

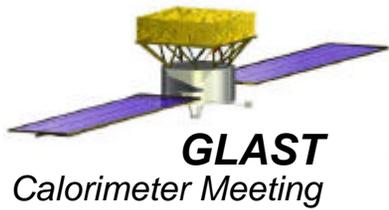
Saclay, France  
10 - 11 Dec. 1998

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# CsI Light Asymmetry and Position Resolution: SLAC '97, MSU '98, and CERN '98

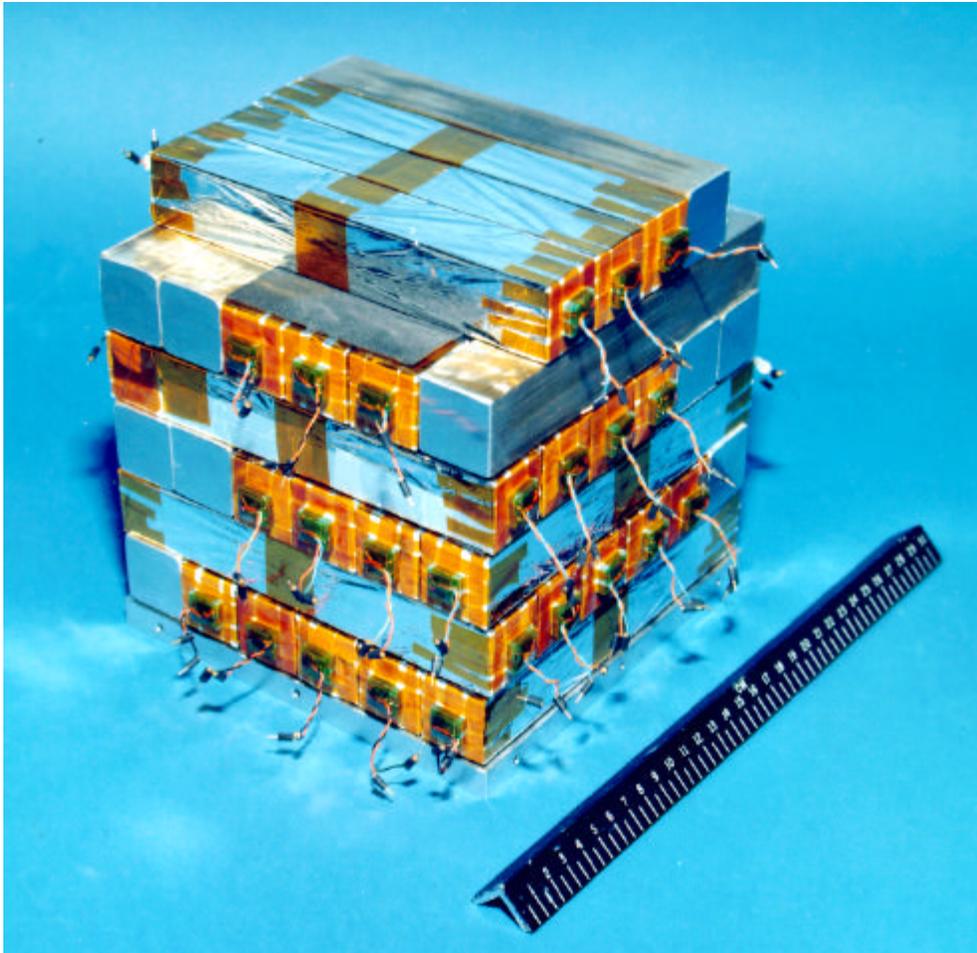
J. Eric Grove  
Naval Research Lab  
10 December 1998





## Calorimeter Prototype - Beam Test '97

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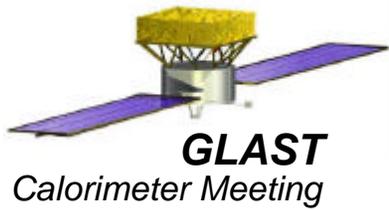
*Calorimeter Prototype  
(partial Stack)*

