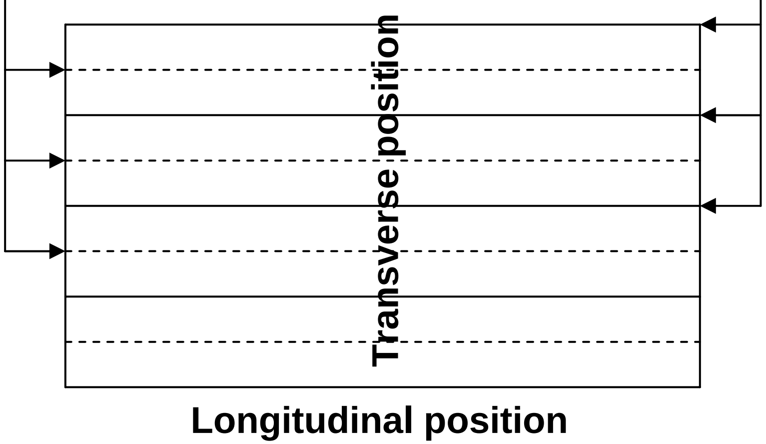
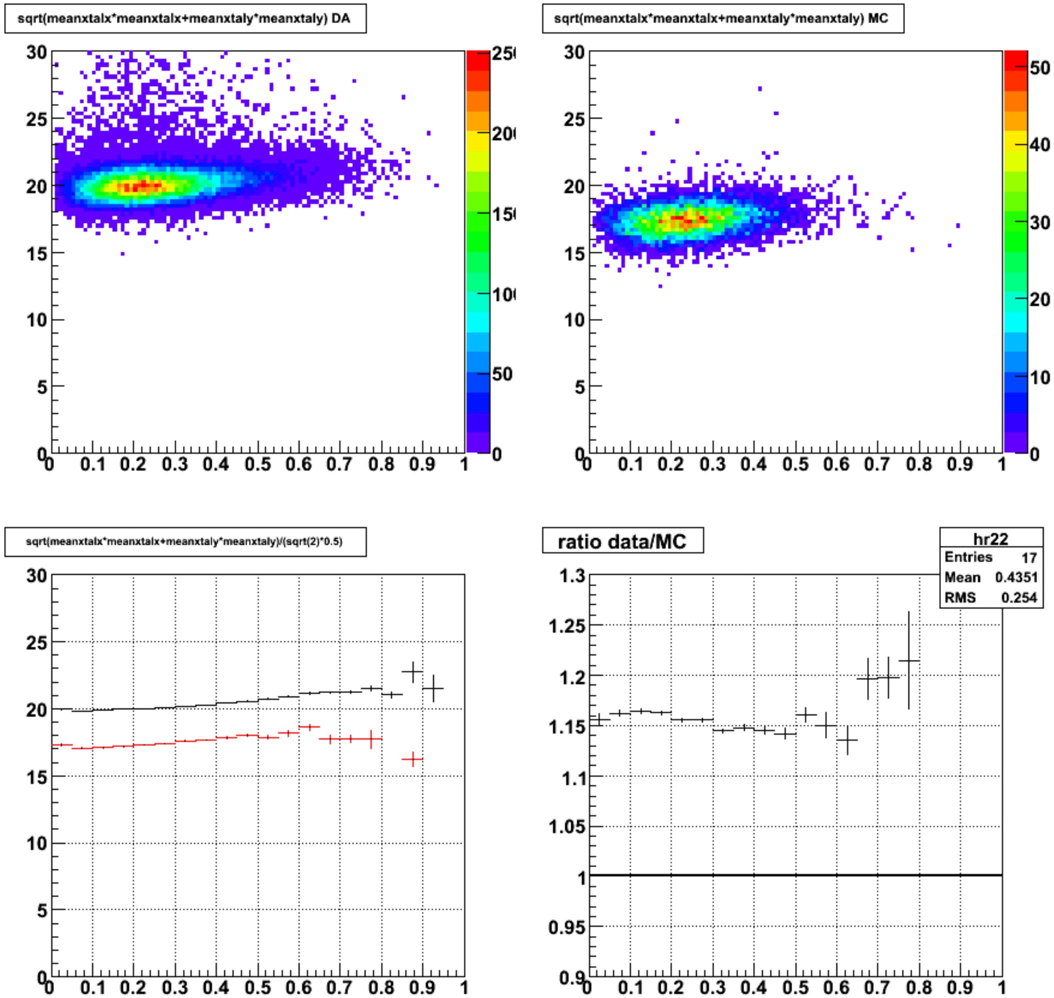
Transverse size analysis of electrons showers and longitudinal position measurement

- Summary of what I have shown at the the last beamtest meeting and the last C&A meeting
- CalTransRms definition
- Transverse size estimation
- Transverse and longitudinal position measurement
- longitudinal position vs energy

CalTransRms discrepancy (reminder)

- 100 GeV on-axis
- CalTransRms is 15% larger than in MC
- X-axis :
  - 0 = center of xtal
  - 1 = between 2 xtals





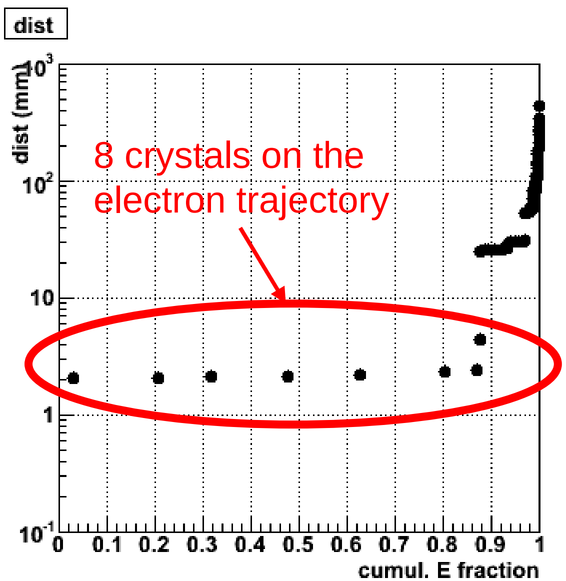
CalTransRms definition

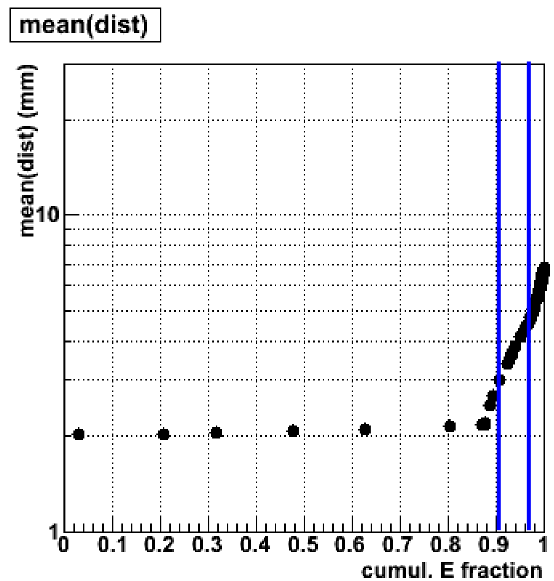
- Inertia tensor : when calculated in the referential defined by the principal axis, the inertia tensor is diagonal and the 3 moments of inertia are :
  - $I_{xx} = \int(y^2+z^2)\, dm\, dxdydz$
  - $I_{yy} = \int(x^2+z^2)\, dm\, dxdydz$
  - $I_{zz} = \int(x^2+y^2)\, dm\, dxdydz$
- CalMomentsAnalysis determines, using m=E :
  - the centroid
  - the principal axis (z gives the shower axis, thus the particle direction)
  - the 3 moments : CalTransRms = sqrt(Izz/E)
- It is an iterative procedure during which the more distant crystals are discarded : if distance to axis is greater than CalTransRms x scalefactor (=1.5 in first iteration, 3, 6, 12…)
- CalTransRms is then recalculated with final centroid and with all crystals

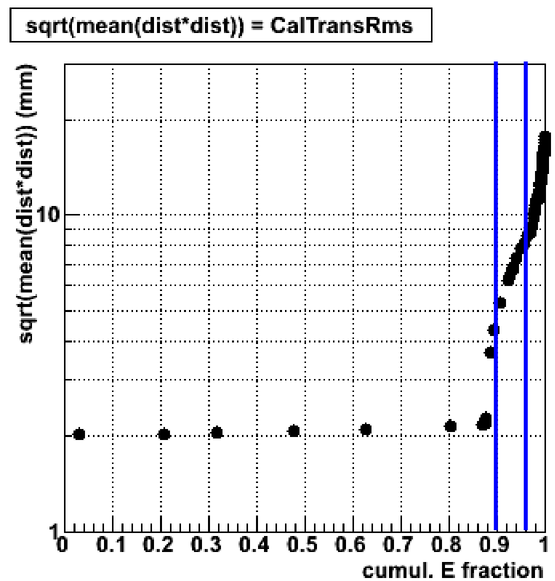
Transverse size estimation

- I wanted to see how sensitive we are to the edges of the shower
- I've used the Tkr1 direction instead of Cal direction
- Sort the crystals in increasing distance to the first track
- For crystal i, Efrac[i] = (E[0]+E[1]+…+E[i])/CalEnergyRaw
- Estimate the transverse size at Efrac= 0.9 or 0.95 or 0.99

