# Use of the D0 Central Preshower in Electron Identification

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APS April 6, 2003

# Outline

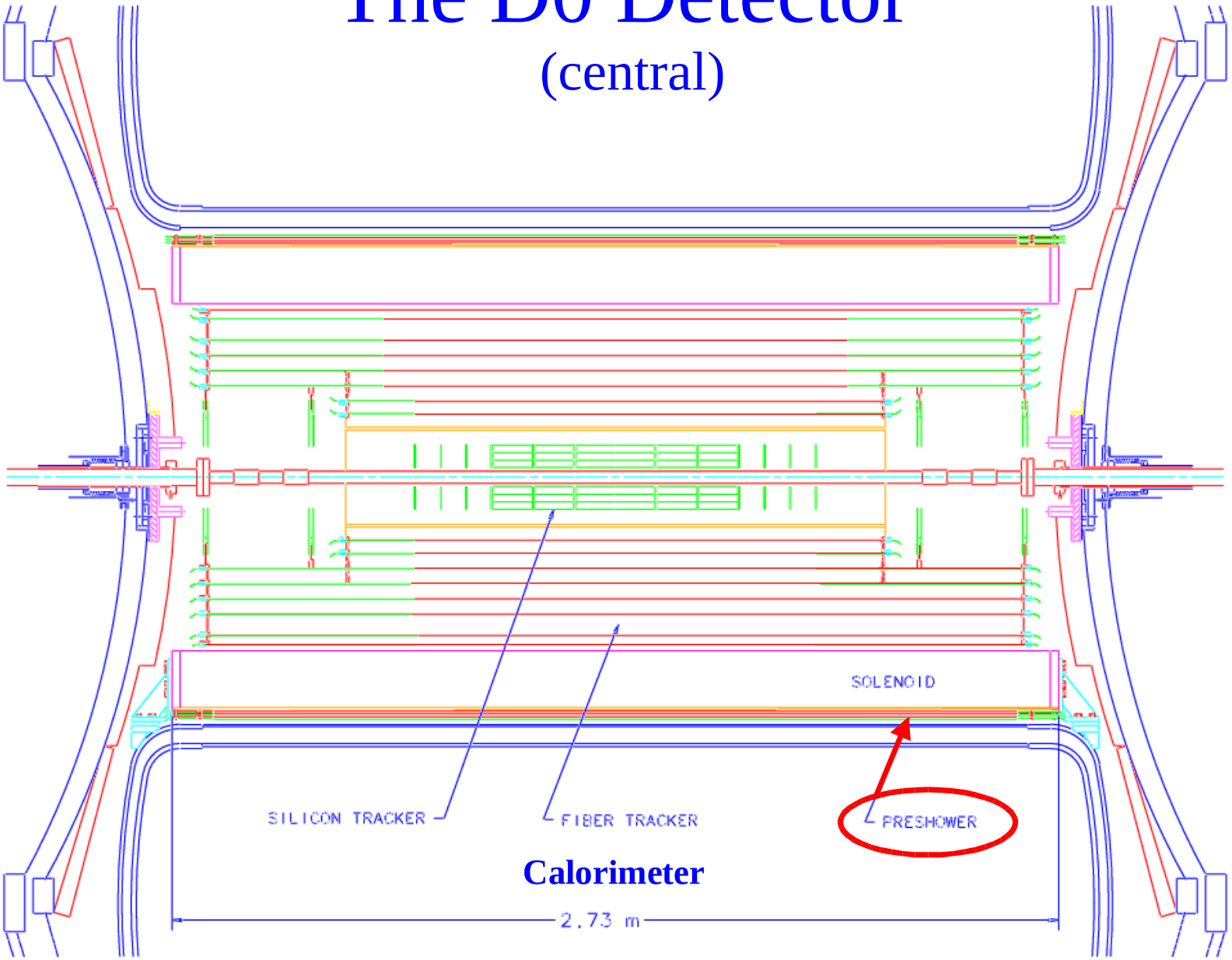
**1) Location of the Central Preshower in the D0 Detector**

