LumiCal, LHCal, BeamCal, GamCal Physics Engineering Interface

W. Morse - BNL

Forward Calorimeters

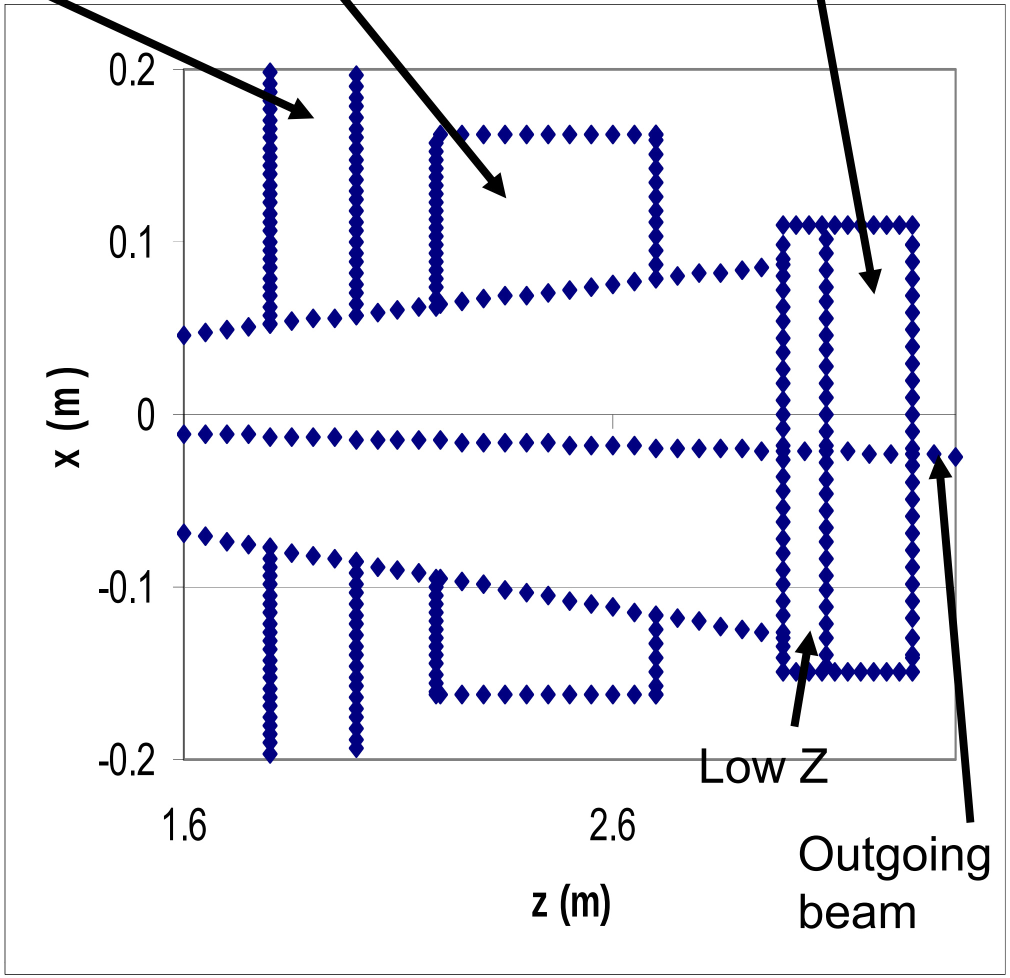
- LumiCal – precision integrated luminosity measurement (Bhabhas), and hermeticity
- $dL/L < 10^{-3}$ for $\sqrt{s} = 0.5$TeV
- $dL/L < 2\times10^{-4}$ for GigaZ – very challenging!
- LHCal – ID muons behind LumiCal
- BeamCal – instantaneous luminosity optimization (beam-strahlung pairs) and hermeticity
- GamCal - instantaneous luminosity optimization (beam-strahlung γ detector at $z \approx 190$m)

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

- Engineering/physics issues
- Do we need more masking in LHCal region? – Markiewicz
- Vacuum chamber design – Bill Cooper et al.
- Support of weight – Bill Cooper et al.
- Cabling, LumiCal/ECal hermeticity - all



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....

