


Silicon detector alignment study review

POL analysis meeting

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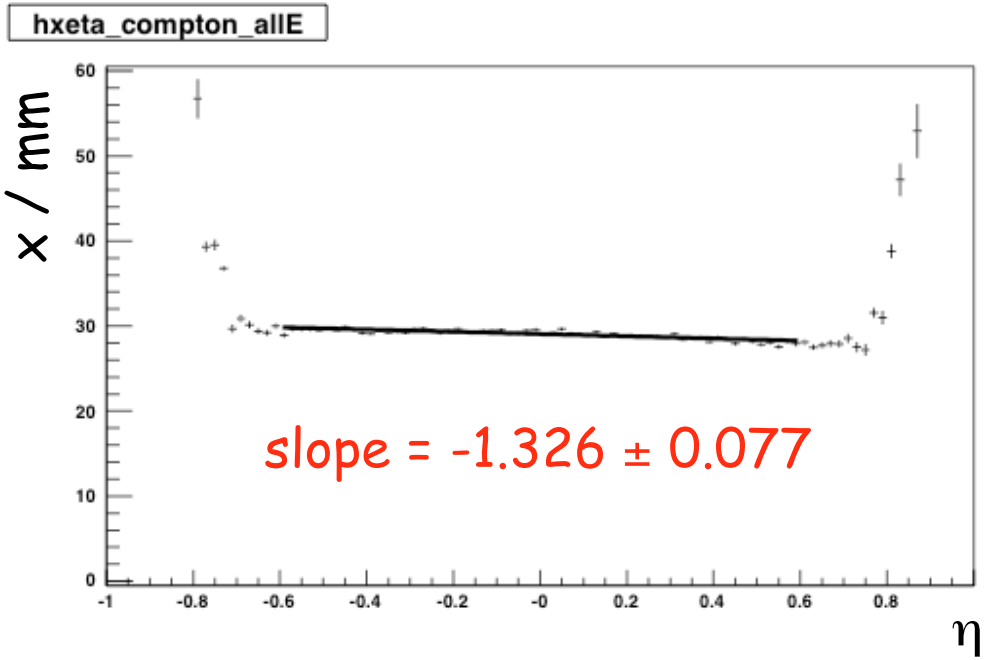
Catherine Fry

Imperial College London

Outline

- Data
  - x-η slope
  - fit beam ellipse to silicon data
- MC
  - tuning parameters
  - vary cal angle w.r.t. beam for fixed silicon angle
- Compare data and MC to extract silicon-calorimeter angle

x-η distribution



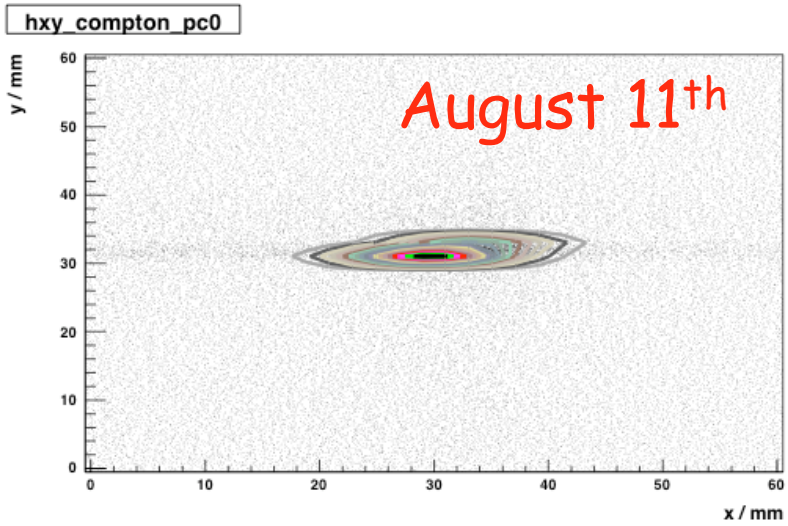
Compton only

August 11th

- This distribution should be flat if silicon and calorimeter are perfectly aligned
- But we see a slope of -1.3 mm / η ➔ suggests some angle between the two detectors
- Will use MC to find which angles for silicon and calorimeter w.r.t. beam give the same slope

Beam tilt measurements

- Measure beam tilt w.r.t. silicon detector
- Fit 2D ellipse to background-subtracted data
- See that beam tilt changes over time:



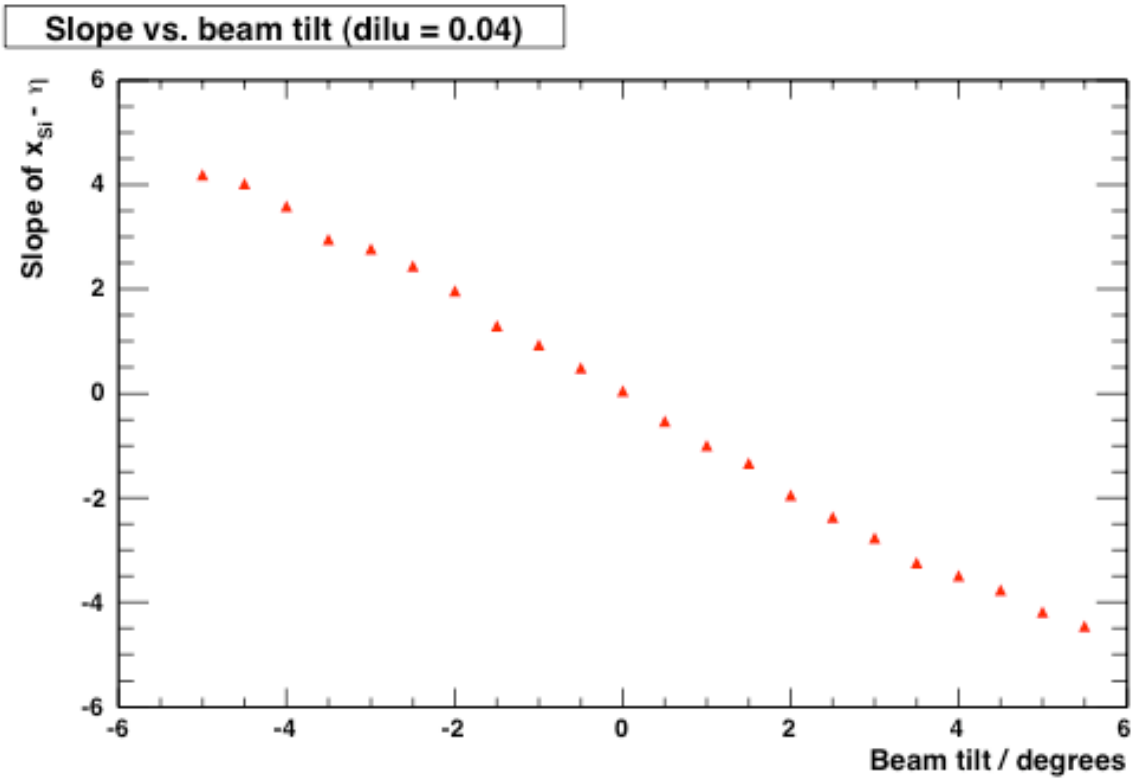
1st March	6.8 ± 0.3 °
7th March	4.6 ± 0.1 °
24th May	3.0 ± 0.1 °
8th July	3.4 ± 0.3 °
9th July	3.4 ± 0.5 °
12th July	3.4 ± 0.3 °
13th July	4.7 ± 0.4 °
15th July	3.5 ± 0.6 °

3rd August	4.5 ± 0.3 °
4th August	4.7 ± 0.4 °
5th August	4.1 ± 0.4 °
6th August	4.3 ± 0.4 °
10th-11th August	3.5 ± 0.2 °
11th August	3.3 ± 0.3 °
11th August	3.4 ± 0.2 °

MC - beam tilt dependence

- Keep silicon and cal angles w.r.t. beam equal and vary them together
- Plot x-η slope as function of beam tilt

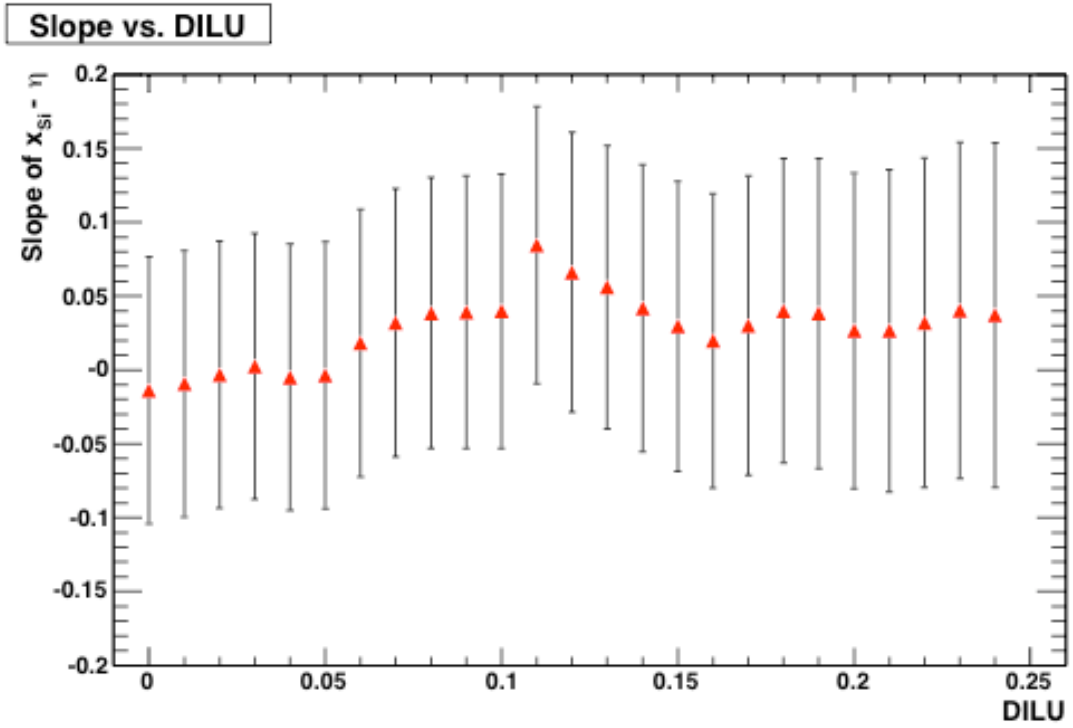
- Seems simulating a beam tilt of a few degrees can have relatively large effect on x-η slope (compared to data value of -1.3)