**2) Purpose & Design**

**3) Matching to particles**

**4) Electron id analysis**

# The D0 Detector
(central)



# The Central Preshower (CPS)

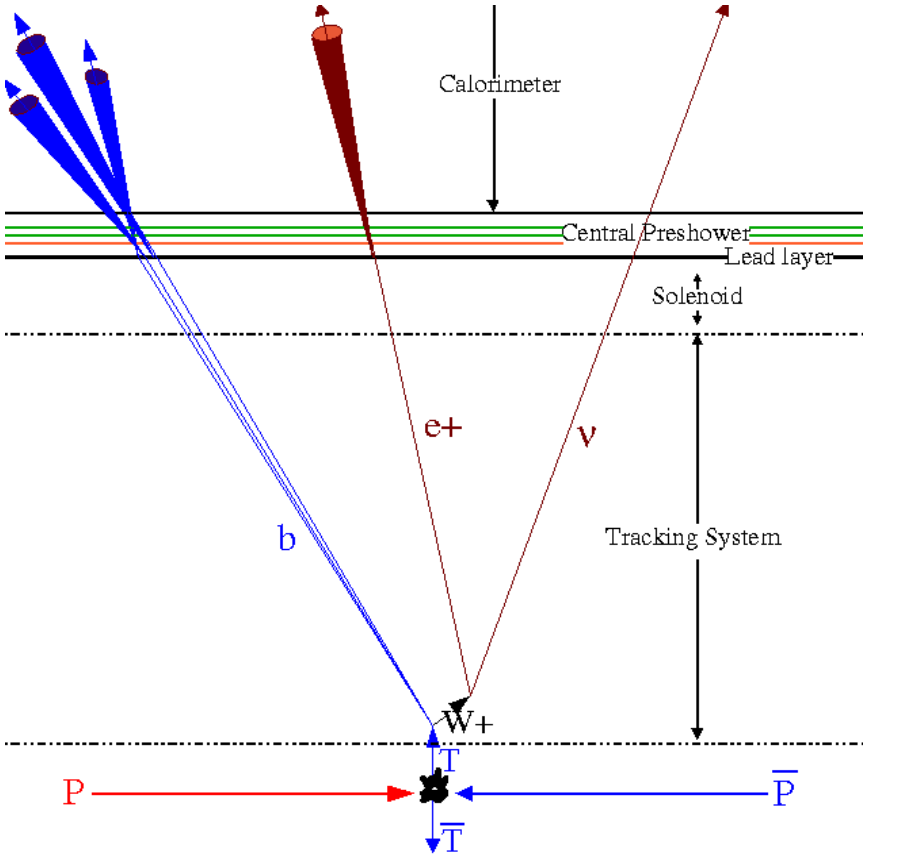
**-compensates for resolution loss due to the solenoid**