SiD Masses

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

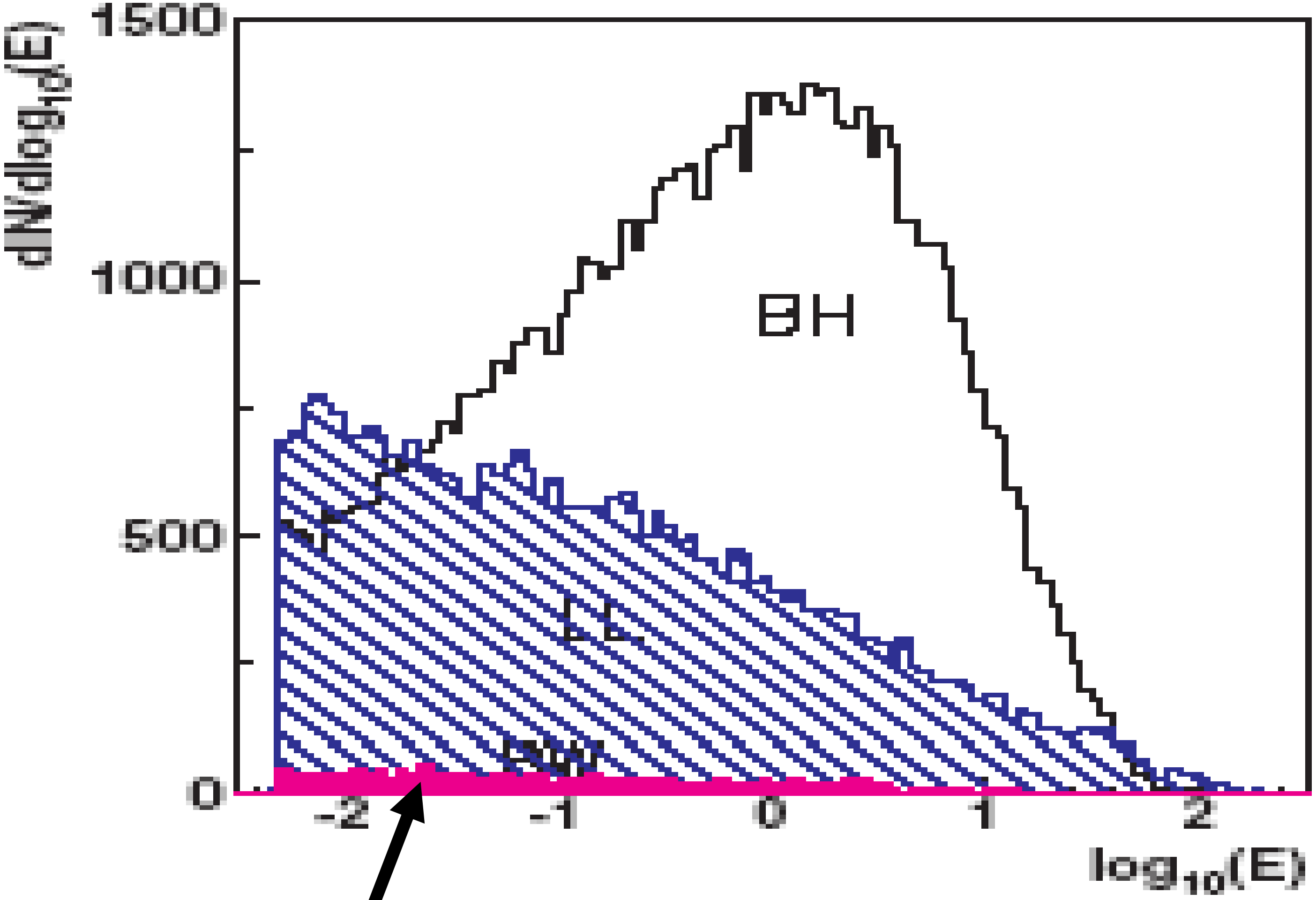
Luminosity Feedback Detectors BeamCal and GamCal

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.