MC - DILU dependence

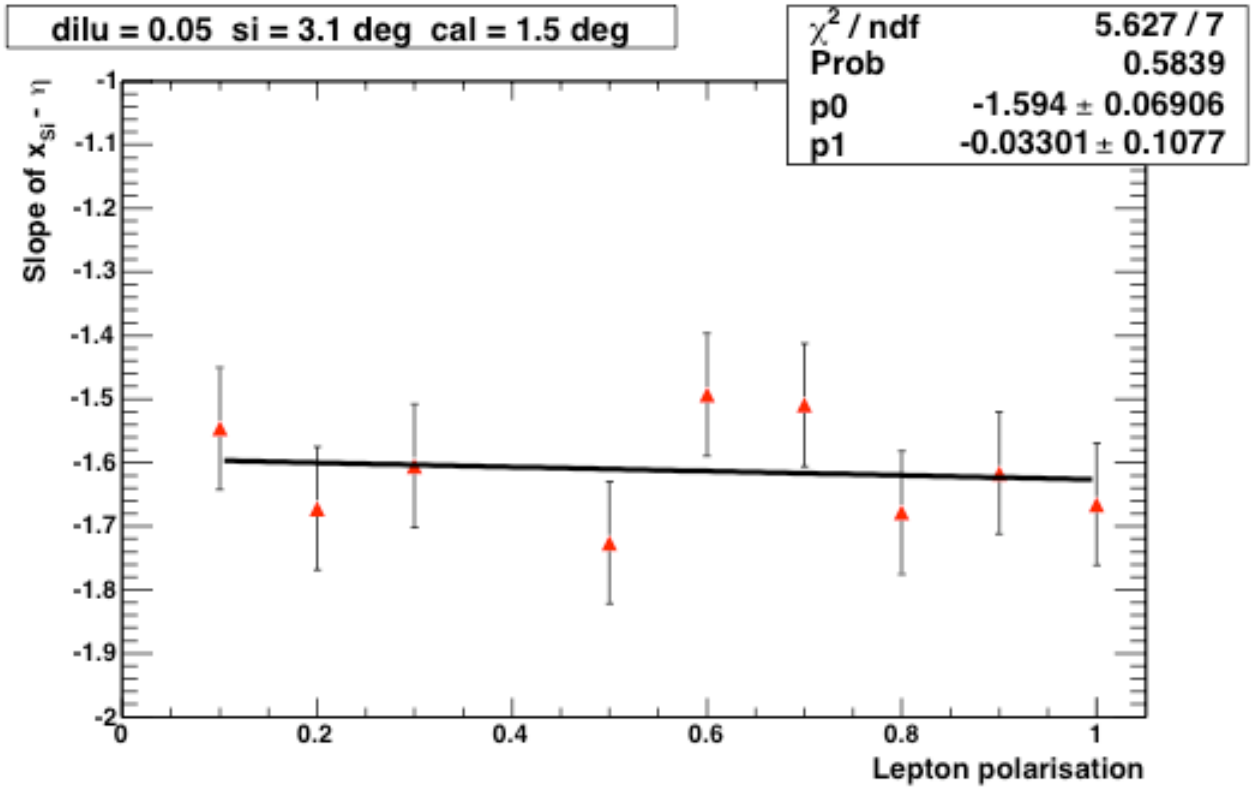
- Plot x-η slope as a function of DILU (fraction of light penetrating into opposite cal plate - up/down)
- Find that, given the size of errors, DILU has no significant effect on the x-η slope (compared to data value of -1.3)

- Vary DILU until find value whose η distribution best matches the data
  - DILU = 0.05
- (N.B. should really do this whilst re-optimising other parameters)



MC - polarisation dependence

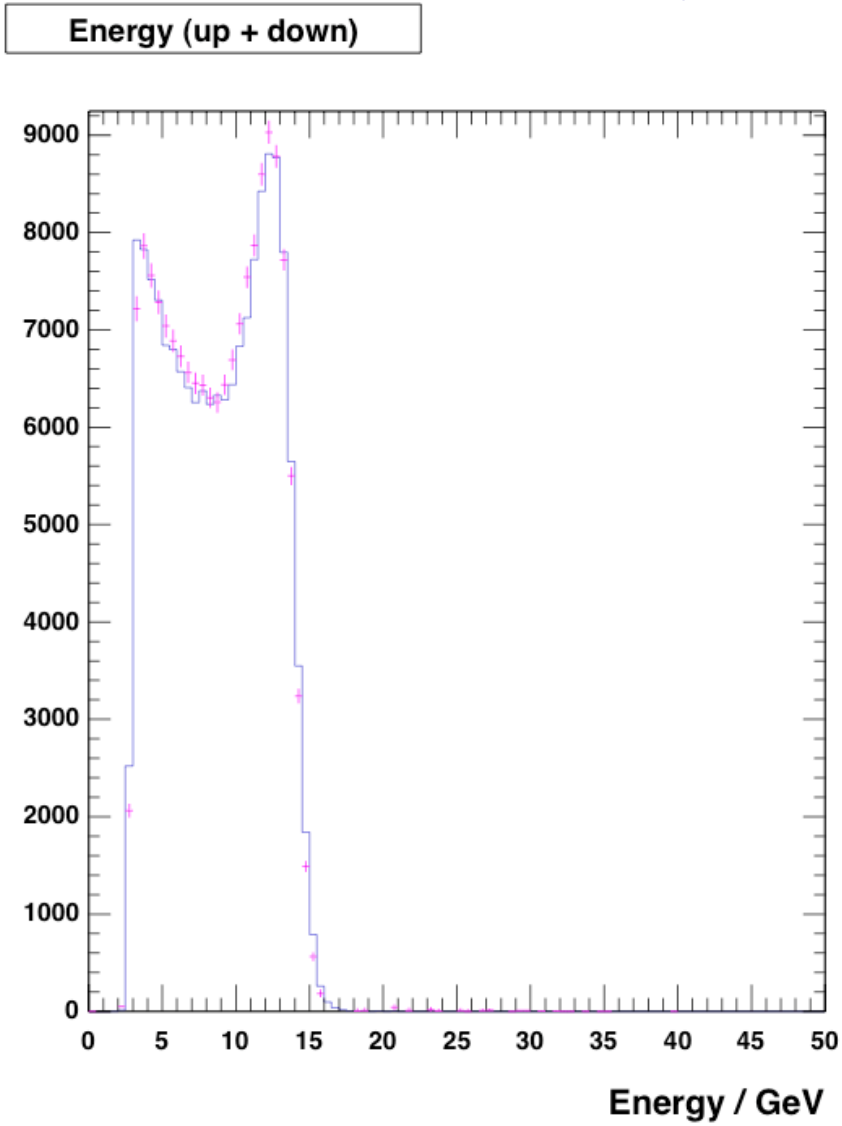
- Seems P_y has no effect on x-η slope (as expected) so no need to simulate the exact value for each data sample for the rotation study

