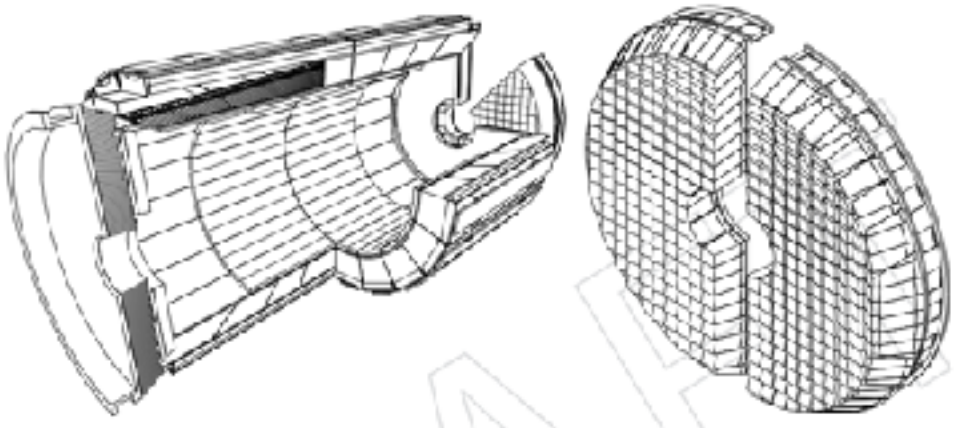
Northeastern Group Meeting

01/19/17

ECAL Alignment

ECAL Geometry

- Composed of Lead Tungstate crystals mounted in the central barrel part, enclosed by two end caps
    - **Barrel section** - consists of 36 identical Supermodules(SM), corresponds to $0 < |\eta| < 1.479$
    - **Endcaps(EE)** - structured as two Dees, each consisting of structural units of 5X5 crystals known as Supercrystals. Corresponds to $1.479 < |\eta| < 3$



(a) ECAL (b) ECAL EE

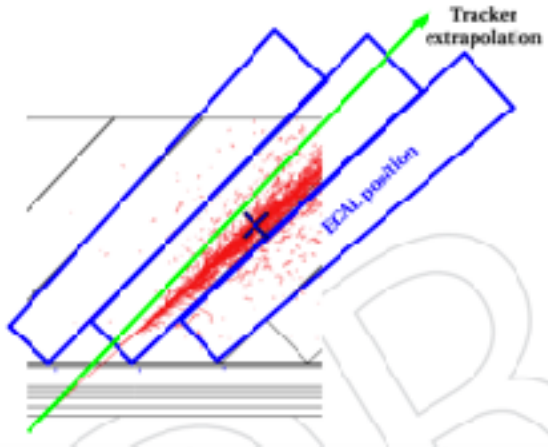
Alignment Necessity

- Very important to have accurate position measurement of particles impacting on the calorimeter
- Critical to correctly match the energy deposits in ECAL with the hits in the tracker for both the trigger and offline electron reconstruction and identification. This is an important tool in identifying and removing fake electrons
- Typical electron identification - difference of at most 4.10^{-3} units in pseudo rapidity and 20 mrad in Φ between the extrapolated position from the tracker and the reconstructed position
- Position resolution of about 10^{-3} can be reached by using ECAL only
- Necessary to perform further alignment to bring this error down even more

Alignment Procedure

- The alignment procedure relies on track measurement of isolated electrons produced by the W and Z decay
- Distance between track extrapolated on ECAL and the position measurement provided by the ECAL are minimized as a function of certain alignment coefficients
- Tracker based position is the point of closest approach to the Supercluster position, extrapolating from the innermost track position

Cross indicates the position reconstructed by the ECAL



Red spot indicates the position extrapolated from the tracker

Distance along η and Φ directions of the two points are used to define $\chi^2 = \chi^2_+ + \chi^2_-$

$$\chi^2_{\pm} = \sum_{lepton} \frac{(\Delta\varphi - \langle \Delta\varphi^{MC}_{\perp} \rangle)^2}{\varepsilon^2_{\varphi}} + \frac{(\Delta\eta - \langle \Delta\eta^{MC} \rangle)^2}{\varepsilon^2_{\eta}}$$

- Here ε is the error associated with SC position determination and is dependent on electron energy
- The MC expectation values are not expected to be zero due to the electron trajectory bending in the magnetic field and the tilt of the crystals.
- For each ECAL element this function is calculated and minimized wrt 3 dimensional translations(dx,dy,dz) and 3 Euler angles(alpha,beta,gamma).