Silicon Update

POL meeting

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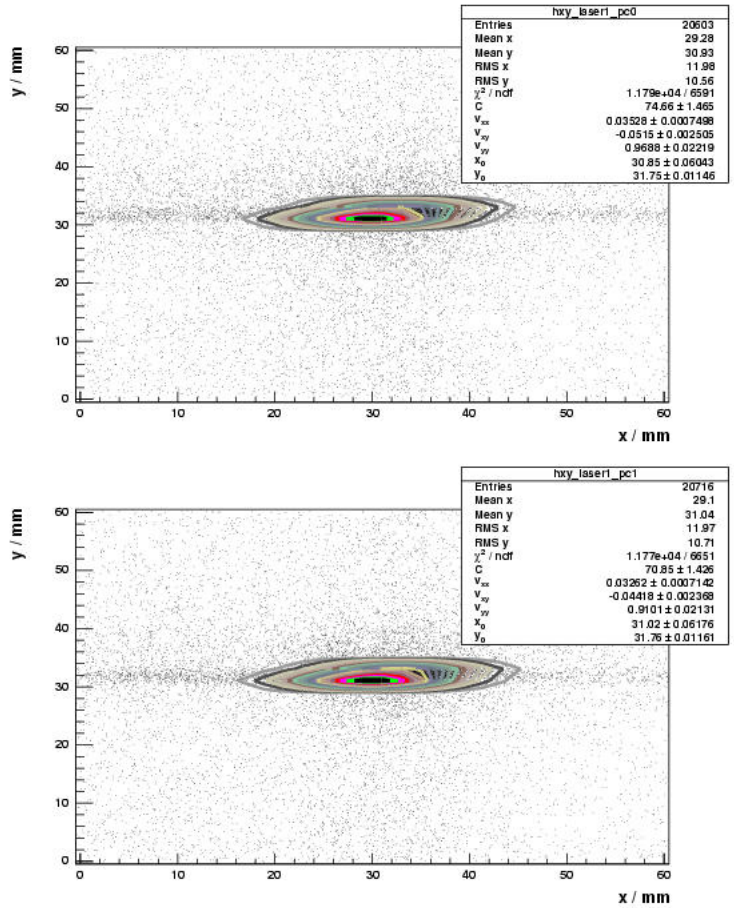
Catherine Fry

Imperial College London

- Analysis
- Software
- Shutdown work

Fitting beam ellipse to silicon data

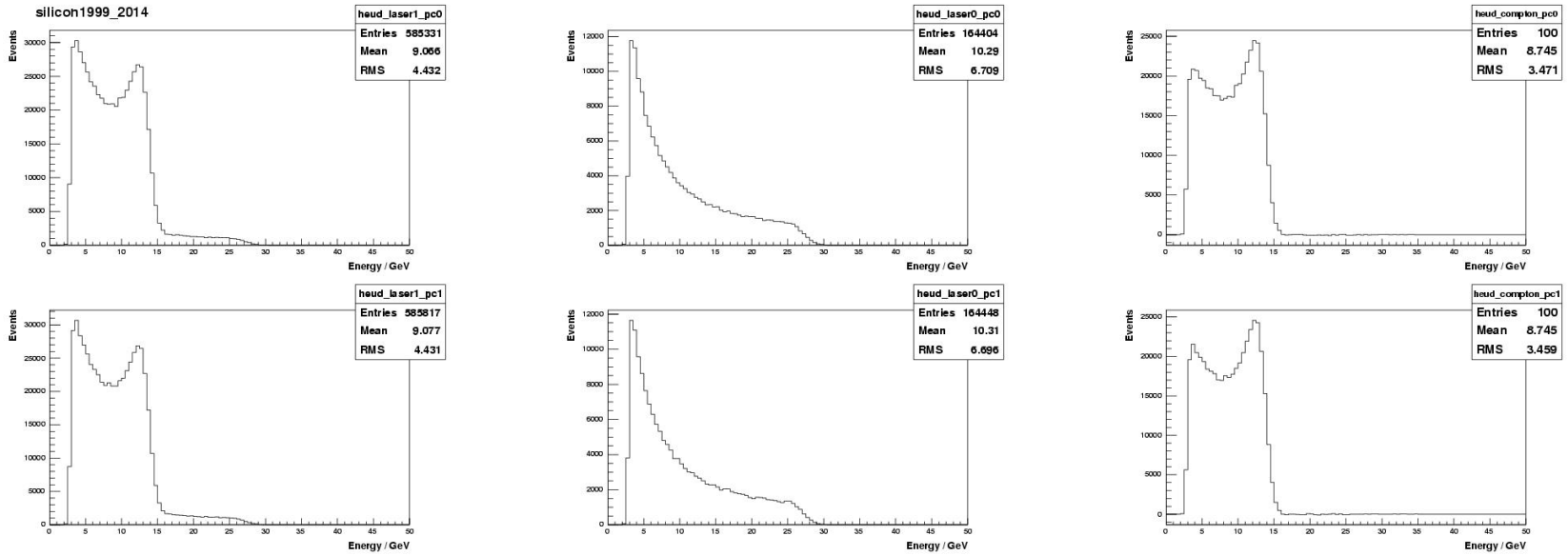
- As shown previously, can fit a 2D ellipse to silicon data with the following function:
  - $f(x,y) = C\exp\Big(-0.5(v_{xx}(x-x_0)^2+2v_{xy}(x-x_0)(y-y_0)+v_{yy}(y-y_0)^2)\Big)$



