

BCAL Leakage

David Lawrence JLab

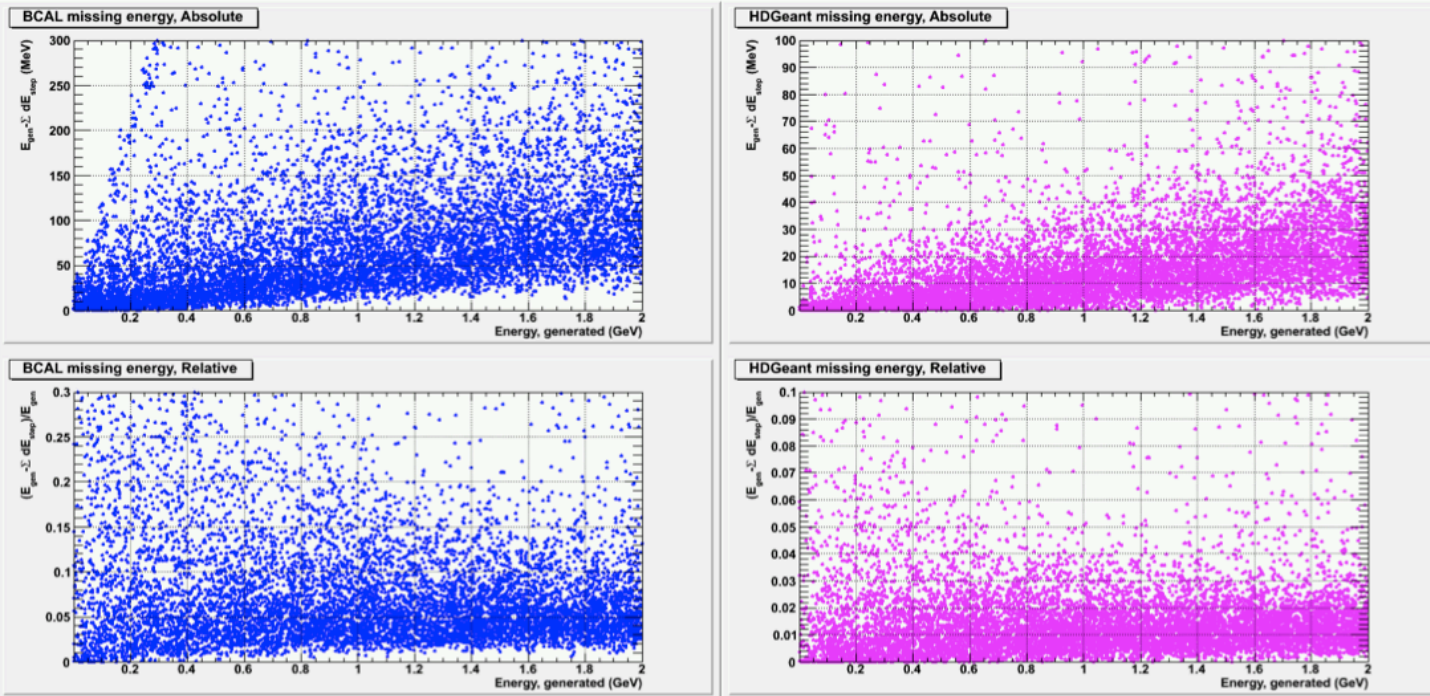
Oct. 10, 2011

From last week ...

Missing Energy

BCAL loses energy due to leakage and/or pre-shower

GEANT loses energy due ???



