SiD LumiCal, LHCal, BeamCal, GamCal

W. Morse - BNL

Forward Calorimeters

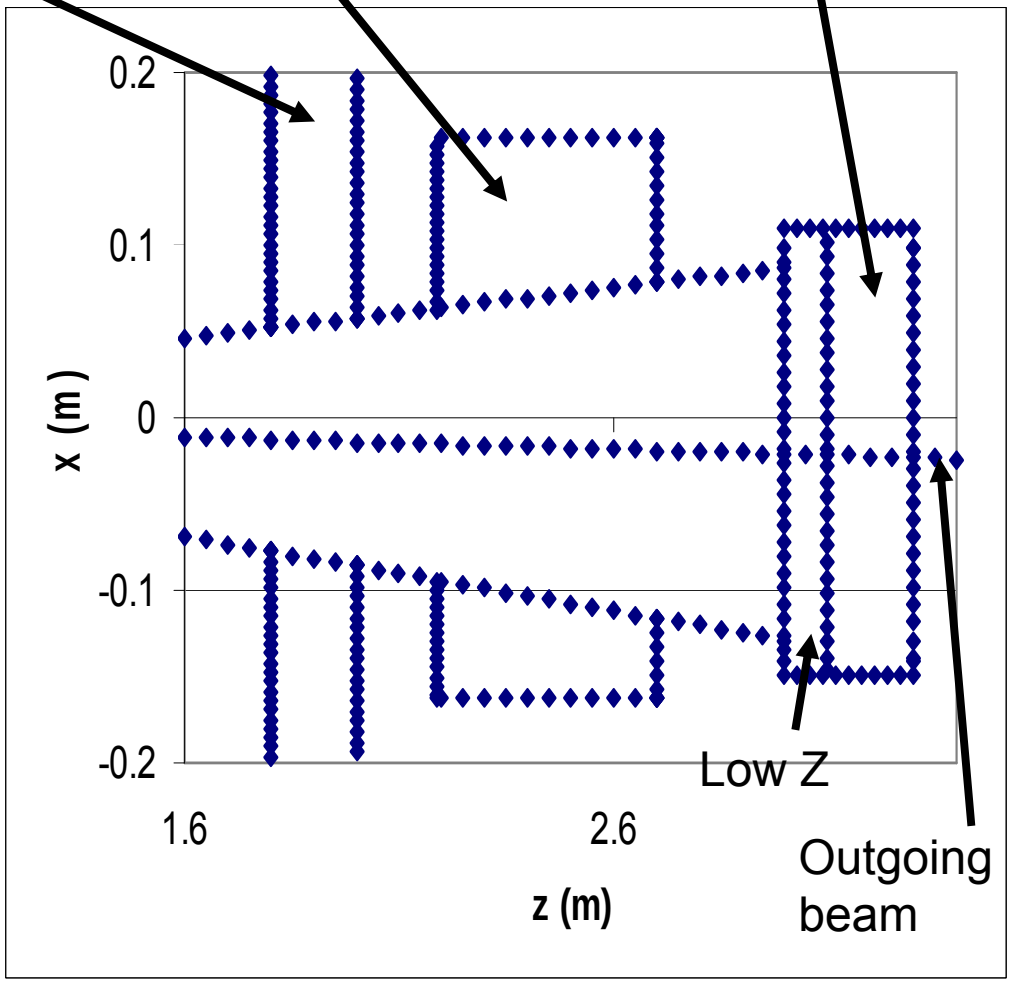
- LumiCal – precision integrated luminosity measurement (Bhabhas), and hermeticity
- dL/L <10^{-3} for $\sqrt{s}$ = 0.5TeV - challenging
- dL/L <2×10^{-4} for GigaZ – very challenging
- LHCal – ID muons behind LumiCal
- BeamCal – instantaneous luminosity optimization (beam-strahlung pairs) and hermeticity
- GamCal - instantaneous luminosity optimization (beam-strahlung γ detector at z $\approx$190m)