Instantaneous Luminosity

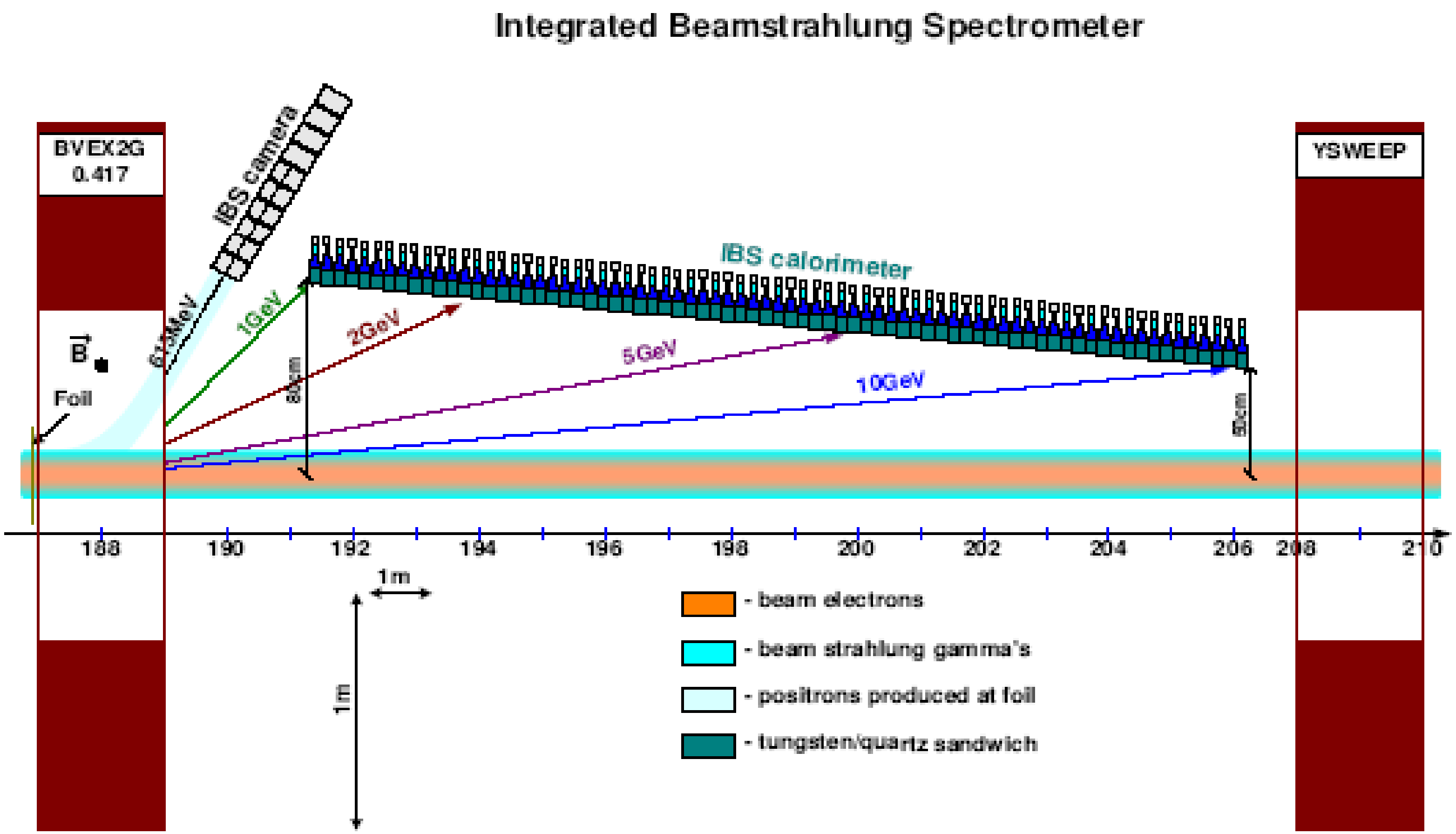
- Bethe-Heitler $e\gamma \rightarrow eee$
- $N_{ee} \propto N_o N_\gamma / A_o$ so $N_{ee} / N_\gamma \propto N_o / A_o$
- N_o and A_o are for the overlap part only
- for the positrons for the left detectors (N_{o+})
- and electrons for the right detectors (N_{o-})
- Instantaneous luminosity:
- $L \propto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