**-particles travel through two radiation lengths of material**

**-causes showering where energy spreads out like a cone**

**-the CPS provides both energy and position measurements while this cone is still small**

**Sideview of a ttbar event going through the CPS**

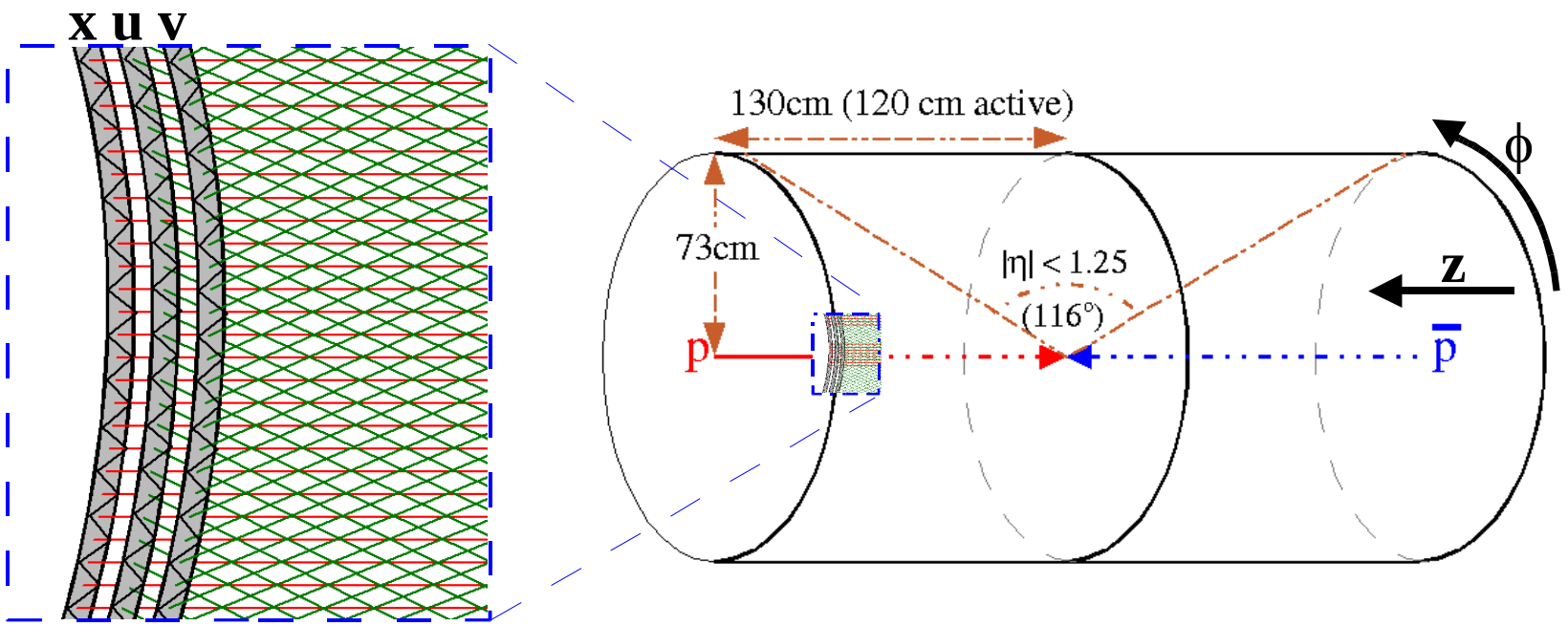


# Design

**-provides coverage for $|\eta| < 1.25$ (and $1.4 < |\eta| < 2.5$ with FPS)**

**-three layers (3 cm total thickness)**

**- divided into two halves at positive and negative z**



# CPS Layers

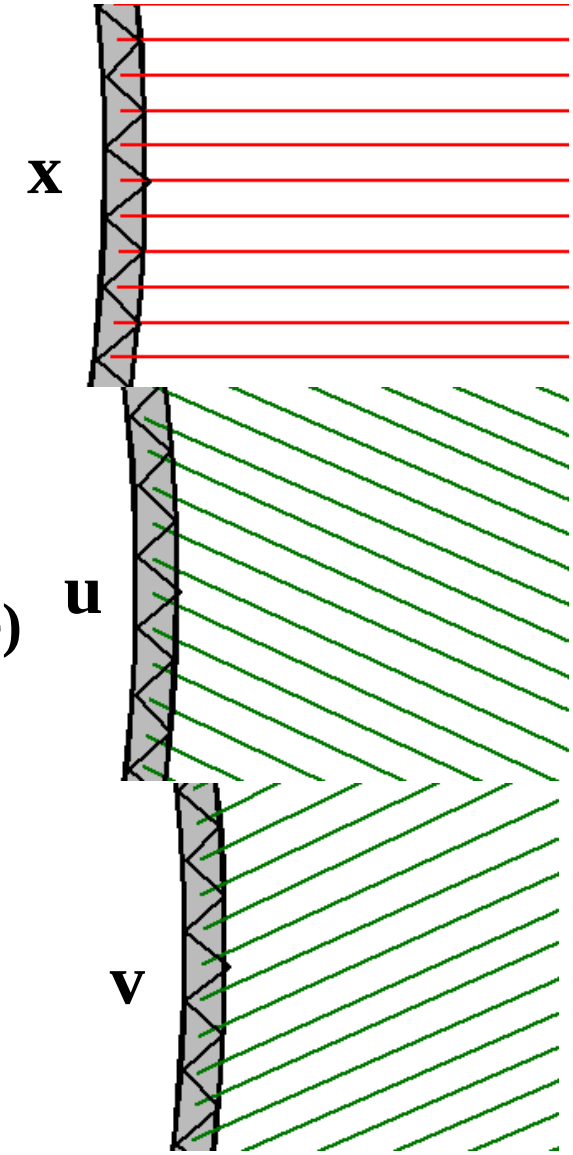
- **x strips run parallel to the beam (z axis)**

