High-Resolution Electronic Particle Detectors

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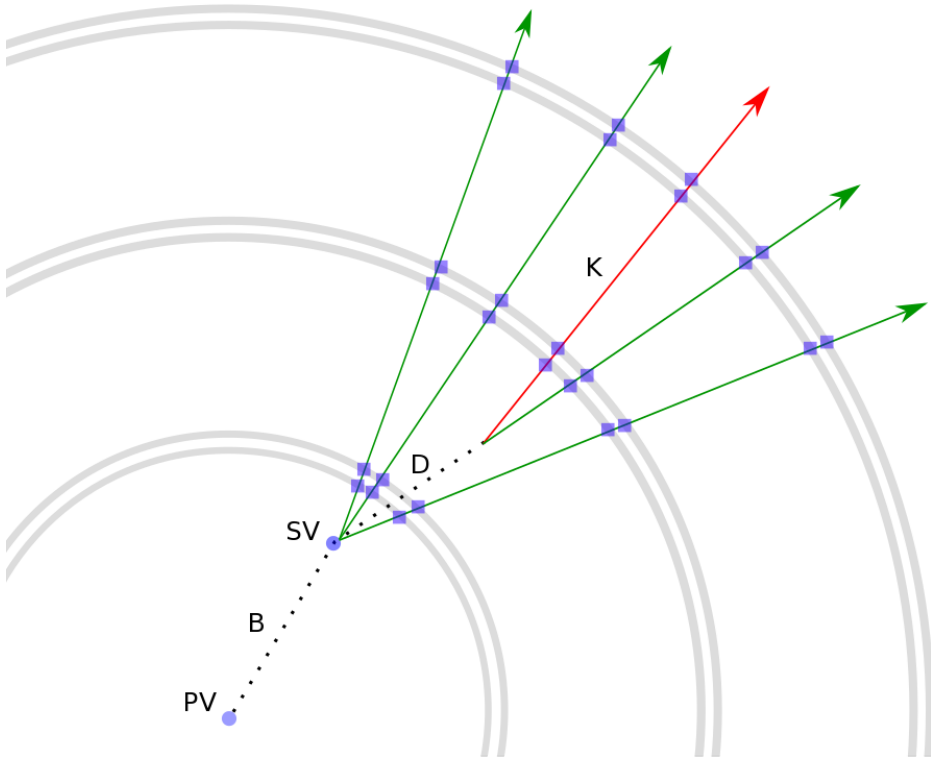
June 27, 2018

Introduction

Vertex Detectors

- Located at the inner most part of the detectors
- Its roles is to identify vertices
- Identification of vertices leads to determination of particles originated from the interaction point.



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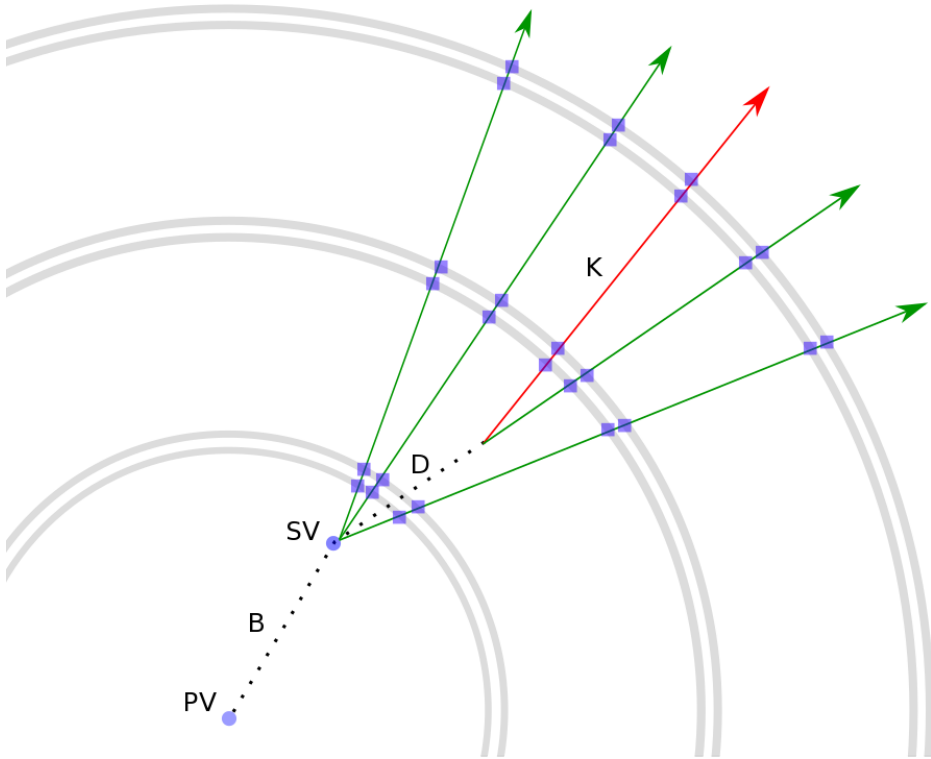

