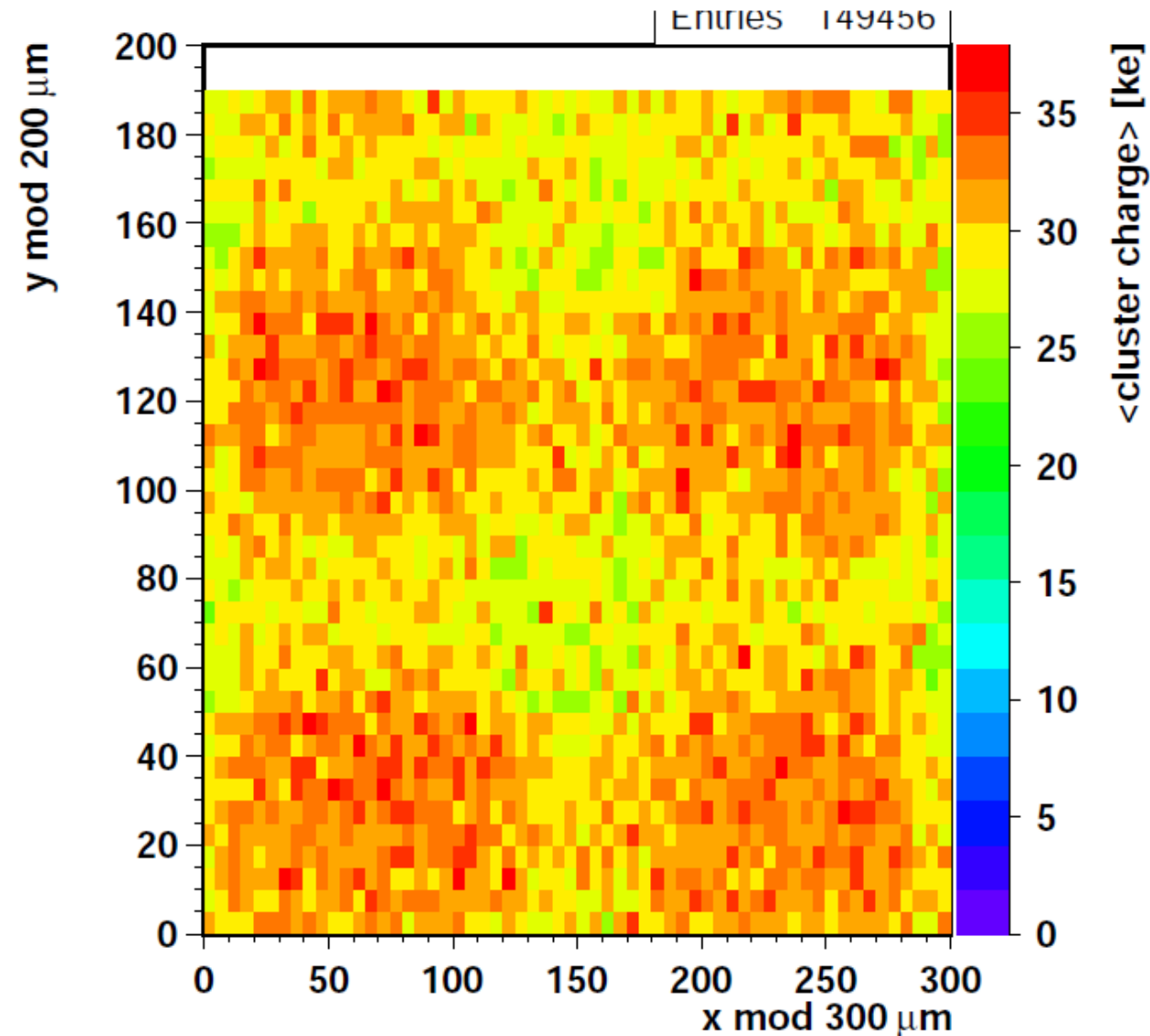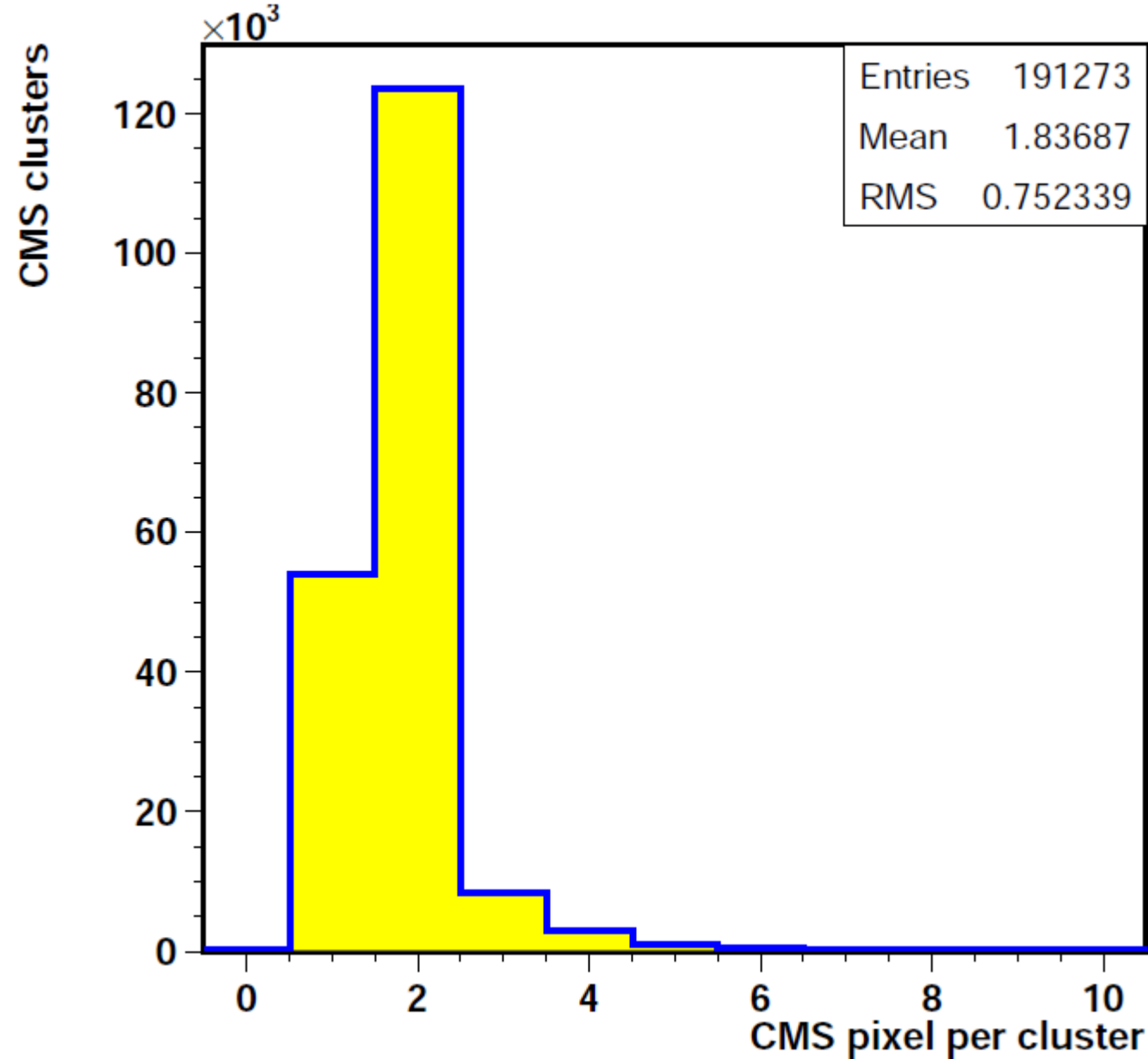# cluster charge studies