One event from run 1981 (100 GeV, on-axis) :



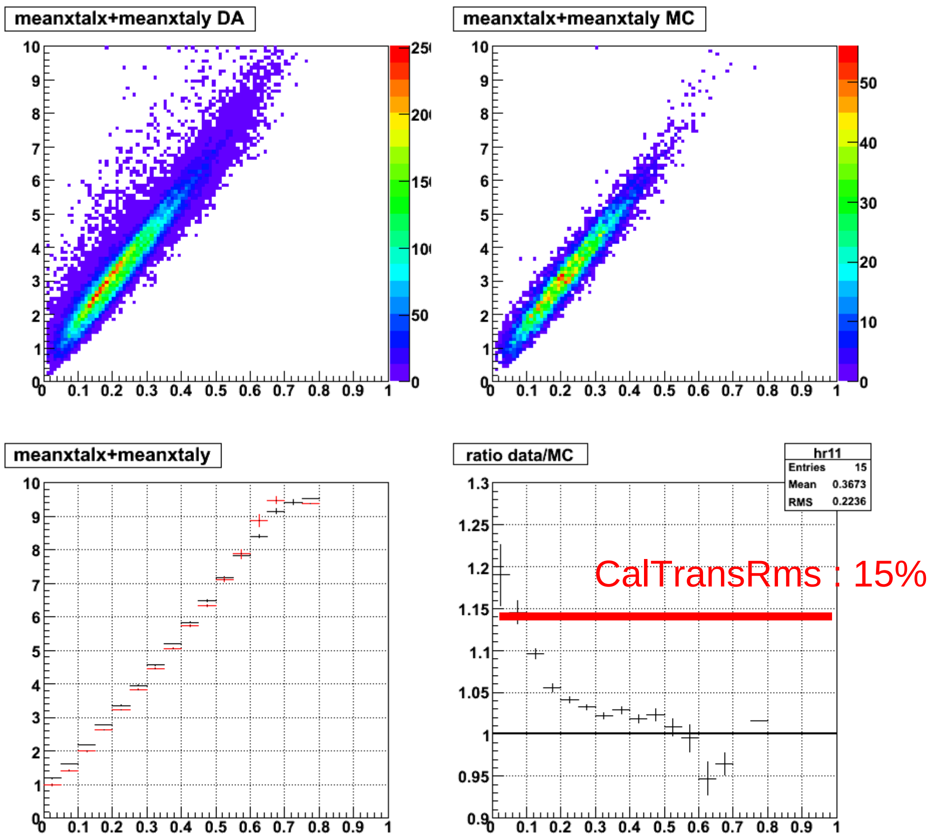




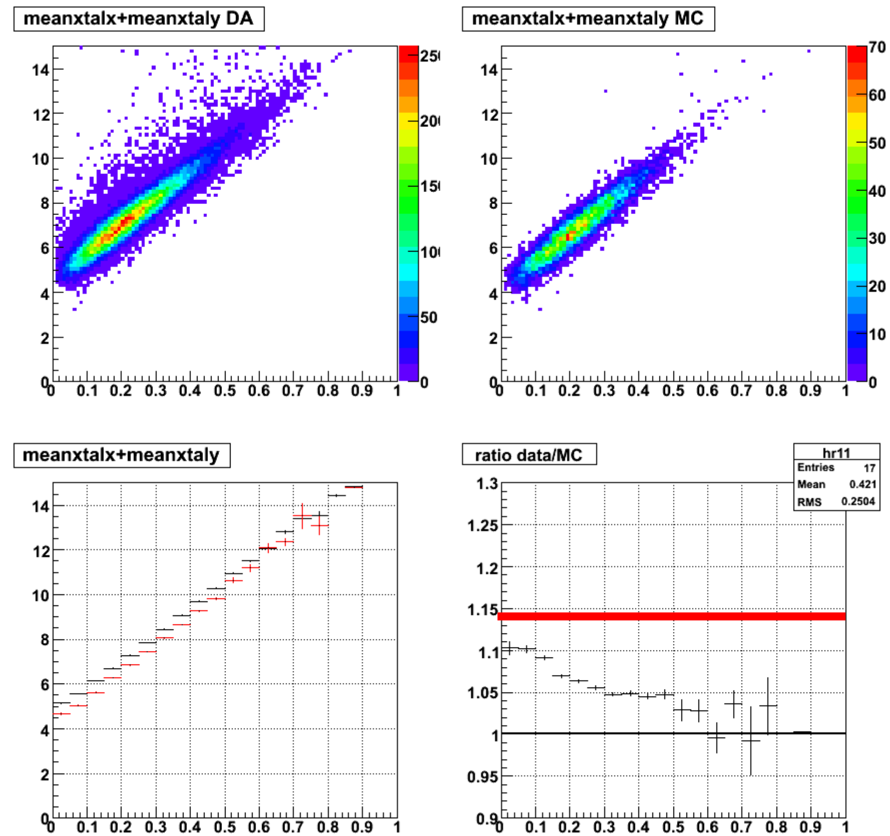
100 GeV on-axis, using only transverse position

- X-axis : 0 = center of crystal, 1 = between two crystals

Mean dist at Efrac=0.9



Mean dist at Efrac=0.99

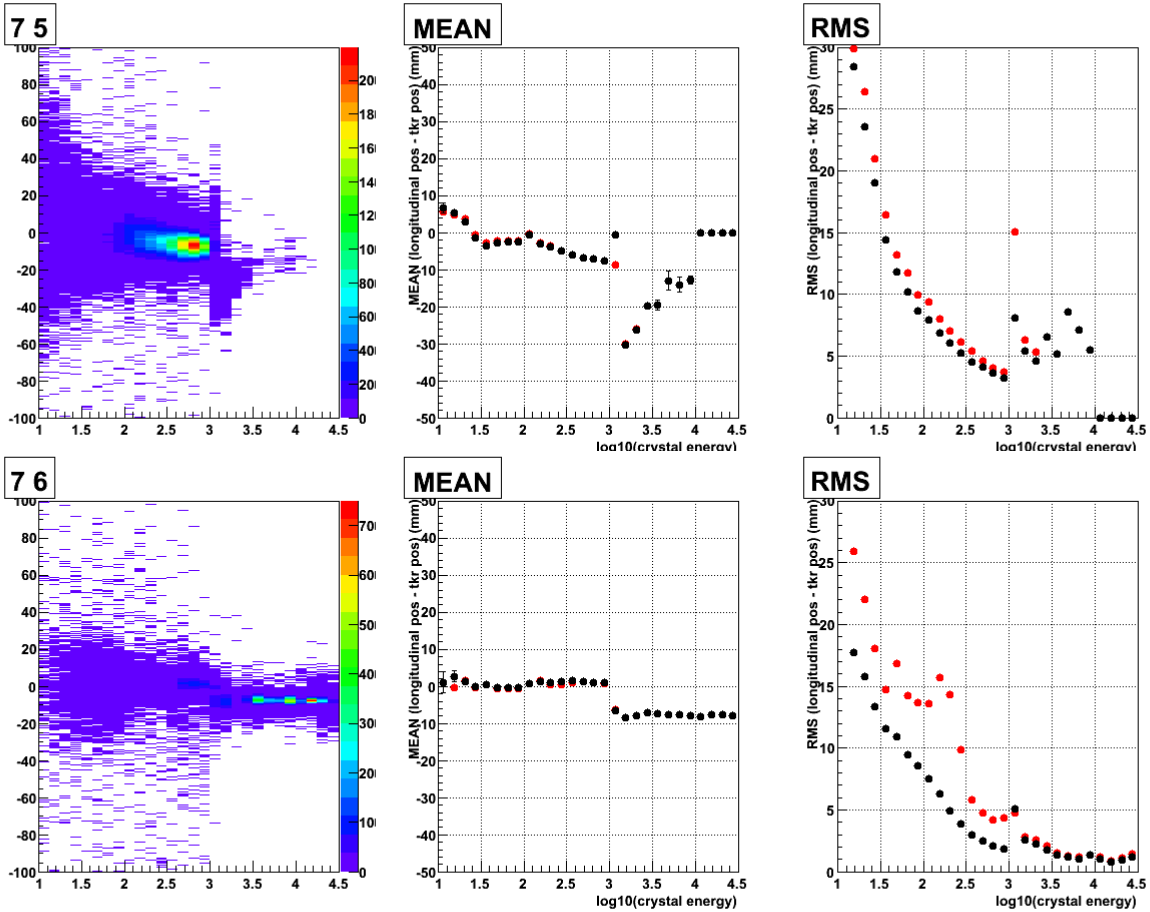


Transverse size estimation

- With the transverse size of the showers using only the transverse position measurement, we have a far better agreement between data and MC
- The agreement is better at Efrac=0.9 than at Efrac=0.99 : the remaining discrepancy comes from energy deposition discrepancy between data and MC at the edge of the shower