- **(to get a z position) have u and v layers with a 23º slant to x**

- **7680 total scintillating fiber strips (1280 per layer per side)**

- **4.9 mrad (or 3.6 mm) strip separation**

- **resolutions (will improve)**
  **z: ~3mm , phi: ~1.5mm**



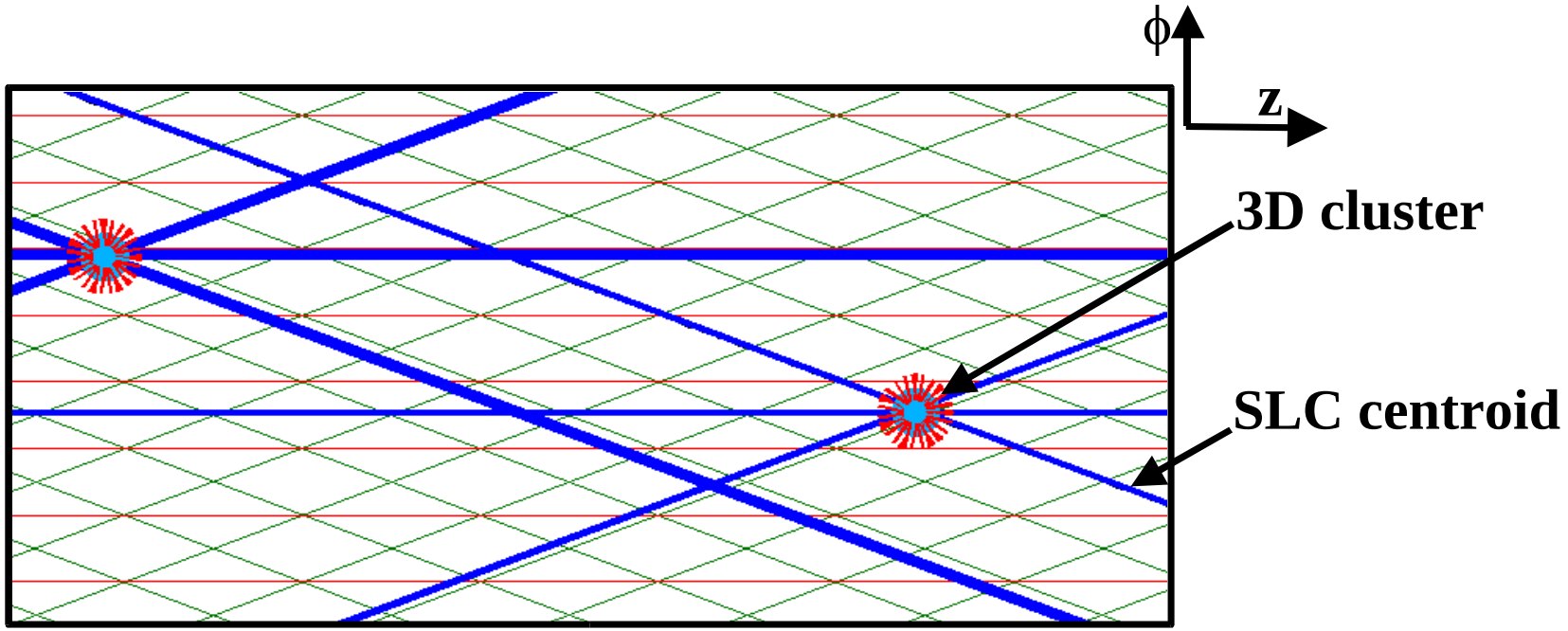
# Clustering

**single layer clusters (SLC's):**

**formed when particles passing through the CPS deposit energy in one or more adjacent strips**

**3D clusters:**

**formed where SLC's from all 3 layers intersect**



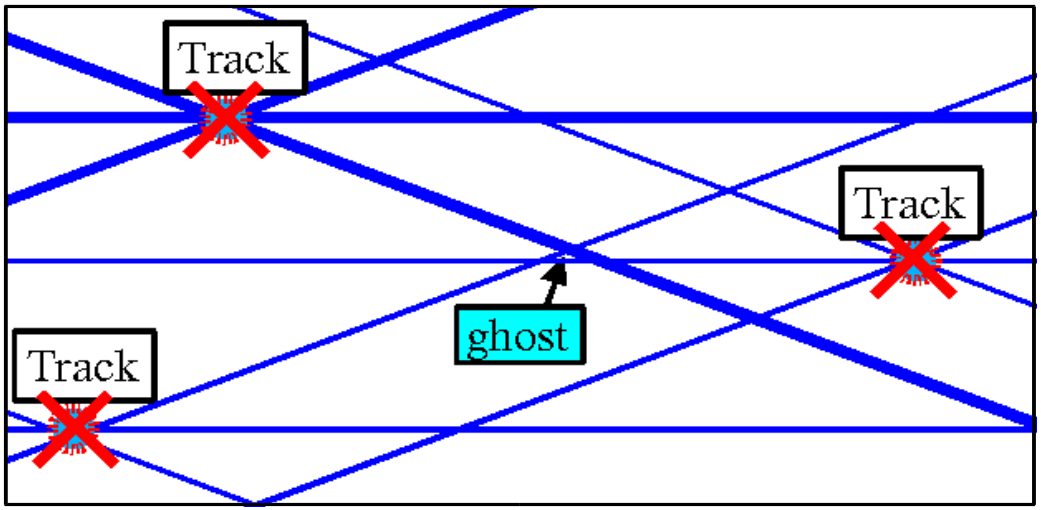