Beam-strahlung Pairs



10cm low Z

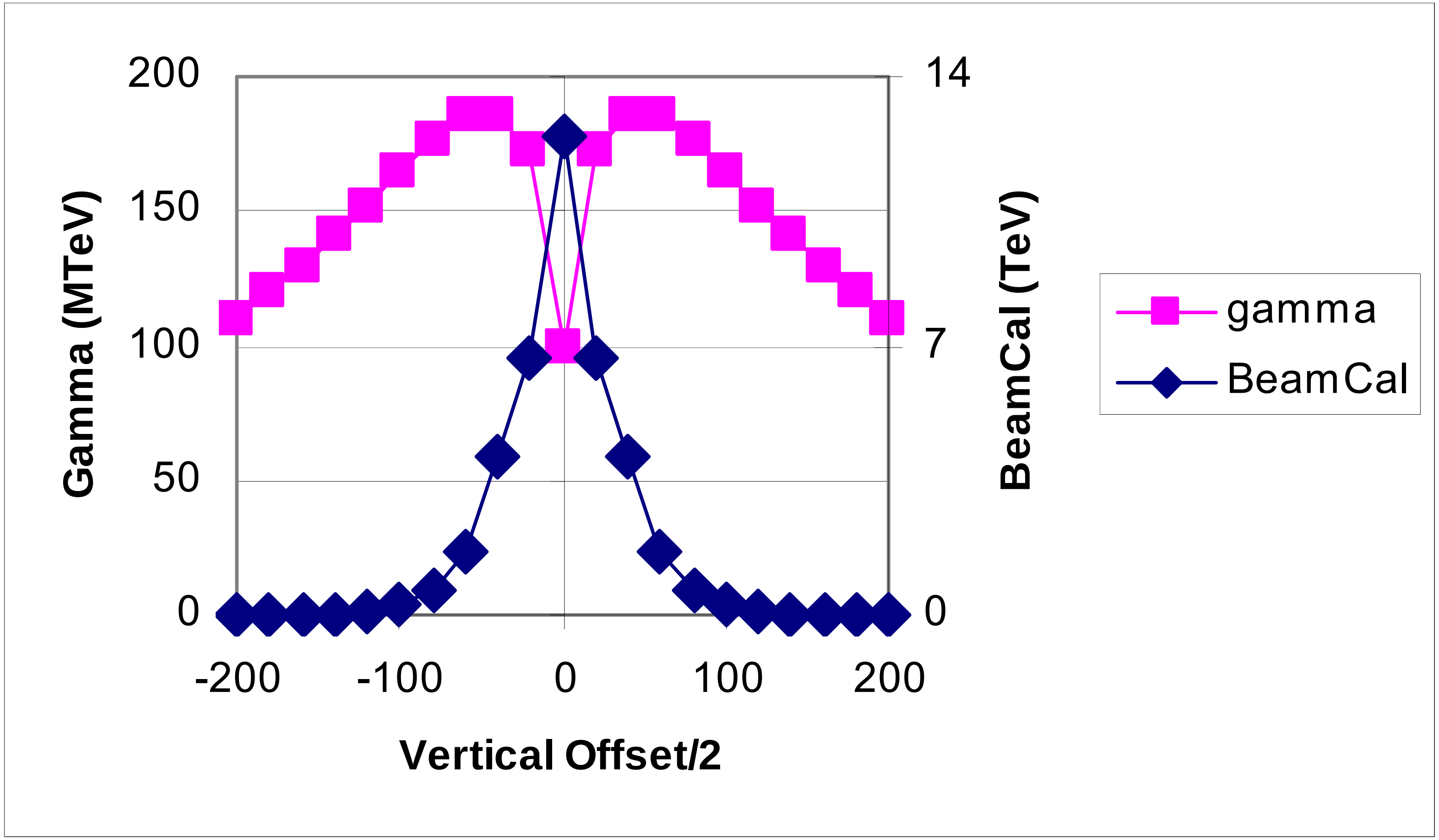
GamCal – Yale Group Design