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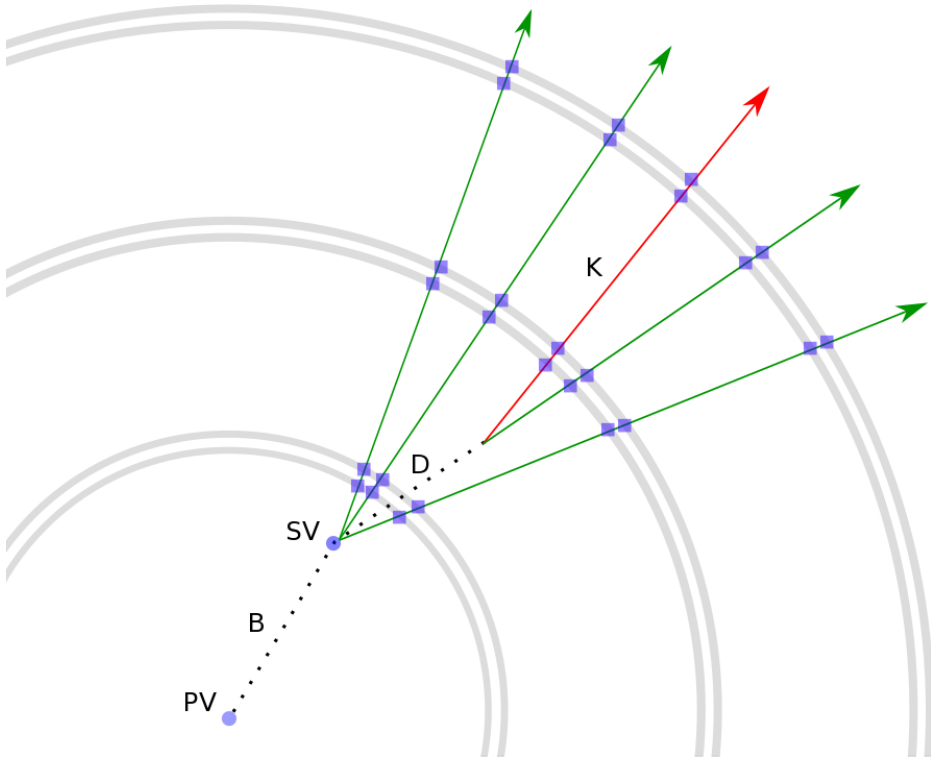
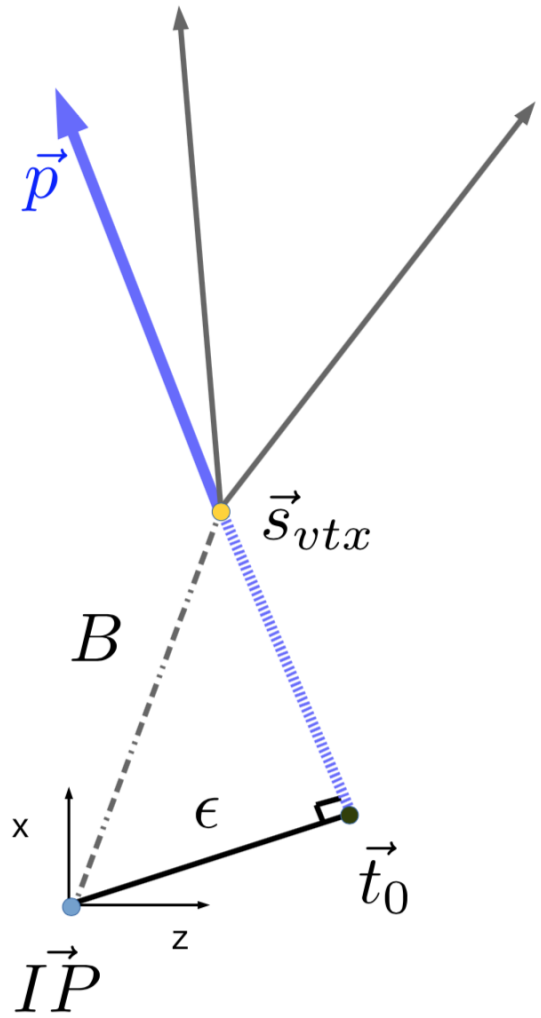


