LCal Performance in LDCv5 Detector Concept

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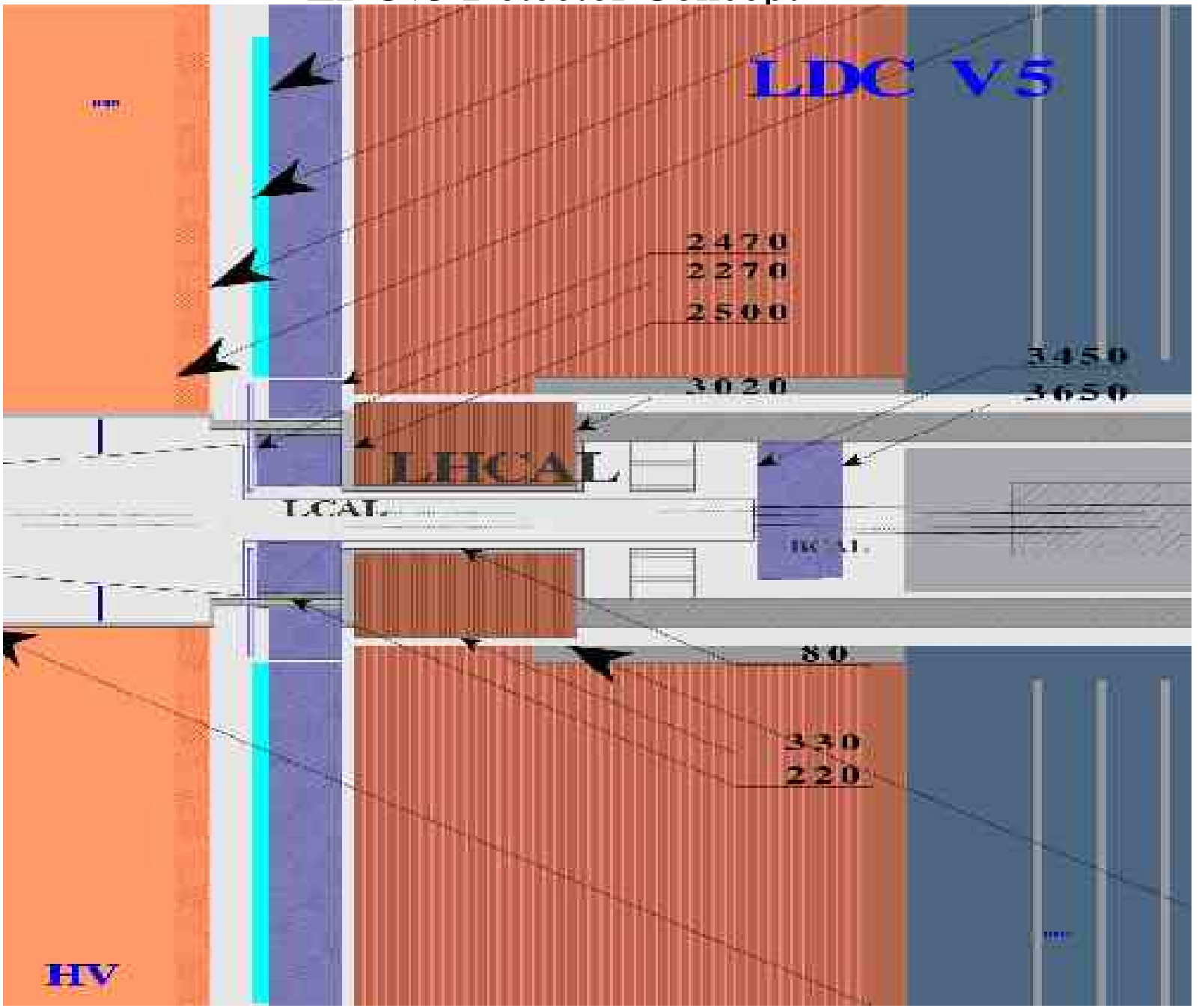
LDCv5 Detector Concept