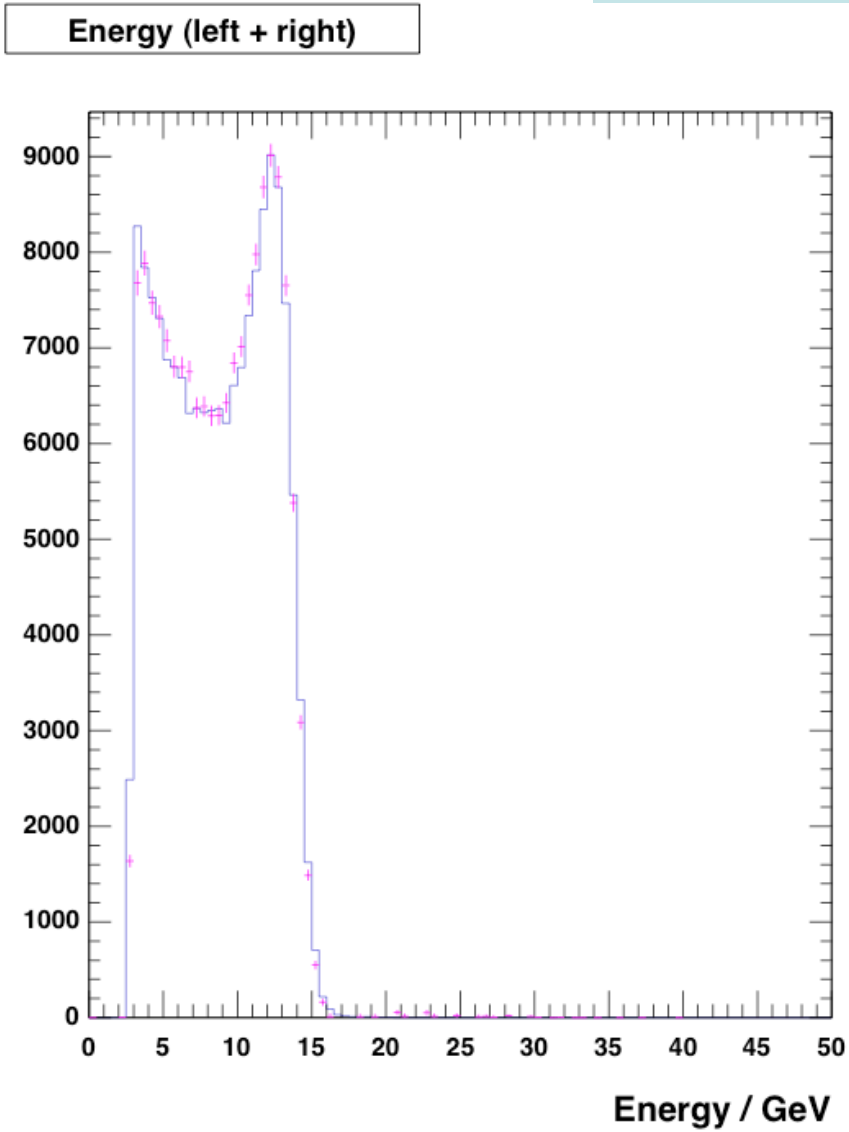


Energy (u+d and l+r)