Introduction

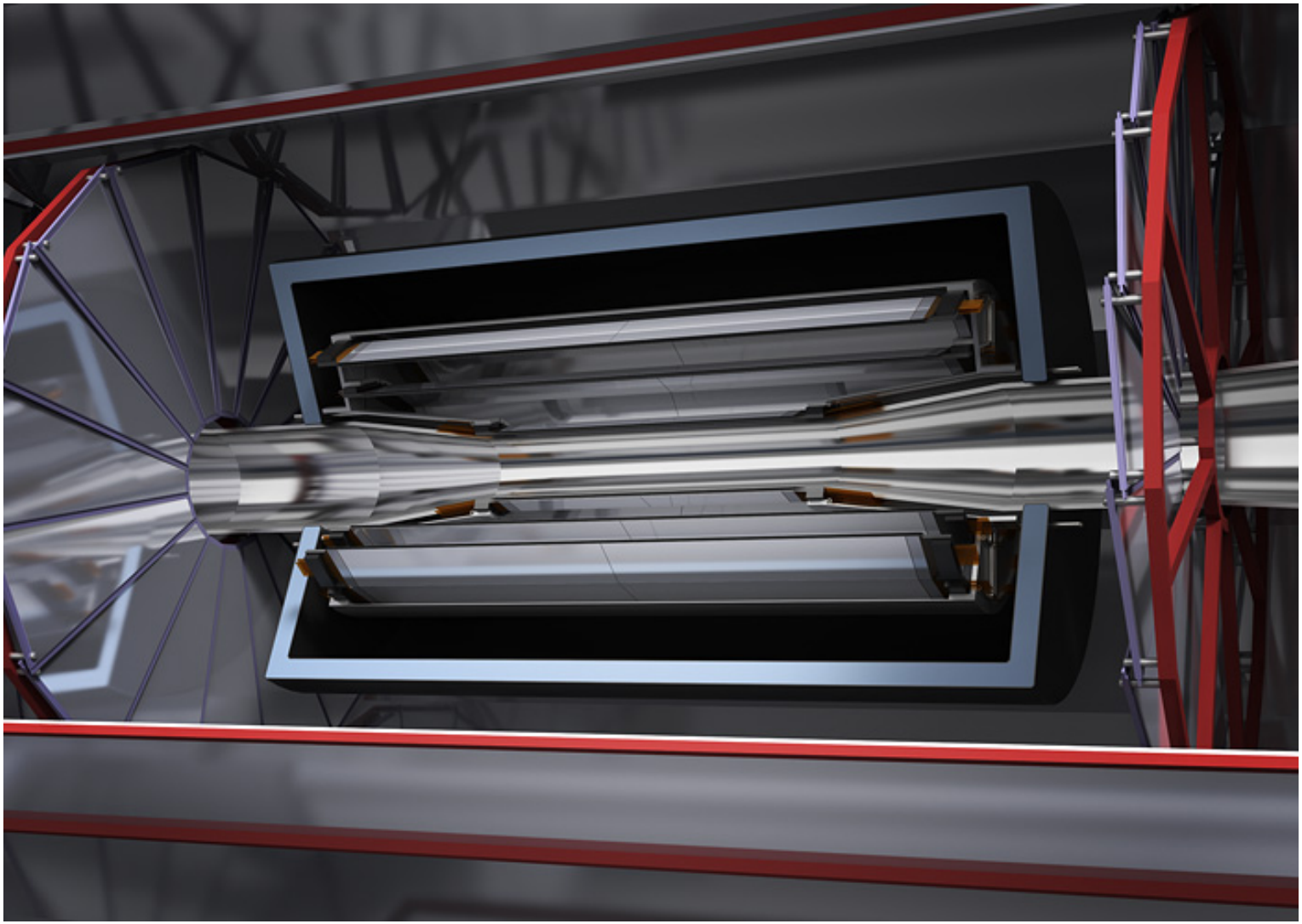
Reconstruction of Secondary Vertex

Secondary vertex (SV) is reconstructed based on information from constituents.
Its track information is key factor to determine SV.