International FCAL R&D Collaboration

- W. Lohmann (DESY Zeuthen) spokesman
- W. Morse (BNL) beam diagnostics (BeamCal/GamCal) coordinator – also SiD forward coordinator
- B. Pawlik (Cracow) simulations coordinator
- W. Lange (DESY) sensors coordinator
- TBD electronics coordinator
- W. Wierba (Cracow) LumiCal laser alignment coordinator

SiD LumiCal, LHCal, BeamCal

- Centered on outgoing beam
- Keep VTX cables away from LumiCal fiducial region
- Vacuum chamber, support tube, etc. design – Bill Cooper et al.
- Ring of death just miss LumiCal – Tom et al.
- ≈10K pairs/BX hitting BeamCal; ≈3MGy/yr with anti-DiD



Neutron Backgrounds

- Recent calculation of the neutron fluence at the SiD VXD layer 1 by Takashi et al.
- 1.1×10^{9} MeV equivalent n/cm^2/yr from the beam hitting the dump at z $\approx$ 300m.
- Including neutrons from the pairs hitting BeamCal, etc. gives 2×10^{9} MeV en/cm^2/yr
- VXD Si radiation damage FoM: 10^{10} MeV equivalent n/cm^2 – looks OK.

M. Sullivan Background Summary Talk at IRENG07

- Again, ignorance may be a problem
- Is there some sort of summary document or spreadsheet that lists all backgrounds that have been thought of and has links to write ups and/or presentations by people who have thought about or studied a particular background? Ideally it would also include a description of each background. It might also list what code was used. The background lists would no doubt be slightly different for the different collision designs.
- It would be a great help in keeping track of what has been worked on and by whom and would also be helpful in understanding if what has been done is sufficient or if more work needs to be done.
- This is a fairly big effort but I think it will payoff in the long run. It would be a big step toward a comprehensive summary of all background efforts and calculations which is going to be needed for the next ILC report

SiD LumiCal and BeamCal

LumiCal inner edge	≈36mrad about outgoing
LumiCal outer edge	≈113mrad about 0mrad
LumiCal fiducial	≈46-86mrad about outgoing
BeamCal outer edge	≈46mrad about outgoing
LumiCal	$30X_0$ Si-W
BeamCal	$30X_0$ rad-hard Si,diamond....

Luminosity Feedback Detectors BeamCal and GamCal

2.7.4.2.3 **Luminosity feedback** Because the luminosity may be extremely sensitive to bunch shape, the maximum luminosity may be achieved when the beams are slightly offset from one another vertically, or with a slight nonzero beam-beam deflection. After the IP position and angle feedbacks have converged, the luminosity feedback varies the position and angle of one beam with respect to the other in small steps to maximize the measured luminosity.