- Pockels cell 0:
  - $\sigma_{max} = 5.55 \pm 0.00$ mm
  - $\sigma_{min} = 1.06 \pm 0.00$ mm
  - $\alpha = 3.15 \pm 0.17$ degrees
  - $\chi^2/ndf = 1.8$
- Pockels cell 1:
  - $\sigma_{max} = 5.74 \pm 0.01$ mm
  - $\sigma_{min} = 1.09 \pm 0.00$ mm
  - $\alpha = 2.88 \pm 0.17$ degrees
  - $\chi^2/ndf = 1.8$

Compton only data

- Want to subtract laser off data from laser on for silicon data to leave just the Compton beam
- Laser on, laser off and Compton only energy distributions for Pockels cell 0 and 1:



- Compton distribution produced by normalising tail of laser off (Bremsstrahlung) energy distribution to the tail of the laser on (Compton + Bremsstrahlung) energy distribution
- The normalisation factor is then used to weight the laser off distribution and subtract it from the laser on distribution for all histograms

Difference in x_0 and y_0 between Compton and bremsstrahlung data with Pockels cell 0 or 1

Beam	Pockels cell	x_0	y_0
Compton	0	26.30 ± 0.00	31.76 ± 0.00
Compton	1	26.35 ± 0.01	31.79 ± 0.00
Bremsstrahlung	0	25.55 ± 0.04	32.27 ± 0.01
Bremsstrahlung	1	25.32 ± 0.04	32.36 ± 0.01

- x_0(bremsstrahlung) $<$ x_0(Compton)
- y_0(bremsstrahlung) $>$ y_0(Compton)
- Bremsstrahlung beam shifted w.r.t. Compton beam in x and y direction?
- Not great difference between x and y positions for Pockels cell 0 and 1 for each beam
  - ▷ But we would expect to see a difference in y position for the Compton beam between Pockels cell 0 and 1 $\longrightarrow$ this is the asymmetry we want to measure...

Difference in x_0 and y_0 for different energy ranges

E_{min} / GeV	E_{max} / GeV	Beam	Pockels cell	x_0 / mm	y_0 / mm
0	40	Compton	1	25.96 ± 0.00	31.81 ± 0.00
0	5	Compton	1	25.70 ± 0.00	31.73 ± 0.00
0	10	Compton	1	26.14 ± 0.01	31.83 ± 0.00
0	16	Compton	1	25.83 ± 0.00	31.82 ± 0.00
10	16	Compton	1	26.35 ± 0.01	31.79 ± 0.00
10	40	Compton	1	26.78 ± 0.01	31.78 ± 0.00
16	40	Compton	1	no beam	no beam
0	40	Bremsstrahlung	1	24.94 ± 0.02	32.52 ± 0.00
0	5	Bremsstrahlung	1	24.22 ± 0.05	32.54 ± 0.01
0	10	Bremsstrahlung	1	24.45 ± 0.03	32.51 ± 0.01
0	16	Bremsstrahlung	1	24.75 ± 0.02	32.48 ± 0.01
10	16	Bremsstrahlung	1	25.32 ± 0.04	32.36 ± 0.01
10	40	Bremsstrahlung	1	25.35 ± 0.03	32.52 ± 0.01
16	40	Bremsstrahlung	1	25.37 ± 0.04	32.57 ± 0.01