*3 x 3 x 19 cm blocks*

*Also tested single*

*2.5 x 3 x 32 cm block*



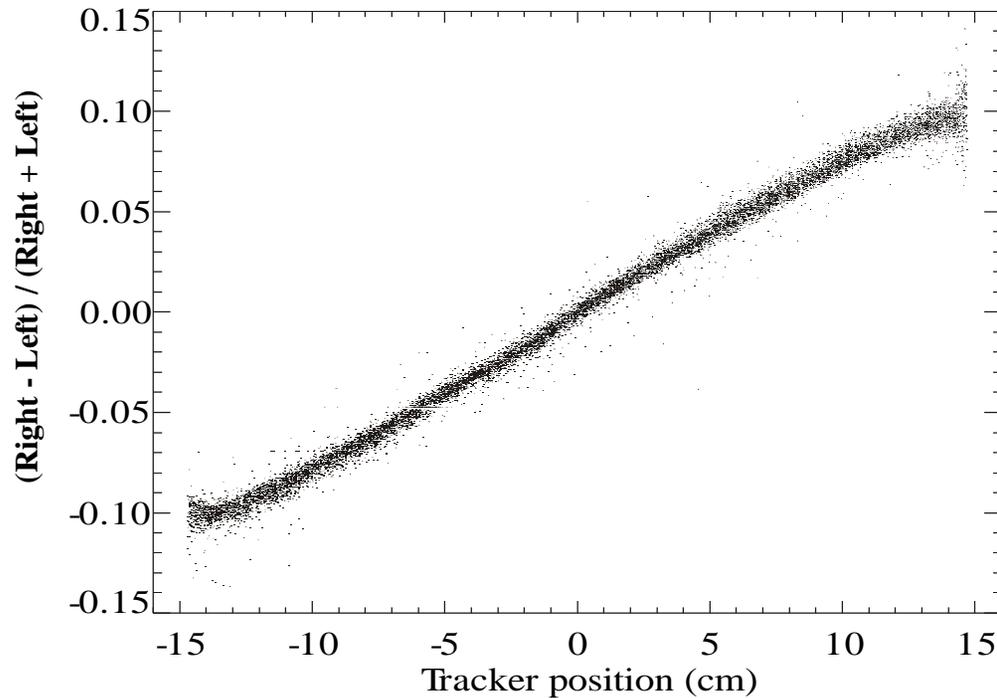


# Positioning with Light Asymmetry

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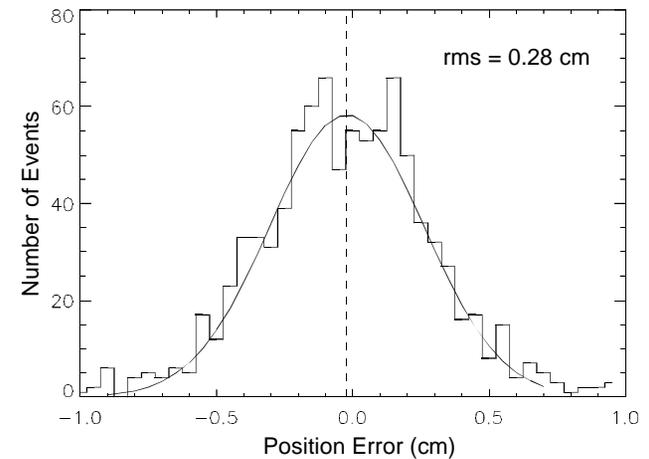
## 32 cm CsI Bar Position Resolution