Beam-strahlung Gammas

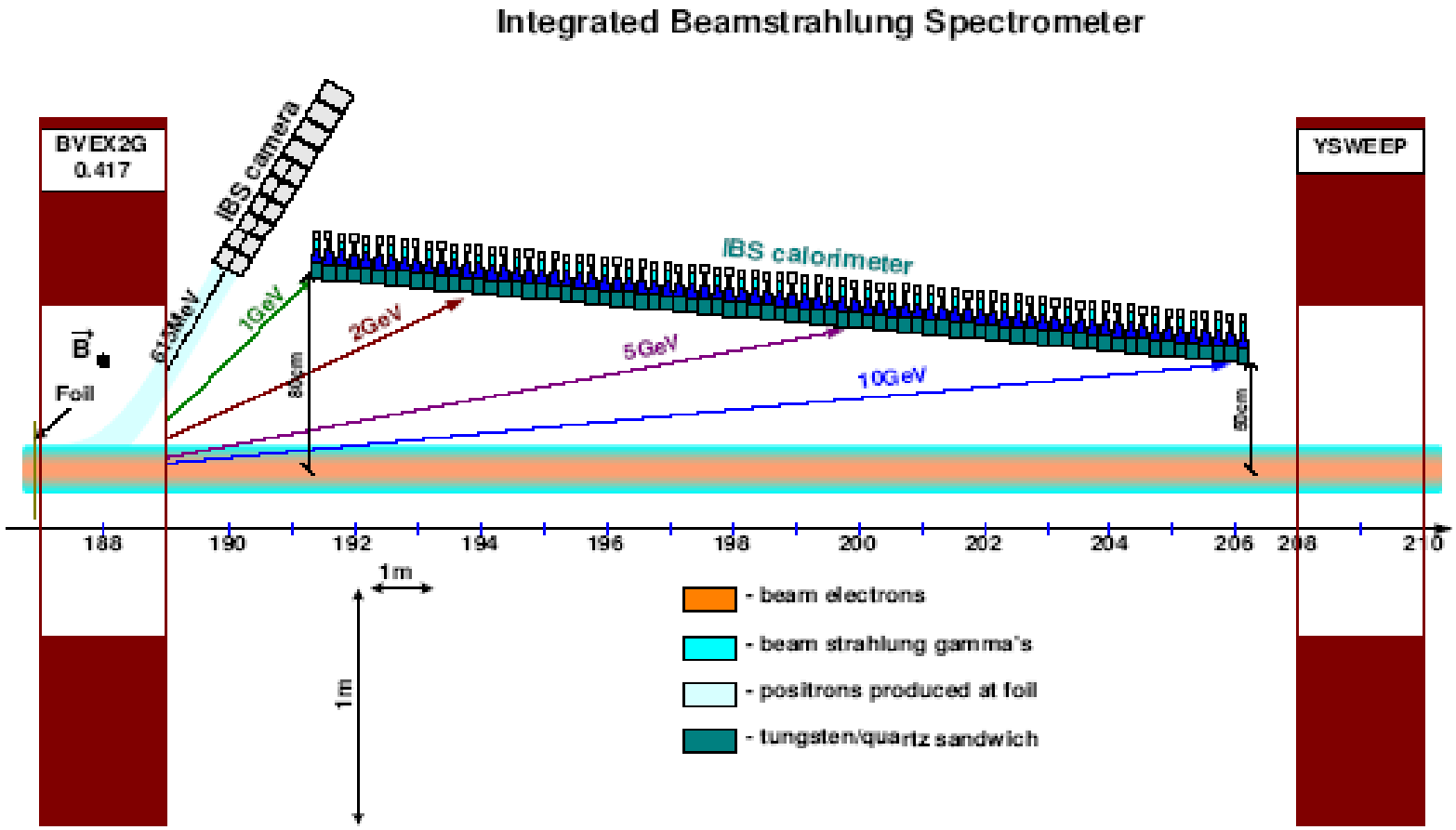
- $F = e(E + c\beta \times B)$
- $E = 0$, $B_{max} \approx 1KT$
- $P_\gamma \approx 3\%\ P_e \approx 0.4MW$
- $N_\gamma \approx 1.5N_e \approx 3\times10^{10}$ /BX

$$B_x = \frac{\mu_0 N e \beta c}{\sigma_x \sigma_z} \frac{y}{\sigma_y} \qquad P_\gamma = \frac{2 r_0 \gamma^2 F^2}{3mc}$$