Daniel Pitzl

DESY CMS pixel upgrade meeting, 11.4.2012
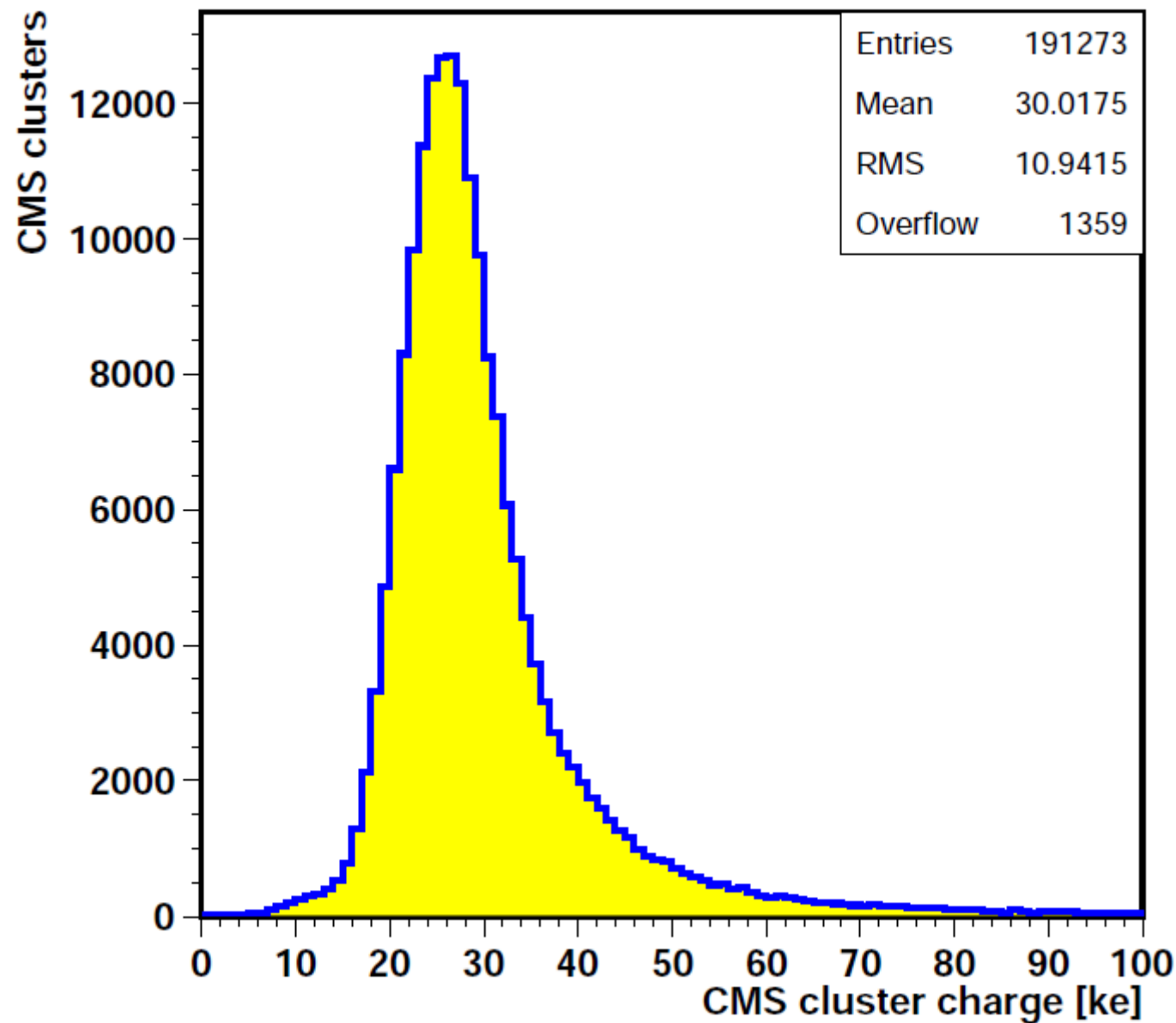