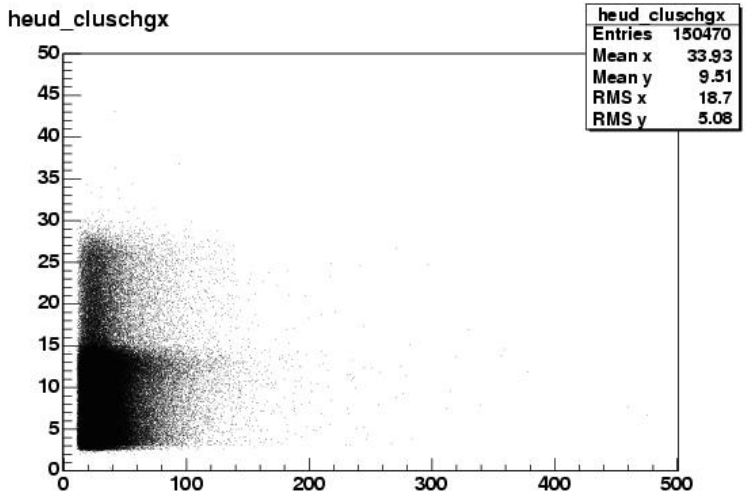
- x_0 and y_0 values obtained by fitting double Gaussian to clusters in x and y strips separately (i.e. not from ellipse fit)
- x_0 maybe increases slightly as energy range increases for both Compton and Bremsstrahlung beams
- No particular trend seen in y_0

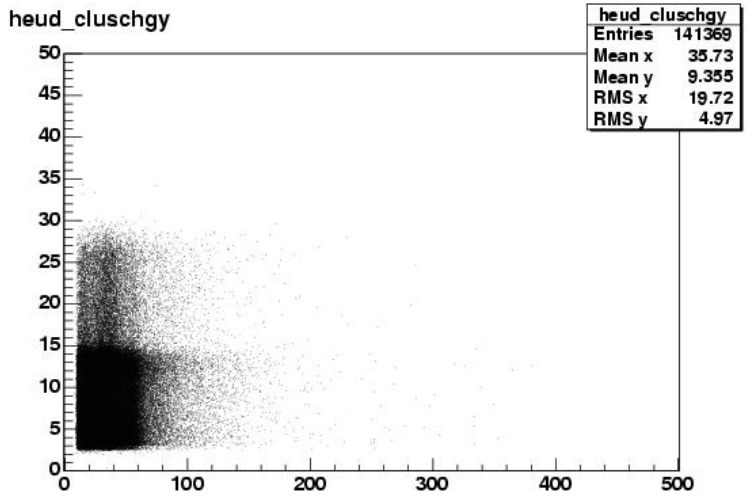
Calorimeter and silicon detector alignment

- Need to check silicon and calorimeter alignment for accuracy of η-y curve
- Need to relate η to vertical position without using silicon detector and then compare this to x and y from silicon to measure any eventual angle between the calorimeter and silicon y-axes
- Could maybe use MC to get theoretical η-y curve assuming perfect alignment and then measure deviation from this curve
- Needs more thought and work...

Cluster charge vs. energy

- Wanted to see if could make a cut on cluster charge
- Plotted energy / GeV vs. cluster charge in x and y for single cluster events, but distribution fairly smooth $\longrightarrow$ no obvious cut



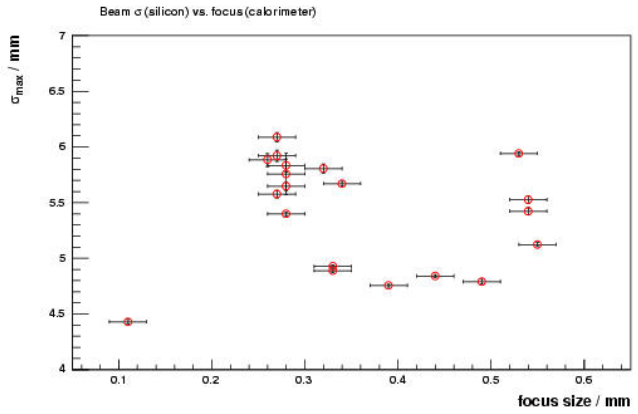


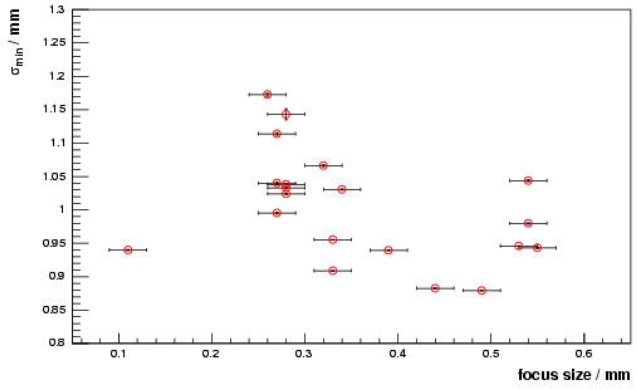
Silicon beam size vs. beam focus from calorimeter I