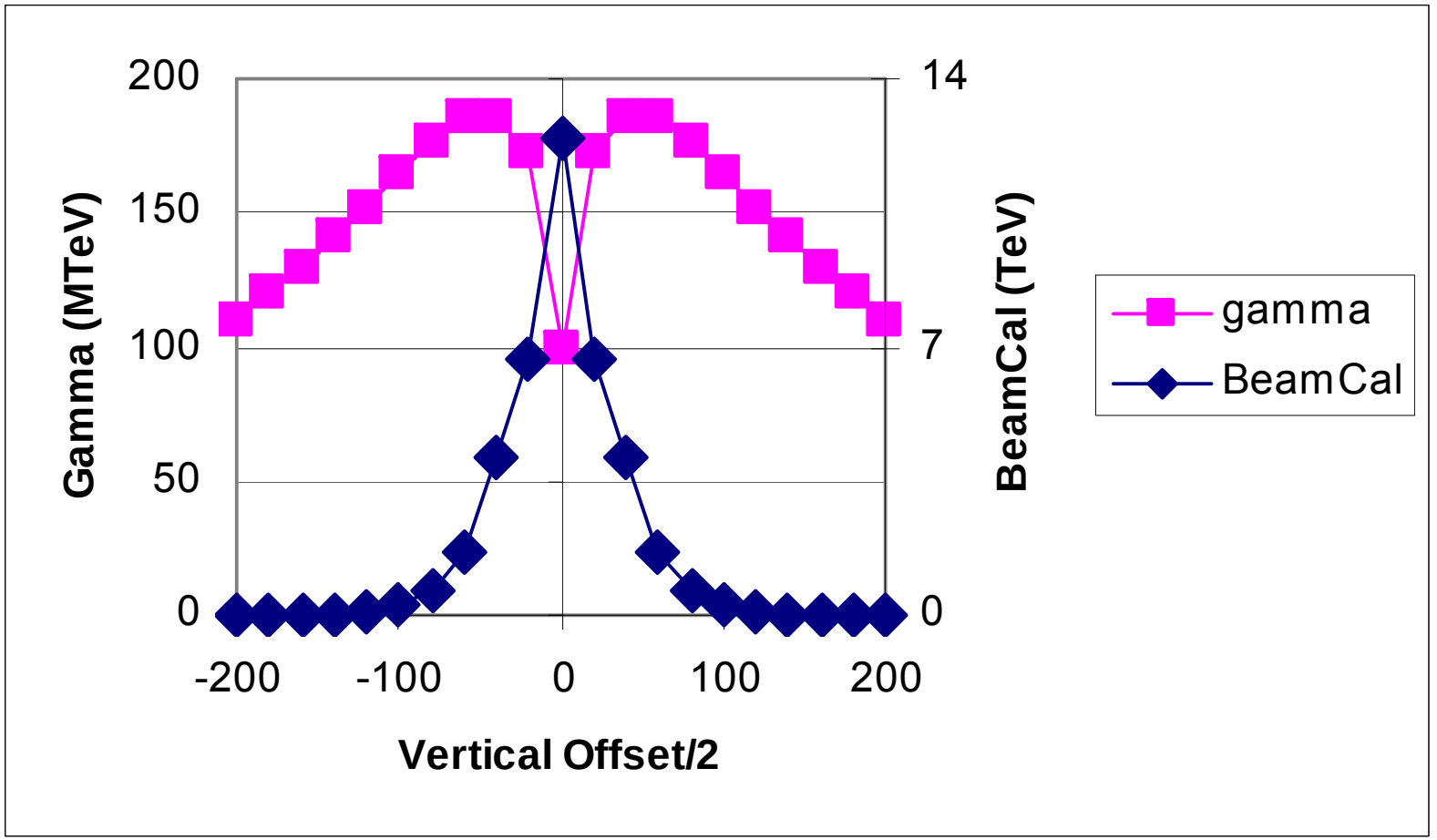
Instantaneous Luminosity

- Bethe-Heitler $e\gamma \rightarrow eee$
- $N_{ee} \propto N_e N_\gamma / A_o$ so $N_{ee} / N_\gamma \propto N_e / A_o$
- N_e and A_o are for the overlap part only
- for the positrons for the left detectors (N_+)
- and electrons for the right detectors (N_-)
- Instantaneous luminosity:
- $L \propto N_+ N_- / A_o$