- some observations from the test beam:
  - ‣ cluster charge vs cluster size
  - ‣ cluster charge within one pixel
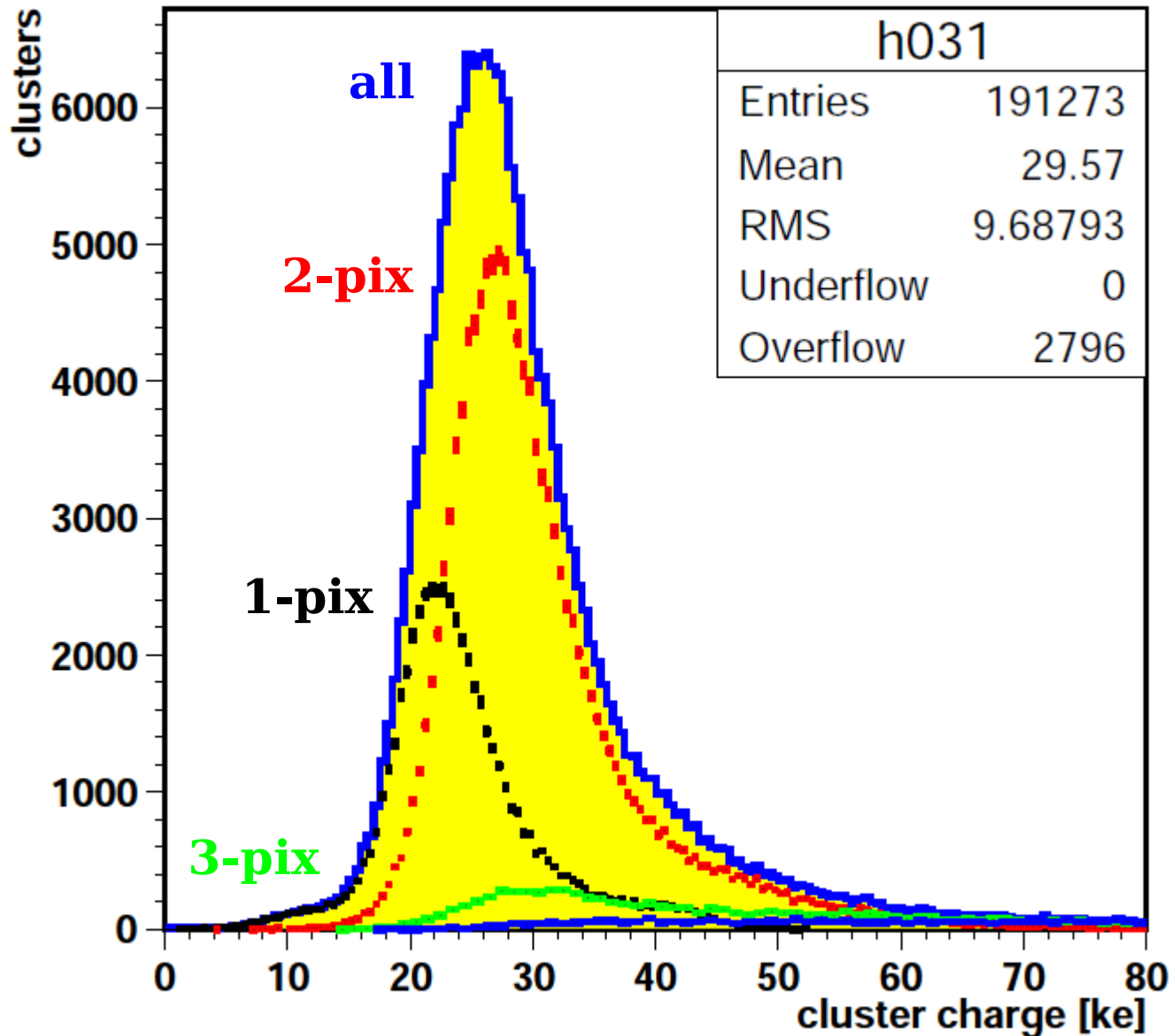 - ‣ charge across columns

