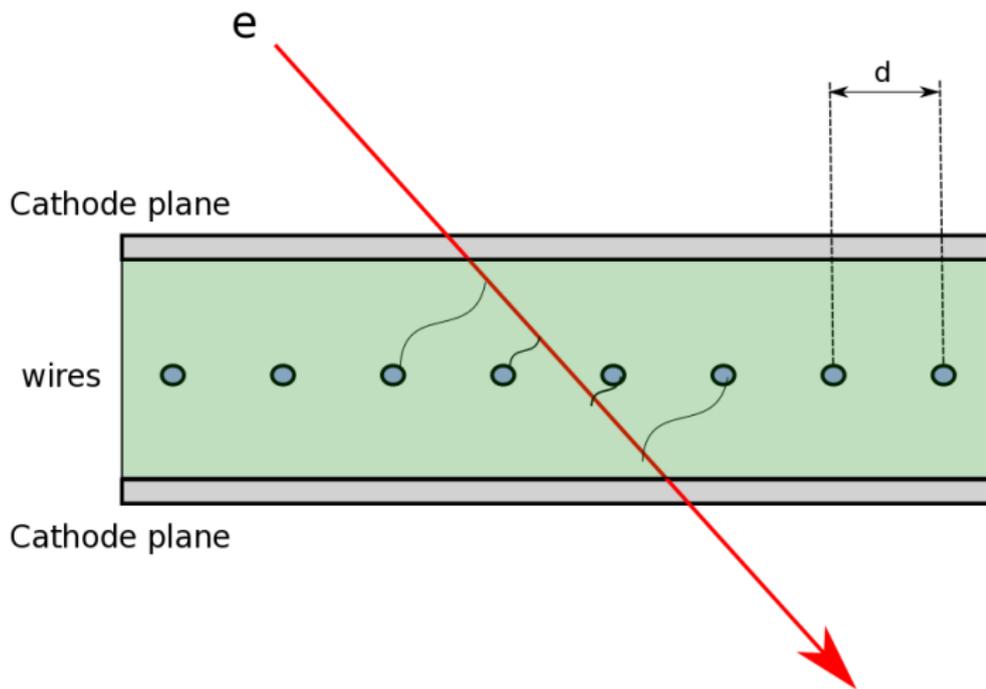Detects charged particles and their tracks by marking marking ionization pathways.

Pros

Depending on gas you use, you can keep it reasonable. Drift chamber localization accuracy can be achieved up to $\sim 20\ \mu$m.

Cons

Issues regards to space consumption. Difficulty upon implementation of large multi-electrode detectors at high pressure.

Introduction

Drift and Diffusion of Charges in Gases

Consider spherically symmetric Gaussian diffusion.

$$\sigma_x = \sqrt{2Dt} \tag{1}$$

Introducing characteristic energy ϵ_k

$$\sigma_x = (w\epsilon_k x/eE)^{\frac{1}{2}} = (w\epsilon_k x/EP^{-1})^{\frac{1}{2}} P^{-\frac{1}{2}} \tag{2}$$