# Ghosts

**- fake 3D clusters which occur where SLC's from different particle tracks coincide**

**- limit the number of 3D clusters which can share a SLC**

**- use position an energy based matching qualities to decide which are kept**

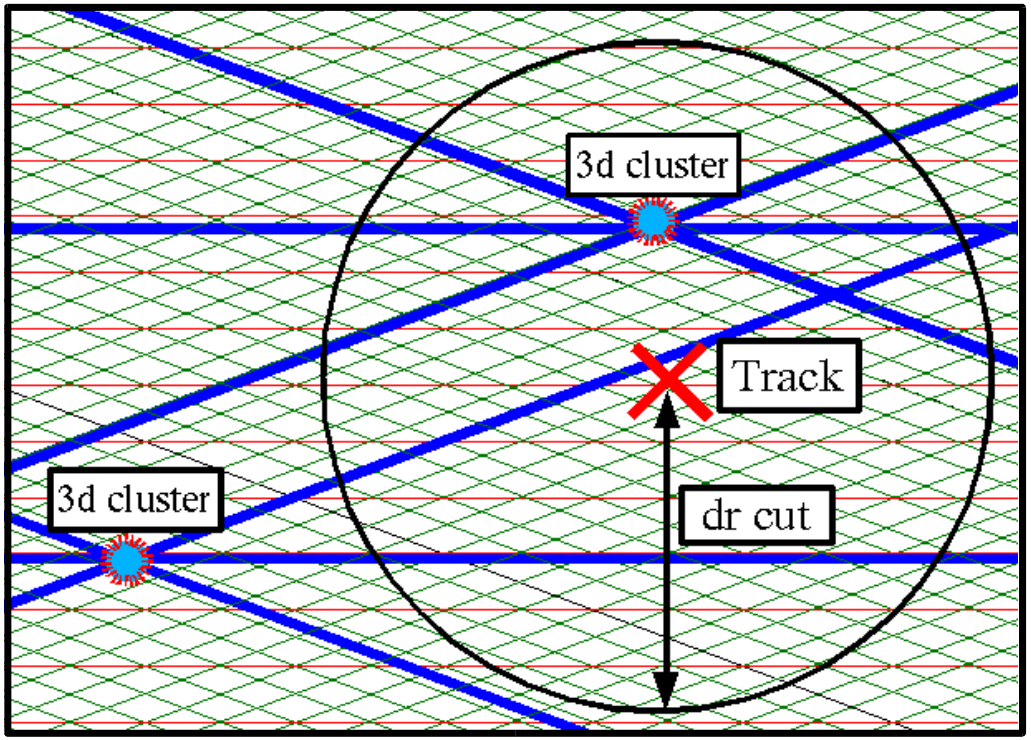
**Example of a ghost**



# CPS - Track Matching

**-a 3D cluster is a match to a particle track if its distance (dr) is smaller than the dr_cut**