Cluster size

- 4 GeV e-, run 2880

- 20° tilt

- 2-pixel clusters dominate at this tilt angle.
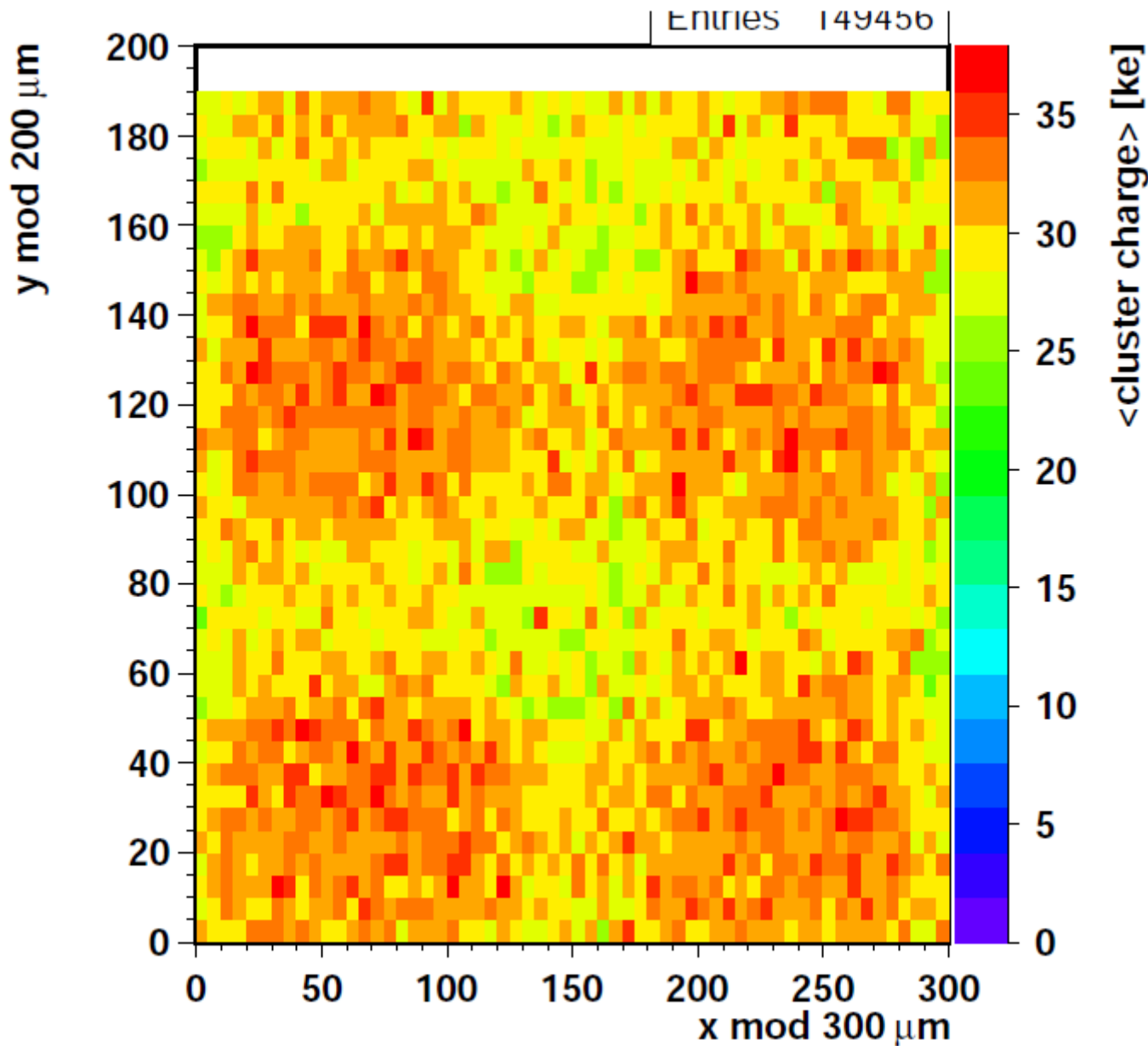
Cluster charge

- 4 GeV e-, run 2880, chip 10

- Test pulse gain calibration applied: gaintanh.dat

- Peak position OK

- Too broad?