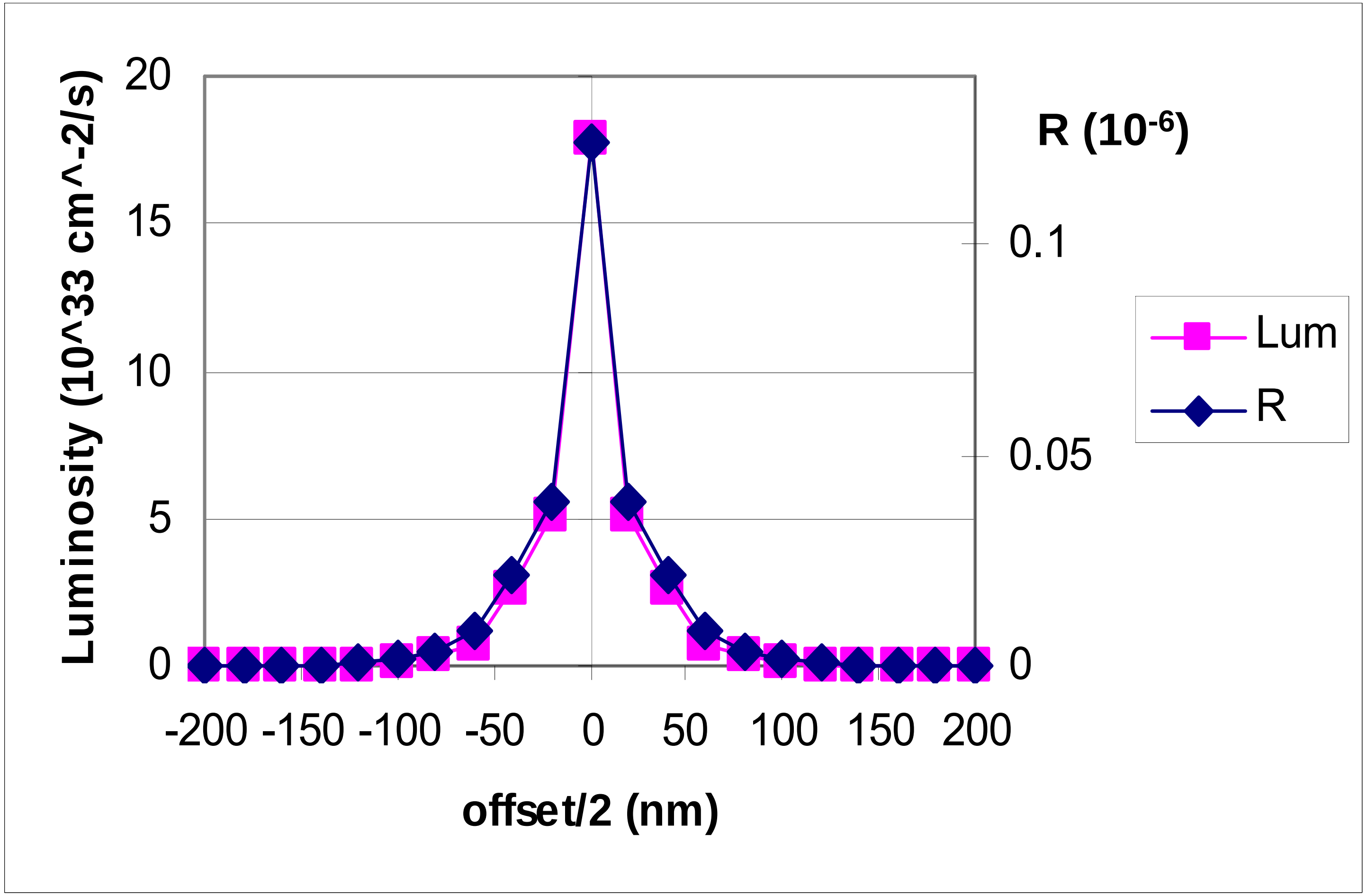
SNS Stripping Foil

- 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.