Offset corrections

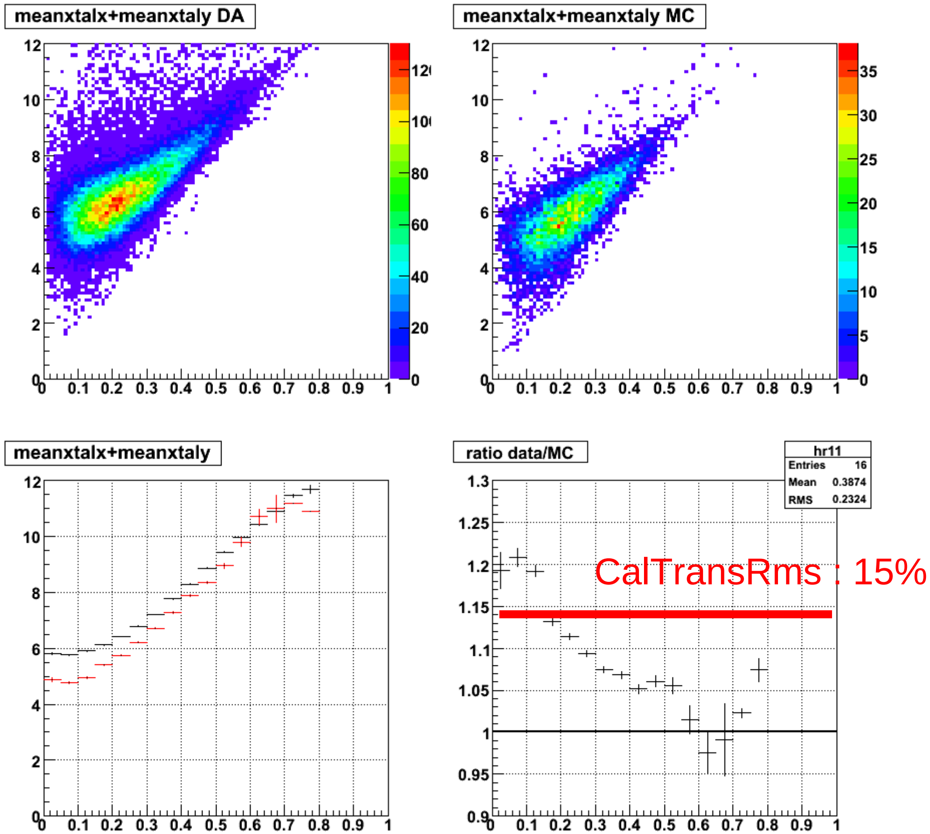
- I've used all runs at 0 deg from 5 to 282 GeV
- For each crystal, I've determined the offset as function of log10(energy) :



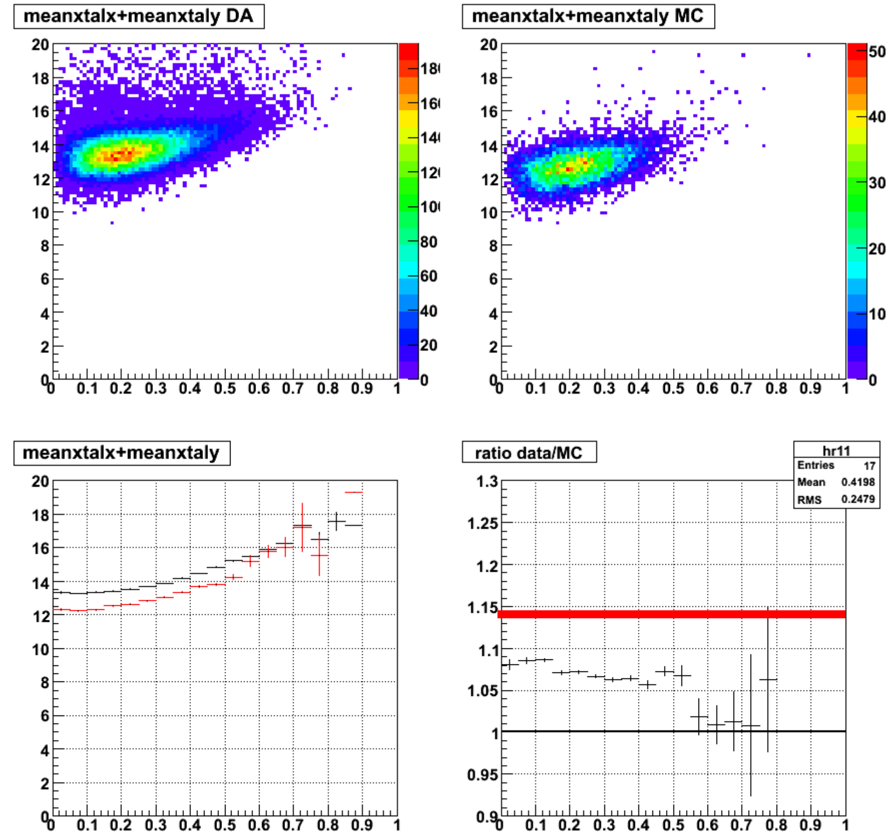
100 GeV on-axis, use corrected longitudinal position

