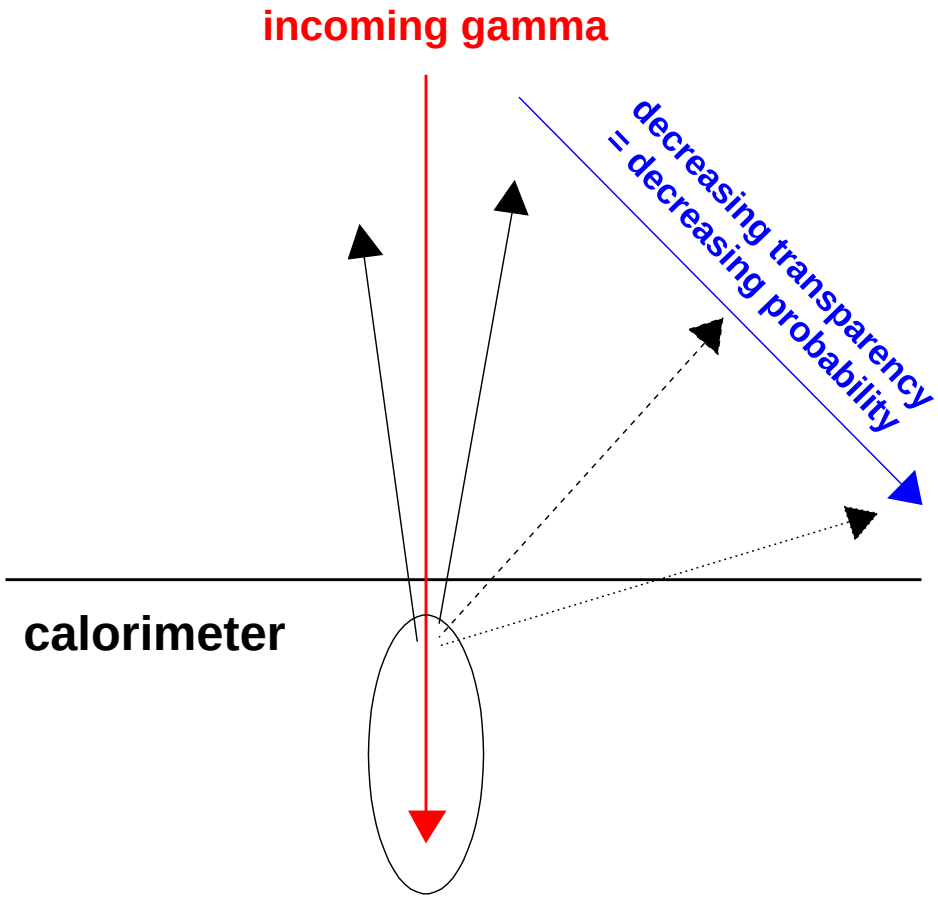
Backsplash study with the ACD

(thanks to Eric Charles and Alex Moiseev)

- backsplash and other splashes
- ACD tiles signal
- backsplash measurement
- effect of cracks
- effect of incoming angle
- how can we test backsplash at SPS ?

Pure backsplah

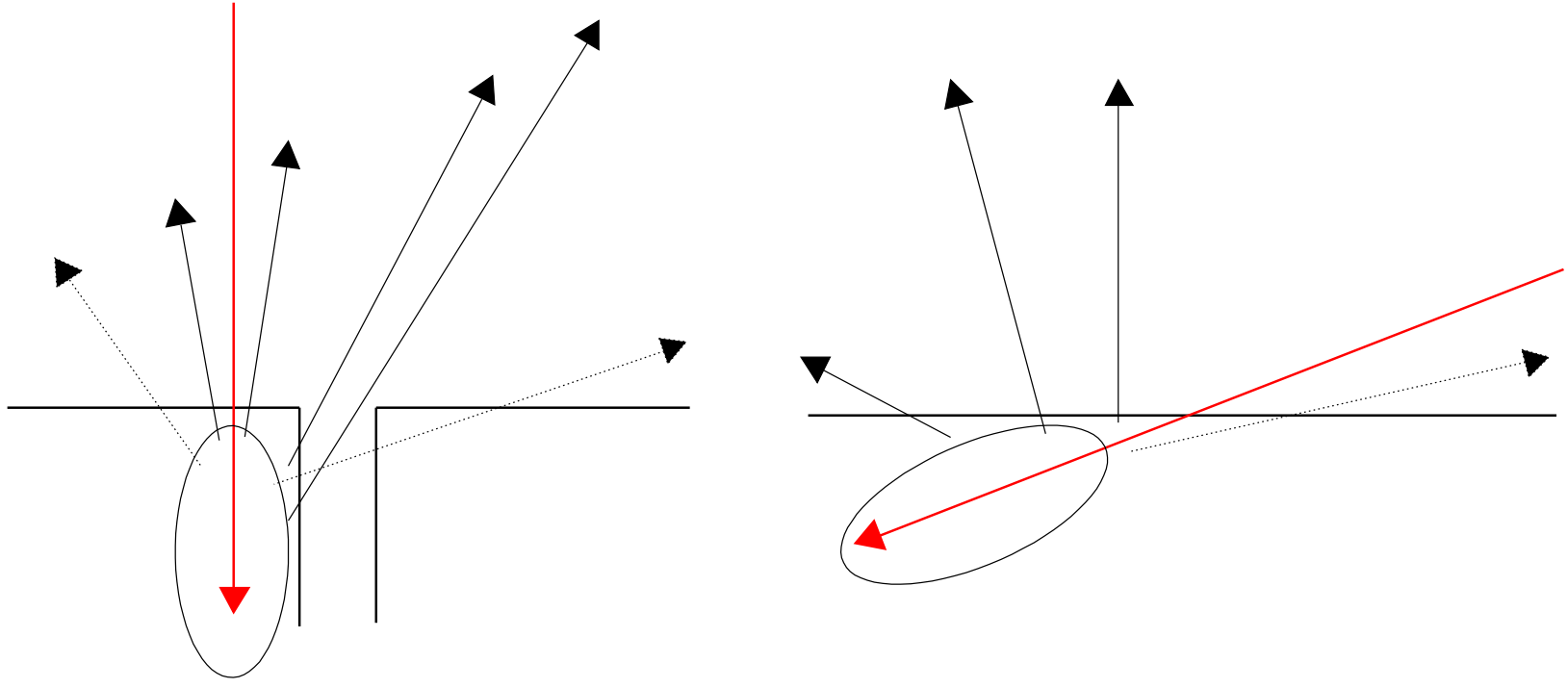
- high energy incoming gamma (> 10 GeV)
- some low energy outcoming photons (hundreds of keV)



- backsplash should be maximal at 180 deg. ($\Rightarrow$ back)
- and should decrease to zero at 90 degrees

Crack-splash and side-splash

- particles of the shower escaping through cracks
- when no more on-axis, the maximum of backsplash is no more at 180 degrees
- no more only photons ...



Simulation

Simulation of high energy gammas

- in the entire LAT
- using v7r3
- pencil beam with radius = 1cm
- 10, 50, 100 and 200 GeV
- various impact positions and incoming angles

Selection

- at least one track
- conversion point inside the tracker (= not inside ACD)

Backsplash in ACD

- on the top : 5 $\times$ 5 tiles (face 0)
- on each side (face 1,2,3,4) :
  - 3 rows of 5 tiles
  - + one large bottom tile