Cluster charge

h031	
Entries	191273
Mean	29.57
RMS	9.68793
Underflow	0
Overflow	2796

- 4 GeV e-, run 2880, chip 10

- Test pulse gain calibration applied: gaintanh.dat
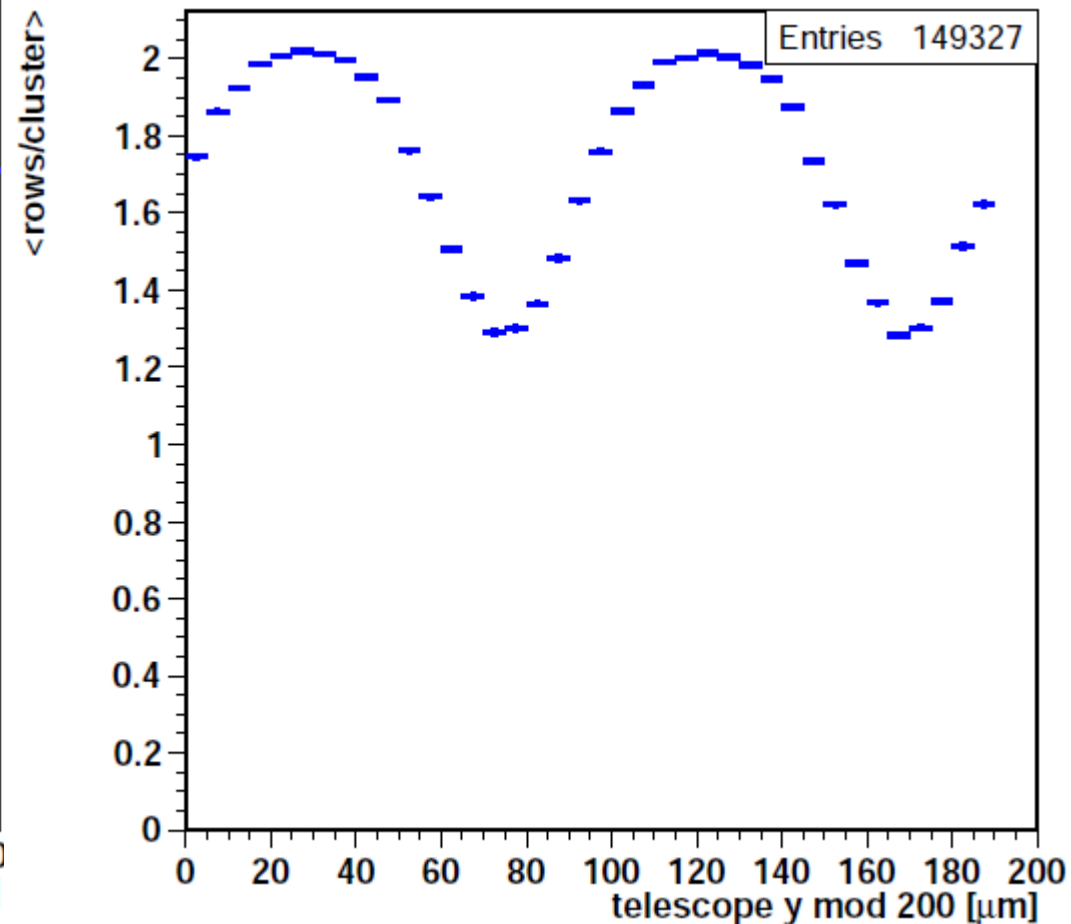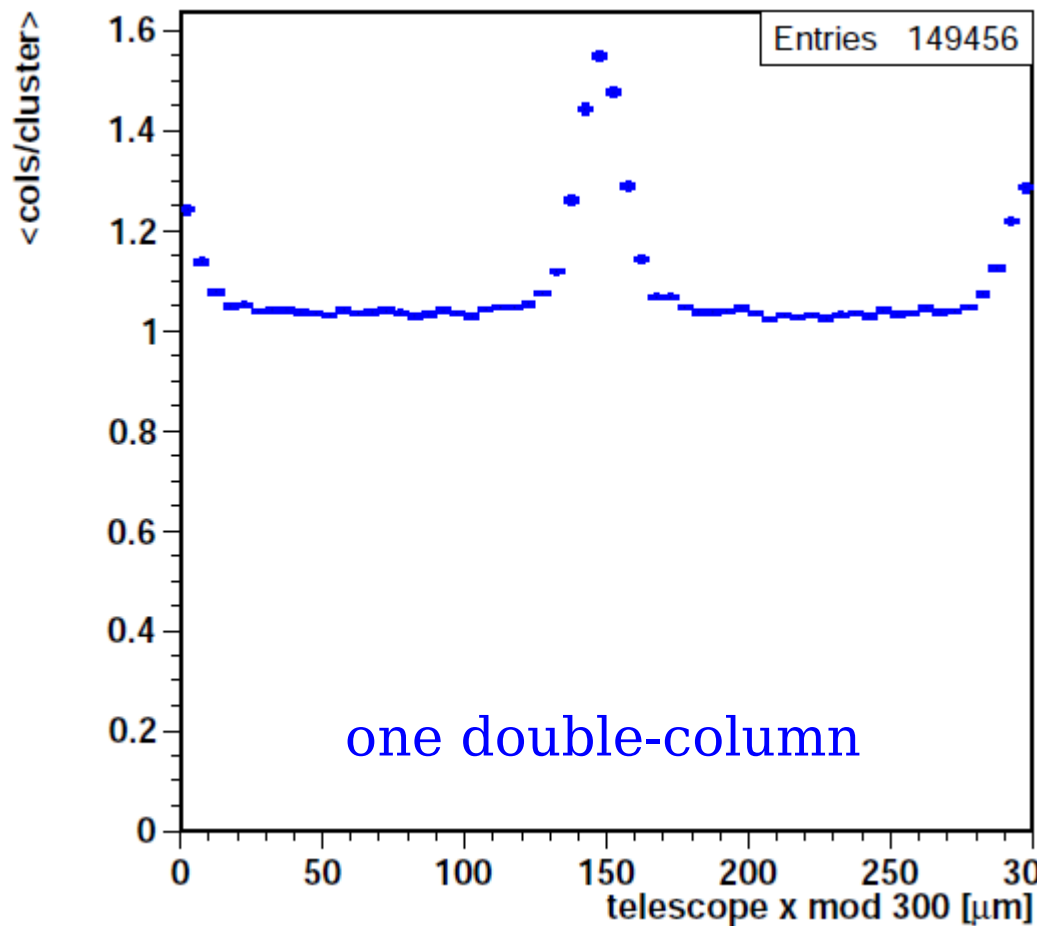