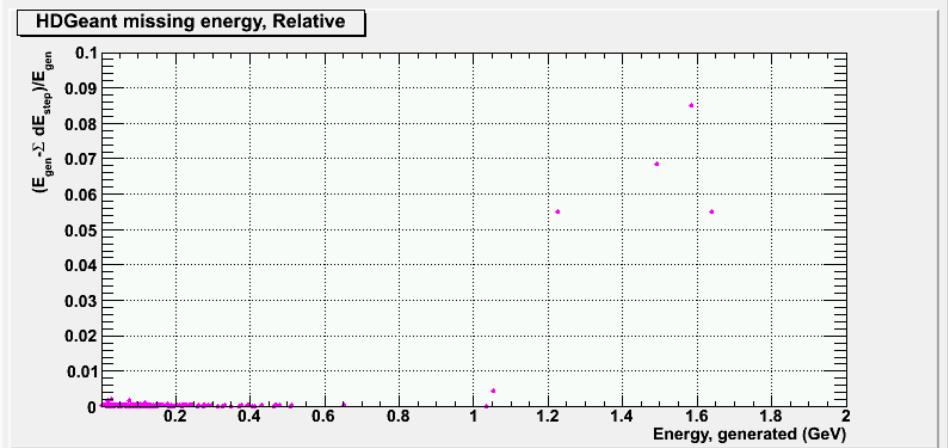
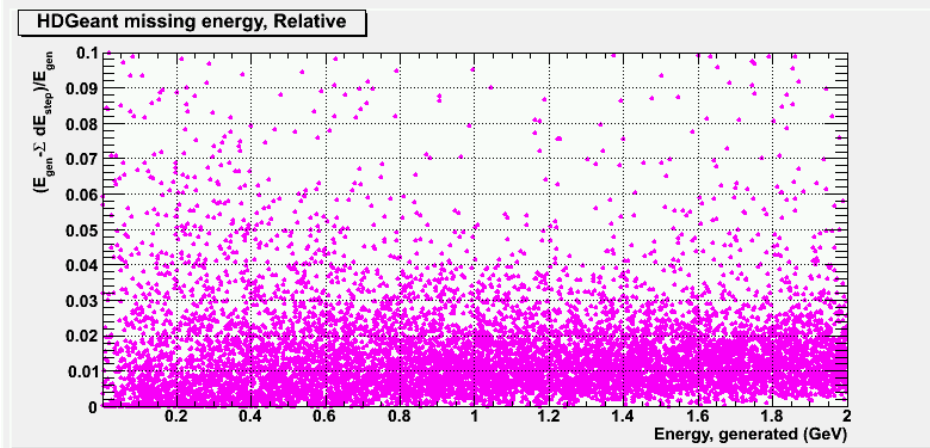
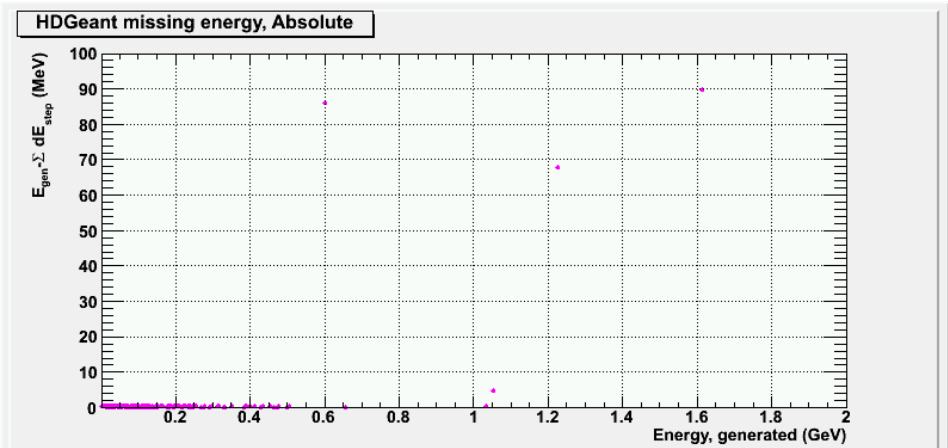
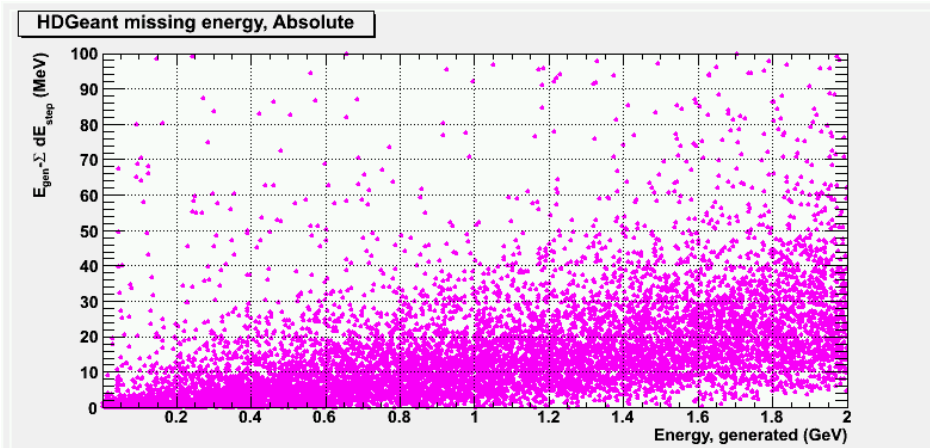
Total energy missed by BCAL is around 5%, of which, around 1%-1.5% is missed by gustep/DESTEP altogether

