Status Report: Run 3 Electron Reconstruction Studies

Furkan Cetin

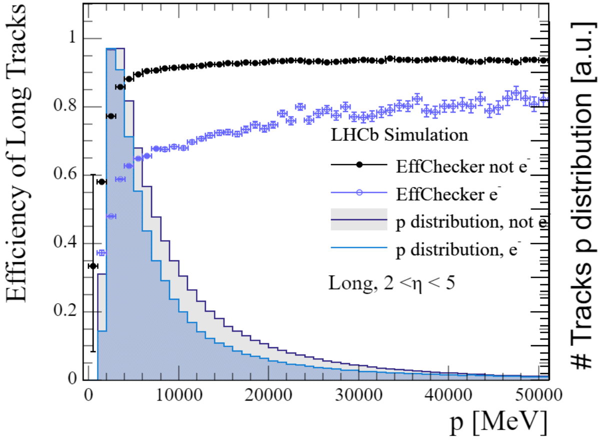
Heidelberg University

cetin@physi.uni-heidelberg.de

October 30, 2023

Motivation

- looked at track finding efficiencies
- electrons underperform against other particles



Track Types

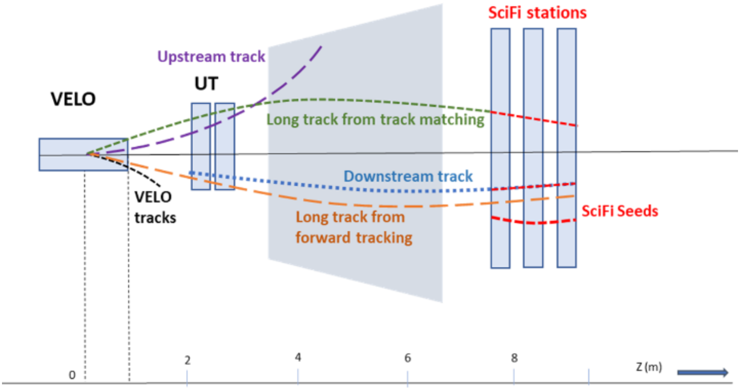


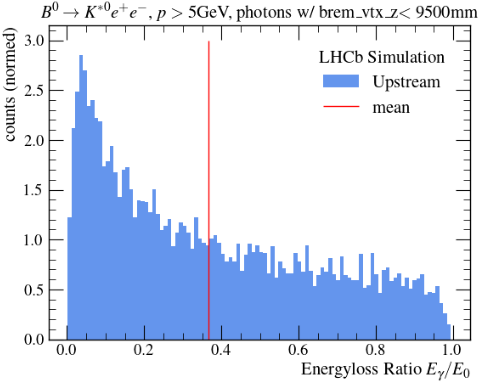
Figure: LHCb Track Types

Problem: electron has many possibilities to emit Bremsstrahlung

Tracking Electrons in LHCb

Difficulties for reconstructing electrons:

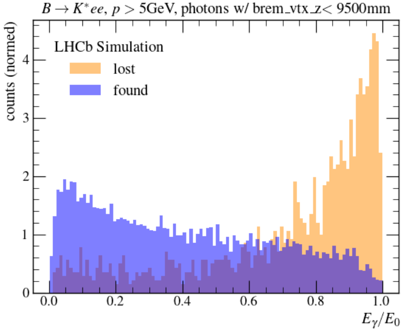
- typically lose 30% – 40% of their energy before they reach the magnet
- all parametrisations for pattern recognition explicitly exclude electrons - no measures to recover electron tracks

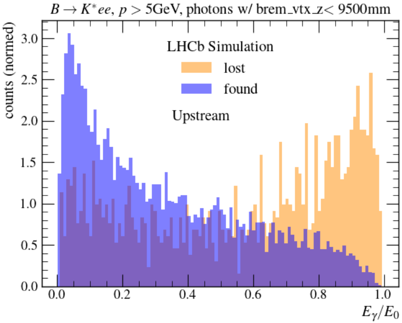


Here are a few of my findings.

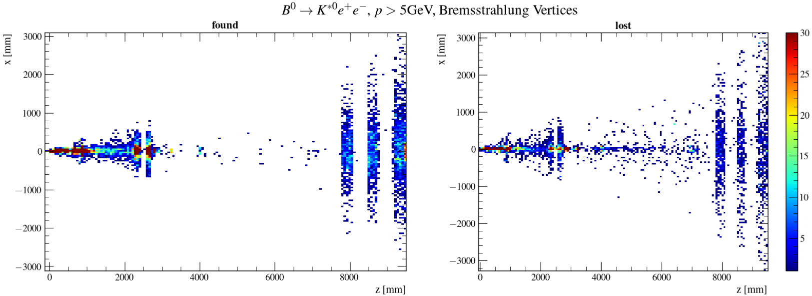
Bremsstrahlung

- most lose energy upstream





Bremsstrahlung Vertices



- found: no emissions in magnet
- lost: material interaction and emissions in magnet