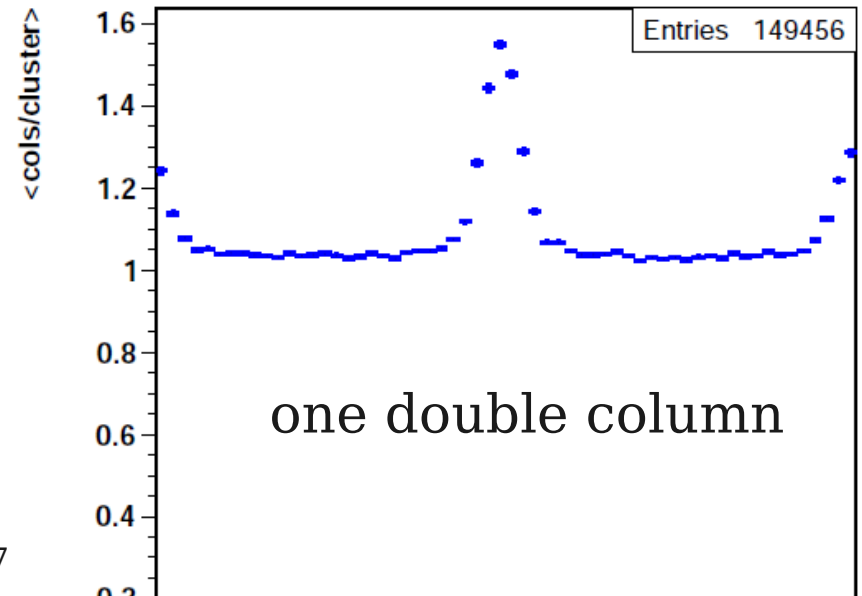- distinguish by cluster size:
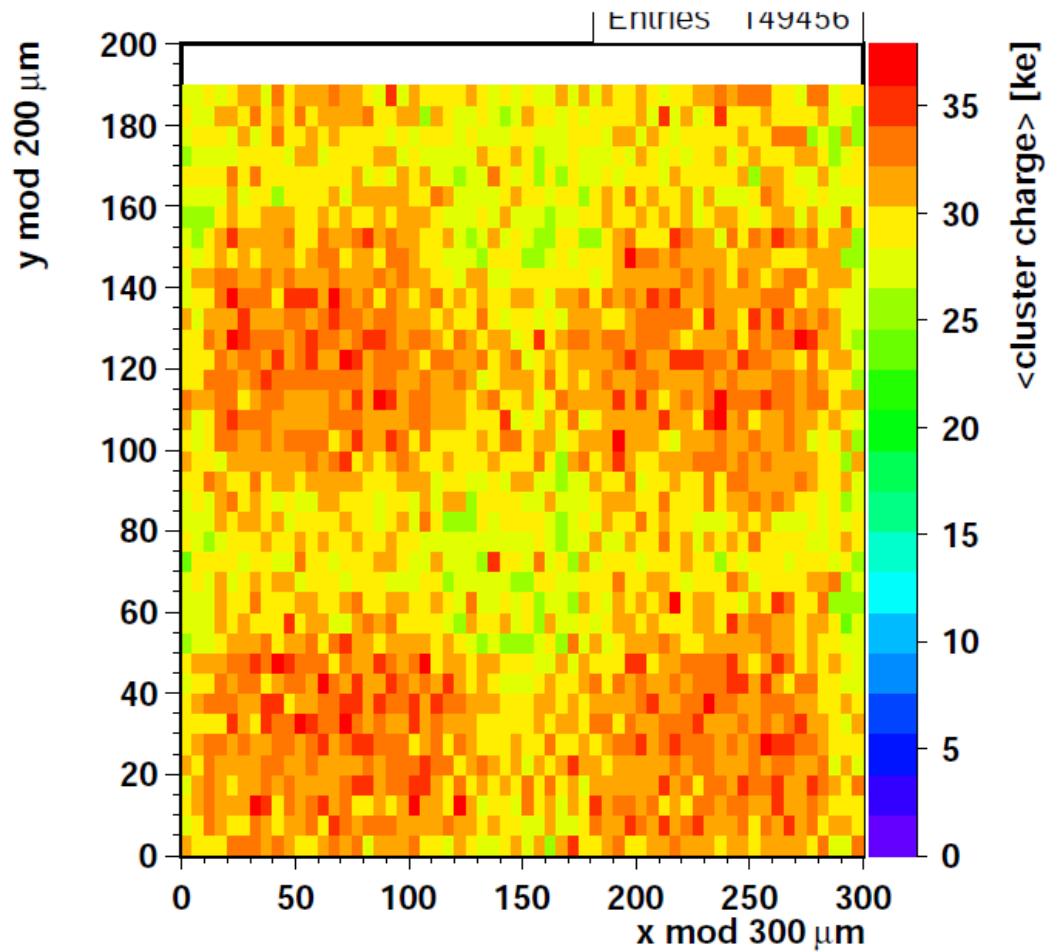 ‣ peak get shifted
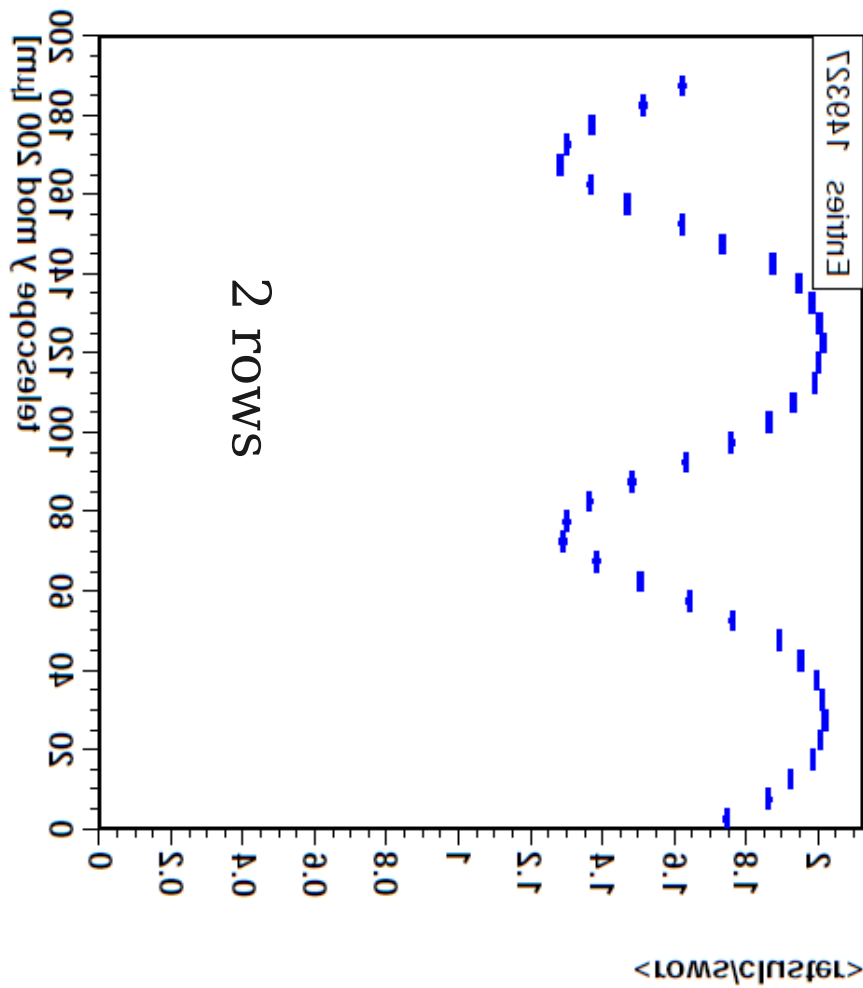
in-pixel charge map