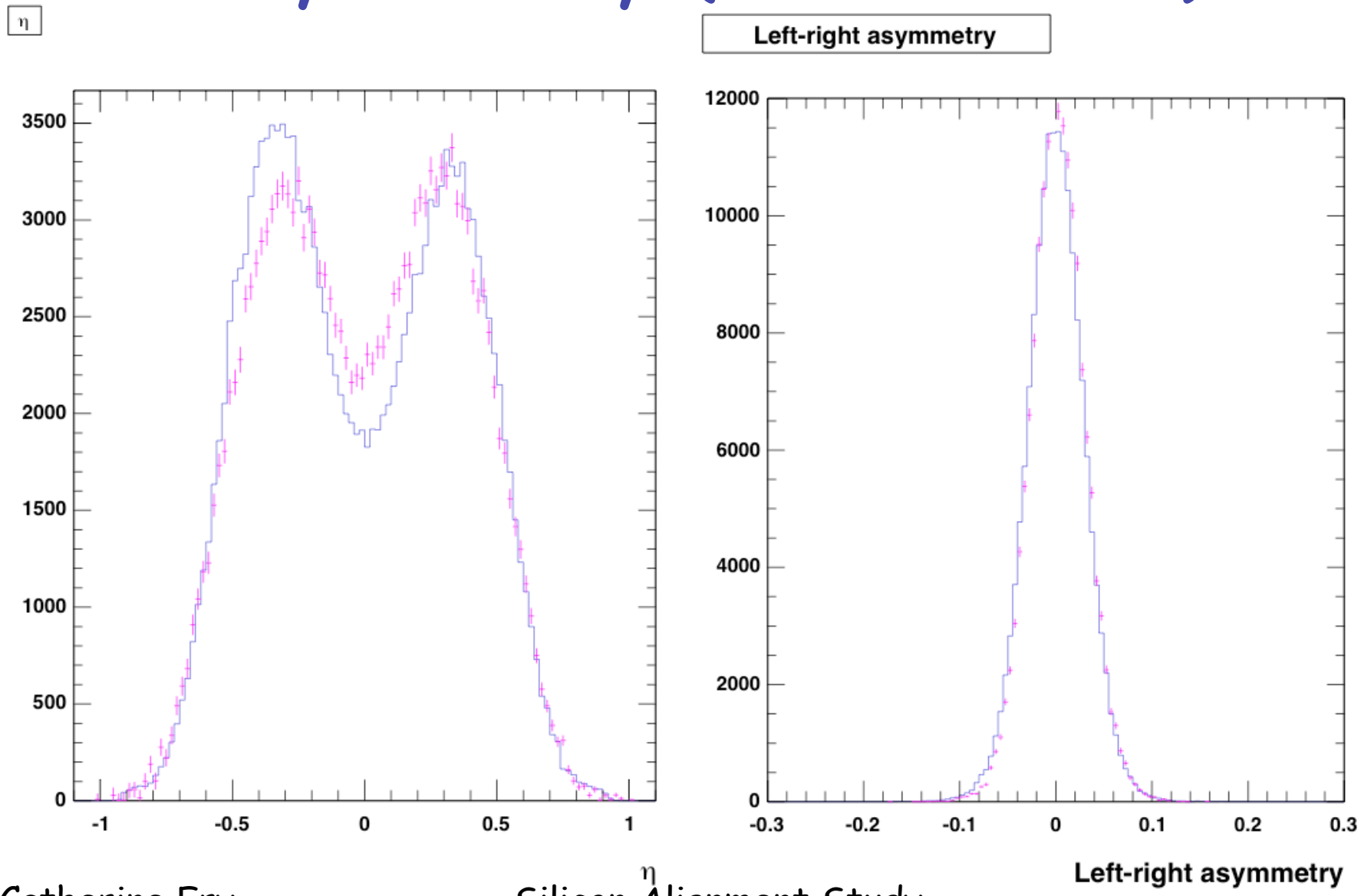
pink = data

blue = mc

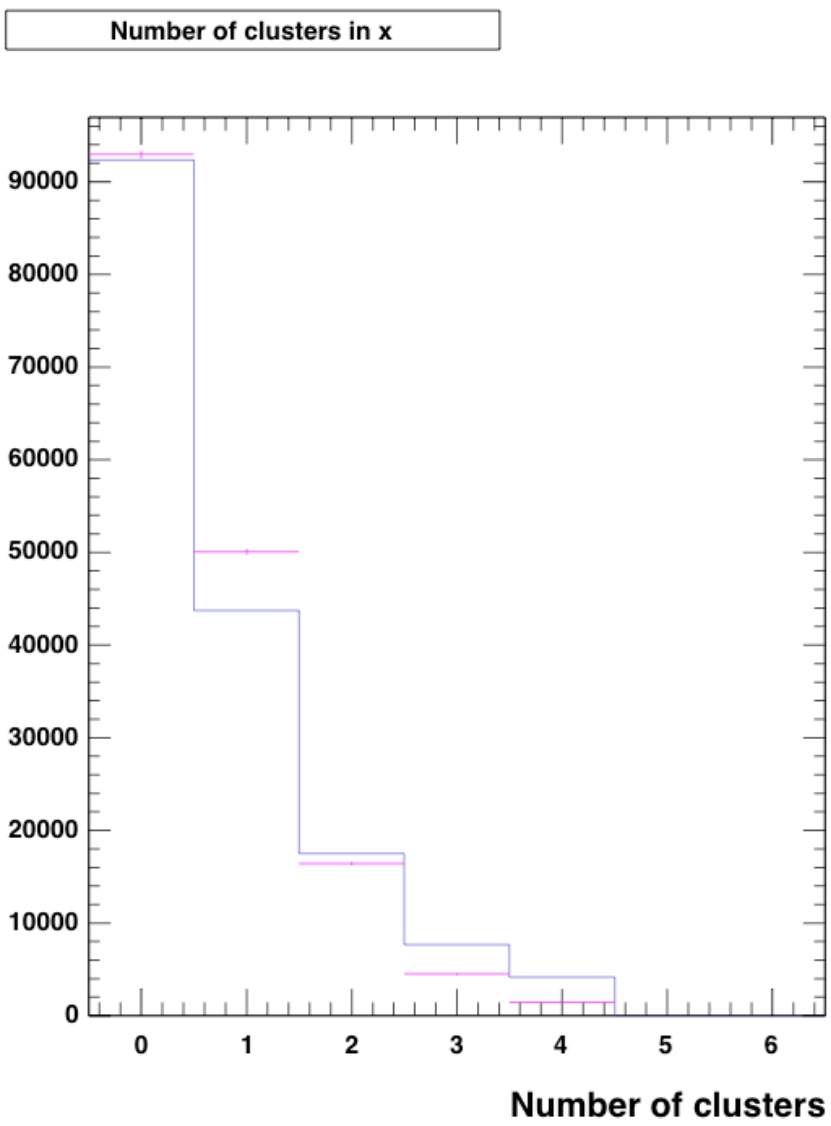