- X-axis : 0 = center of crystal, 1 = between two crystals

Sqrt(mean dist*dist) at Efrac=0.9

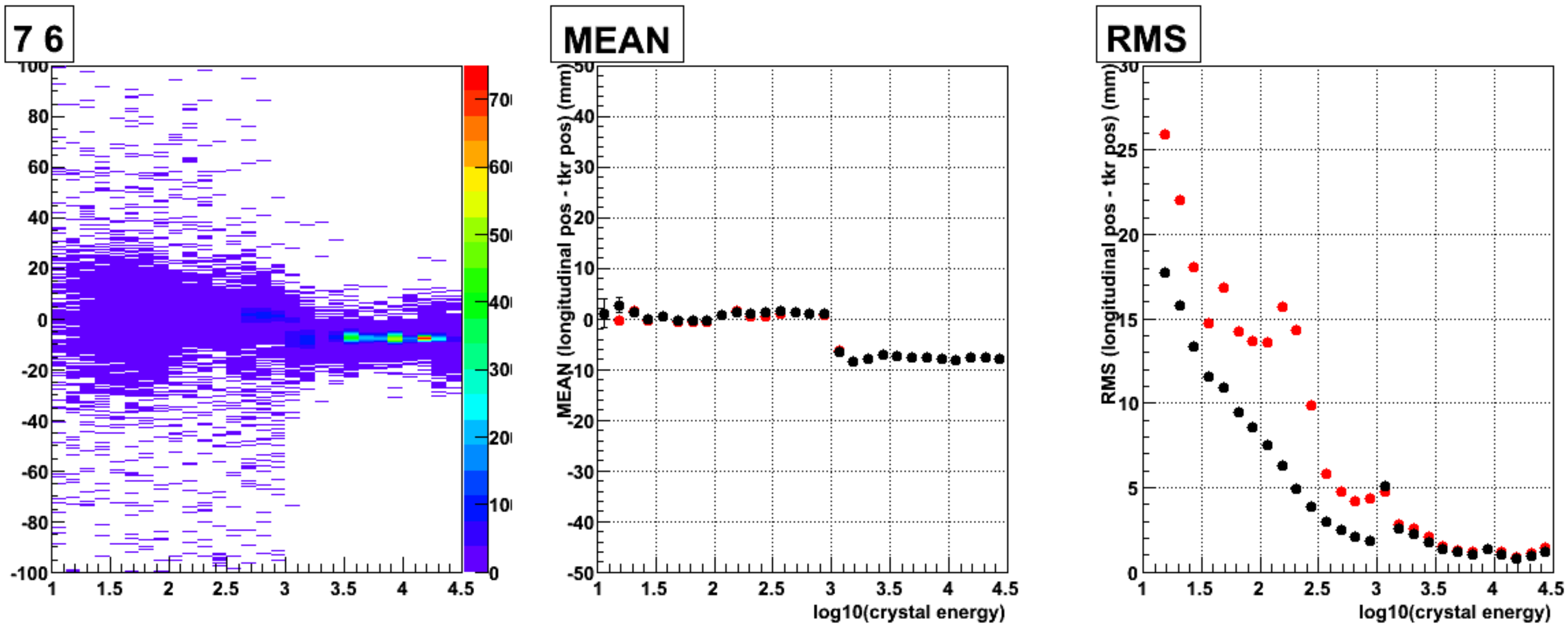


Sqrt(mean dist*dist) at Efrac=0.99



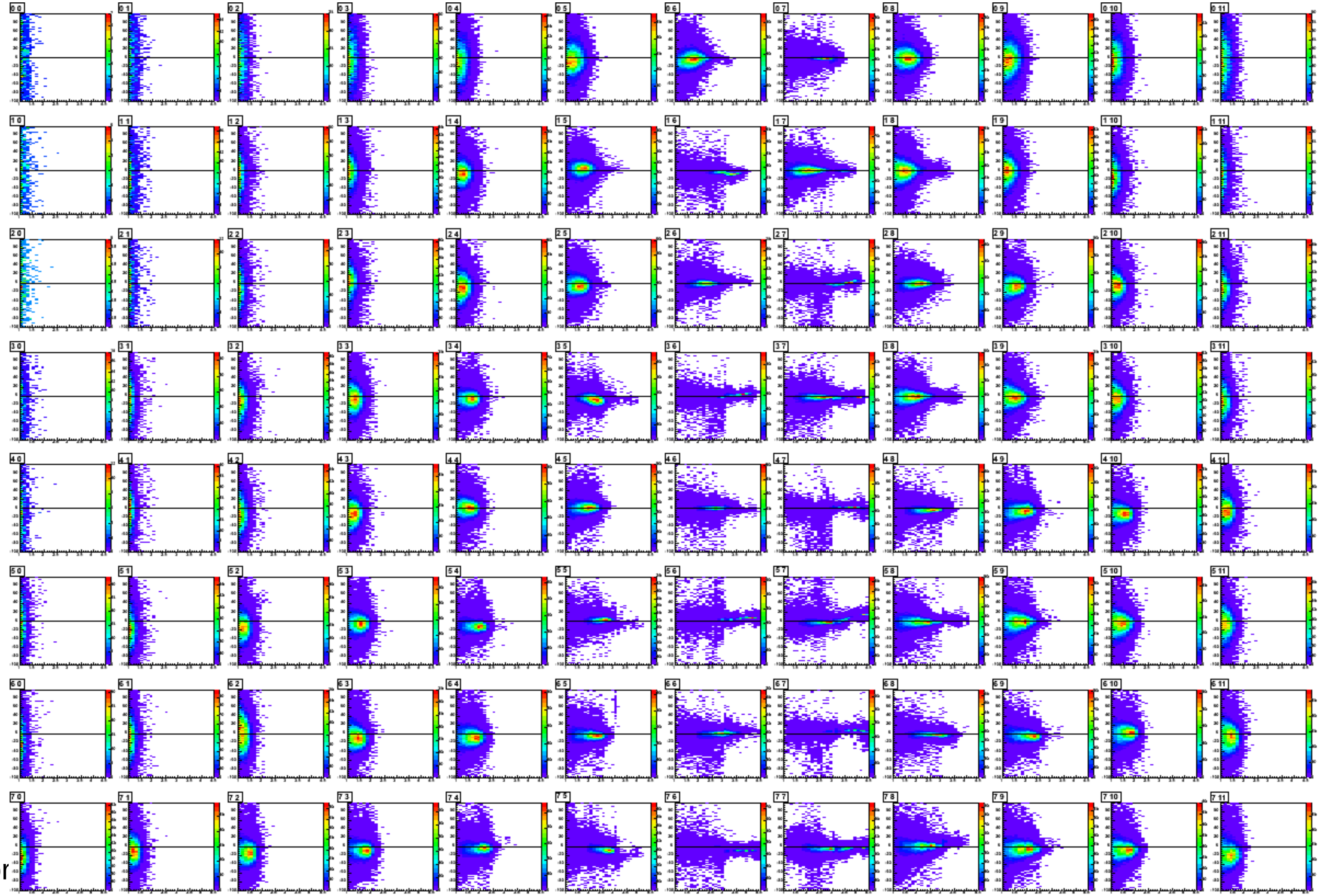
Coming back to offset corrections

- I've determined 4 sets of offset corrections for all energies at 0, 10, 20 and 30 deg
- For each crystal, I've determined the offset as function of log10(energy) :