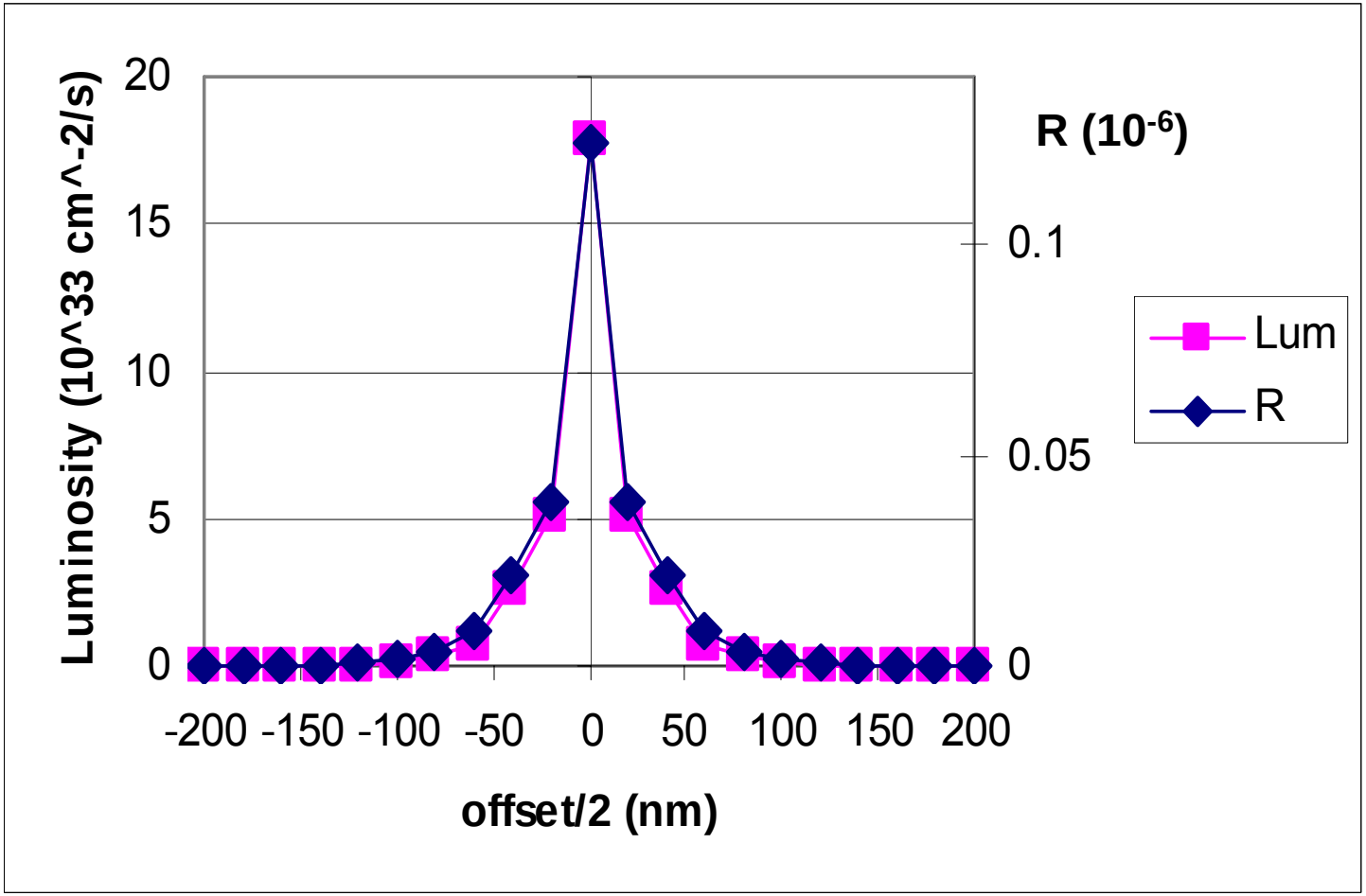
GamCal – Yale Group Design



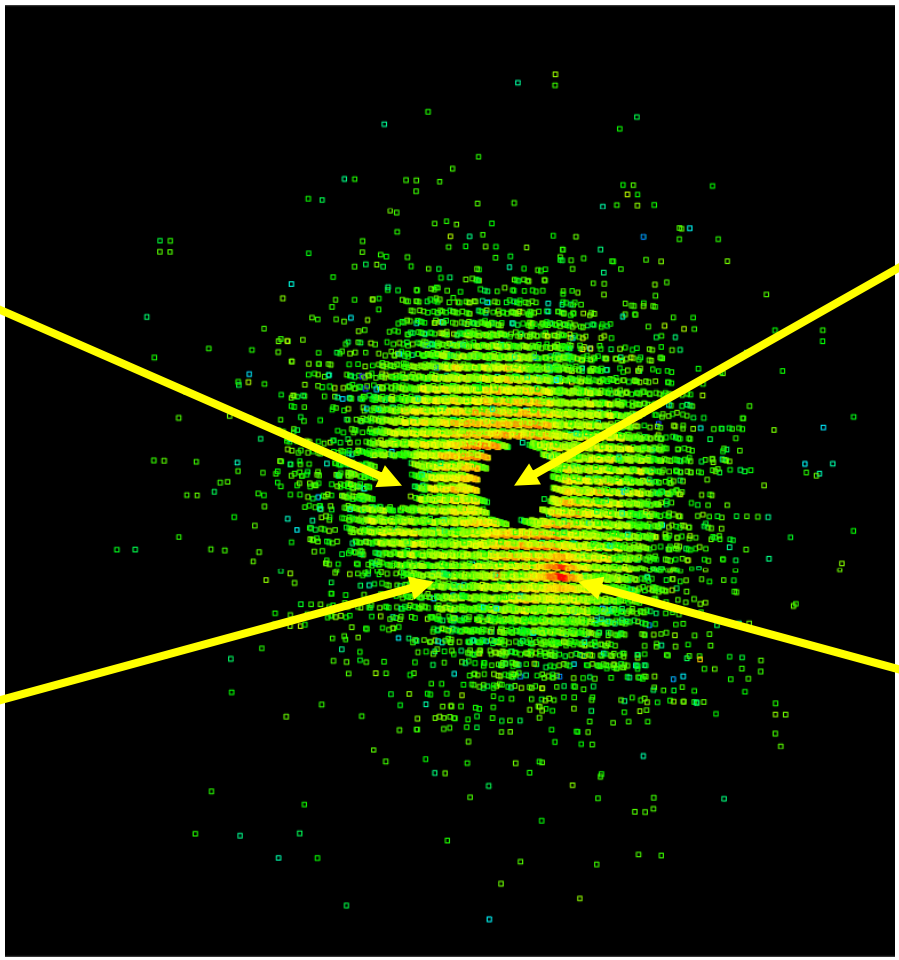
BeamCal and GamCal give Complementary Information



Vertical Offset



BeamCal Hermeticity – Univ. of Colorado, Boulder



SiD FCal

- W. Morse, BNL Physics Dept: Coordinator
- B. Parker et al., BNL Magnet Div: QD0-BeamCal Interface issues
- M. Zeller et al., Yale: GamCal Conceptual Design
- Jeff Gronberg et al., LLNL: GamCal converter issues
- U. Nauenberg et al., Colorado: BeamCal hermeticity simulations
- G. Haller et al., SLAC: BeamCal readout chip
- W. Cooper et al., Fermilab: Vacuum, support, etc. issues
- Z. Li et al., BNL Instrumentation: BeamCal radiation damage issues

SiD FCAL new group efforts

- LumiCal systematic error studies (effects of 1KT B field, etc.)
- Hermeticity at LumiCal/ECal interface
- Hermeticity at LumiCal/BeamCal interface
- LHCal design
- Pixel measurement of position at LumiCal front face for Bhabha systematics, muons: fit to $Z \rightarrow \mu\mu$
- DAQ, ….