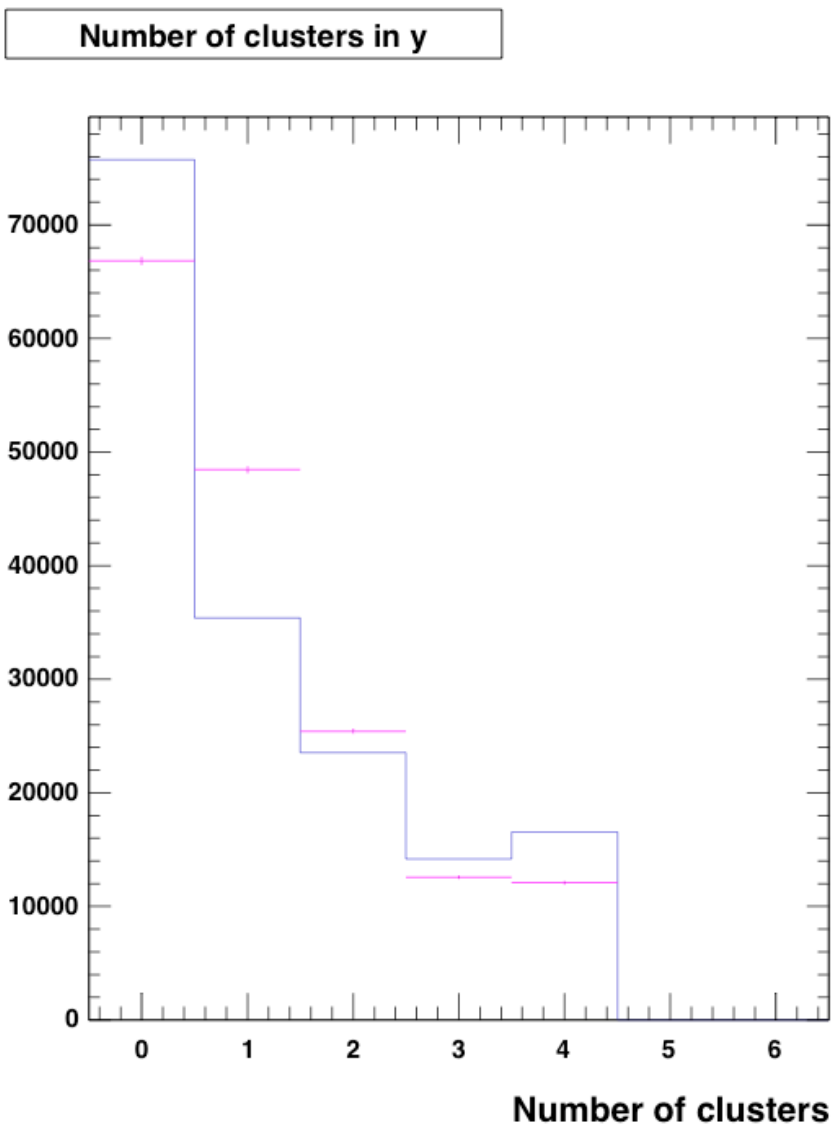


Asymmetry (u/d and l/r)