Energy leaving mother volume

Leaving mother cut: x or $y > +/-100\text{cm}$ or $z > +/- 1000\text{cm}$

Not subtracting energy leaving mother

With energy leaving mother subtracted



From Last week ...

Investigating floor term

Turn off most stochastic effects in simulation to investigate origin of large floor terms

Turned off:

- Dark Hits
- Photo-statistics
- Sampling fluctuations
- SiPM Time jitter

Asymmetric Gaussian:
Same mean and amplitude, different σ 's on left and right sides

$$\sigma_{tot}^2 = \frac{\sigma_1^3 + \sigma_2^3}{\sigma_1 + \sigma_2}$$

$$\Delta\sigma_{tot} = \frac{3(\sigma_1^2\Delta\sigma_1 + \sigma_2^2\Delta\sigma_2) - \sigma_{tot}^2(\Delta\sigma_1 + \Delta\sigma_2)}{2\sigma_{tot}(\sigma_1 + \sigma_2)}$$

Calculated about center of Gaussians, not center of distribution

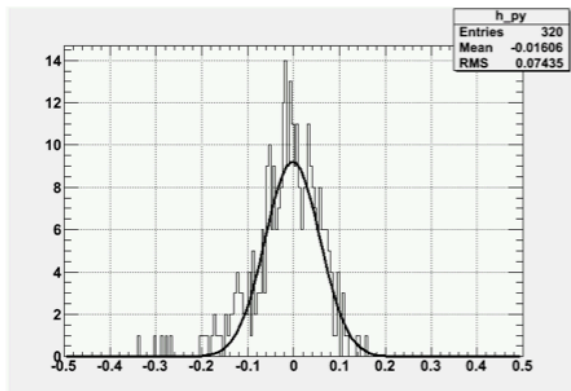
Corrected formula:

$$\sigma_{tot}'^2 = \sigma_{tot}^2 - \mu^2$$

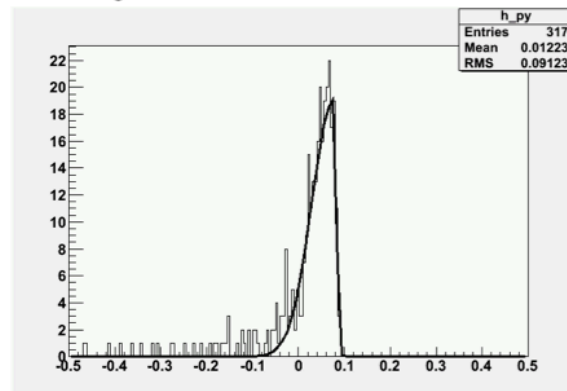
where:

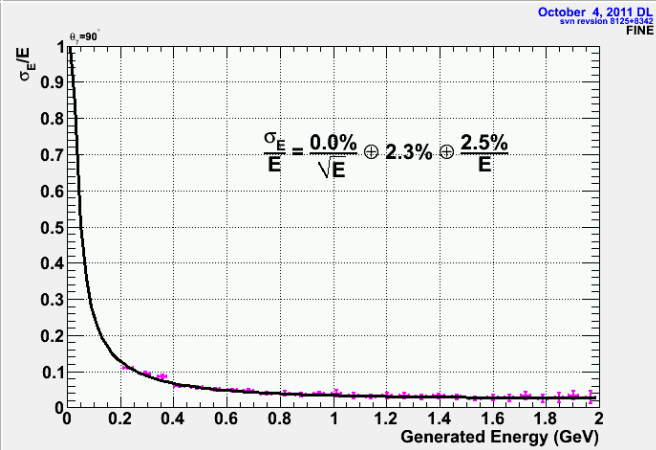
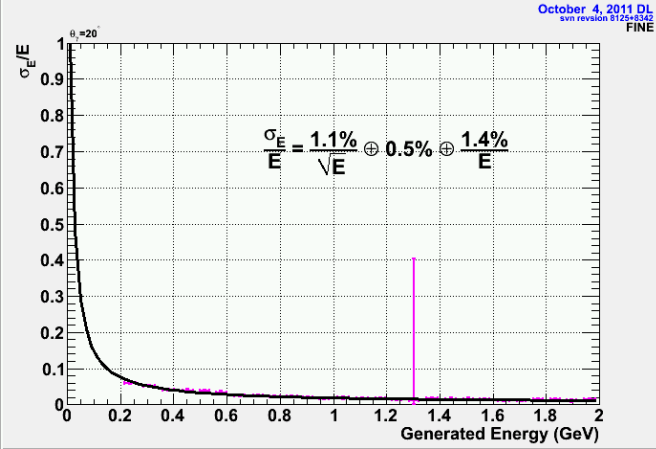
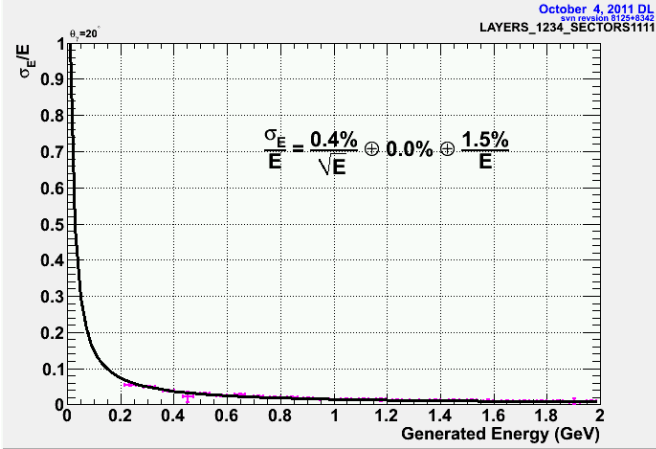
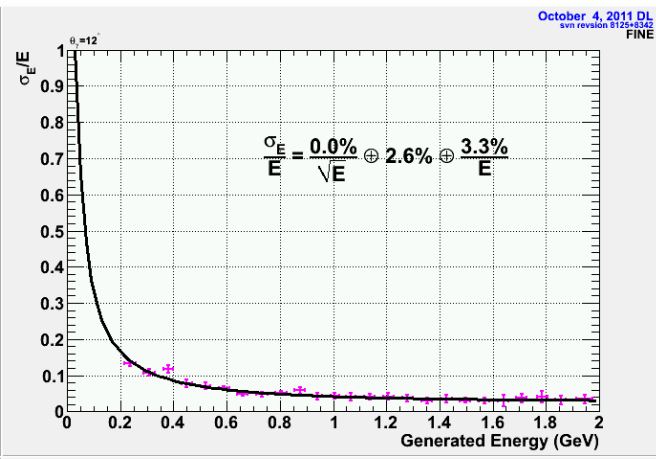
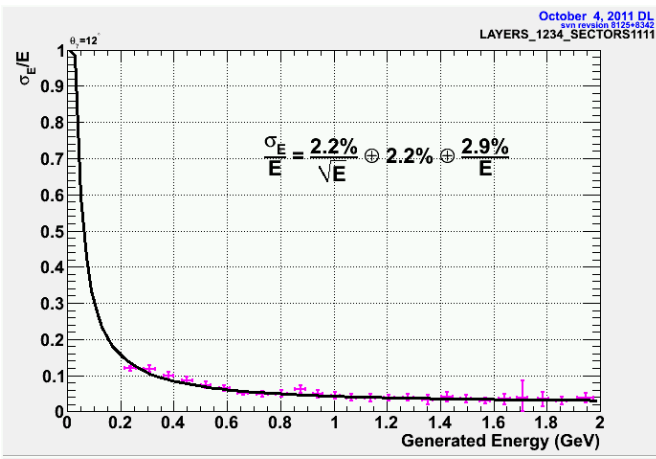
$$\mu = \sqrt{\frac{2}{\pi} \frac{(\sigma_1^2 - \sigma_2^2)}{(\sigma_1 + \sigma_2)}}$$

Example of energy residual fit to symmetric Gaussian.