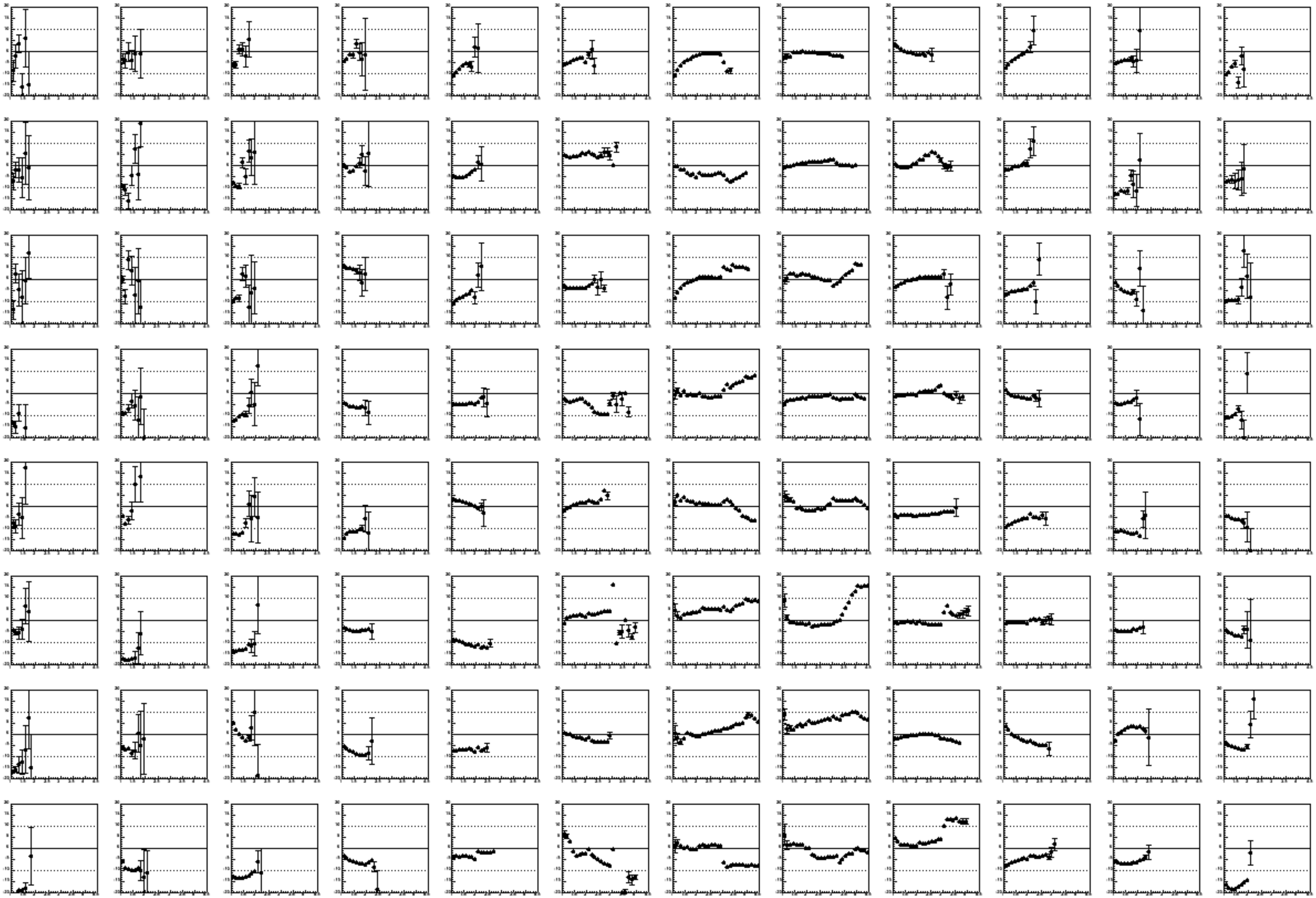


Offset determination at 0 deg

y- scale : -100, 100



Offset determination at 0 deg



y- scale : -20, 20

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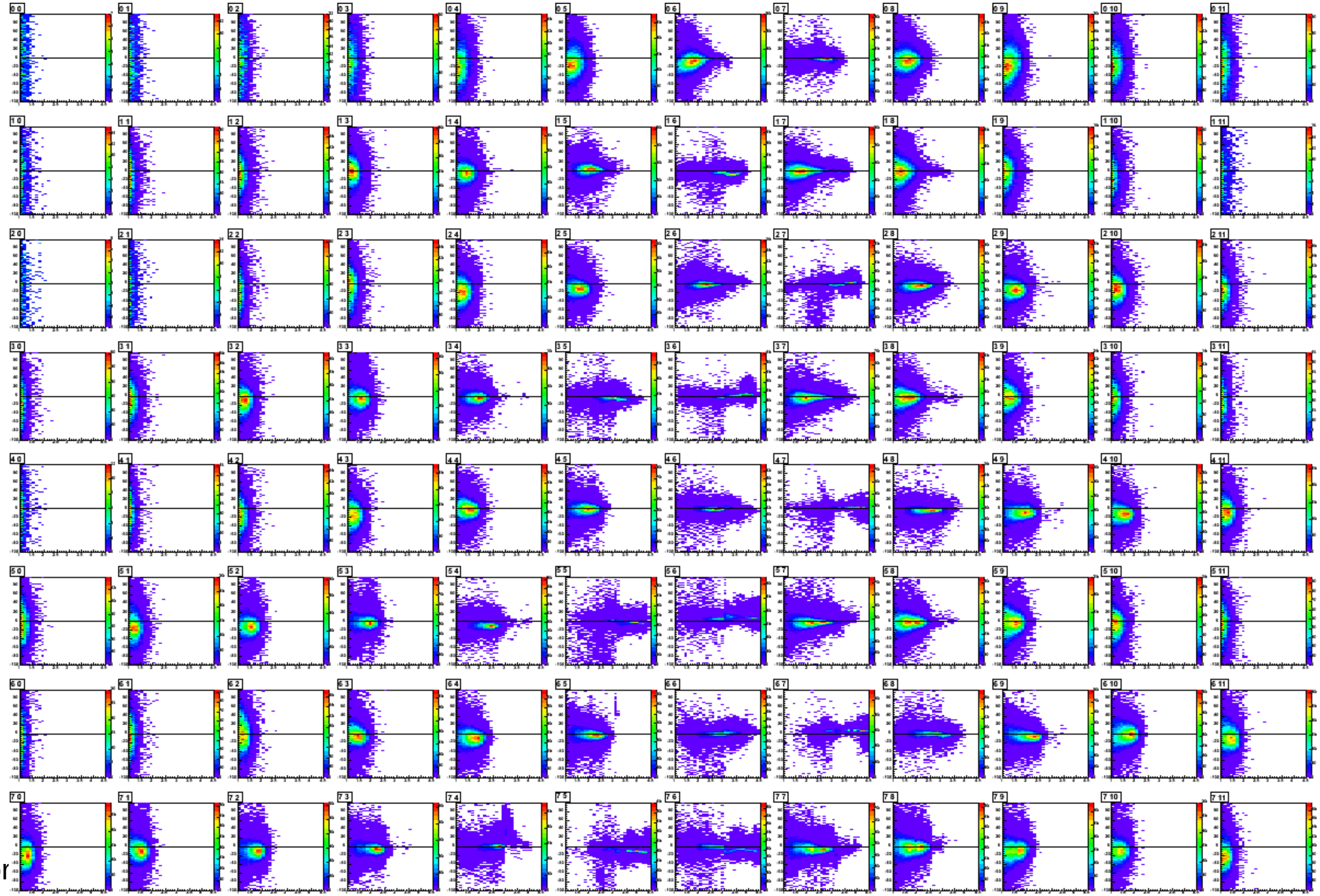
Offset determination at 10 deg

y- scale : -100, 100



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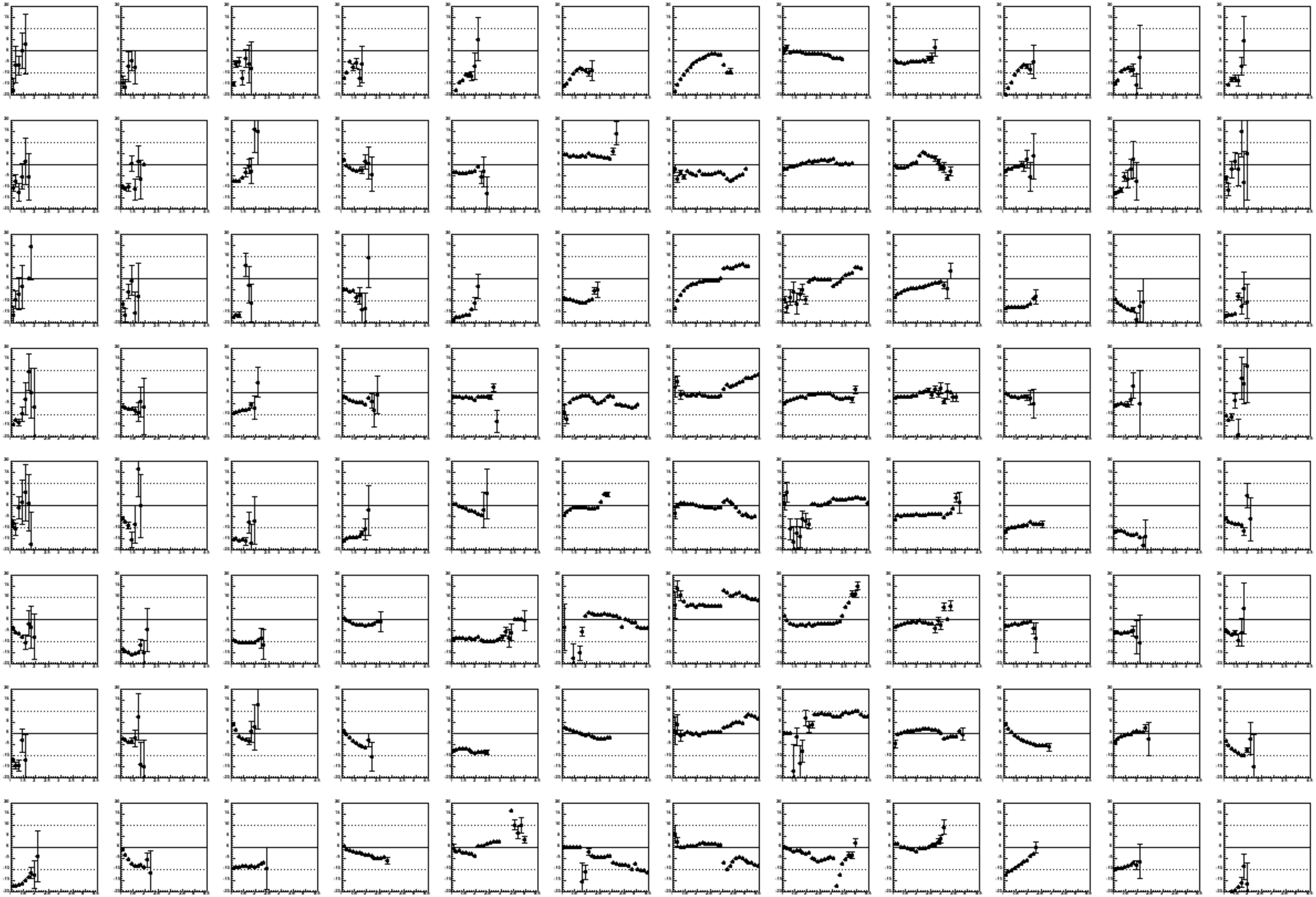
Offset determination at 10 deg