- 4 GeV e-.

- chip 10, 20° tilt

- Test pulse gain calibration applied: gaintanh.dat

- Telescope track

- significant non-uniformity!

- pattern?

column and row profiles

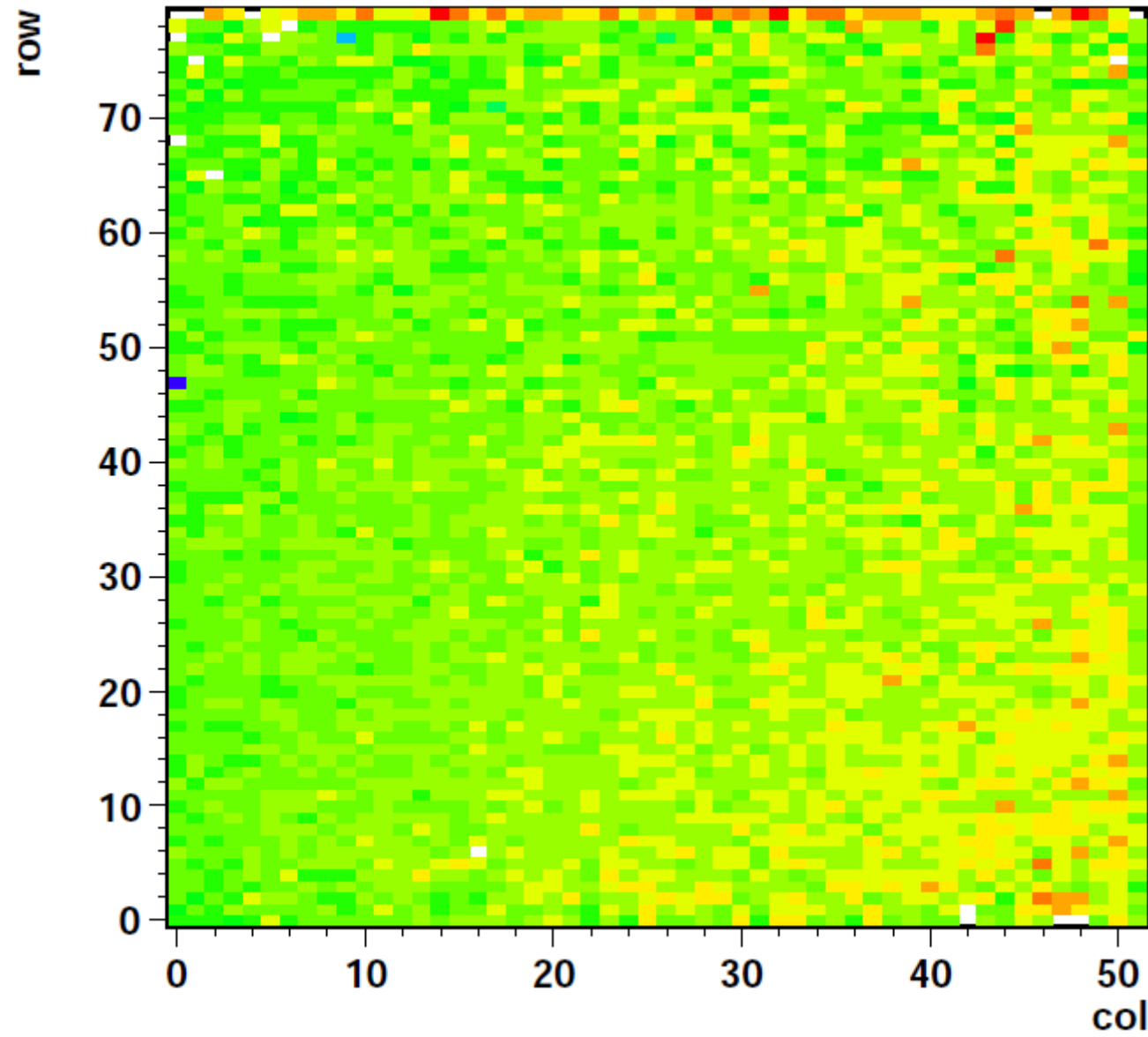4 GeV e-, run 2880, chip 10, 20° tilt

one double-column

middle peak higher: same DC
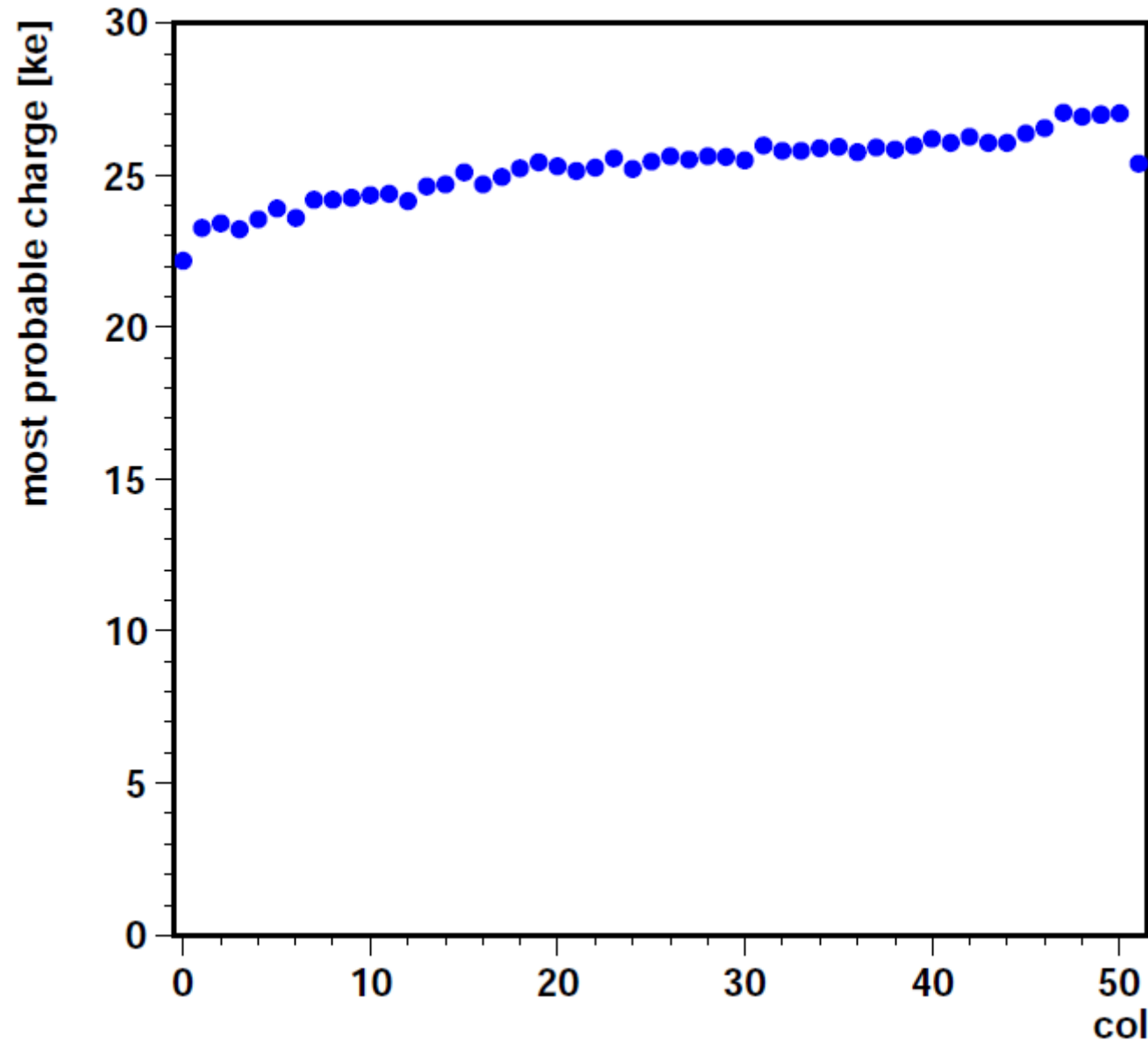edges: some loss into next DC?

- more charge for 2-row clusters
- less charge for 2-col clusters
- calibration problem?
- thresholds?
- sensor?

one double column

Cluster charge map

- 4 GeV e-.

- chip 10, 20° tilt

- Test pulse gain calibration applied: gaintanh.dat

- mean charge per cluster

- Trend across the chip

- Quite uniform along one column.

Cluster charge profile

- 4 GeV e-

- chip 10, 20° tilt

- Test pulse gain calibration applied: gaintanh.dat

- peak charge

- Observe ±8% gain variation across the chip:
  ‣ test pulse problem?
  ‣ check with X-ray source!

summary

- problems with cluster charge observed in recent beam test data:

  ‣ charge increases with cluster size

  ‣ charge varies within one pixel (track impact point)

  ‣ charge varies by $\pm 8\%$ across columns

- These non-uniformities lead to a broader pulse height distribution in beam test and X-rays

- Can an improved gain calibration procedure cure them?