ILD Barrel detector shape

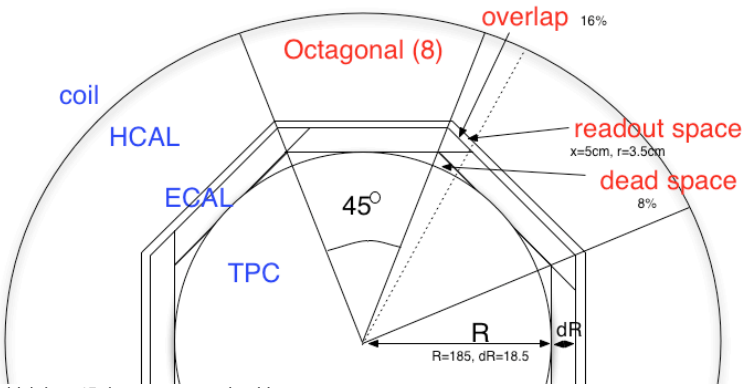
T.Takeshita Aug/2008

LDC proposed Octagonal shape for that, since the overlap region between neighbouring modules in phi is smaller.
GLD proposed Dodecagonal shape for that, since the shape is much closer to a circle which has smoother injection angle for particles.

I compared these cases, and listed up four different points to discuss,
assuming the current structure of the ECAL module.

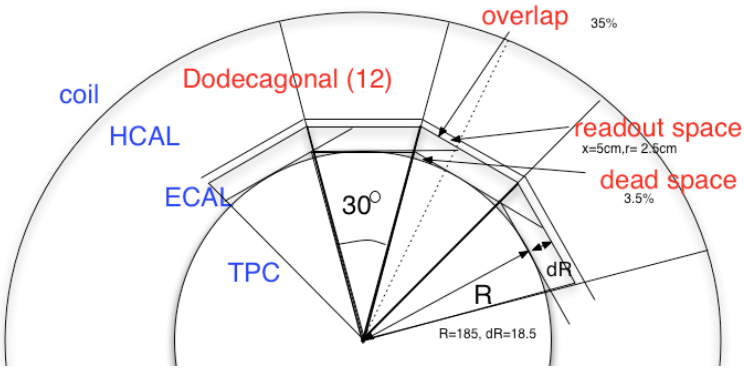
(1) overlap between neighboring ECAL
(2) read out space between ECAL and HCAL
(3) dead space
(4) path length of a particle

The cross sectional view of Octagonal shape barrel detector



which has 45 degree symetry in phi.

The cross sectional view of Dodecagonal shape barrel detector

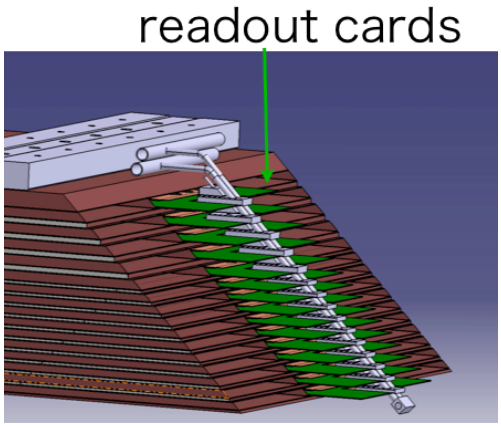


which has 30 degree symetry in phi. We assume here the ECAL radius or TPC outer size is to be 185 cm according to the LDC-prime and GLD-prime detector. Futhermore the thickness of the ECAL is assumed to be 185mm according to the ECAL picture shown below.

Those 4 points are summarized in table

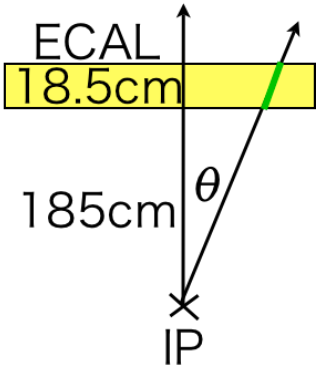
	8	12
dead space betw. TPC	8%	3.5%
ECAL overlap	16%	35%
ECAL read out dR	3.5cm	2.5cm
δthickness	1.5cm	0.6cm

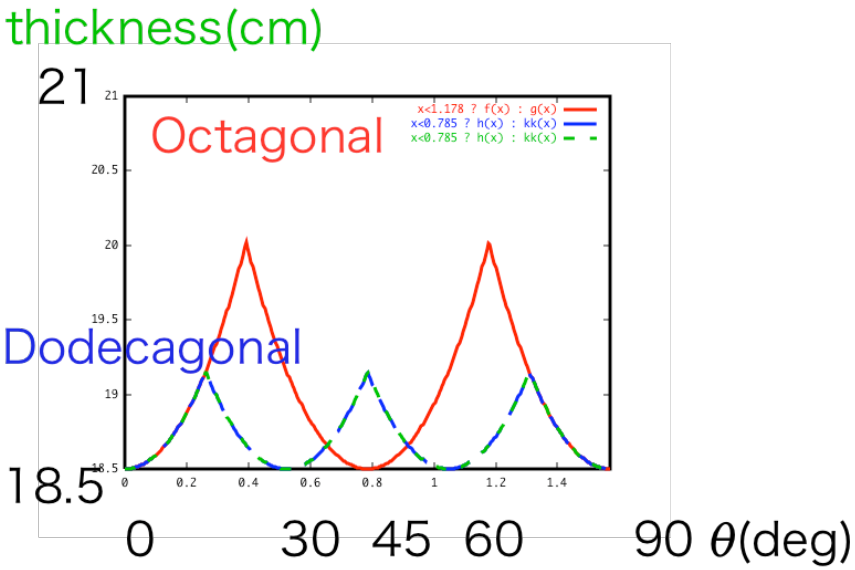
(1) Overlap region between neighboring module in ECAL.
There are about 7.1 degree and 10.5 degree in phi of overlap region, which correspond 16% and 35% for Octagnal and Dodecagonal shape , respectively from the simple geometrical calculation.
(2) read out space is supposed to be the space between the ECAL and HCAL where the read out cards will be located as shown in the next figure. For those cards, we need some space, assuming 5cm long cards, we need different distance between ECAL and HCAL in r-direction to be 3.5cm and 2.5 cm for Octagonal and Dodecagonal, respectively.



(3) dead space is the regin between the round TPC and shaped ECAL shown in the cross section figure. The ratios devided by the TPC cross section are listed in the table. They are 8% for Octagonal shape and 3.5% for Dodecagonal shape.

(4) path lenght of a particle
The path lenght when the momentum of a muon is infinit is ploted, the muon travese the detector with a straight line. The path length in the ECAL can be easily calculated with different shapes and shown in the figure follow below. The pass length depeneds on the angle theta as 1/cos(theta) and has some singler points according to the shape of the detector.





The thickess begins with 18.5 cm when it passes perpendicular to the ECAL and increases with angle theta as 1/cos(theta). There are 3 or 2 times symetry until 90 degree depending on the shape whether octagonal or dodecagonal. The increase of the thickness is about 6mm for Dodecagonal shape and 15mm for Octagonal.

Those differences listed especially (1) and (4) should be tested by simulations for the physics point of view for their effect.