**Example of track with one cps match**



# Electron ID Analysis

**-<u>GOAL</u>: demonstrate that the CPS can distinguish between jets and electrons**

**- use two types of data samples**

**1) fake electrons using back to back jets**

**2) good electrons from diem events**

**- both fake and good electrons pass the same tight electron cuts (including a track match)**

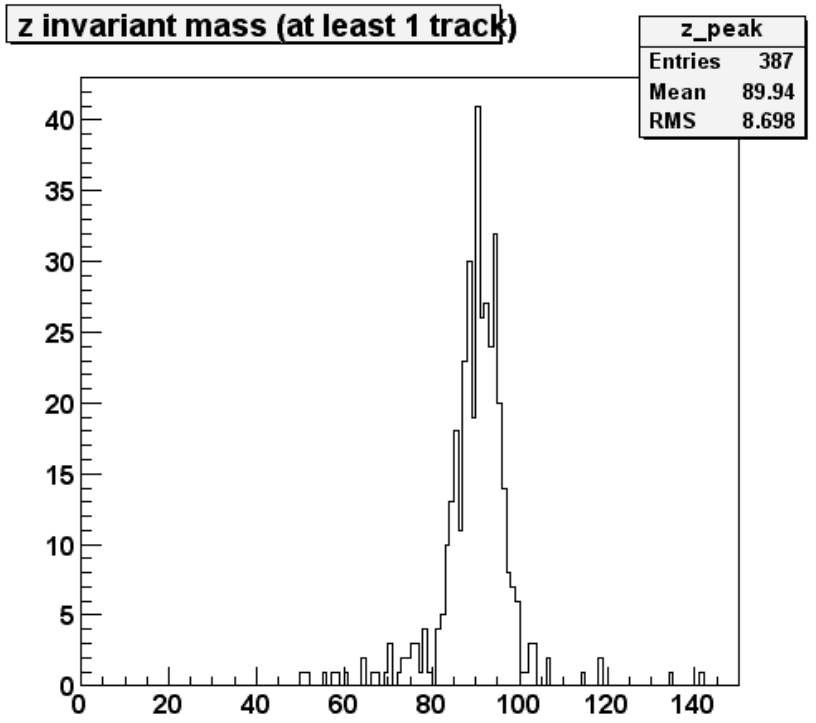
**- require a cps-track match and see what percent of each is kept**