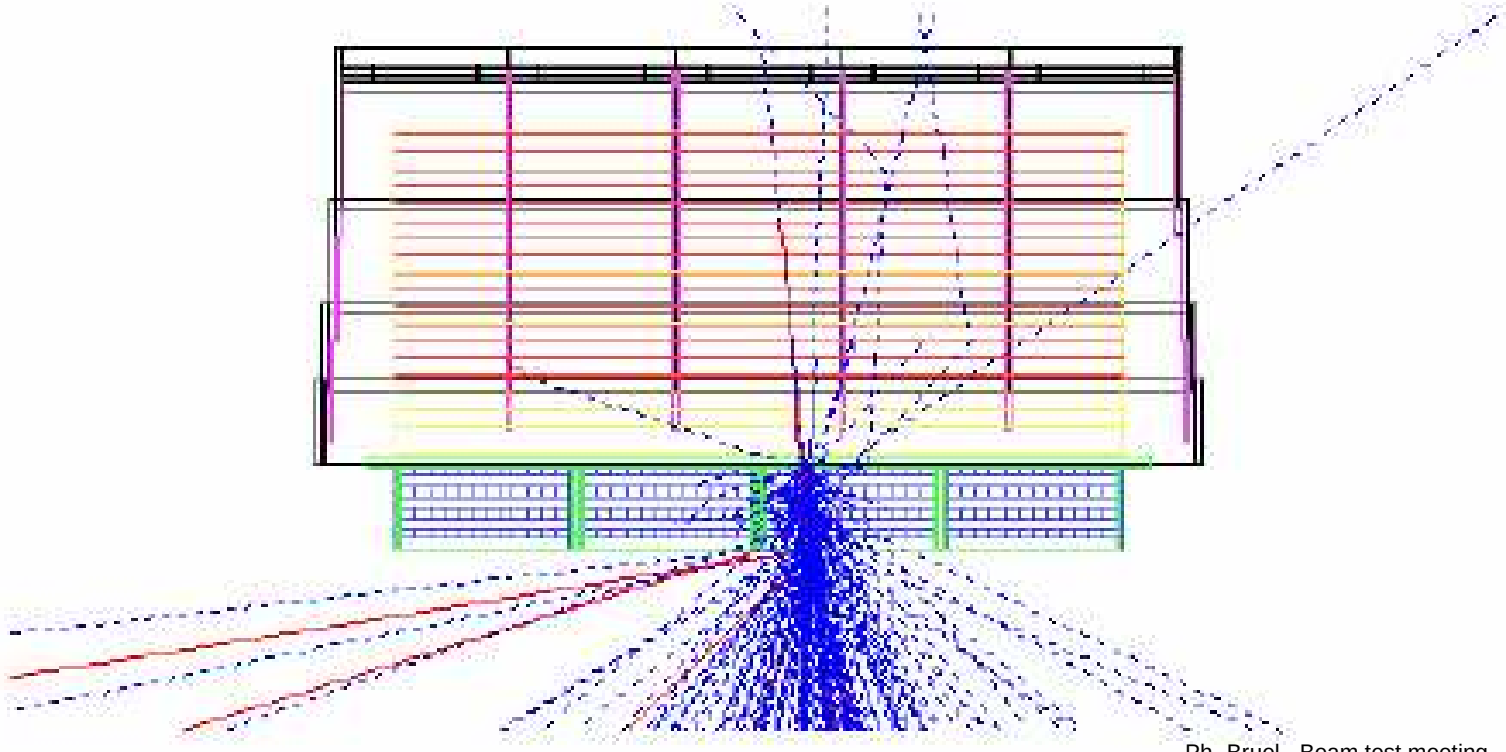
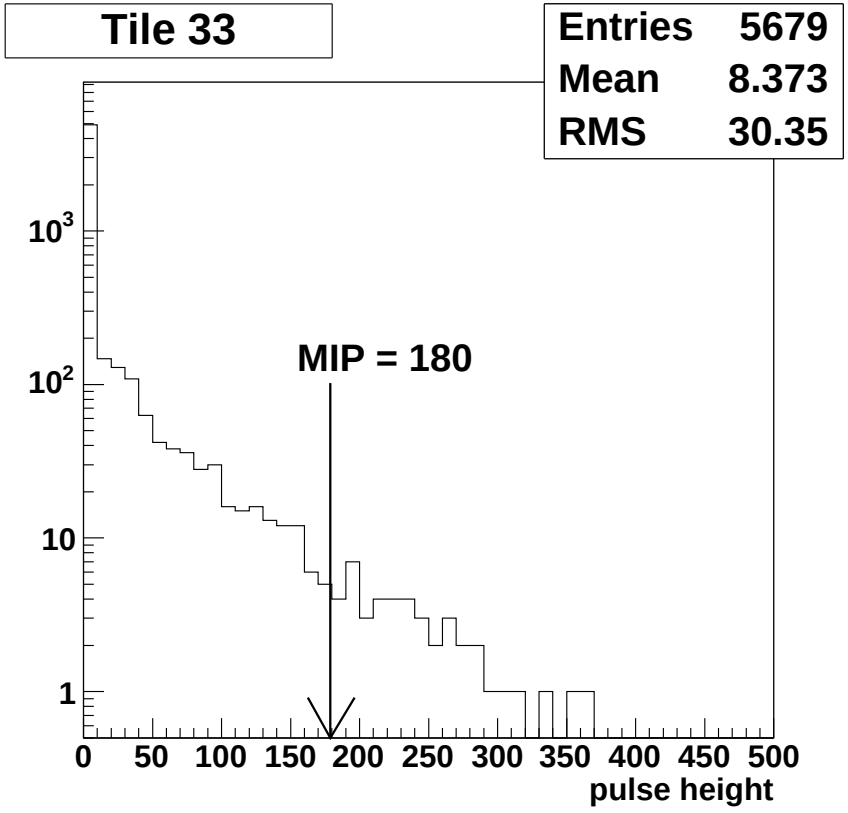


figure from Alex et al talk (IA workshop, July 14, 2005)

ACD tiles signal

usual backsplash pulse height distribution in tile above impact point when on-axis



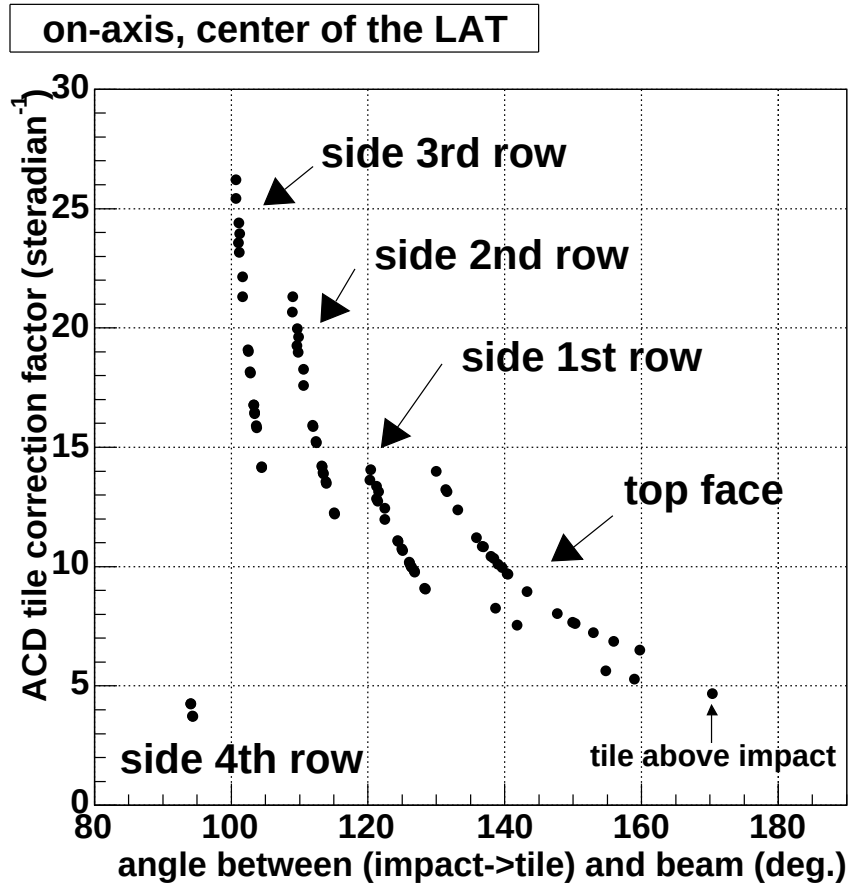
two estimators :