Extra

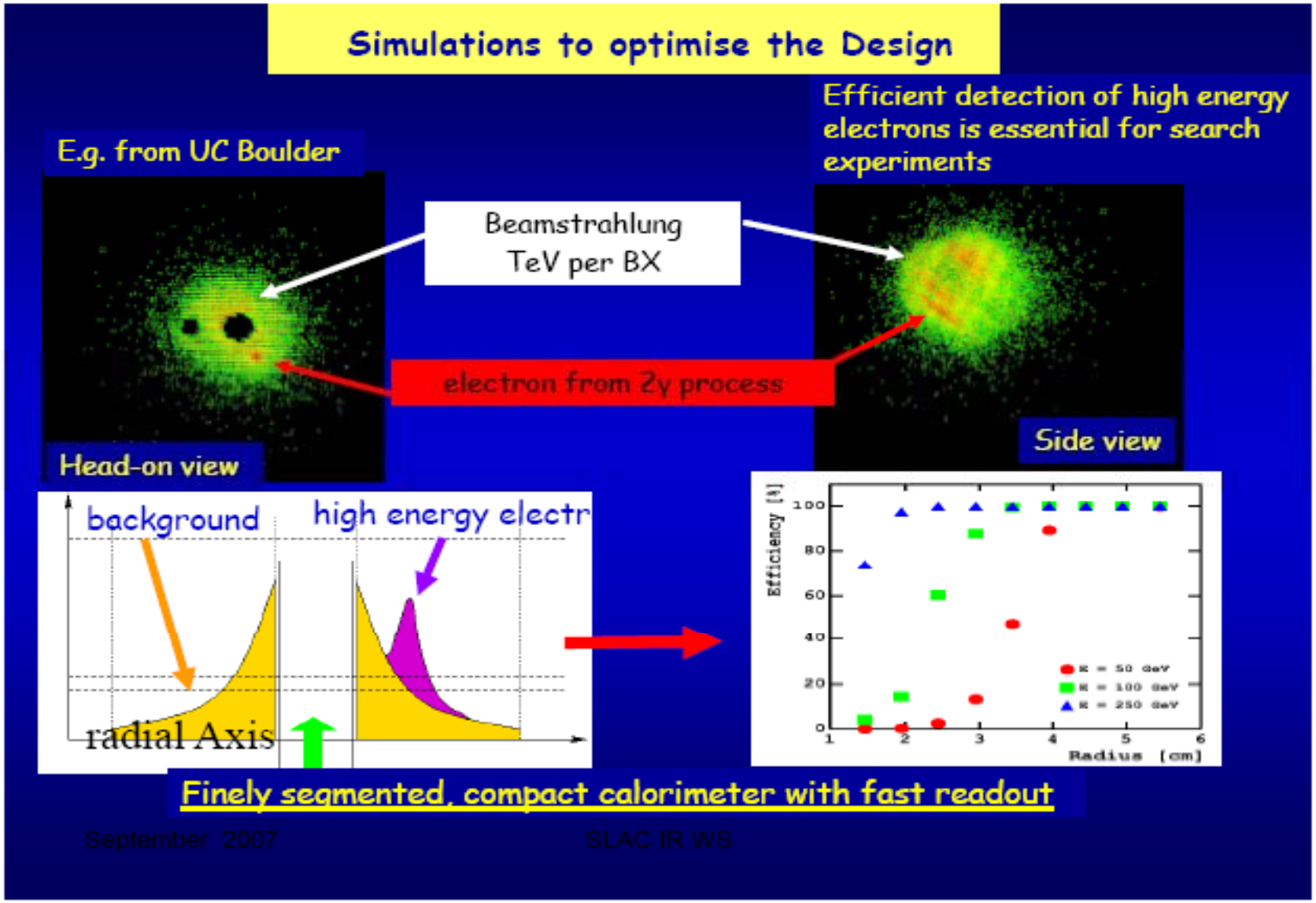
SiD Masses

Cal	Mass
LumiCal	≈325 kg
LHCal	≈270 kg
BeamCal	≈130 kg

SNS Stripping Foil

- Developed and tested by BNL
- 1μm thick cvd diamond
- For SNS H^- injection strips electrons: $H^- \rightarrow p + e + e$
- SNS foil has more energy deposited than we would
- Looks promising, but we need engineering, as our foil is different geometry, etc.

BeamCal Hermeticity



Beam-strahlung Pairs