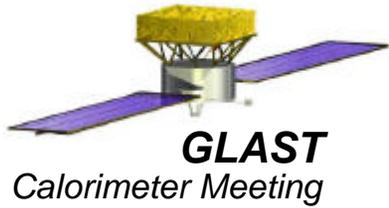
*Light Asymmetry*



*Position Resolution*

SLAC  $e^-$  beam, 2 GeV  
 $\Delta E \sim 130$  MeV

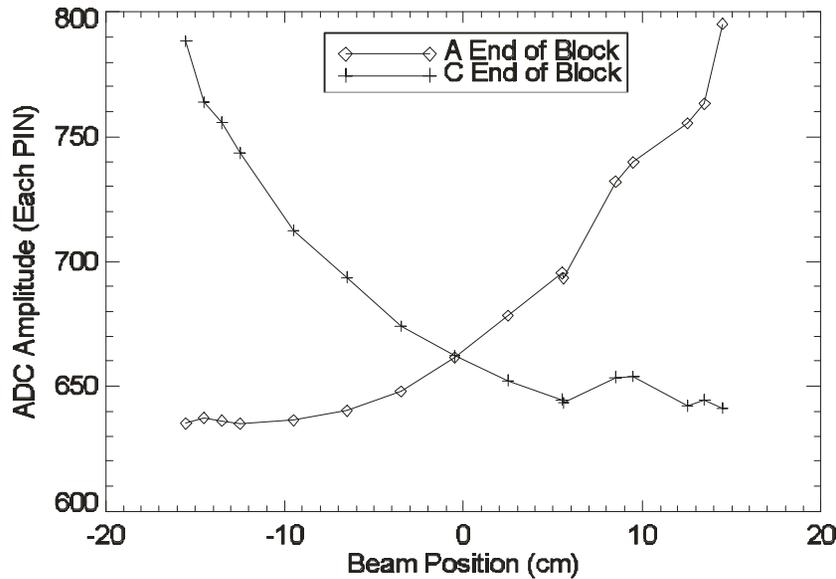




# MSU Beam Test '98 - He Beam

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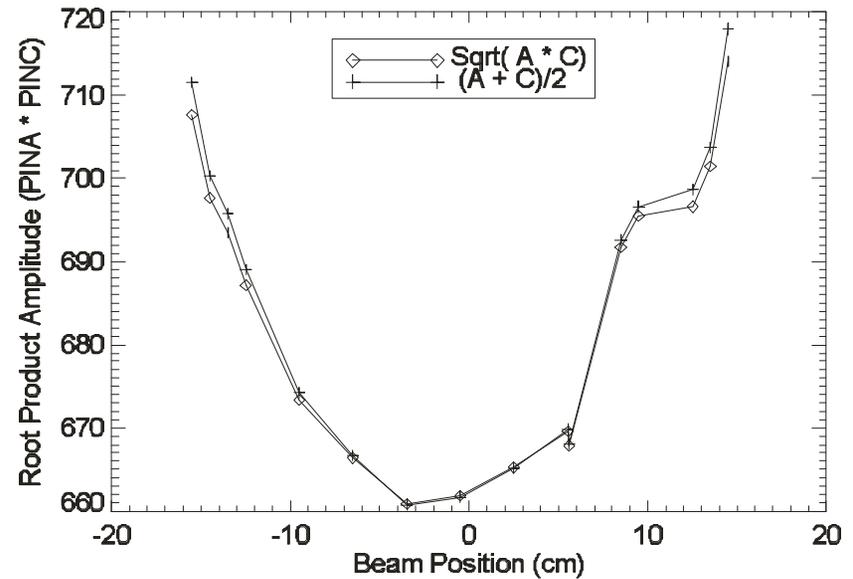
*Each End of CsI Block*



Light amplitude seen at each end of the 32 cm CsI block as a function of position.

He Beam: 160 MeV/nuc  
Energy Deposition: ~150 MeV

*Sum of Ends of CsI Block*

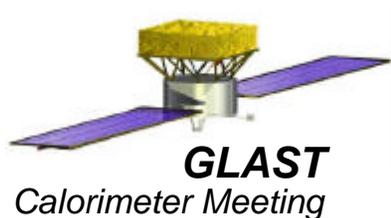


Sum of signals from both ends of the 32 cm CsI block as a function of position.

Variation with position:  $\pm 4\%$

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# Position Resolution, SLAC '97

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Longitudinal position resolution:

- $\sigma_x = 0.04 \text{ cm} - 0.4 \text{ cm}$ .
- 3 x 3 x 19 cm crystals.