LCal Parameters

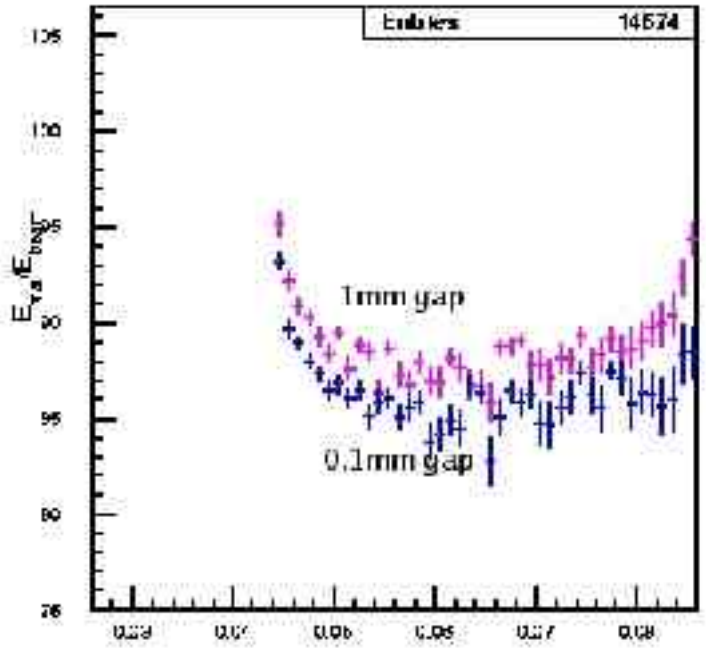
	Tesla TRD	LDCv5
zpos [mm]	3050	2270
rmin/rmax [mm]	80/280	100/208
weight [kG]	460	180
fiducial volume [mrad]	26 - 86	48-82
thickness	30X0	25X0
segmentation (r/φ)	64/120	96/48
θ-cell size [mrad]	1.0	0.5
φ-cell size [deg]	3	7.5
silicon thickness [mm]	0.5	0.3
σ_{Bhabha} seen [nb]	~5	~1.6
frequency [Hz]	~150	~50

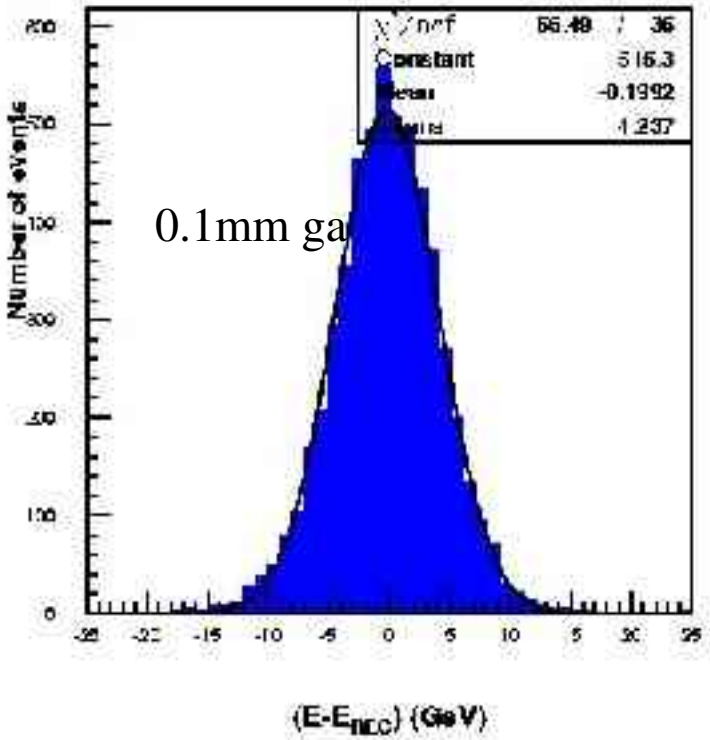
LCal Performance

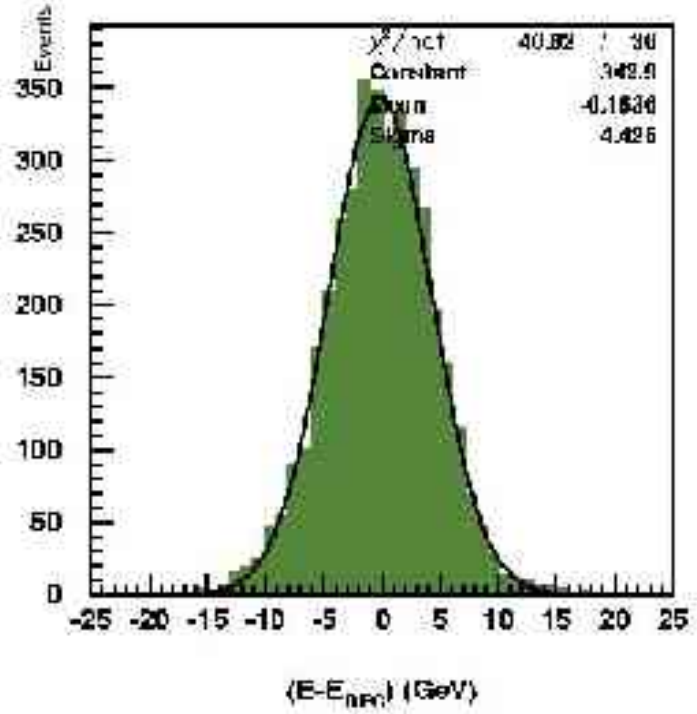
Parameter	Tesla TRD	LDCv5
Energy resolution	25% $(\sqrt{GeV})$	28% $(\sqrt{GeV})$
θ resolution	3.5 * 10^{-5} rad	2.6* 10^{-5} rad
φ resolution	10^{-2} rad	3*10^{-3} rad
$\Delta\theta$	~ 1.5 * 10^{-6} rad	~1.1* 10^{-8} rad
Electronics channels	25,200	276,480