y- scale : -20, 20



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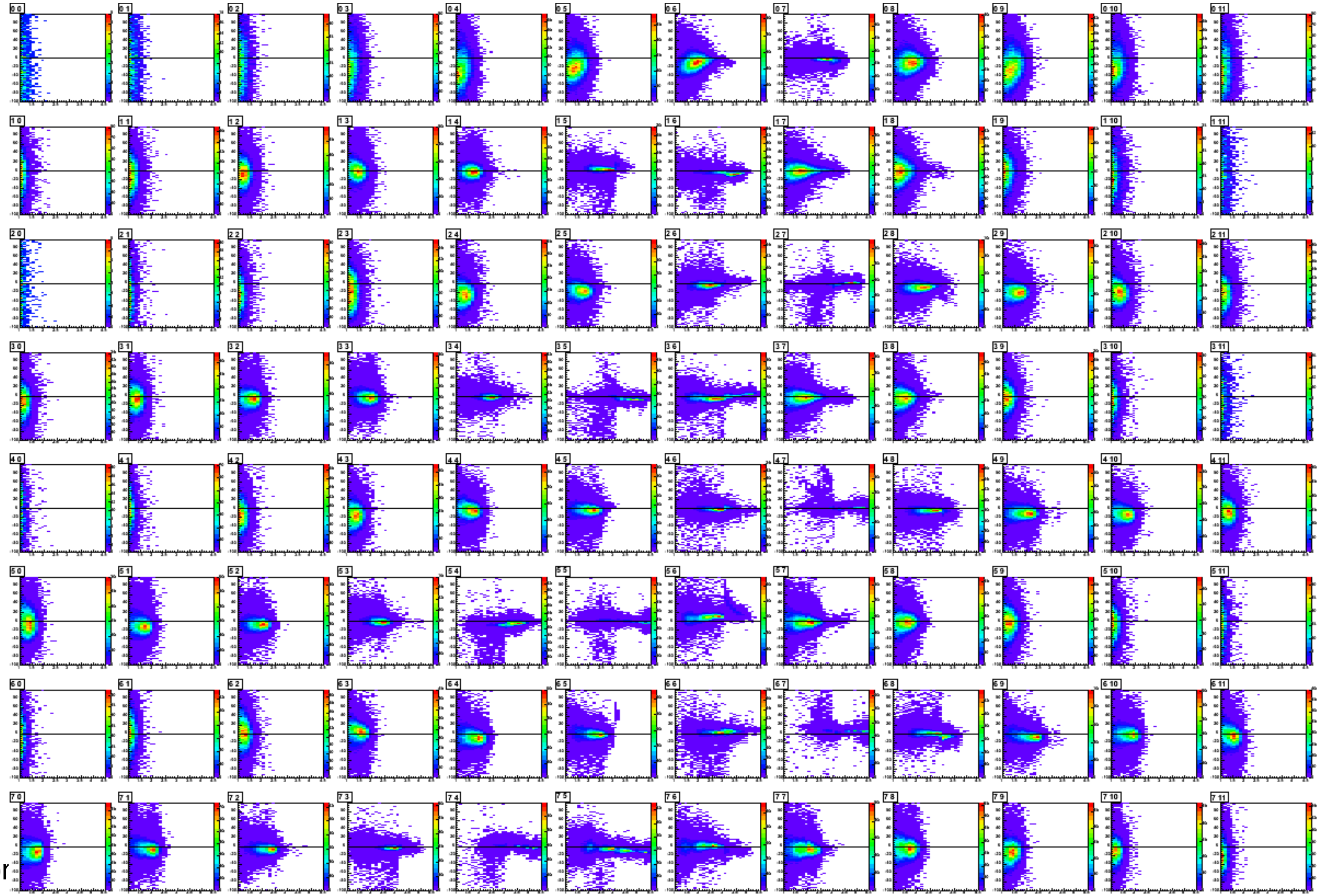
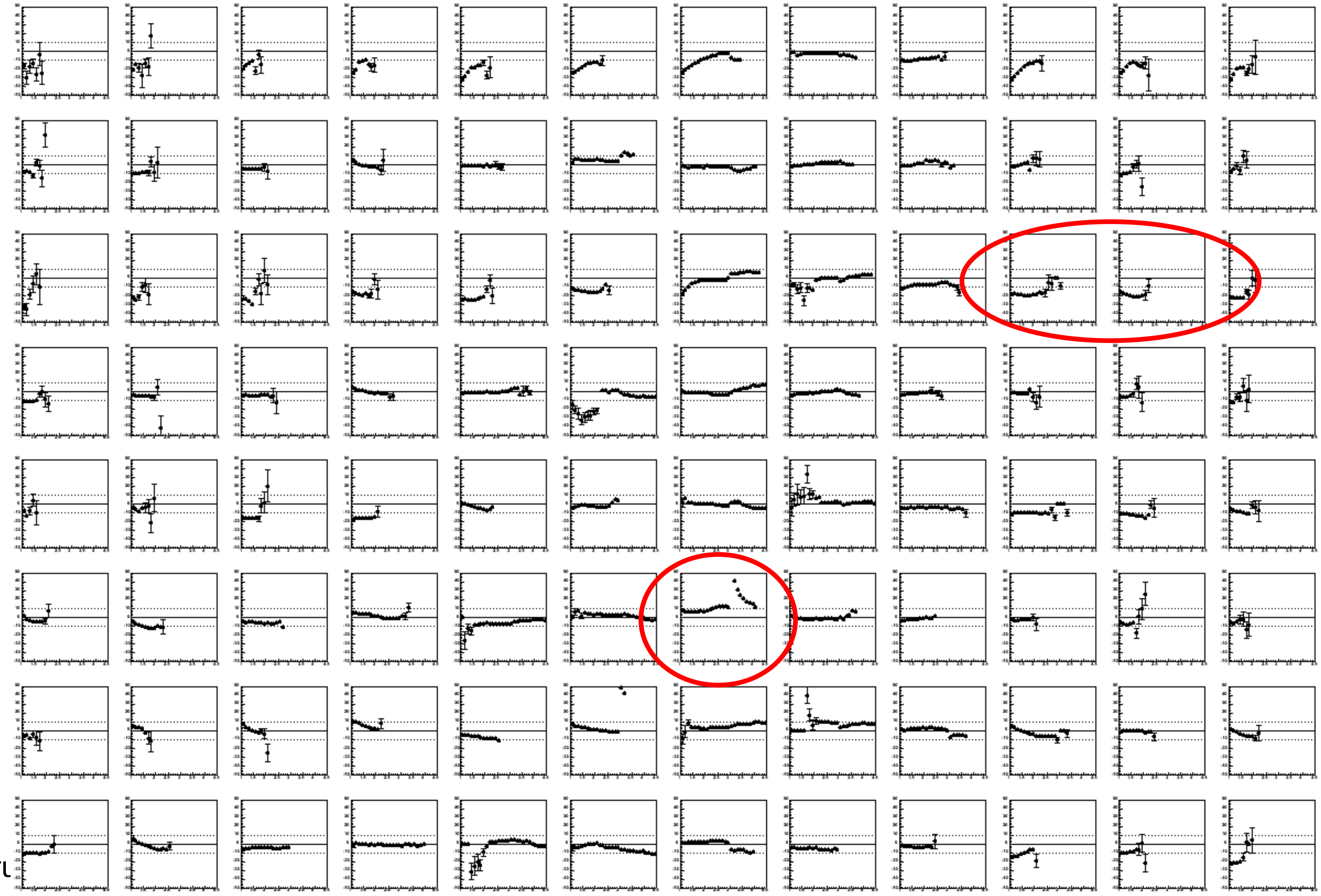
Offset determination at 20 deg

y- scale : -100, 100



Offset determination at 20 deg



y- scale : -50, 50 !!!!