- pulse height average
- fraction of events above a certain fraction of MIP

Geometrical correction

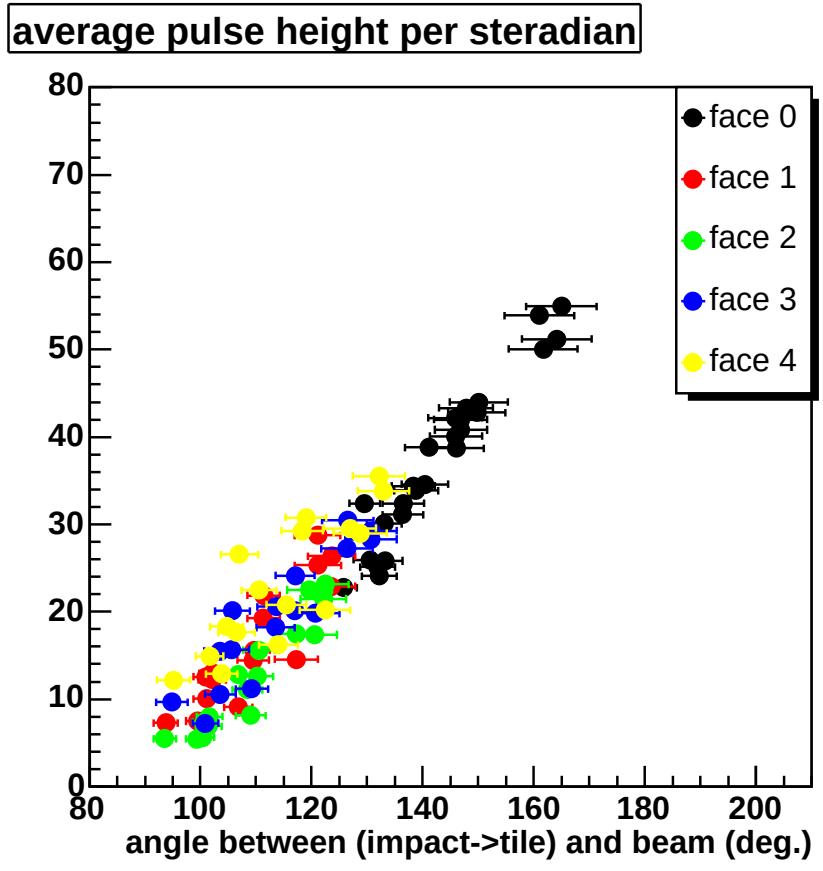
In order to compare signals of different tiles :

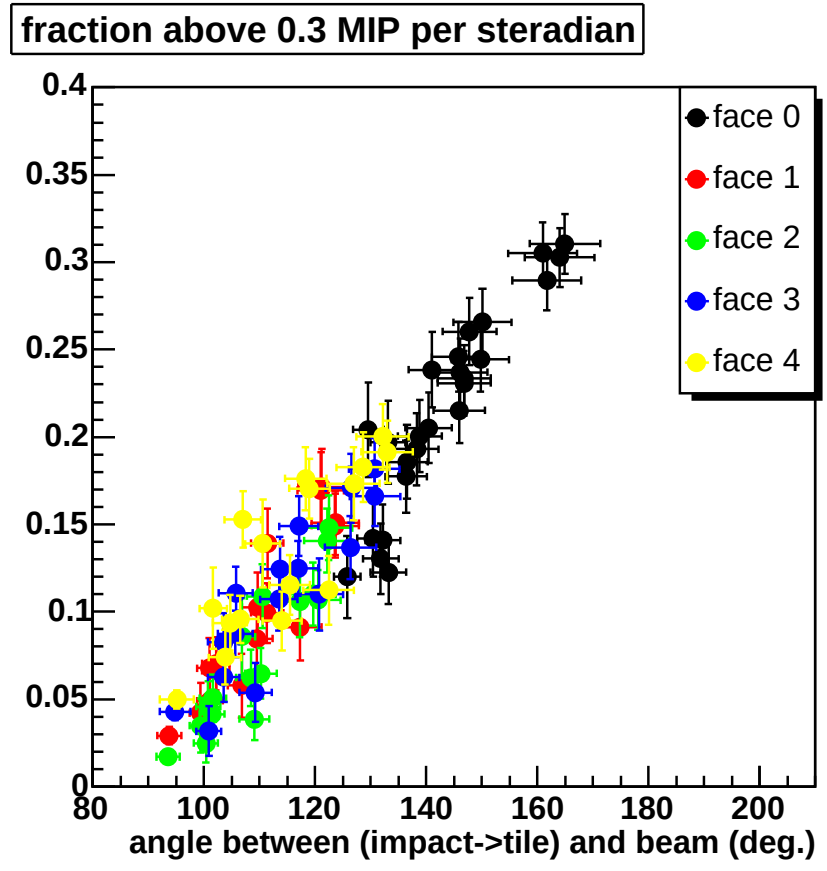
$\Rightarrow$ signal $\times$ 1/(solid angle) $\times$ 10mm/(mean path length)



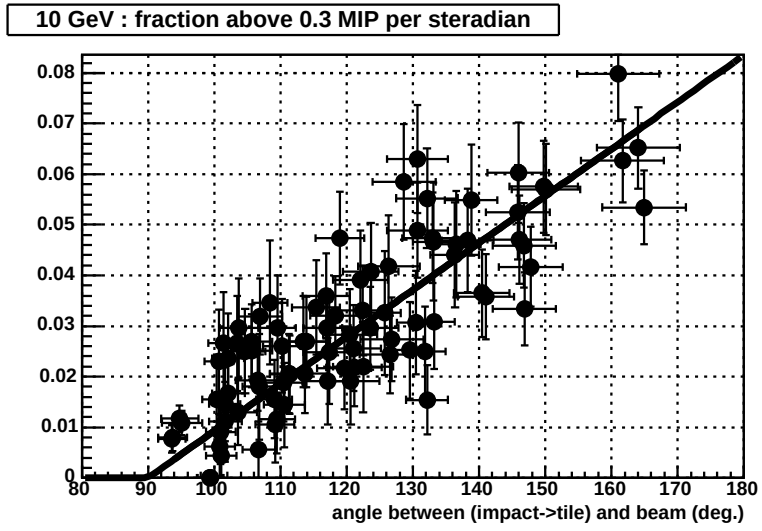
Backsplash angular distribution

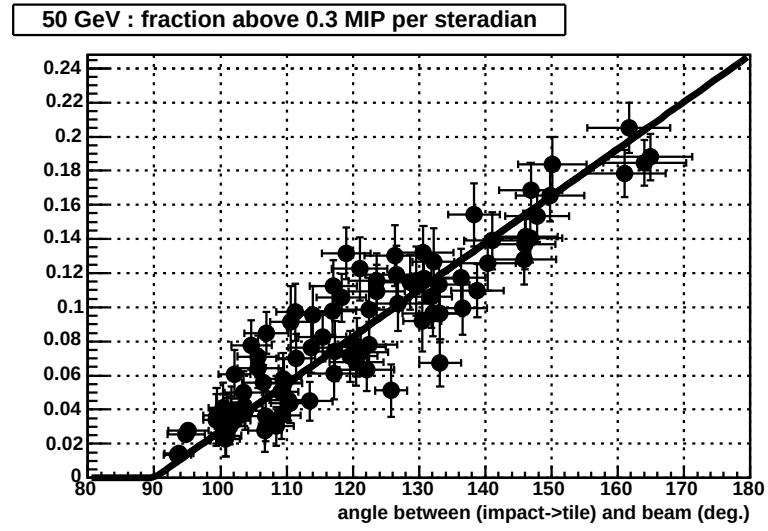
- the correction seems to work well
- from 0 at 90 degrees to maximum at 180 degrees