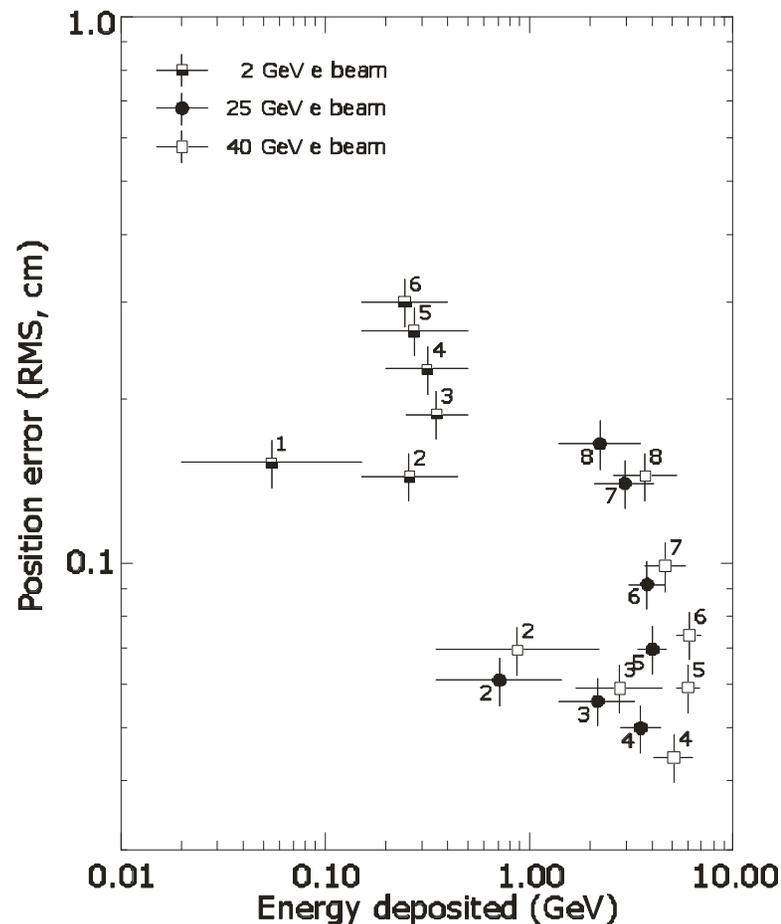
Position resolution is a function of:

- Slope of asymmetry measure;
- Energy deposited in crystal;
- Shower multiplicity;
- Transverse development of shower.

Light attenuation length:

$$x = \lambda \times (R-L) / (R+L)$$

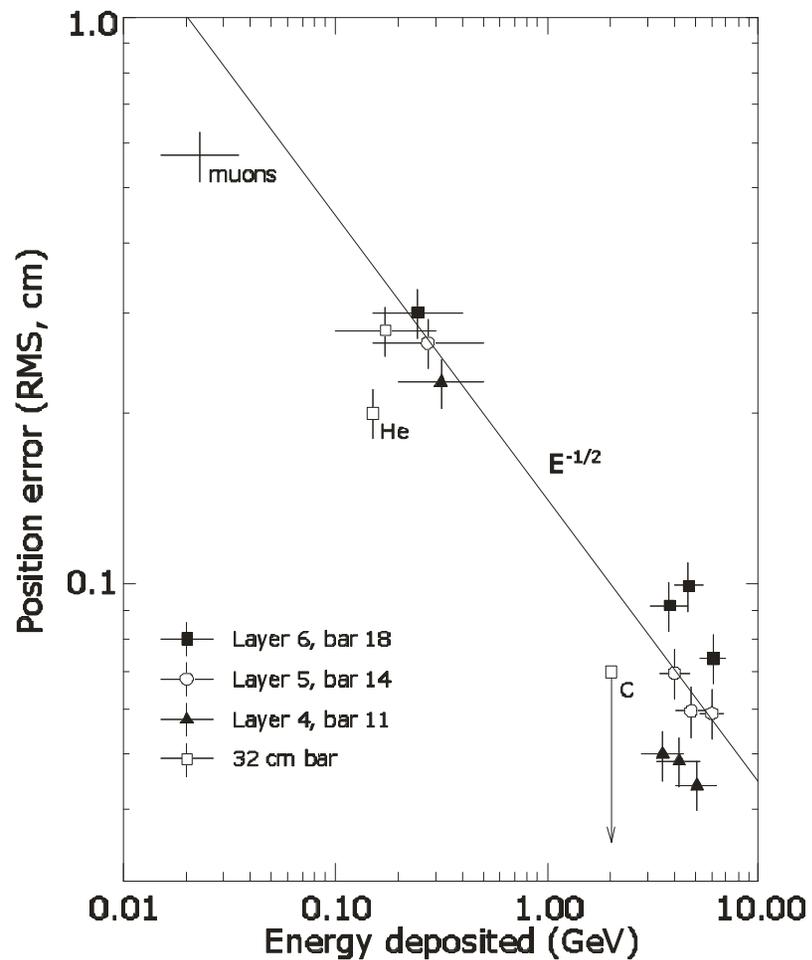
$$\lambda = 40 \text{ cm} - 120 \text{ cm}.$$