Requirements

Vertex Detector



Requirements

Basic Requirements for Vertex Detector

Unlike the cases at LHC or Belle II, ILD does not require vertex detector to have high radiational resistivity or trigger rate. What ILD needs to focus is its resolution.

- A spatial resolution near the IP better than 3 μm
- A material budget below 0.15% $X_0/layer$
- A first layer located at a radius of ~ 1.6 cm
- A pixel occupancy not exceeding a few %

Impact parameter resolution

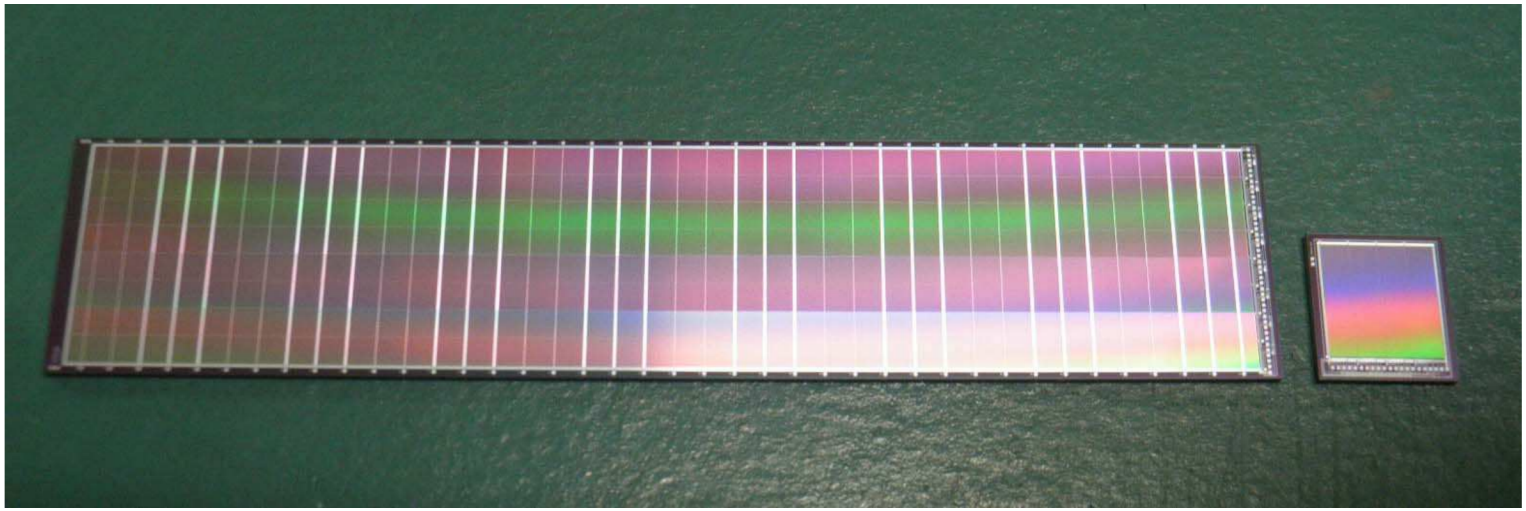
$$\sigma_{ip} = 5\ \mu m \oplus \frac{10}{p\beta \sin\theta^{3/2}}\ \mu m.GeV/c$$

Multiple Coulomb Scattering

Multiple Coulomb Scattering

$$\sigma_{d_0} = \frac{r_1}{cp} 13.6\ MeV \sqrt{\frac{x}{X_0}} \left[1 + 0.038 \left(\frac{x}{X_0} \right) \right]$$

Therefore it is necessary to make FPCCD as thin as possible.



FPCCD

Fine Pixel Charge Coupled Device

An integrated circuit etched onto a silicon surface forming light sensitive elements called pixels. Photons incident on this surface generate charge that can be read by electronics and turned into a digital copy of the light patterns falling on the device.

- Pixel size: $5 \times 5\ \mu m^2$
- Thichness: $15\ \mu m$