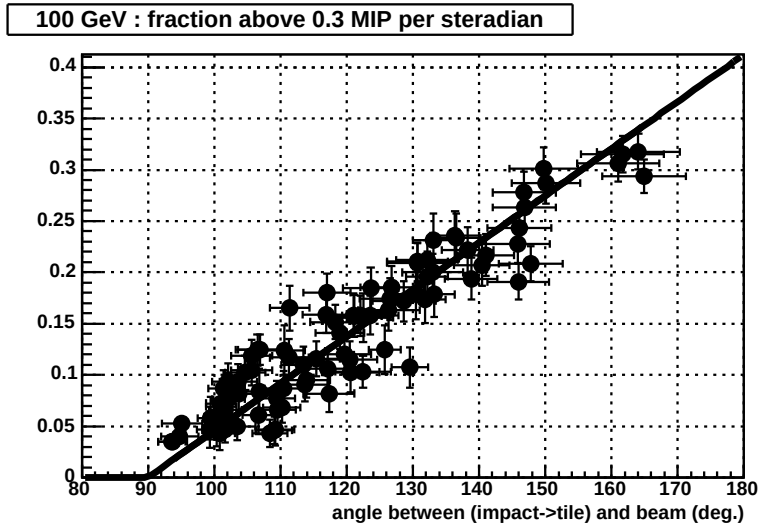


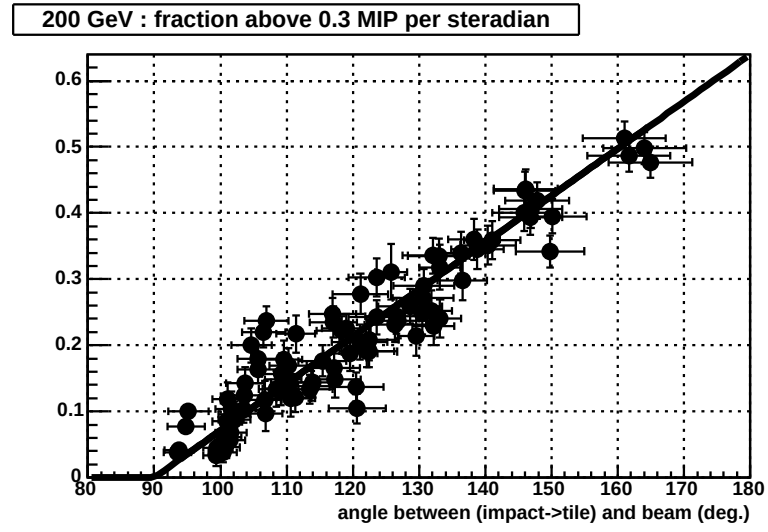


Energy dependence



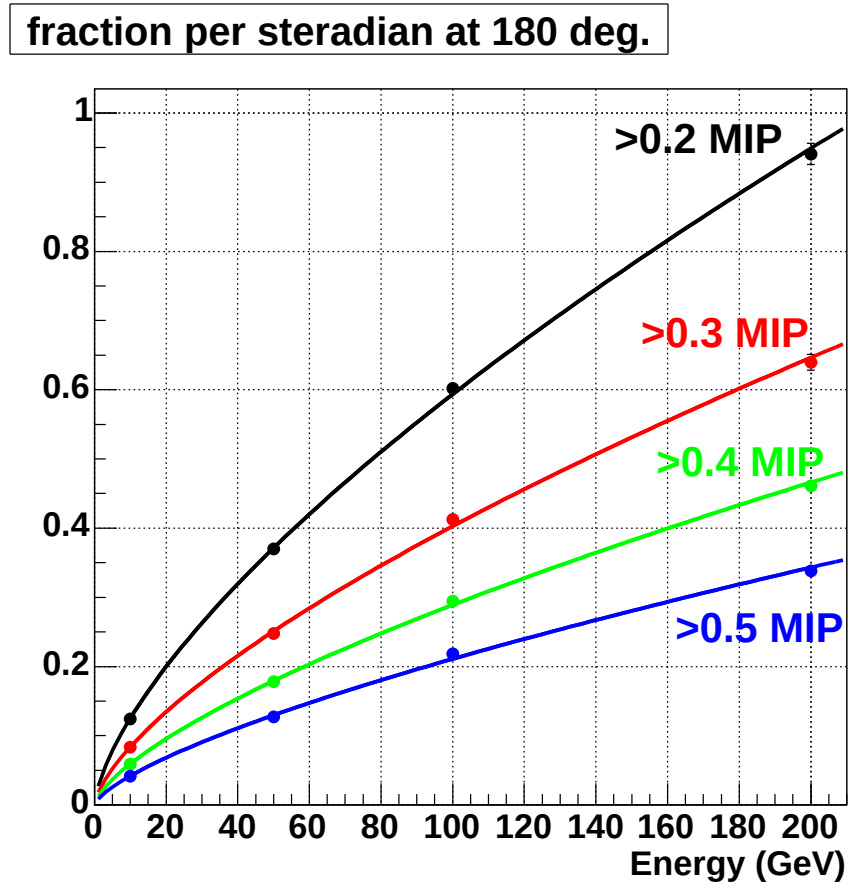






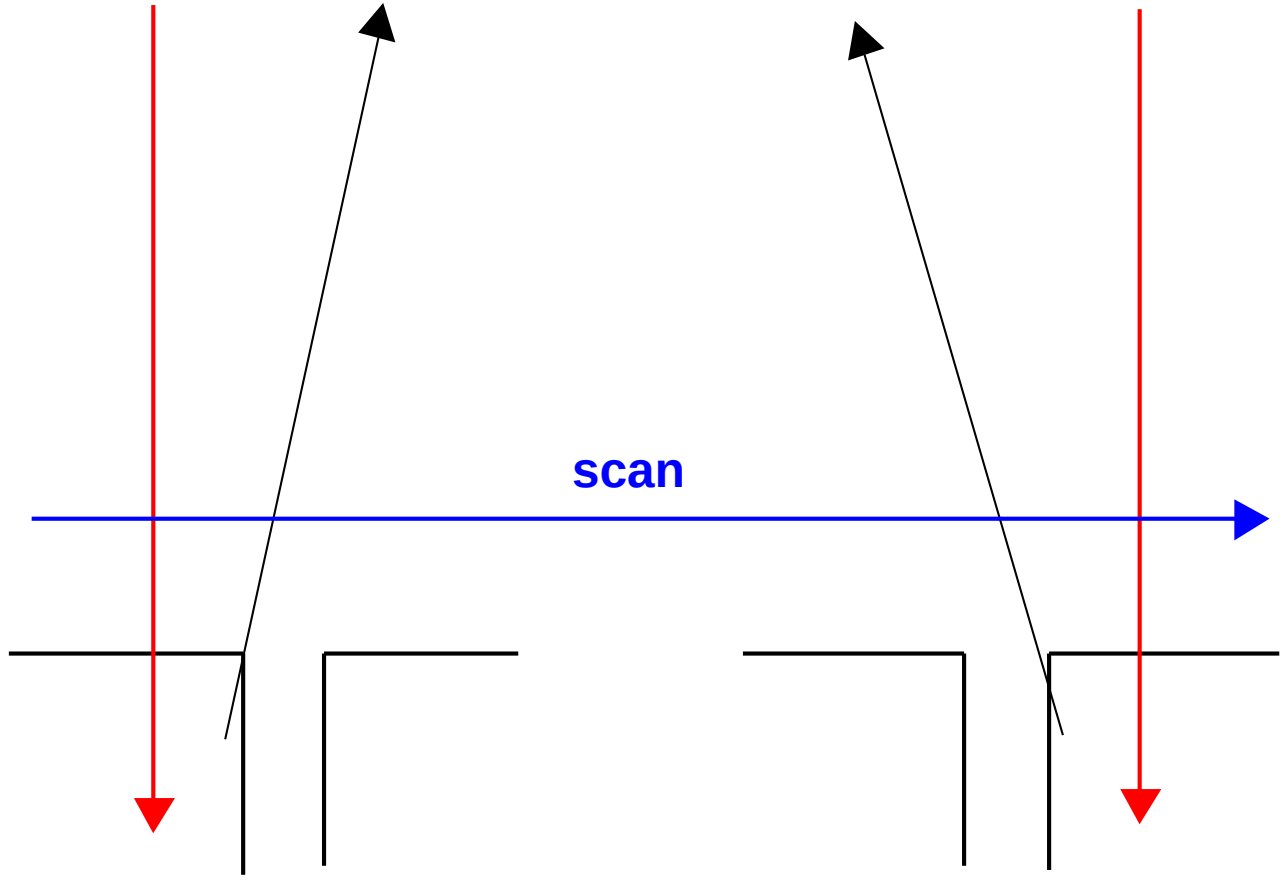
Energy parameterization

fraction per steradian at 180 deg. $\propto E^{0.7}$



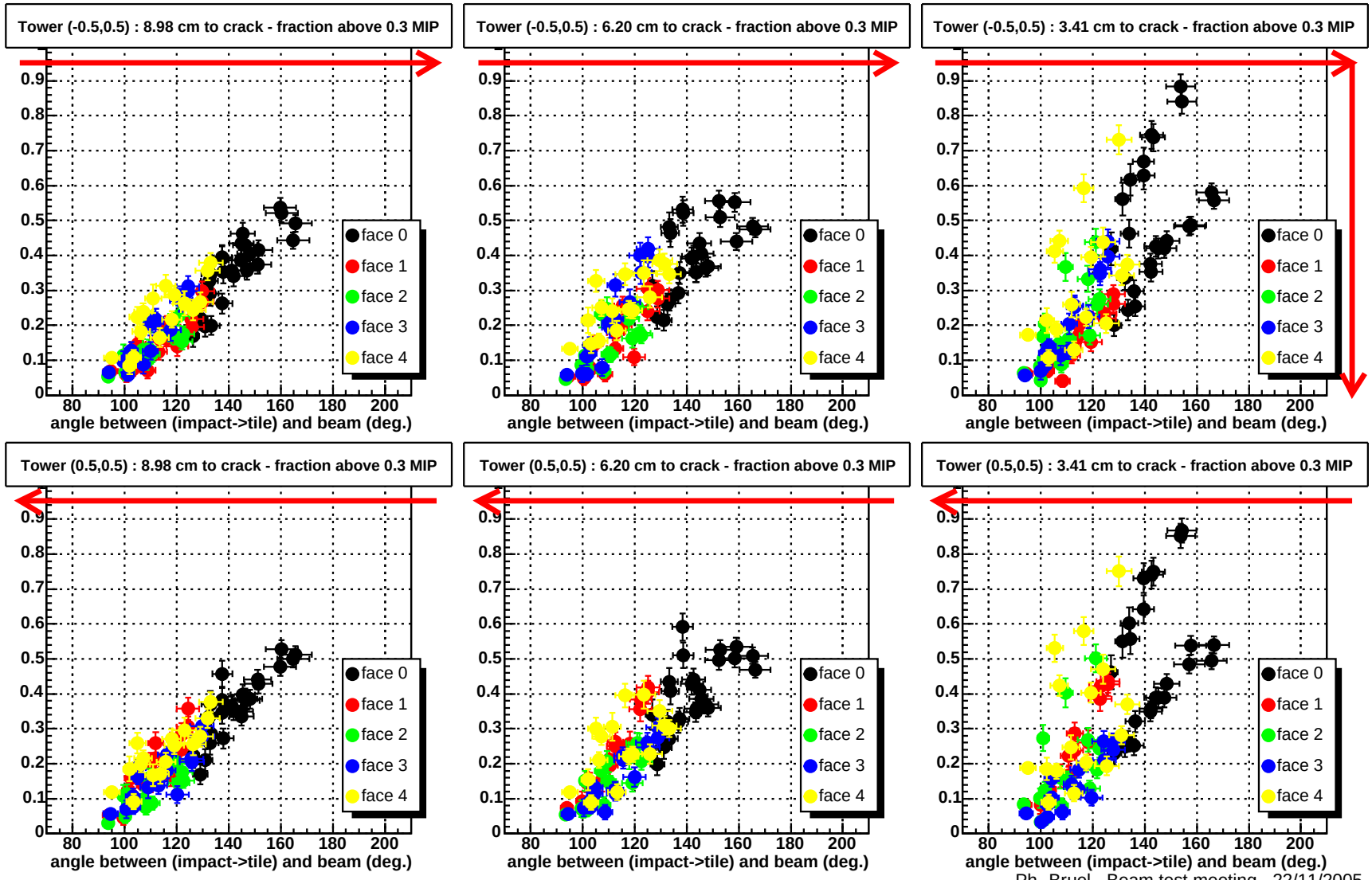
Cracksplash

the signal should be enhanced in the tiles on the opposite side of the crack



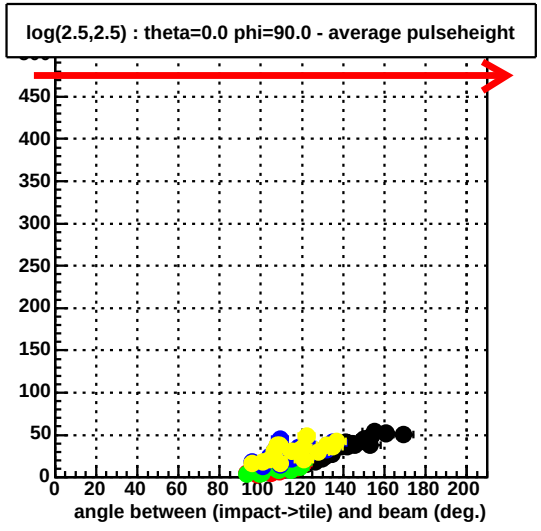