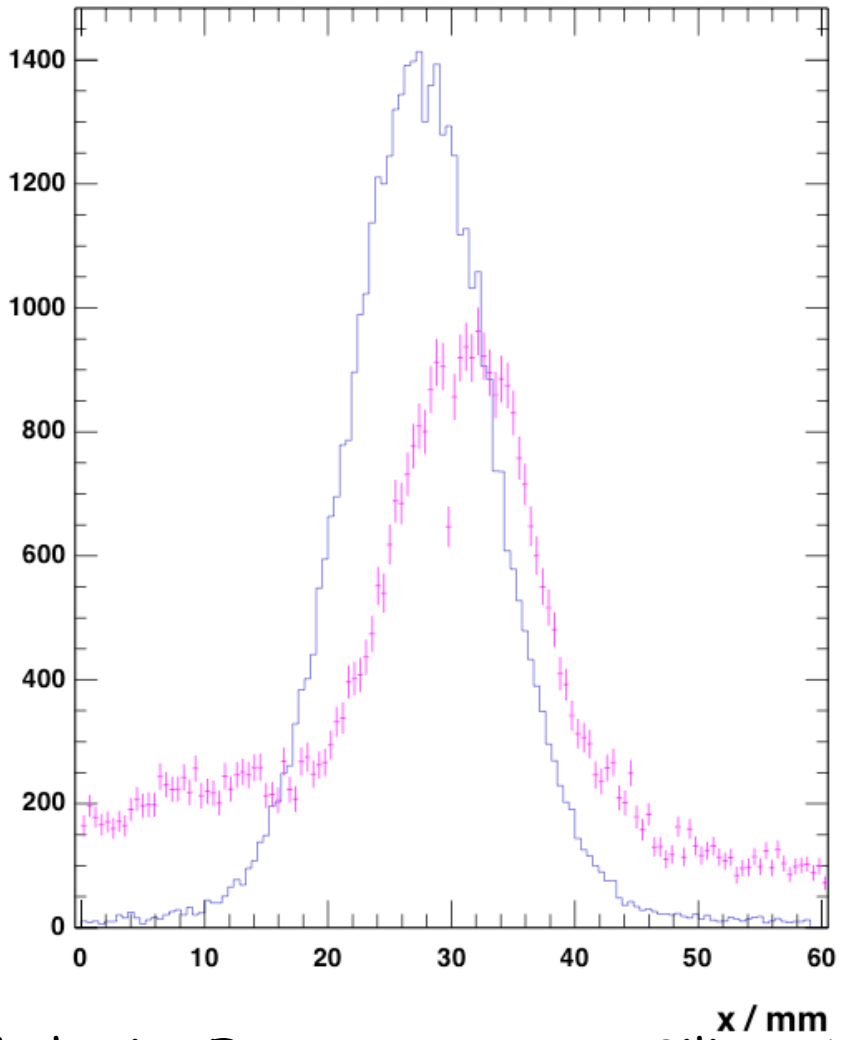
Number of silicon clusters



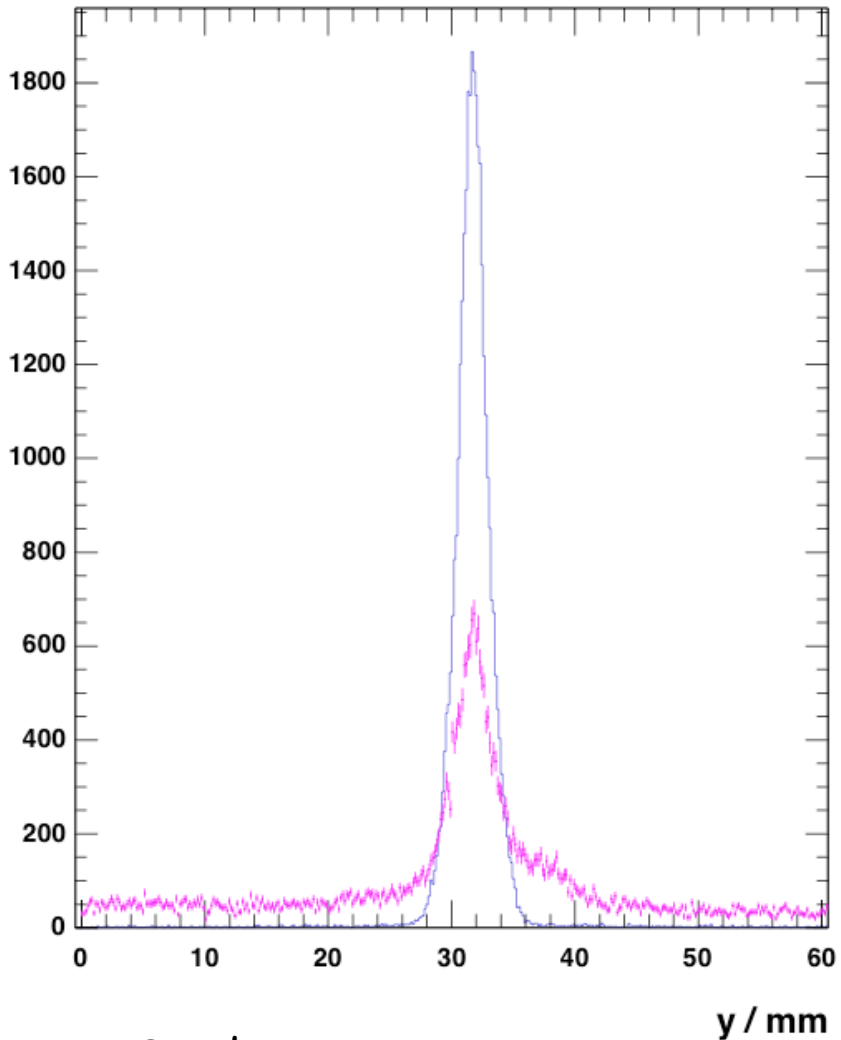


Silicon cluster position

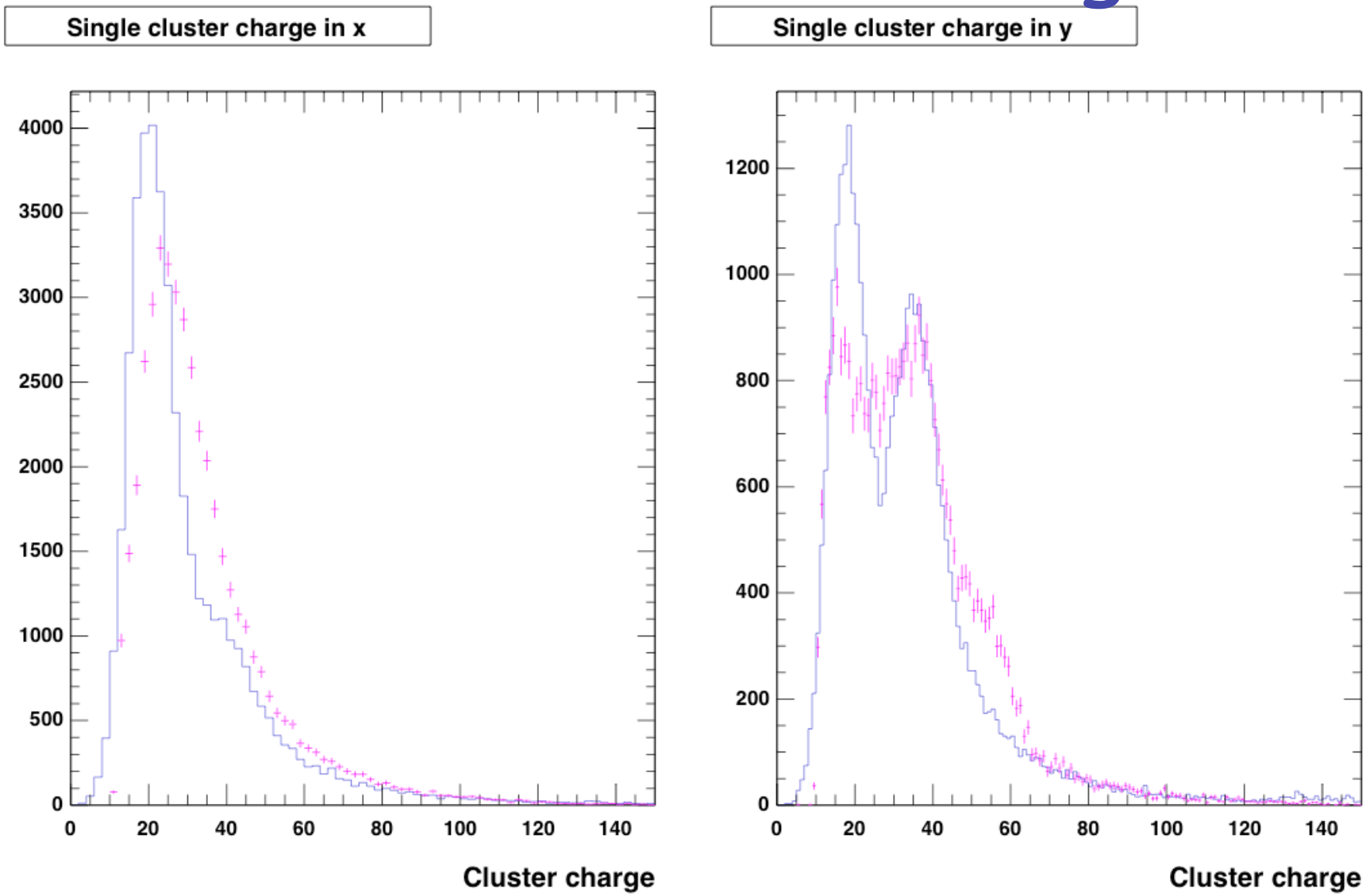
Single cluster distribution in x



Single cluster distribution in y



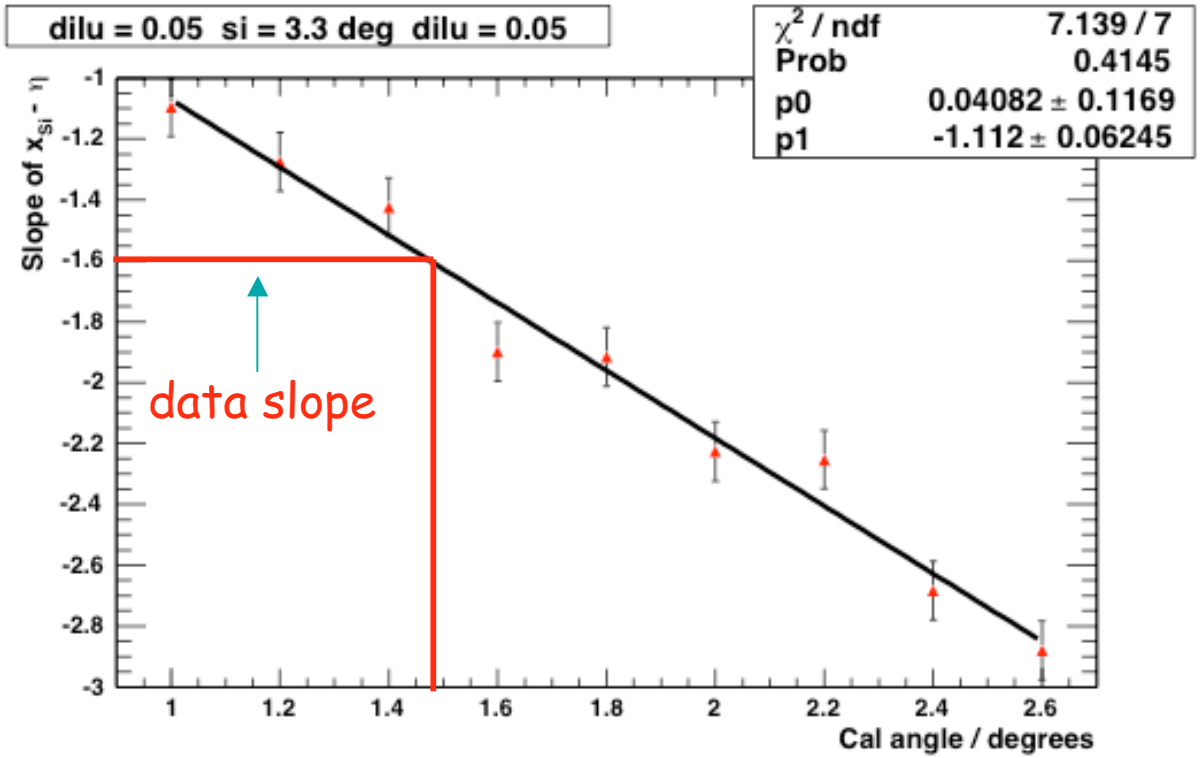
Silicon cluster charge



The measurement

- In MC fix silicon angle w.r.t. beam to that measured by ellipse fit for each data sample
- Vary cal angle w.r.t. beam and simulate 200k events at each angle
- Measure x-η slope from MC for each cal angle

- Plot x-η against cal angle and fit a straight line
- From fit, calculate which cal angle matches the x-η slope from the data



Si-Cal angle

Date	Beam tilt / °	Cal angle / °	Angle between silicon and cal / °
1st Mar	6.8 ± 0.4	1.7 ± 0.2	4.4 ± 0.5