Example of energy residual fit to asymmetric Gaussian. Energy calibration causes shift to values greater than zero.





40mV threshold fits

- Fits to “clean” showers
- No photo-statistics
 - No sampling fluctuations
 - No dark hits
 - ...

Fit only to data with
 $E_\gamma > 200\text{MeV}$

No photo-statistics, sampling fluctuations, or dark hits

$$\frac{\sigma_E}{E} = \frac{a}{\sqrt{E}} \oplus b \oplus \frac{c}{E}$$

“b” is floor term

Significant leakage in the forward and 90° directions.

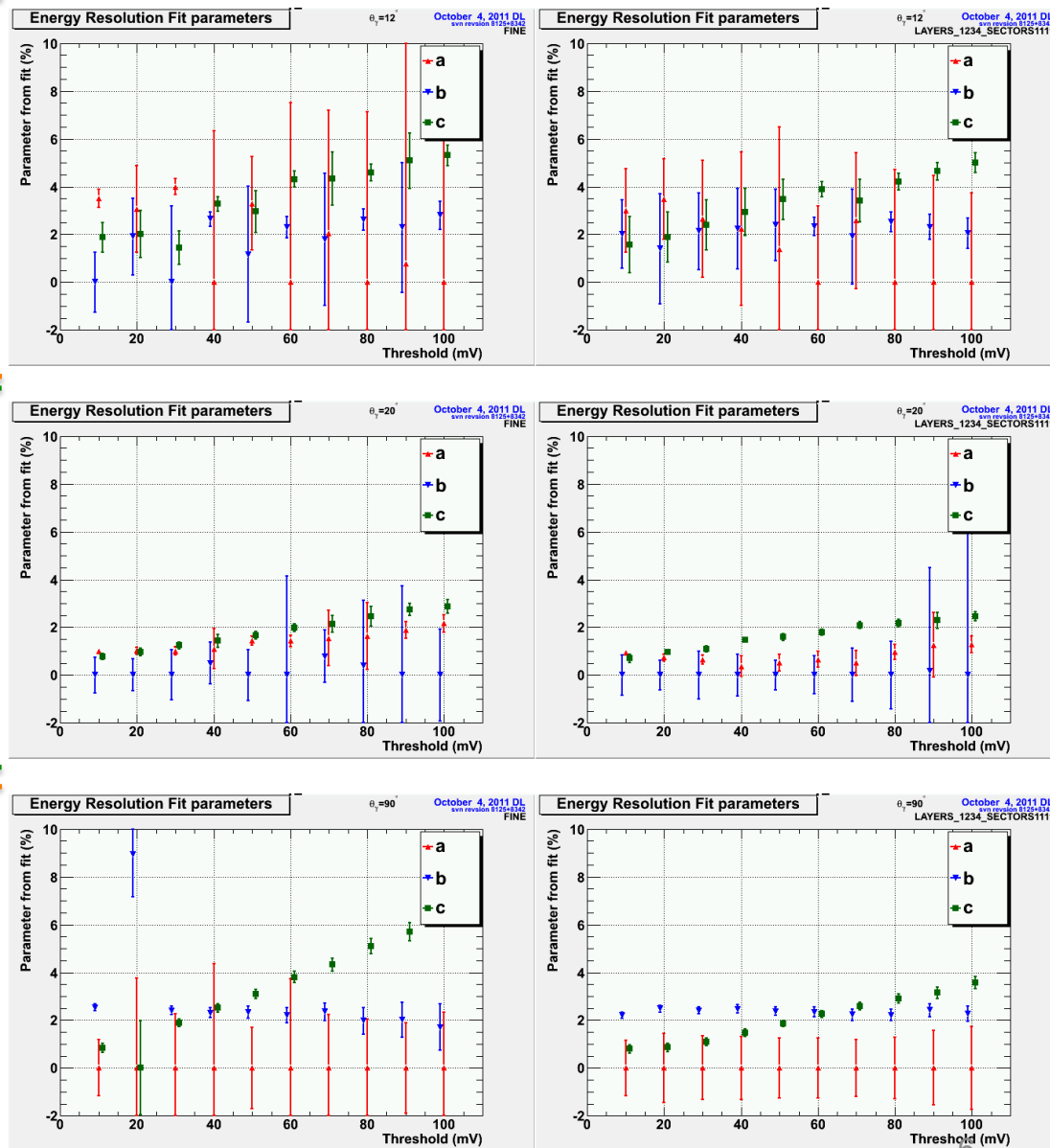
Shower fairly well contained at 20°

Floor term is 2%-2.5% at 90°

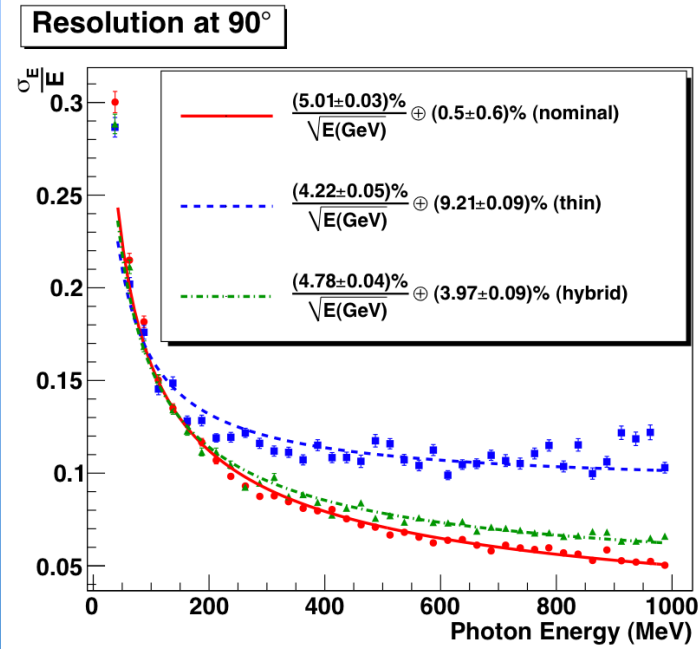
More Leakage

Less Leakage