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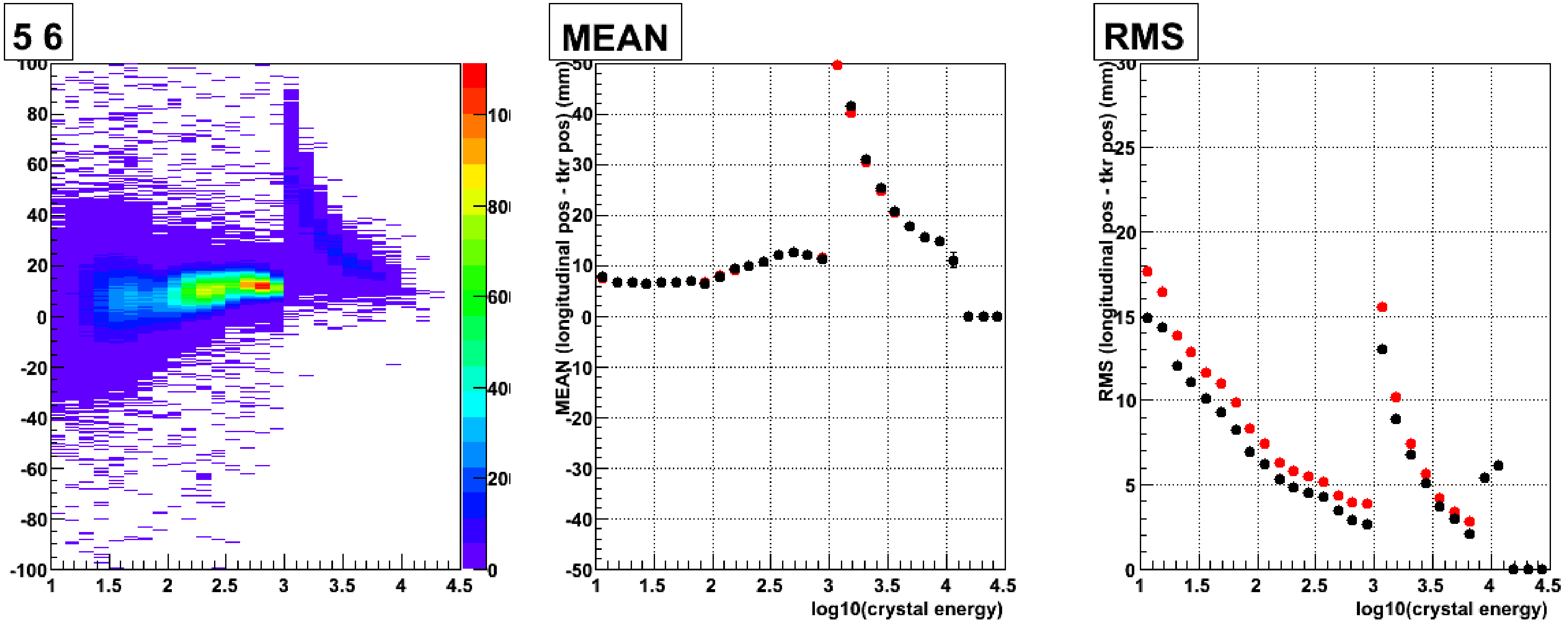
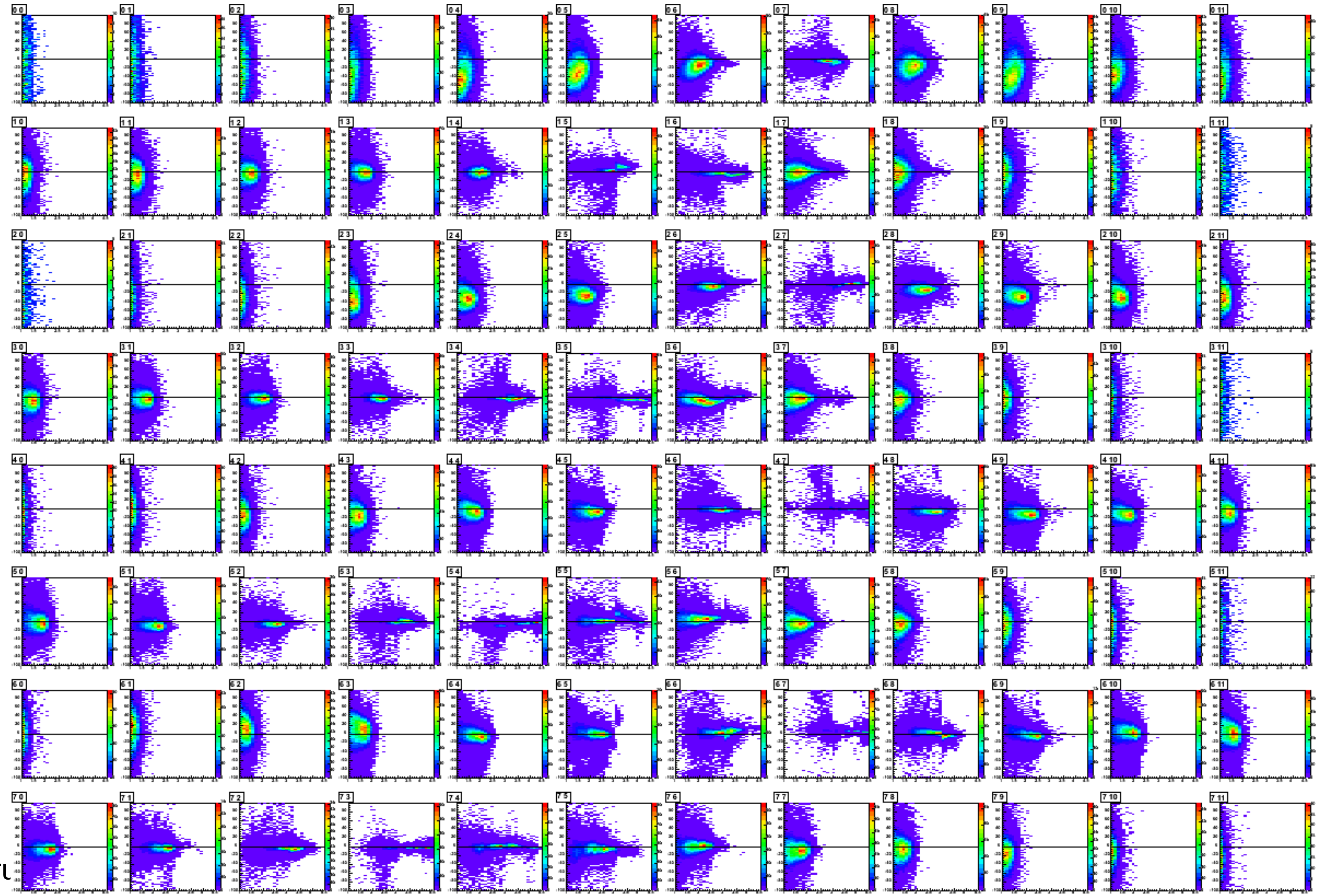
Crystal 5/6 (20 deg)