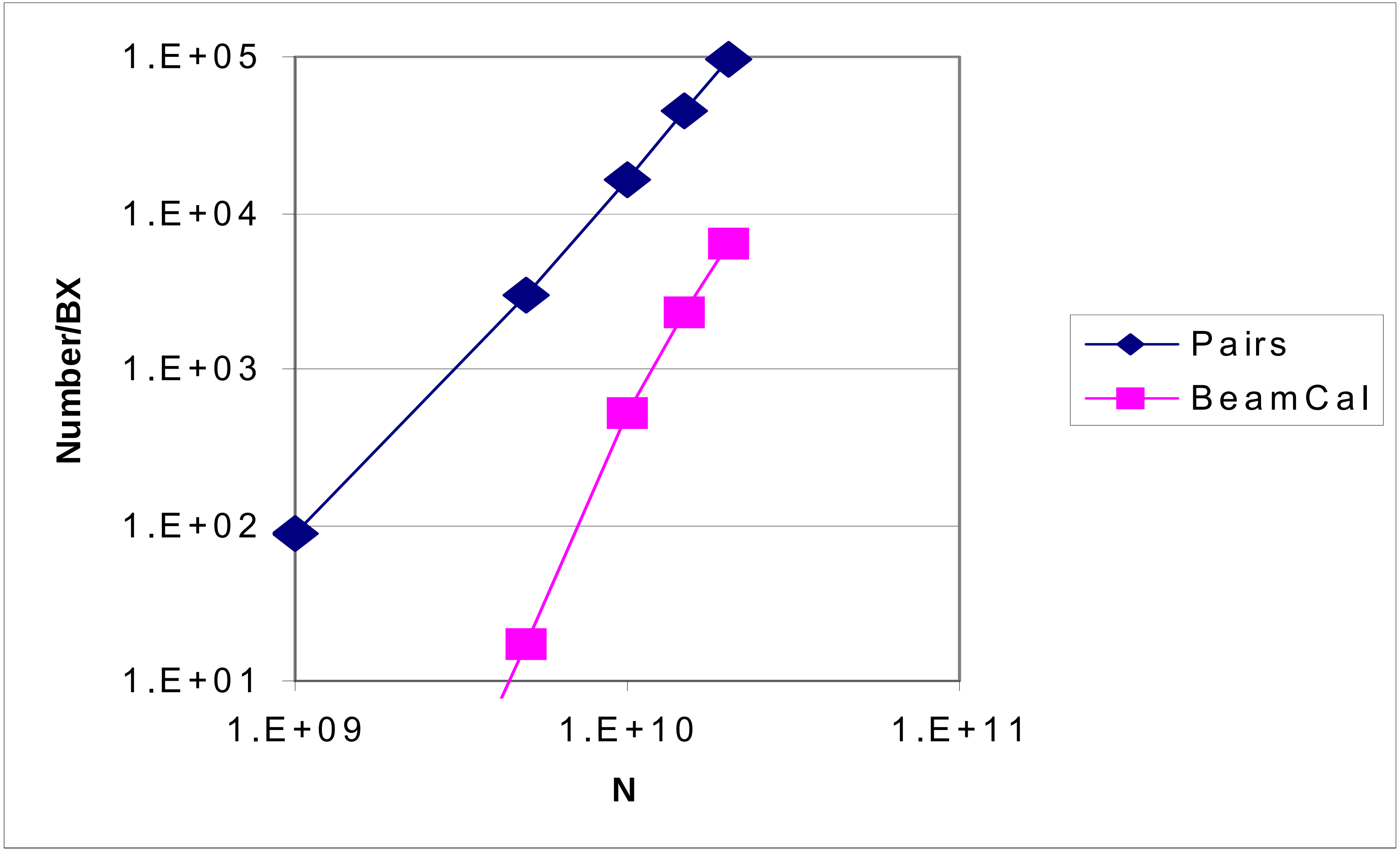
BeamCal and GamCal give Complementary Information