Simplified Track Model

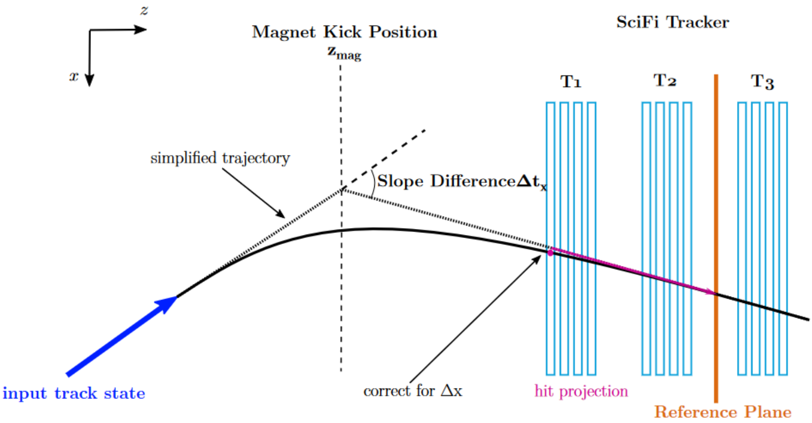
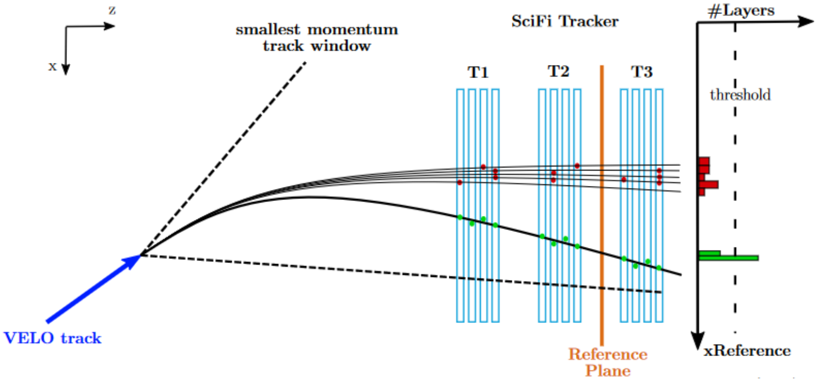


Figure: Illustration of the Optical Model method to describe a trajectory through the magnet

Forward Tracking

- forwards Velo tracks and searches for possible Scifi hits

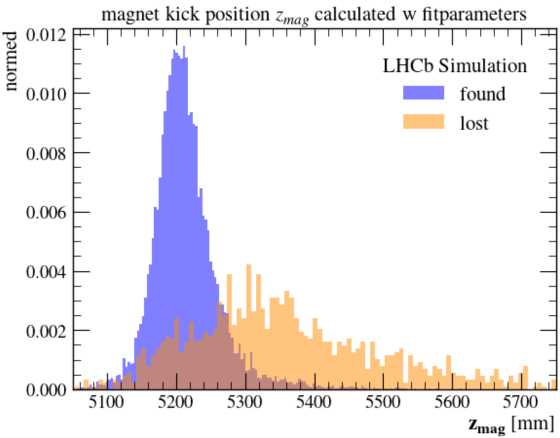


Magnet Kick Position

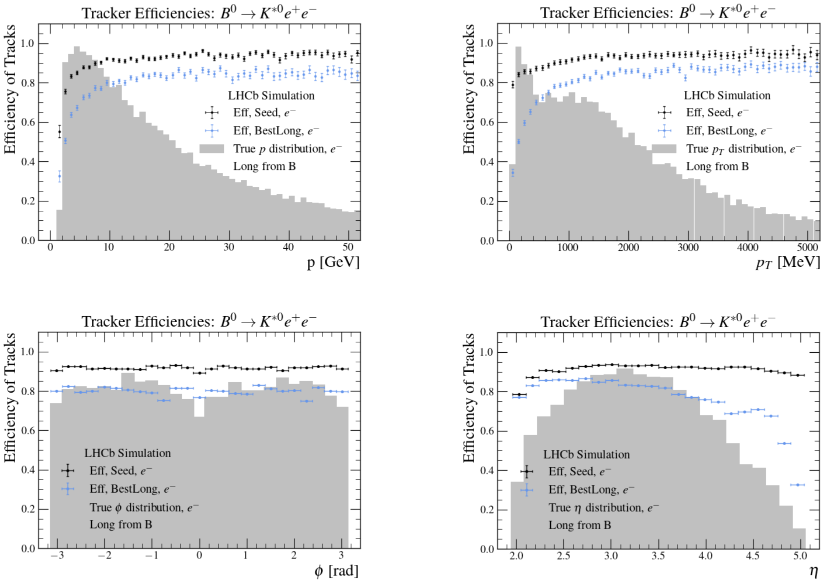
z_{mag} generally closer to the Scifi for lost electrons.

→ in general lost electrons are bent more by the magnet

→ lower energy than found electrons



Efficiency, from B



The Matching Algorithm

Idea:

- baseline track finding already creates Velo and Scifi tracks independently
- implement Matching algorithm, for electrons, over residual Velo tracks

Basic Idea of Matching:

- quantify the level of agreement, i.e. a match, between Velo and Scifi track segments

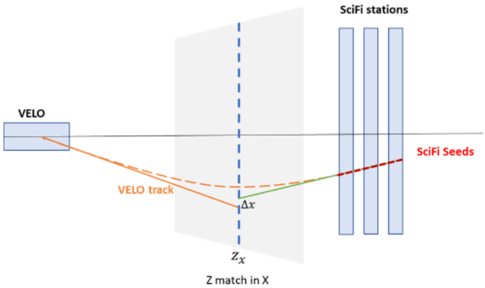


Figure: Basic Idea of the Matching algorithm

Variable	Preselection
χ^2_{match}	< 15
D_x	$< 250\,\text{mm}$
D_y	$< 250\,\text{mm}$
$\|\Delta t_x^{\text{match}}\|$	< 1.5
$\|\Delta t_y^{\text{match}}\|$	< 0.15
$t_x^2 + t_y^2$	

Figure: Input Variables of the Matching MLP