Scan close to crack (200 GeV on-axis)

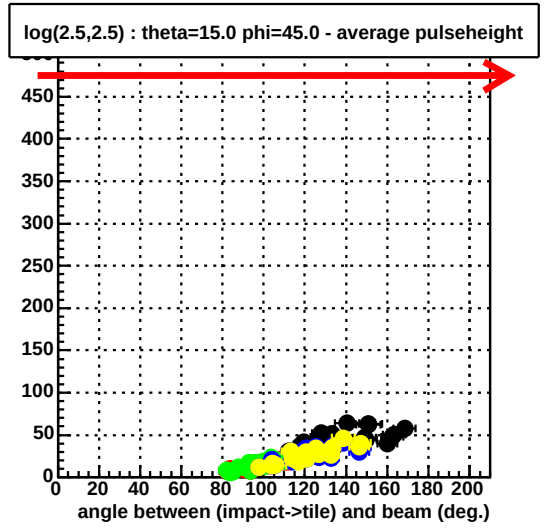
distance to crack : -9cm → -6 → -3.5 → +3.5 → +6 → +9cm

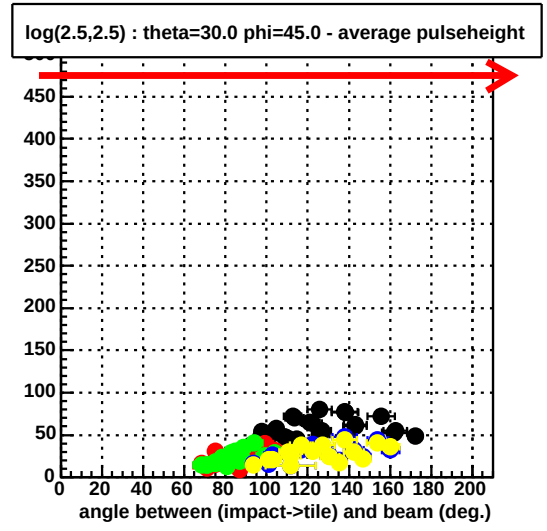


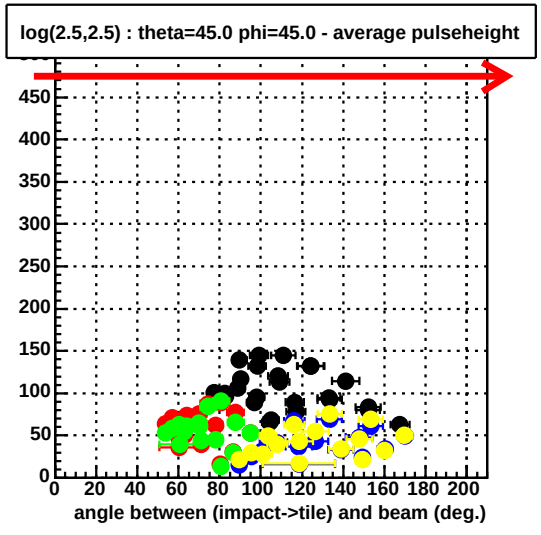
From on-axis to 60 deg (100 GeV)

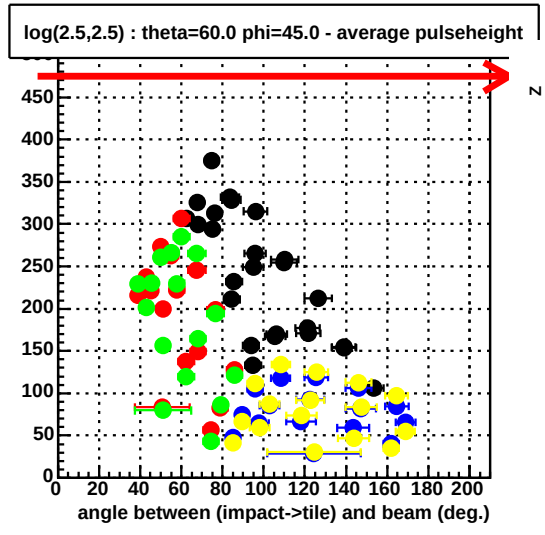
θ = 0 $\rightarrow$ 15 $\rightarrow$ 30 $\rightarrow$ 45 $\rightarrow$ 60 degrees

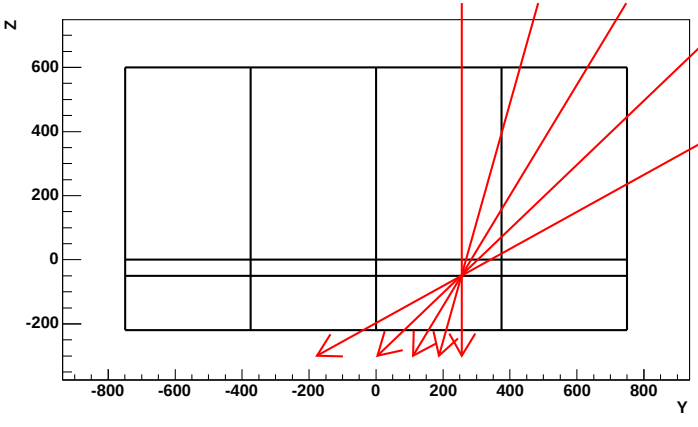












What should be checked at SPS ?