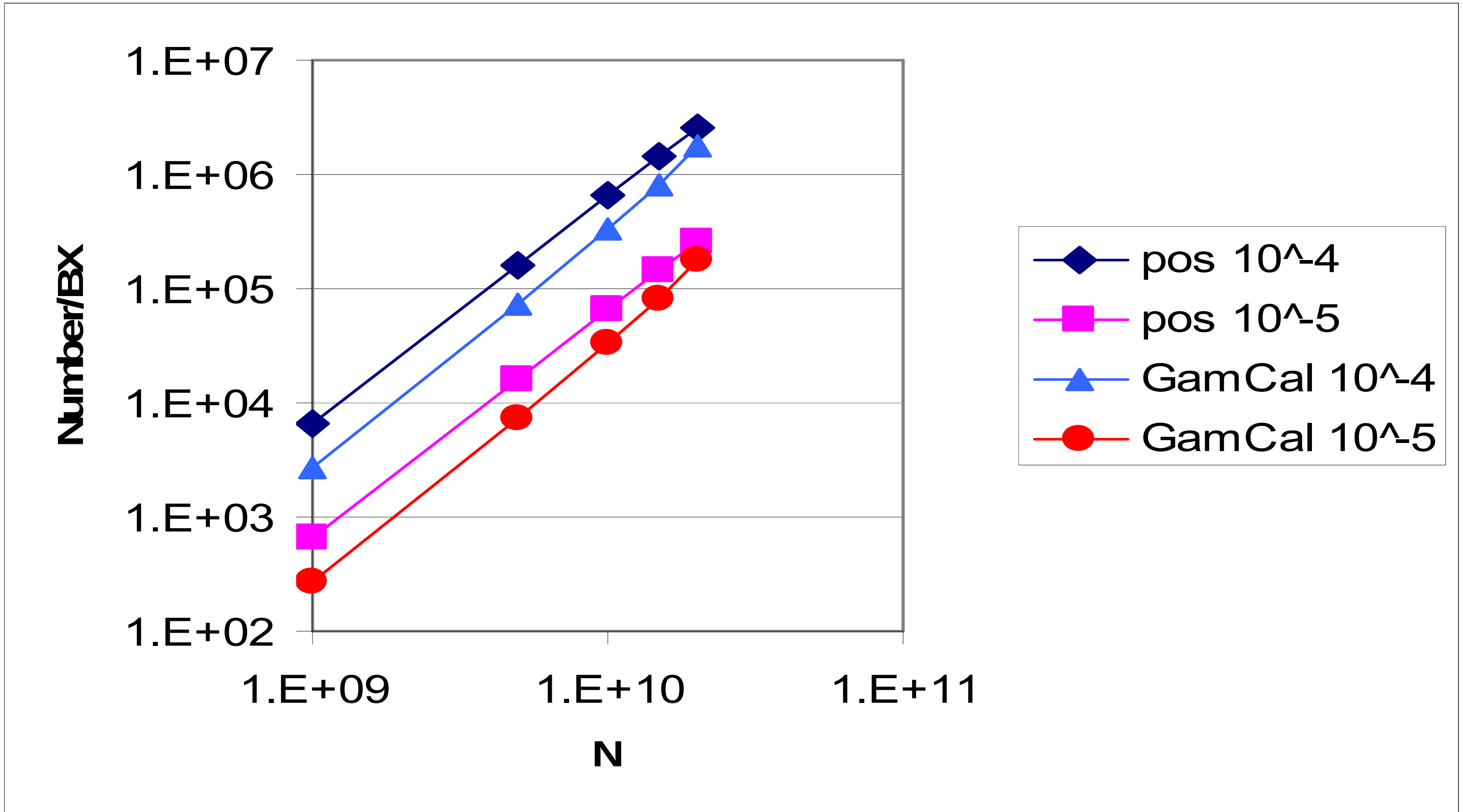
Vertical Offset



BeamCal has Poor Statistics at Low Beam Current for L Feedback



GamCal has Good Statistics



BeamCal/GamCal to do list

- Conceptual GamCal design with GEANT simulation
- Conceptual design of GamCal foil and/or gas jet
- Conceptual design of 14mr cold to BeamCal area, including electronics space, etc.
- BeamCal/GamCal radiation damage issues
- All this requires much more support than we've been getting (BNL/Yale FY07 detector R&D $s were <10% of request).
- Request BDS support for GamCal.
- BeamCal stays with Detector R&D.

Conclusions

- GigaZ LumiCal physics requirement dL/L < 2×10^{-4} is very challenging.
- BeamCal will be statistically challenged at low beam current for instantaneous luminosity feedback.
- GamCal gives complementary info and will have good statistics.

Extra

Neutrons

- BeamCal produces $\approx 2\times10^{14}$ neutrons per year at design luminosity.
- $z \approx 3$m.
- ILC beam dump produces $\approx 4\times10^{22}$ neutrons per year.
- $z \approx 3\times10^{2}$ m.
- How many of these will scatter back into the vertex detector?
- Neutrons are hard to collimate!