A study on electron energy loss within the LHCb detector

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Motivation


energy loss via bremsstrahlung
electron traversing the detector
the resolution

Bremsstrahlung

Bremsstrahlung = "deceleration radiation"

occurs when charged particle looses kinetic energy due to deflection near another charged particle

kinetic energy is set free via emission of a photon

Radiation length

The radiation lengthX_0 of a material is the mean length (in cm) to reduce the energy of an electron by the factor 1/e.

The radiation length depends on the material.

Problem: various di erent materials in the detector

How to measure energy loss

In this project, X_0 is not measured directly. Instead $\ln\langle\frac{x}{X_0}\rangle$ is looked at with x being the length of the path that the particle has already passed.

$$\langle\frac{x}{X_0}\rangle = \ln(\langle\frac{E_{measured}}{E_{initial}}\rangle) \quad (1)$$

where x is the length of the path of the electron, X_0 the radiation length, $E_{measured}$ the energy of the electron after x and $E_{initial}$ the initial energy of the electron at creation.

Comparing two MC datasets

$B^+ \; ! \;\; J/ \; (! \;\; e^+ e \;) K^+$

Comparing two MC datasets

Why are the MC samples different?

! different cuts

How big is the influence of those cuts on $\langle \frac{x}{X_0} \rangle$?

! look at deepest level of simulation possible

Following an electron through the detector

Following an electron through the detector

Following lots of electrons through the detector

My to do list

apply certain kinematic cuts to the deep level simulation and see ho
the energy loss behaviour changes

compare energy loss behaviour in MC data to real data

The end

Thank you!

Backup

Reconstructing particle momenta

In MC data: energy and momentum of particle at creation and particle after the magnet known

in real data: energy and momentum of particle after the magnet known

! need to nd a way to get energy and momentum of particle at creatio in real data!

Reconstructing particle momenta

our decay:

$$B^+ \; ! \quad J= \; (! \quad e^+ e \;)K^+$$

! J= (! $e^+ e$)K^+ must add up to B-mass
! $e^+ e$ must add up toJ= mass
reminder: $m^2 = E^2 \quad p^2$

Reconstructing particle momenta