# Data Samples

## Fake electrons:

- use qqbar events with back to back jets where one passes tight electron cuts

- other jet must also pass hard jet cuts




## Diem electrons:

- events used are in this in this Z-> ee peak

# Cut Parameters

**- keep a particle if these cuts are satisfied**

**dr_cut:**

**- require at least one 3D cluster within dr_cut distance from track**

**dr_iso:**

**- must not have any 3D clusters between a distance of dr_iso and 20 cm from the track**

**- this cut takes advantage of expectation that diem electrons are isolated**

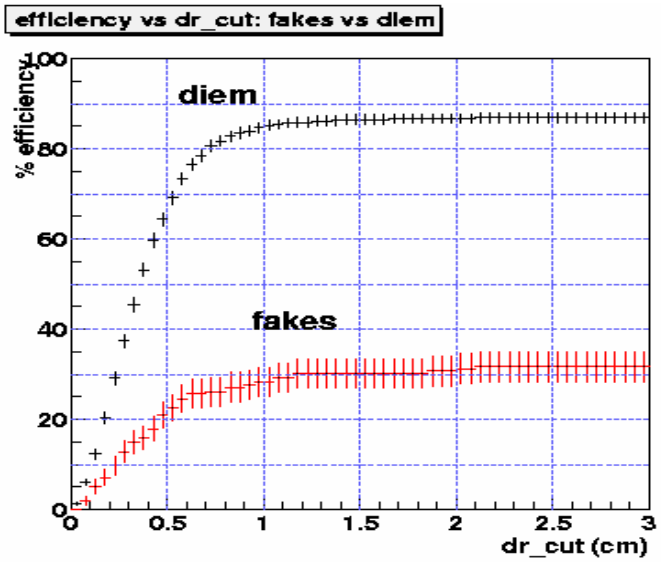
# Quality

- define a quality to decide best choice of parameters:

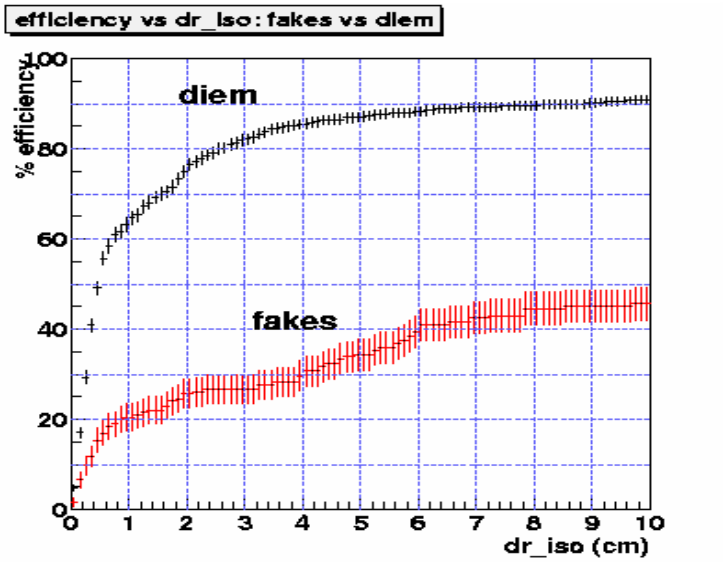
$$\text{Quality} = \frac{(\%\ \text{diem kept})^2}{(\%\ \text{fakes kept})}$$

- vary the two parameters, dr_cut and dr_iso, while keeping track of highest quality

- dr_cut comparison




- dr_iso comparison



# Results and Conclusions

**- using the values 1.05 cm for dr_cut and 3.90 cm for dr_iso yields the highest quality: 2.6 with**

**85% of diem electrons kept and**
**28% of fakes from jets kept**

**-This demonstrates that the CPS can discriminate between qcd jets and diem electrons**

**-More work is needed to both improve this result and demonstrate other cases where the CPS is useful**