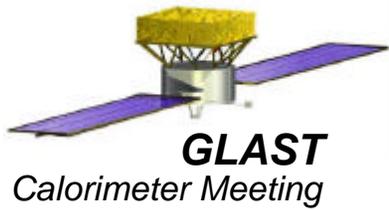


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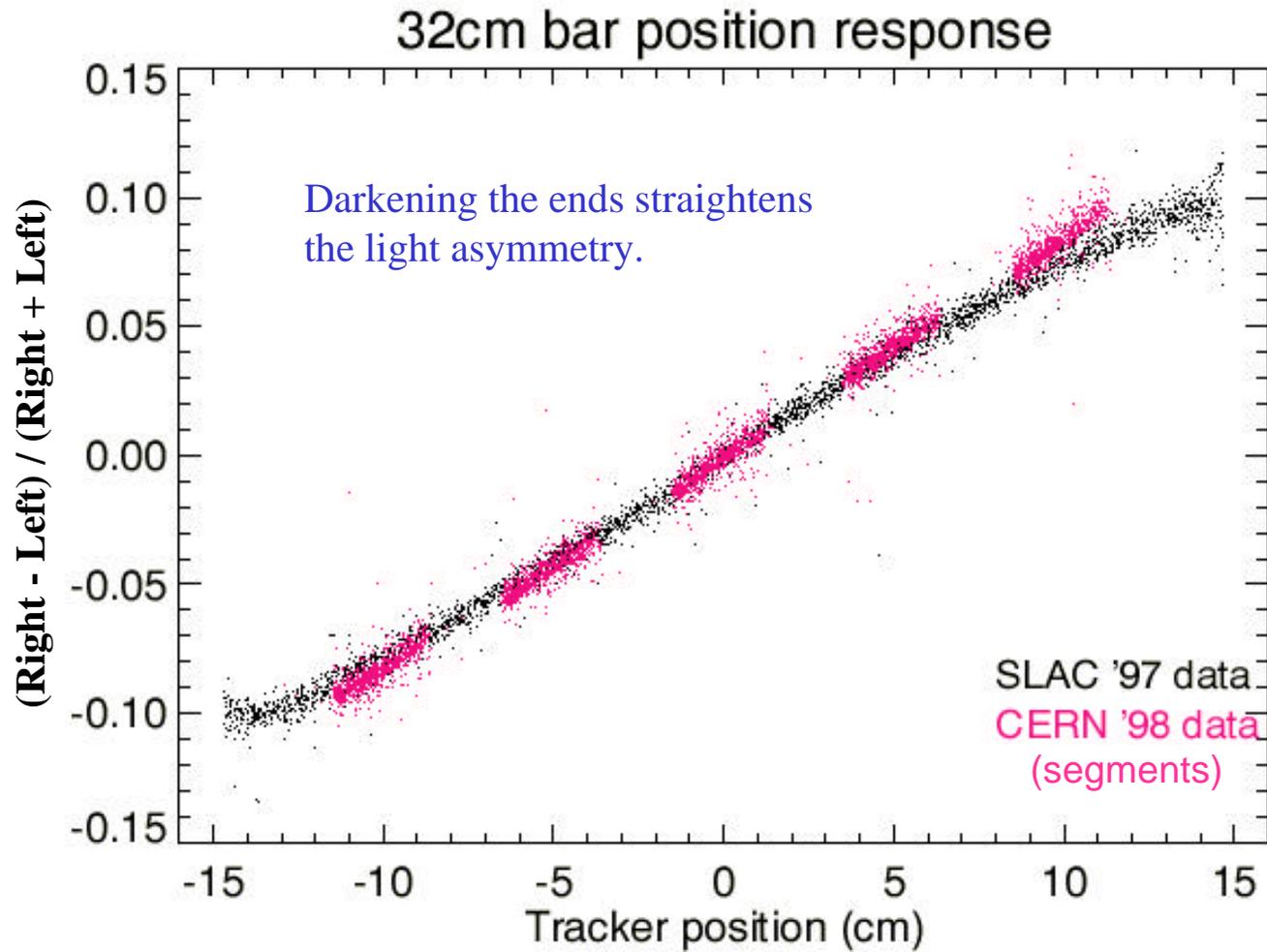
For a given CsI bar, position resolution does indeed scale roughly as  $1/\sqrt{E}$ .