- energy resolution worst (less silicon detector mass) need improvement
- polar angle resolution improved significantly
- number of channels increase by factor of 10

The Energy Resolution Problem



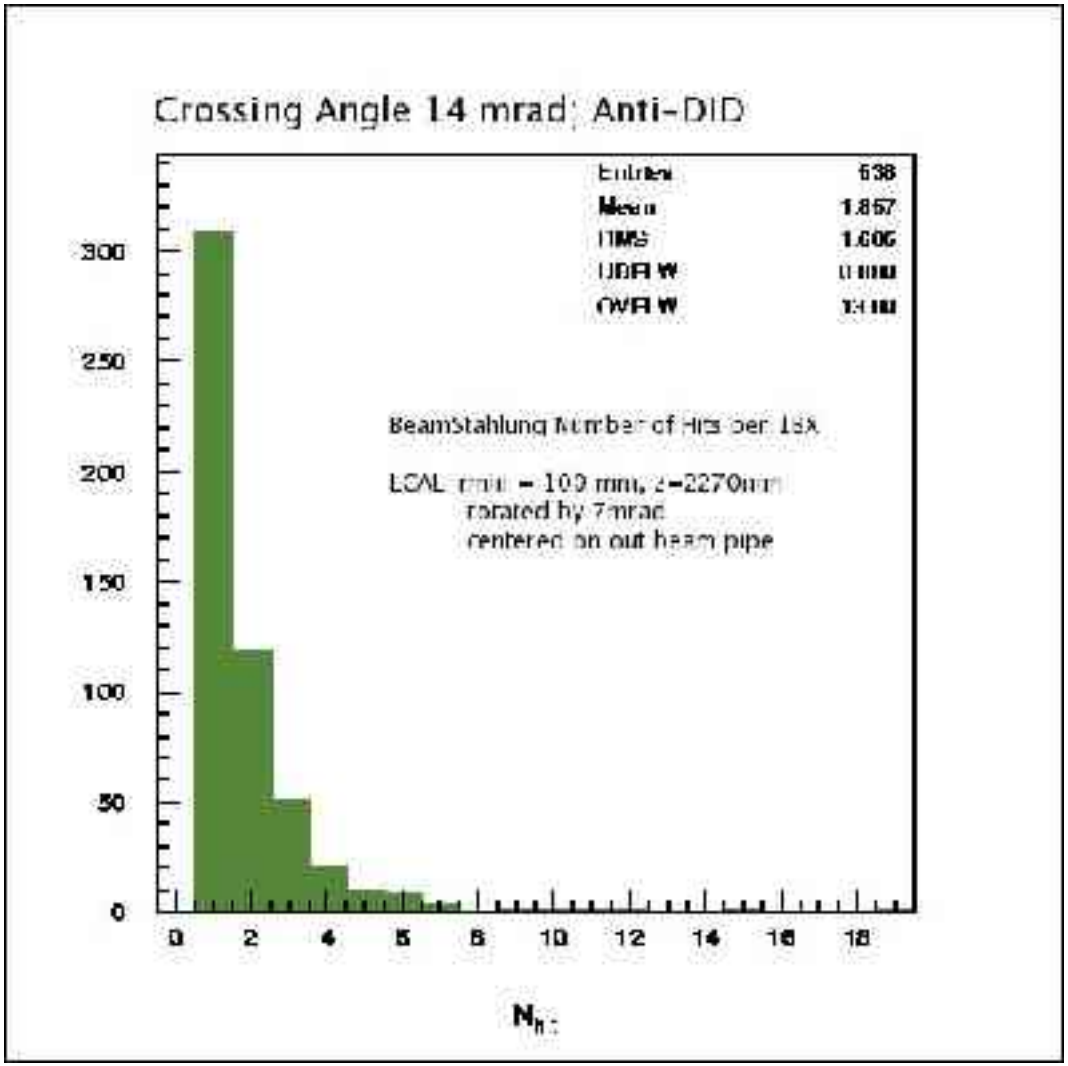


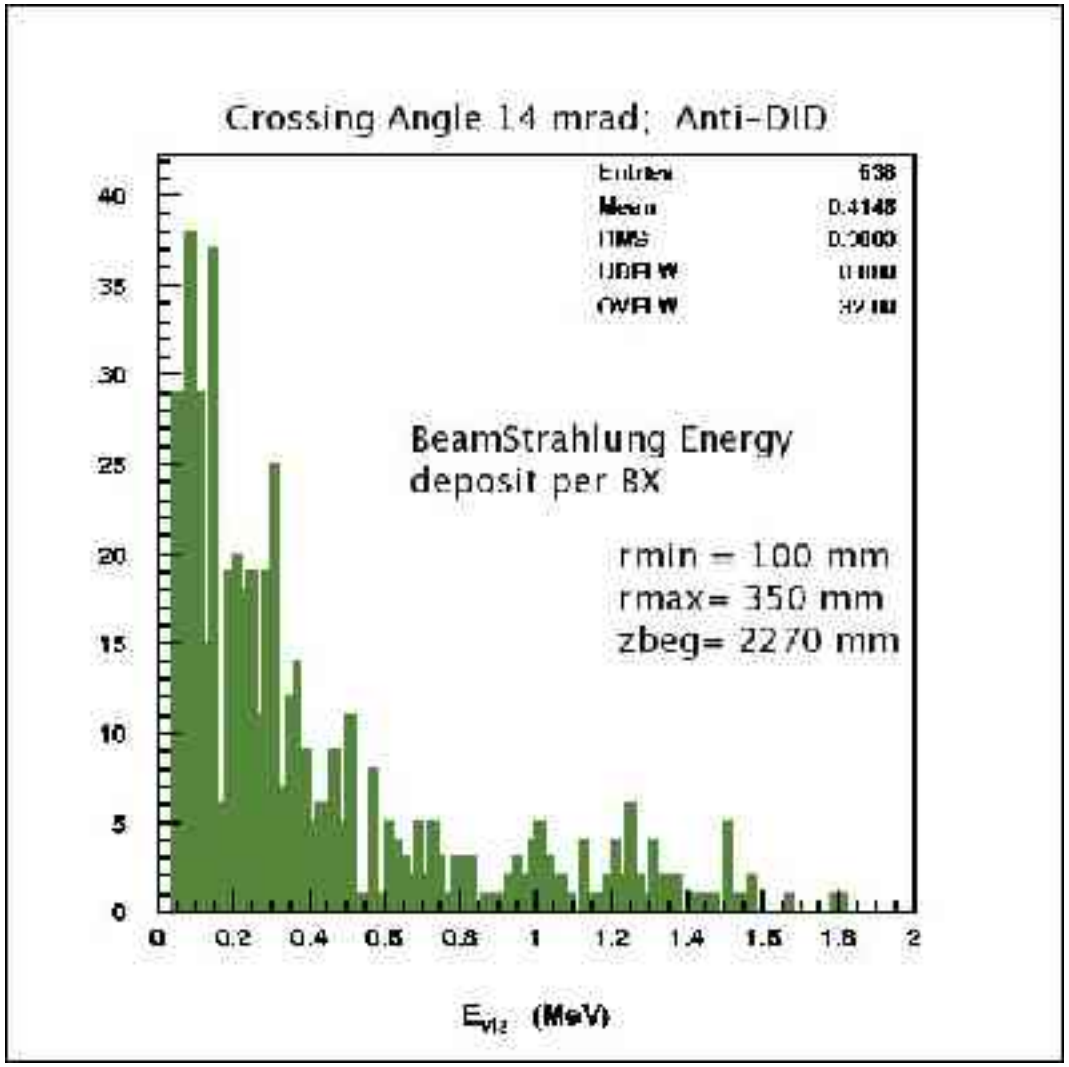


reducing gap to 0.1 mm improves energy resolution, now

$$\sigma(E) \sim 0.26\sqrt{E}$$

The Beamstrahlung Effect





- *there are only few background hits per BX (~ 2000 in Bhabha event)*
- *typical energy deposit ~ 100keV (< 10% of threshold for Bhabha hit)*

Summary

- Pad version of LumiCal in LDCv5 geometry concept can achieve resolution in polar angle θ order of $\sigma(\theta) \sim 2x10^{-5}$ radian and offset $\Delta\theta \approx 1x10^{-8}$ which results in expected luminosity measurement error $\Delta L/L \approx 5x10^{-7}$
- Measurement of electron energy with 30 (25X0) planes can be done with accuracy $\sigma(E) \sim 0.28\sqrt{E}$ at 250GeV
- Reducing gap between planes from 1mm to 0.1mm improves energy resolution to $\sigma(E) \sim 0.26\sqrt{E}$
- Impact of beamstrahlung is negligible