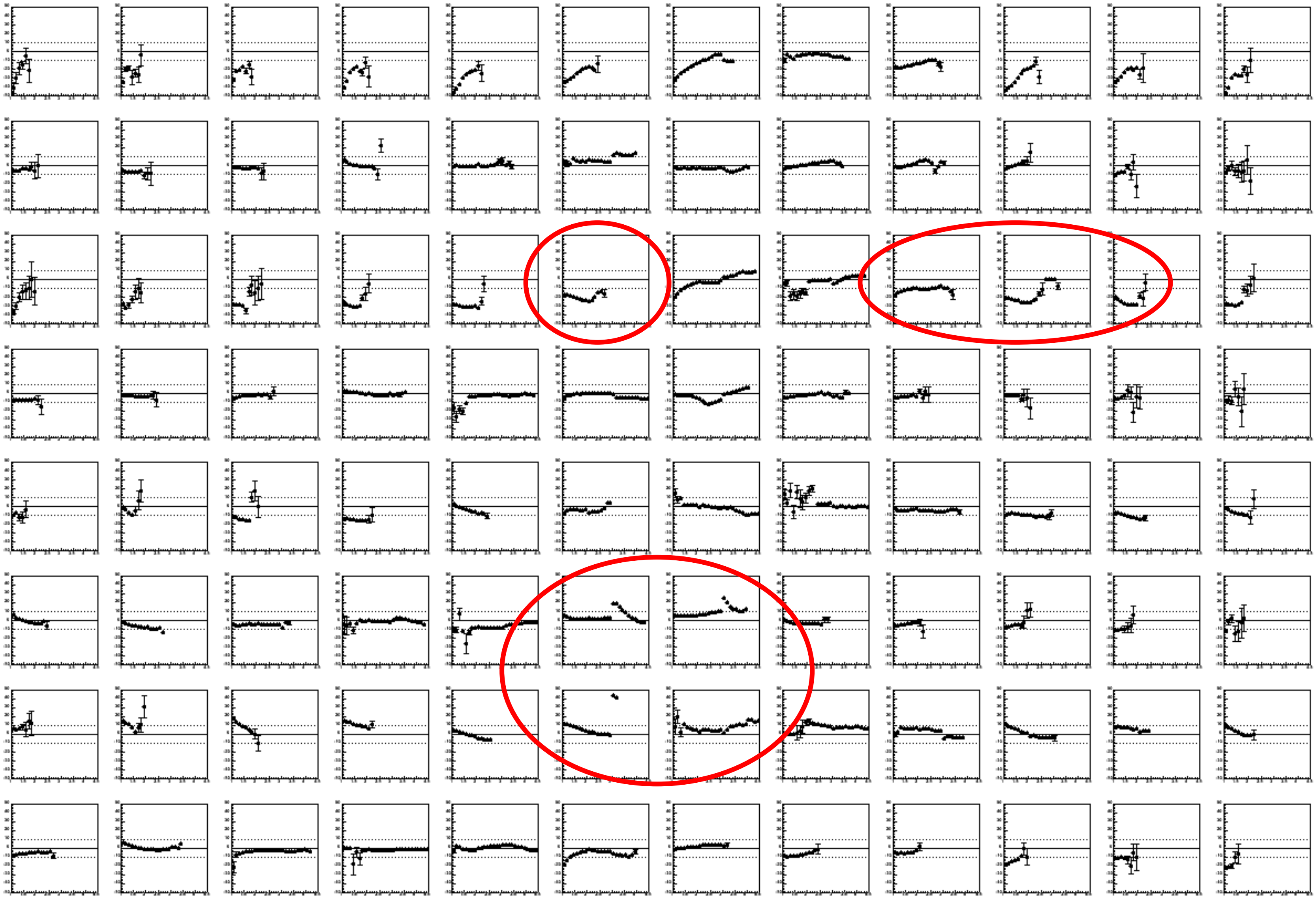
Offset determination at 30 deg

y- scale : -100, 100

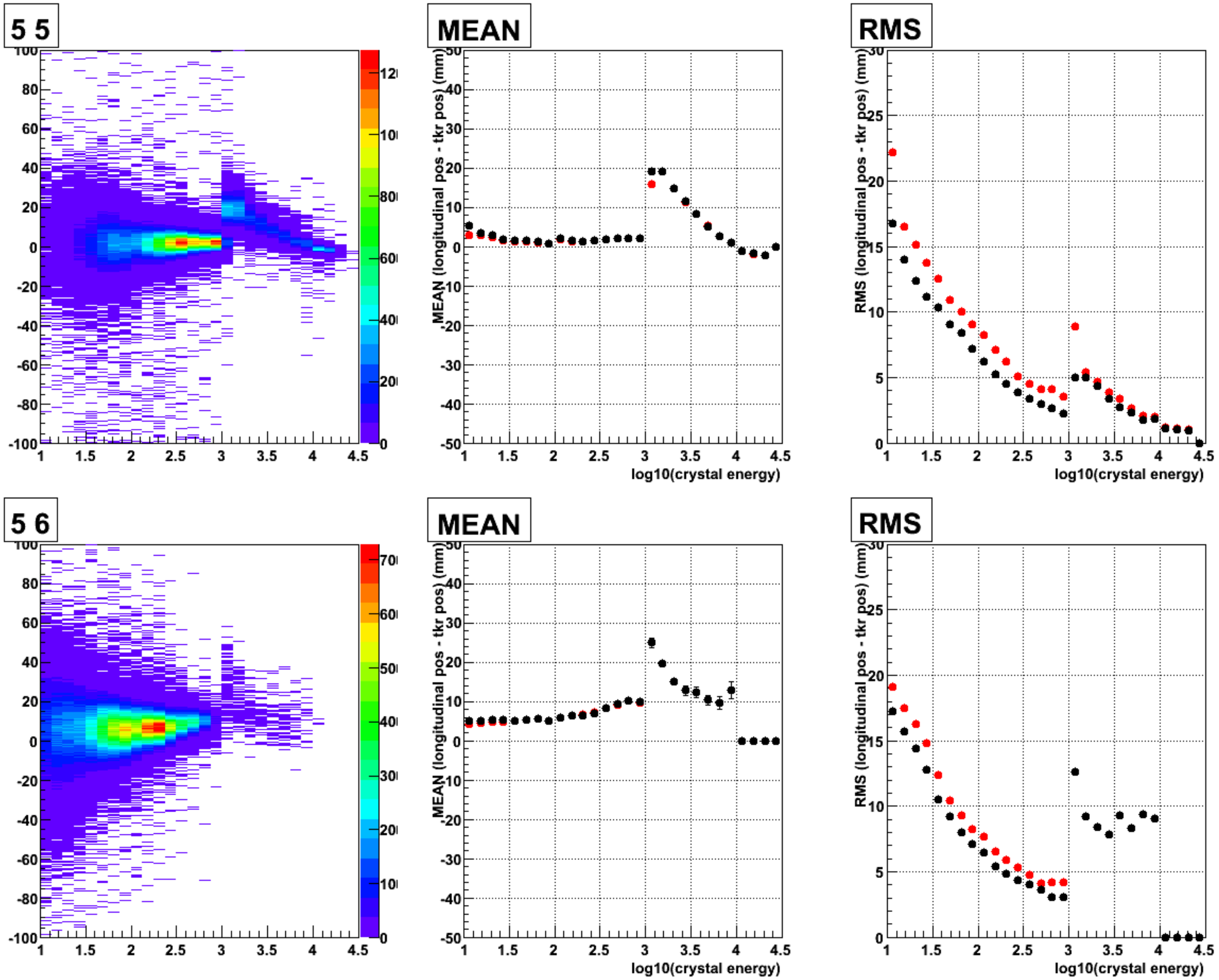


Offset determination at 30 deg

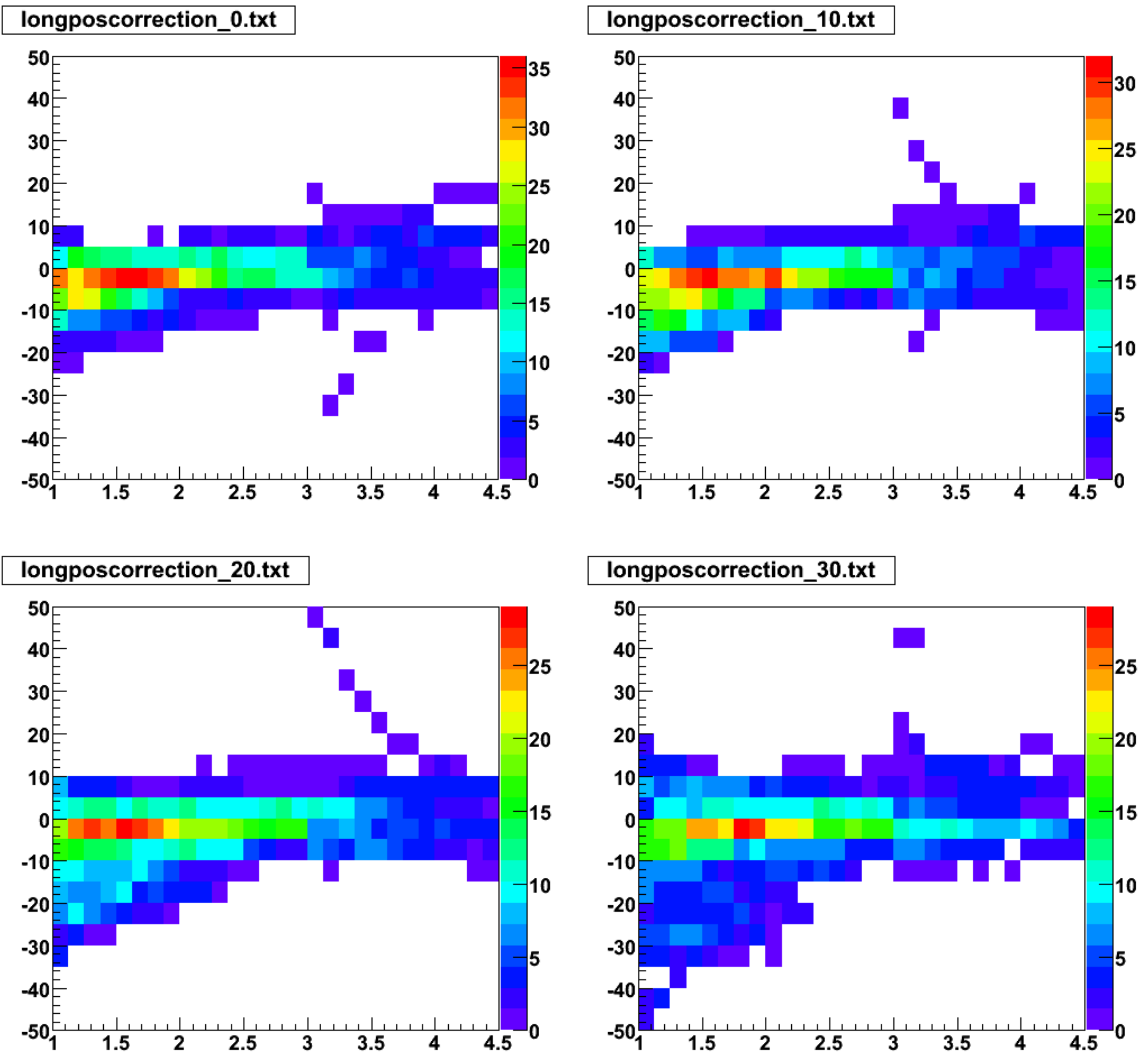
y- scale : -50, 50 !!!!



Crystals 5/5 and 5/6 (30 deg)



Offset summary



- Histograms of all offsets versus log10(crystal energy) : each entry is the offset correction for one crystal for one energy bin (when offset precision is better than 2mm)
- Offsets are not well within +-5mm, even at low energy, and especially at high energy (the distribution is quite flast above 1 GeV between -10 and 10mm)

Offset correlation with energy data/MC