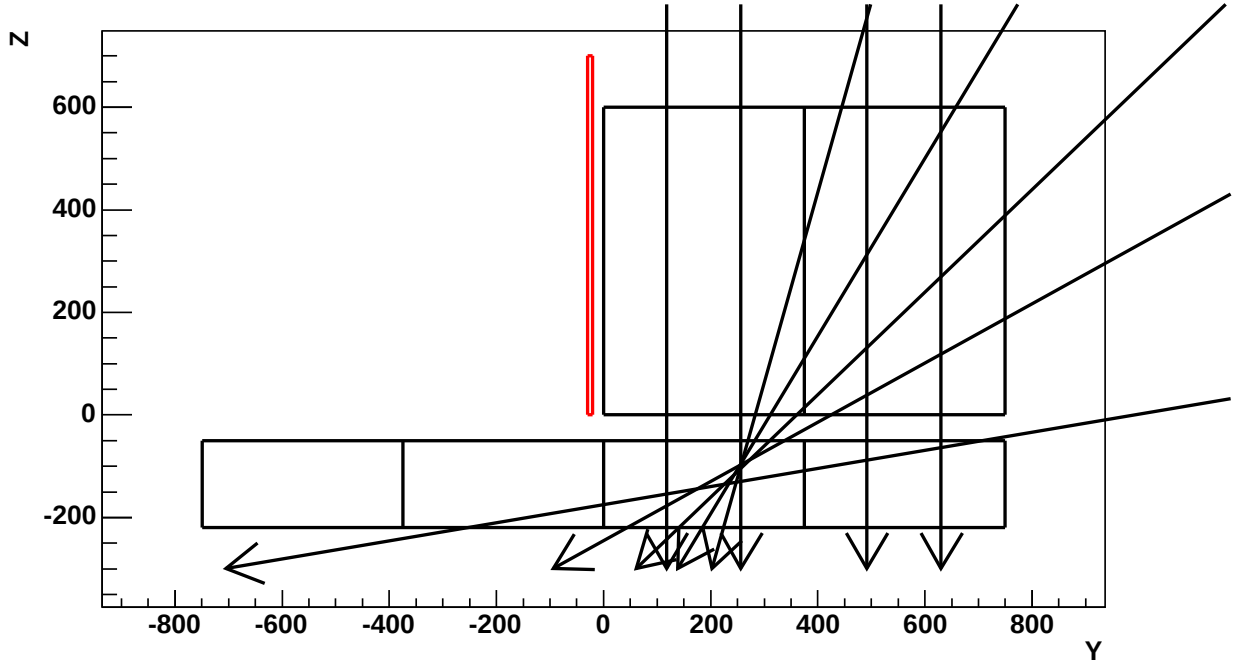
We should check how well the simulation reproduces :

- pure backsplash (intensity, angular distribution, energy dependence)
- the effect of cracks
- the large intensity increase for large incoming angles

Where should we put the ACD tiles ?

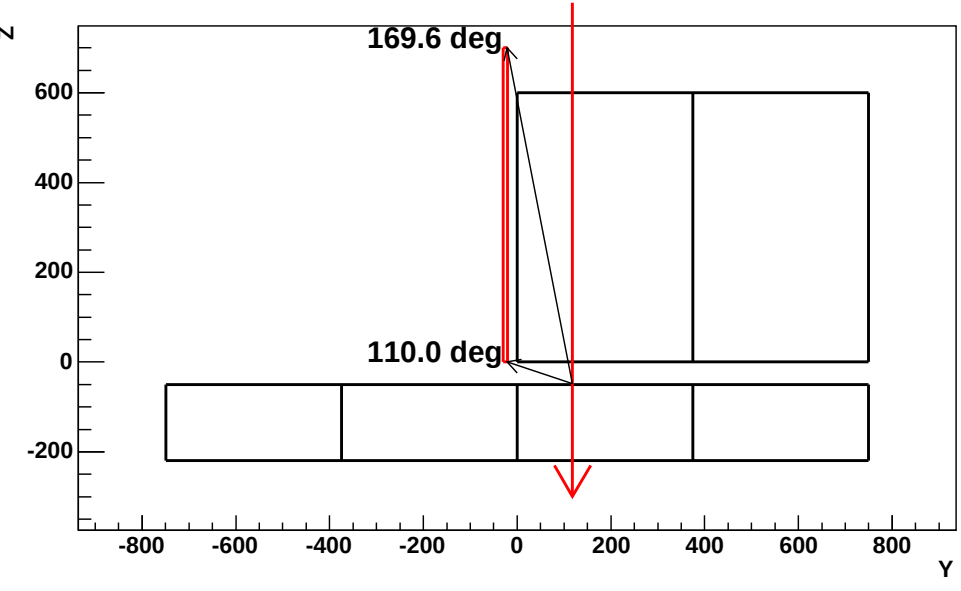
- not in the beam trajectory
  - $\Rightarrow$ not on the top of the two complete towers
  - $\Rightarrow$ not on the right hand side of CU

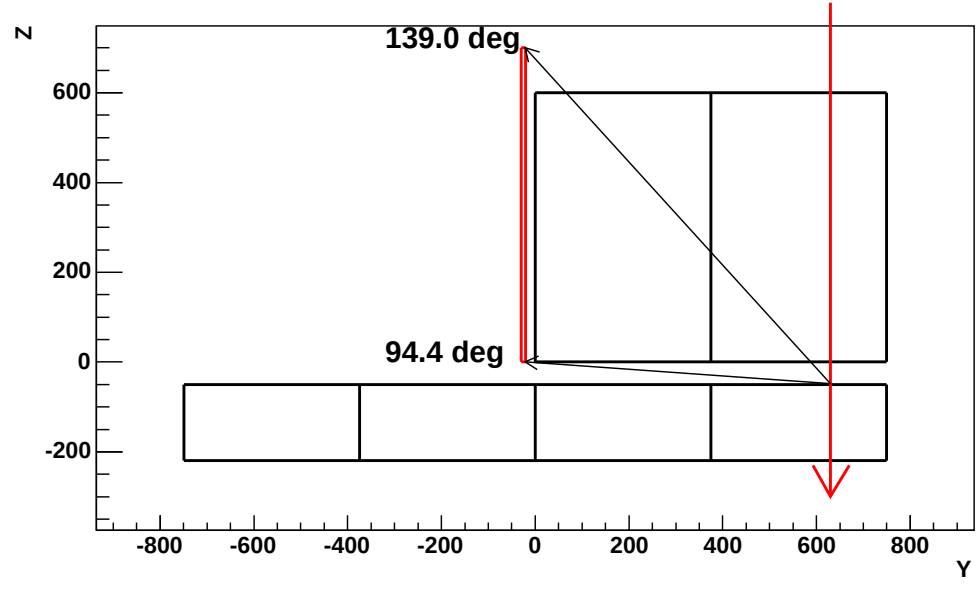
put ACD tiles on the left hand side of the first complete tower



