Exploration of a Crystal based, Fast timing ECAL design

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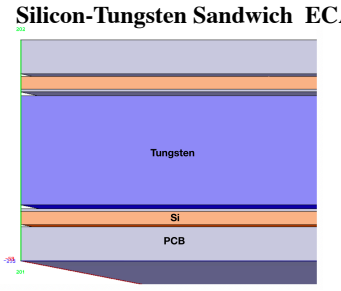
CDR Baseline ECAL

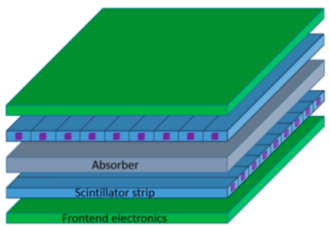
Sampling, PFA Oriented

Two schemes:

Silicon-Tungsten Sandwich ECAL



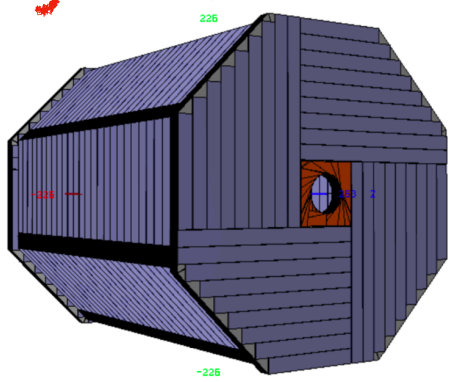
Scintillator-Tungsten Sandwich ECAL



Defects:

1. Poor **Energy Resolution**, especially for Low Energy Photon.
2. **Cost**, **Power consumption** and **Cooling**.

Why a new ECAL?



ECAL Geometry in CEPC CDR

New ideas about ECAL

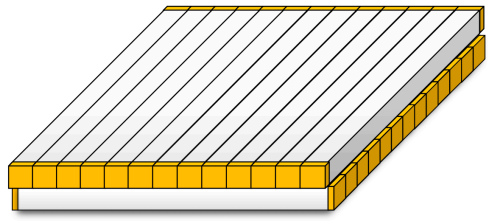
Full Crystal, Fast Timing

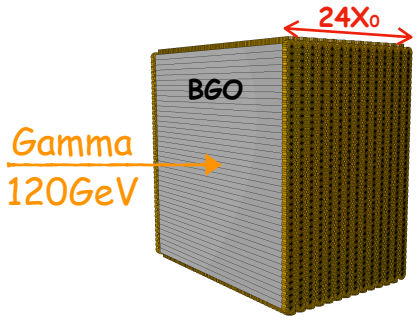
Basic Module

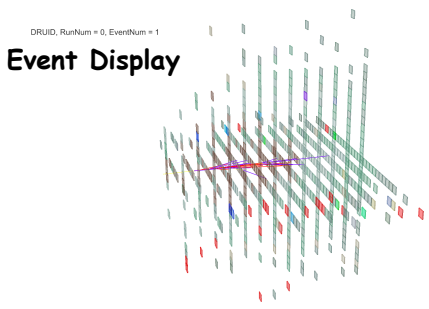
Crystal Scintillator (eg. BGO, LYSO…)

1x1x40cm³

Photon Detectors (eg. FPMT, SiPM…)



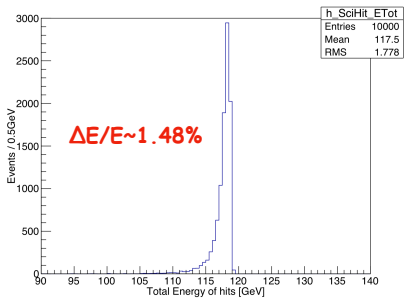


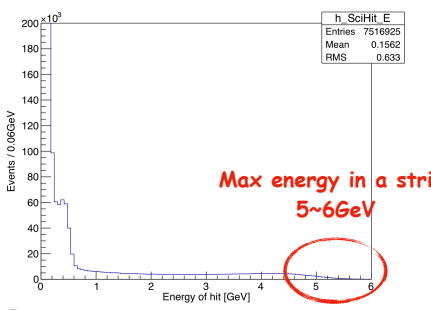


Analysis at Energy Deposition Level

Energy Resolution

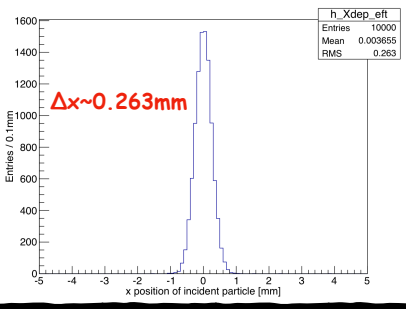
For a basic ECAL unit with 24X₀, energy resolution at energy deposition level is about 1.48%.
The maximum energy deposited in a BGO strip is about 5~6GeV. This will make a demanding requirement for electronics.

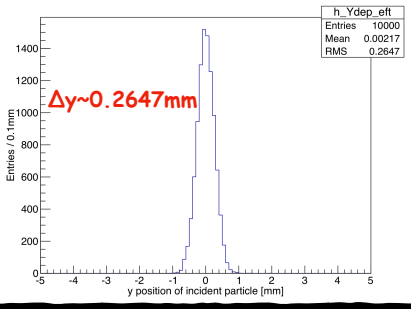




Position Resolution

Position of incident particle is reconstructed by center of energy deposition in each layer. Position resolution can reach about 265μm.

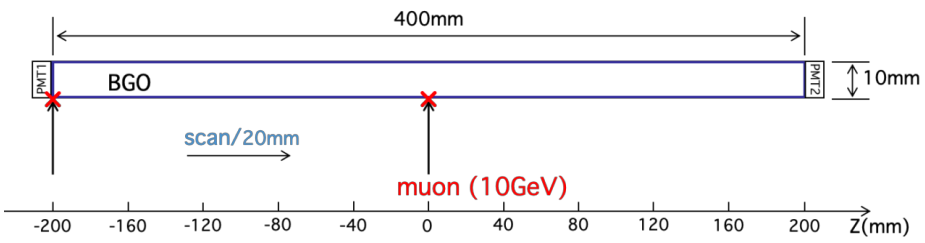




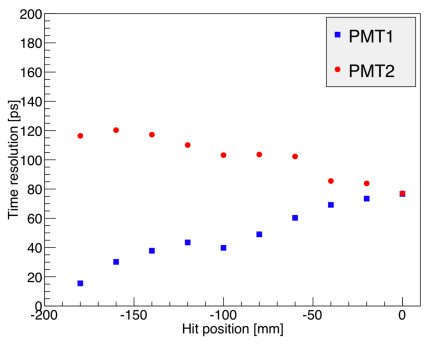
Intrinsic Time Resolution of Crystal

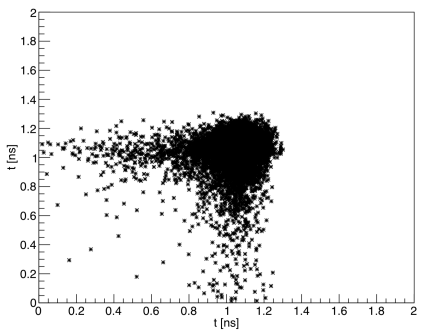
Unlike 3D readout in CDR baseline ECAL, long strip crystal corresponding to 2D readout can not give the position information along the long axis.

Except for the electronics and photodetectors, crystal



Intrinsic time resolution of crystal
in the range of 15-120ps
parameter scan method





Conclusion and Next Step