7th Mar	4.6 ± 0.2	1.9 ± 0.1	2.7 ± 0.3
24th May	3.0 ± 0.2	1.4 ± 0.1	1.8 ± 0.2
8th July	3.4 ± 0.3	1.2 ± 0.2	2.2 ± 0.3
9th July	3.4 ± 0.5	1.9 ± 0.2	1.5 ± 0.6
12th July	3.4 ± 0.3	1.5 ± 0.2	1.9 ± 0.4
13th July	4.7 ± 0.4	1.9 ± 0.2	2.8 ± 0.4
15th July	3.5 ± 0.6	1.4 ± 0.2	2.2 ± 0.6
3rd August	4.5 ± 0.3	2.1 ± 0.2	2.4 ± 0.3
4th August	4.7 ± 0.4	1.9 ± 0.2	2.8 ± 0.4
5th August	4.1 ± 0.4	1.9 ± 0.2	2.1 ± 0.4
6th August	4.3 ± 0.4	1.7 ± 0.2	2.6 ± 0.4
10th-11th August	3.5 ± 0.2	1.3 ± 0.2	2.2 ± 0.3
11th August	3.3 ± 0.3	1.5 ± 0.2	1.8 ± 0.3
11th Aug	3.1 ± 0.2	1.5 ± 0.1	1.8 ± 0.3

average =

2.2 ± 0.4 °

Conclusions

- Made 15 measurements of misalignment angle between silicon and calorimeter
- Average angle = 2.2 ± 0.4 °
- Not yet had time to compare ellipse-fit method of measuring beam tilt with the laser scan method