# CERN Beam Test '98

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# Effects of Diode Size

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Light asymmetry for large and small diodes.

Both show good linearity.

Darkening ends improves linearity.

Slope (i.e. attenuation length) is different.

- $\lambda_{\text{large}} = 120 \text{ cm}$ .

- $\lambda_{\text{small}} = 140 \text{ cm}$ .

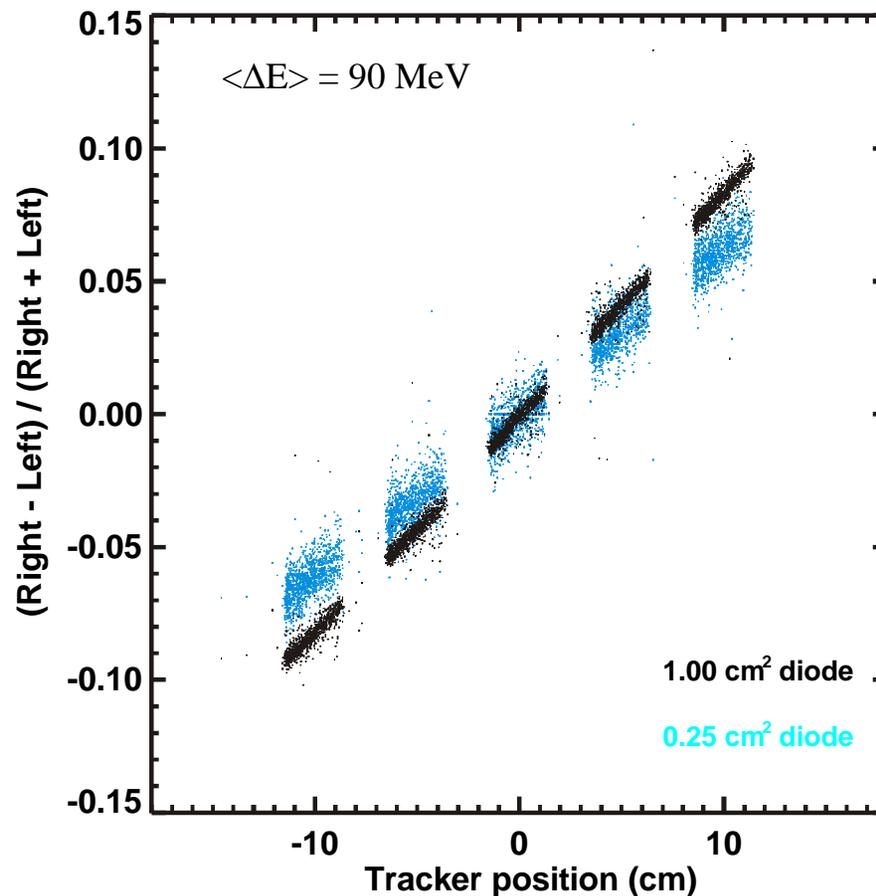
Why the difference?

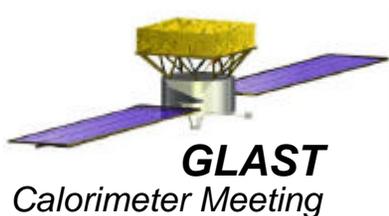
Position resolution:

Large diode  $\sigma_L = 0.27 \text{ cm}$  (same as SLAC).

Small diode  $\sigma_S = 0.75 \text{ cm}$

$$\text{Expect } \sigma_S = (\lambda_L / \lambda_S) \times (4\sigma_L^2 + \sigma_{\text{binwid}}^2)^{1/2} \approx 0.7 \text{ cm}$$





# Effects of Diode Size

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Ratio of signals in diodes.

- Geometric ratio of areas is 4 : 1.
- Avg. observed ratio of signals is 3.7 : 1.

Ratio is position dependent.

- Attenuation lengths are different.
- Change in ratio is consistent with 120 cm v. 145 cm, but shape is wrong: ratio of pure exponentials looks linear on this scale.

Larger diode sees greater fraction of direct light.