More Leakage



Radiation lengths and leakage

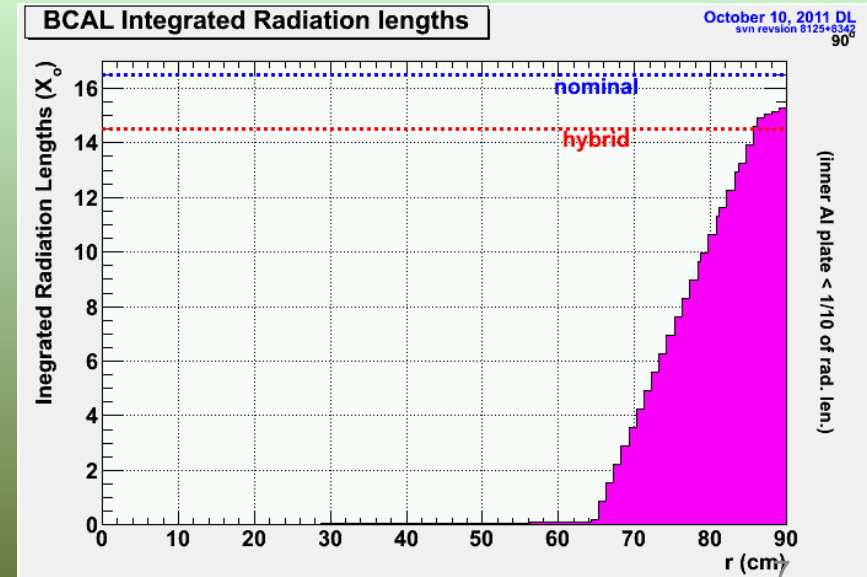


From Stamatis' Thesis
(GlueX-doc-1806)

Table 4.3: Depth of the module expressed in radiation length units. The hybrid module is constructed of a 1.11 mm pitch inner part of thickness $2.32 X_0$ while the outer part has 1.24 mm pitch and is $12.18 X_0$ thick.

Geometry	Front part (X_0)	Rear part (X_0)	No. of X_0
nominal	-	-	16.47
thin	-	-	8.90
hybrid	2.32	12.18	14.51

From sim-recon



- Our current *sim-recon* has a BCAL material definition with about 15.0 radiation lengths
- From Stamatis' simulation (not *sim-recon*), this should result in a floor term between 0.5 (nominal) and 3.97 (hybrid)