Pure backsplash

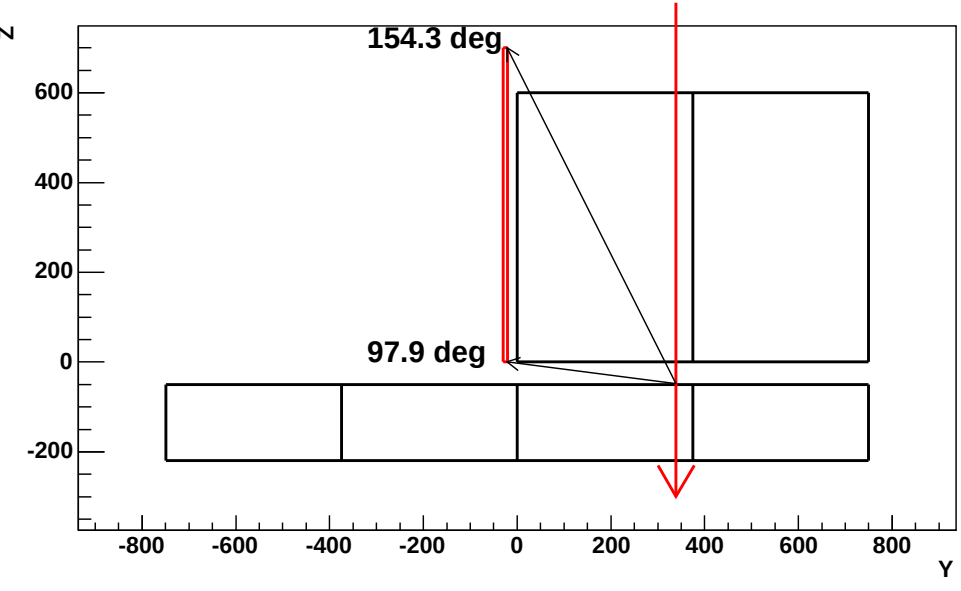
try to cover up to 180 deg. while being far enough from cracks

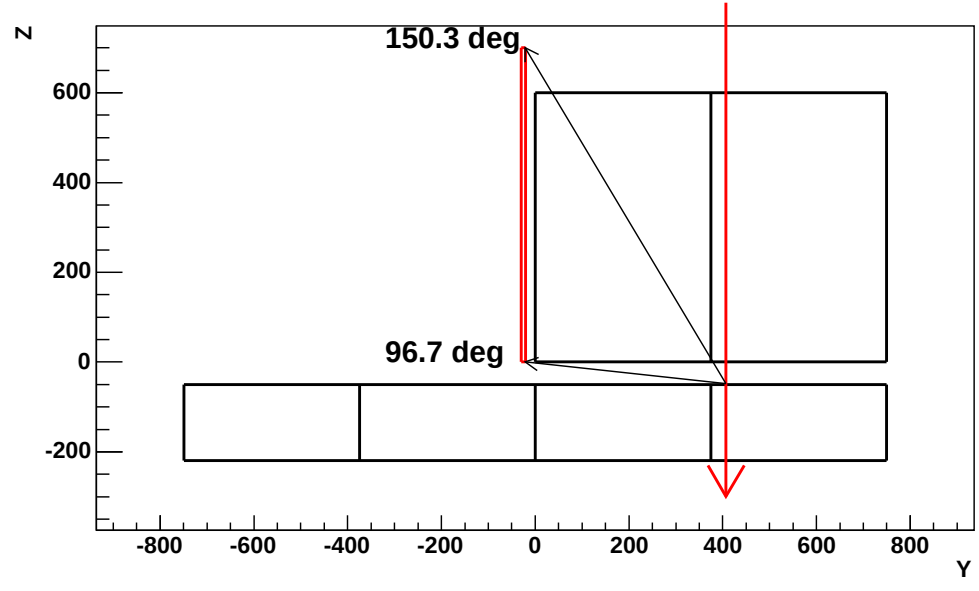




Crack effect

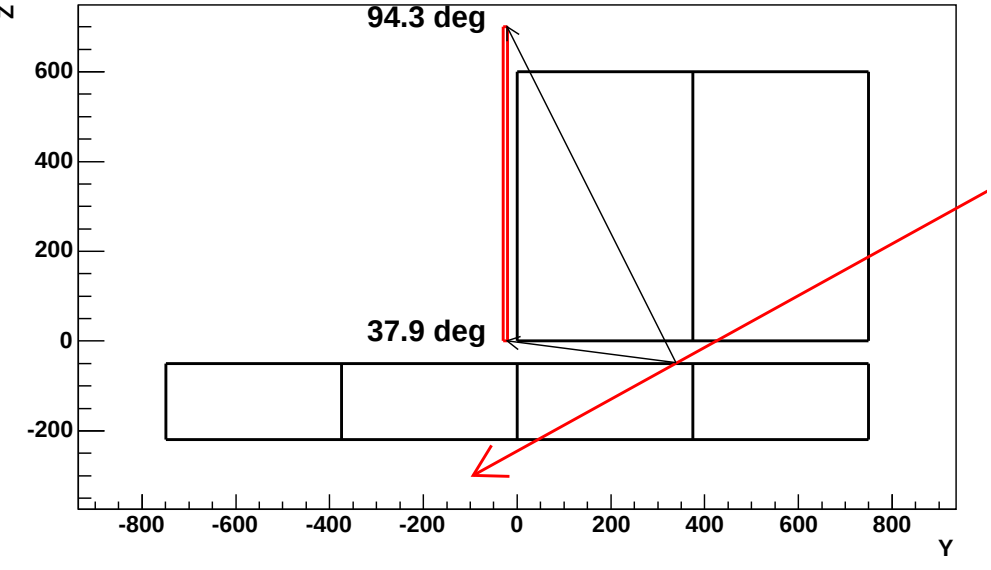
the crack effect is significant above 140 deg.

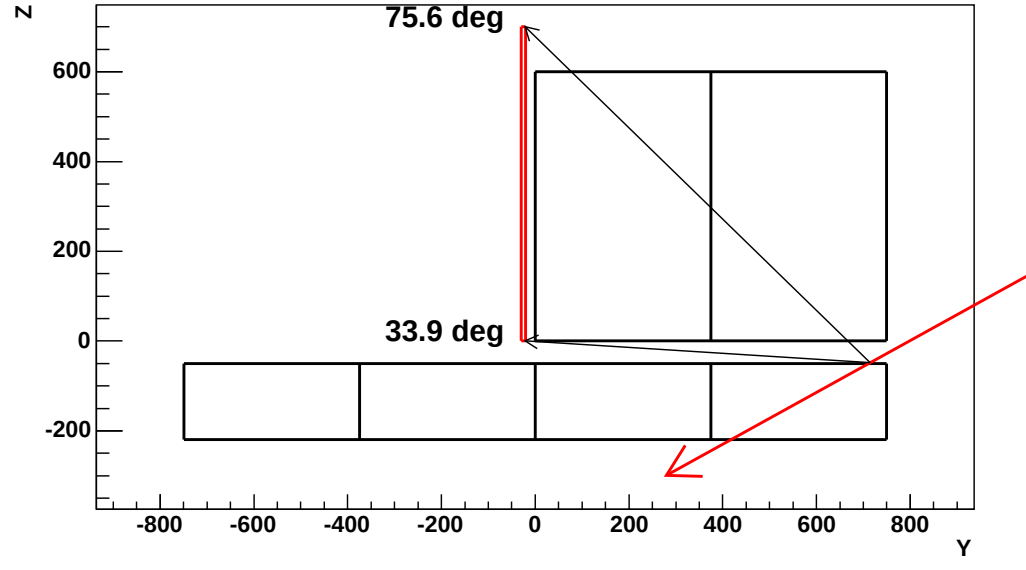




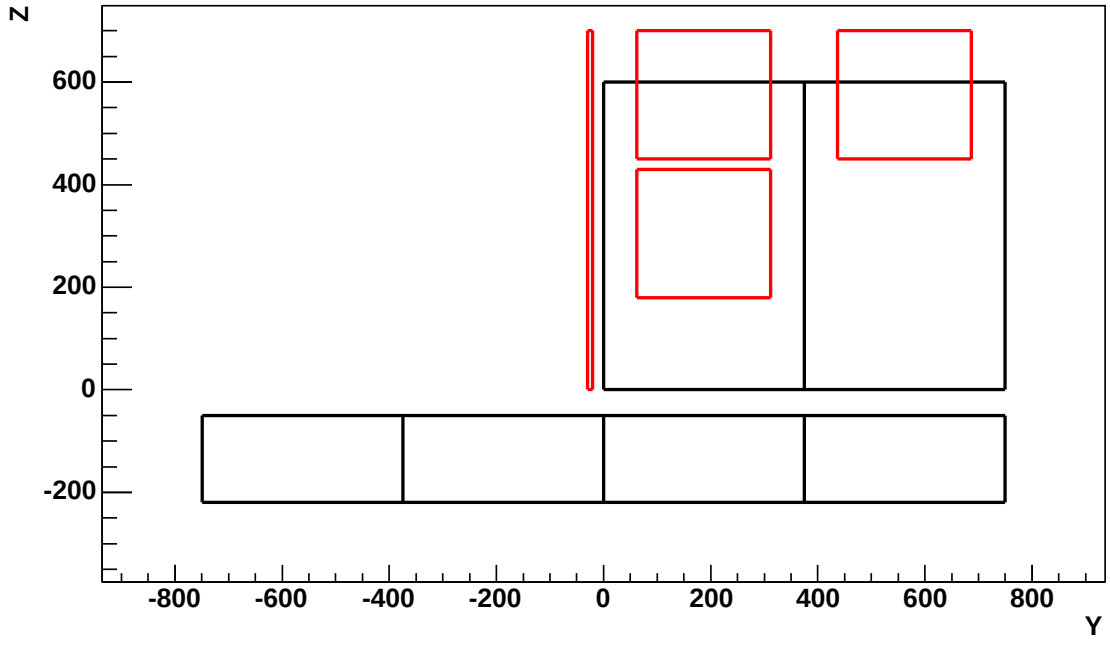
Large incoming angles

incoming angle = 60 deg.$\Rightarrow$ the maximum lies at $\sim$ 80 deg.