- Plot the maximum and minimum sigma from the beam ellipse vs. the focus size from the calorimeter (from oracle database)

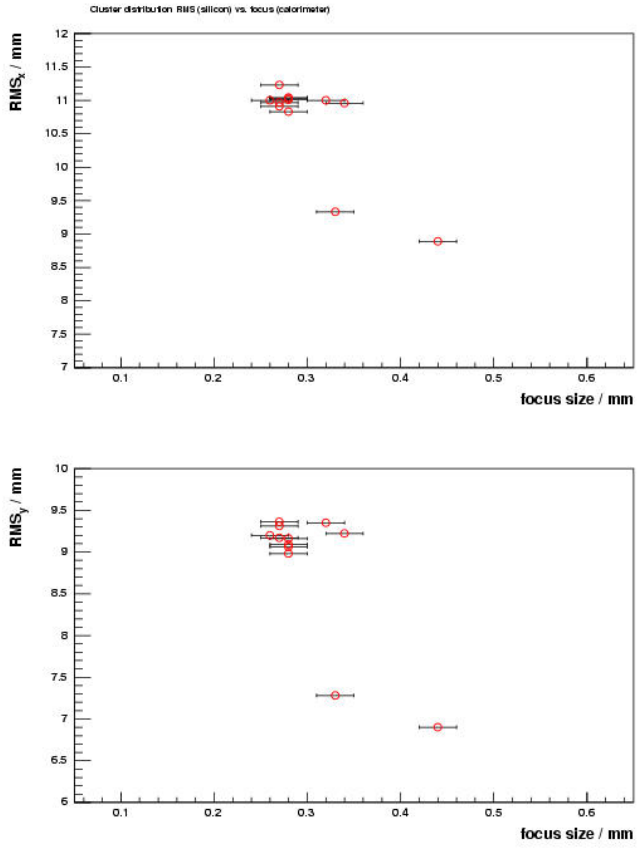
- See negative correlation between maximum and minimum sigma vs. focus size
  - ▷ max: -0.1
  - ▷ min: -0.4

- Not what expect - does it result from ellipse fit?





Silicon beam size vs. beam focus from calorimeter II



- Try plotting RMS of cluster distribution in silicon x and y strips vs. focus size
- Still see negative correlation
  - x: -0.8
  - y: -0.4
- Suggests negative correlation not from ellipse fit, but that the silicon detector measures different beam sizes to the calorimeter?
- Would be nice to check with more points from a greater number of fills (many of these points taken during same fill), not sure how to find focus size data from database if don't know time of run

FED clock skew check

- Need to match the SEQSI clock timing of the trigger signal with the silicon latency, else get an APV error
- Take 10k events at each FED clock skew value (0−9) and count the number of errors

FED skew	Error count
0	222
1	too many
2	1
3	3
4	0
5	3
6	0
7	5129
8	16325
9	too many

- The current value of 4 seems fine

Software

- Rahul (summer student) has added the silicon slow control on the TPOL Monitor
  - Can now turn x and y boards' HV on and off and choose voltage setting
  - Displays voltage, current and status of detector and boards in x and y planes
  - Also displays silicon temperature
  - Now have graphs of other parameters including silicon temperature, fibre position and silicon HV
- Currently working on the finite state machine $\longrightarrow$ important for routine silicon data-taking
- Also plans to work on the chiller control software

Shutdown and future work

- Install HERA clock board $\longrightarrow$ this currently has some timing problems which need fixing
- Understand and fix instability in silicon system $\longrightarrow$ probably to do with the computer...
- Install chiller $\longrightarrow$ probably will not have time for this one during shutdown
- There are spare silicon detectors at IC $\longrightarrow$ Alex is testing these at the moment and then will bring them to DESY once they are ready
- Use LED pulsar to check trigger energy level
- Take silicon data routinely and put ellipse fit online once the silicon DAQ has been made stable
- Develop the silicon analysis with the offline analysis work $\longrightarrow$ make best use of the silicon measurement