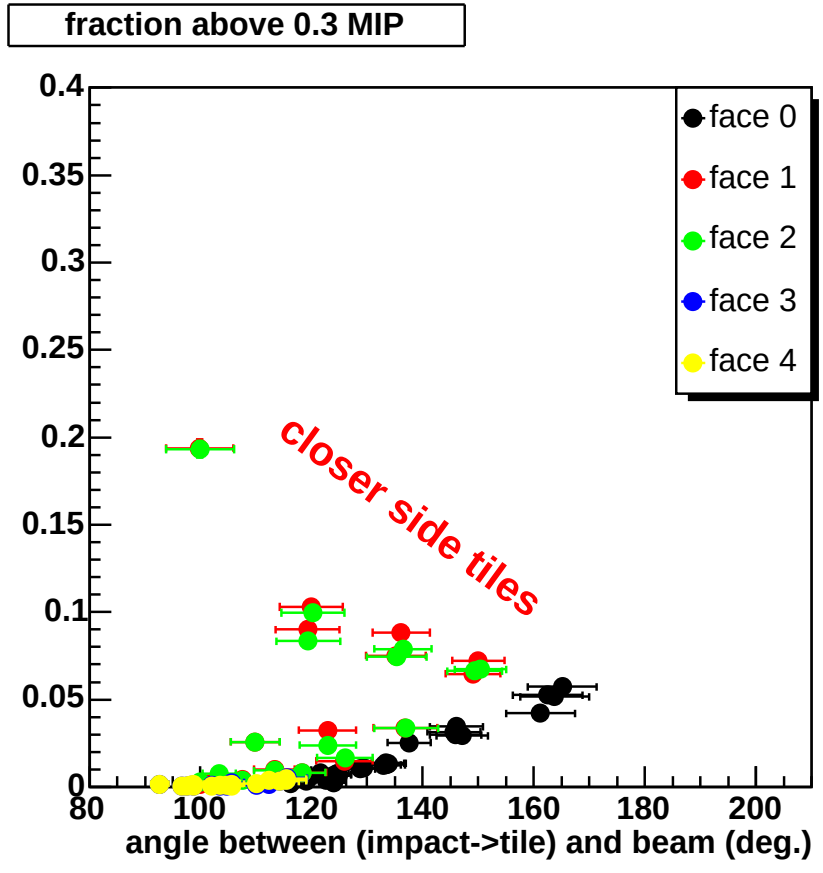


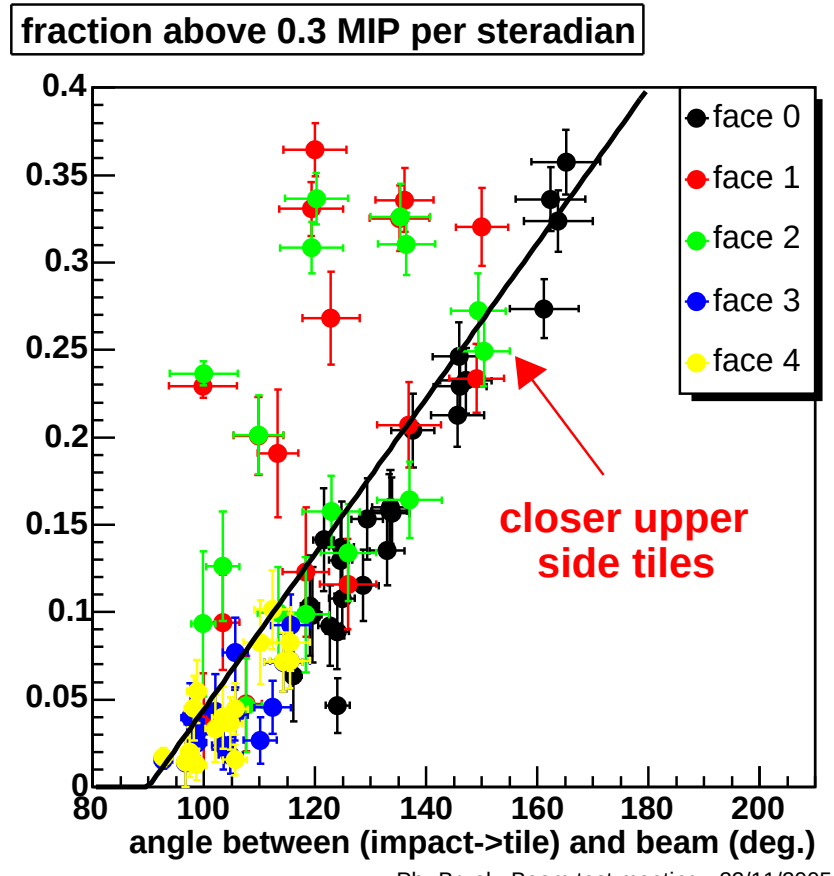
If more tiles are available...



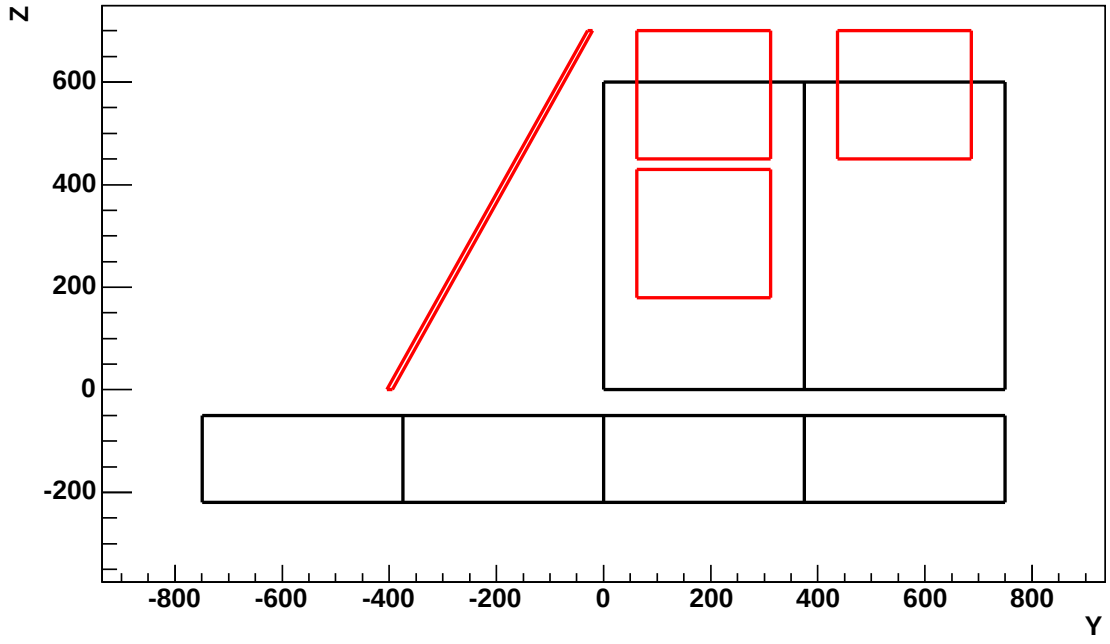
BUT : in the center of a corner tower

- the correction does not work so well...
- should the distance be taken into account ?
- direct “contamination” from the shower ?





A solution ?



Conclusions

- towards a backsplash beam test plan :
  - backsplash, cracksplash and sidesplash
  - preferred position of tiles
  - statistics and configurations
- some remarks :
  - should be confirmed with realistic simulation of CU + ACD tiles with electrons
  - should look at what the tracker measures
  - sensitivity to the beam background