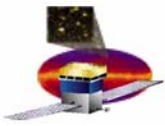
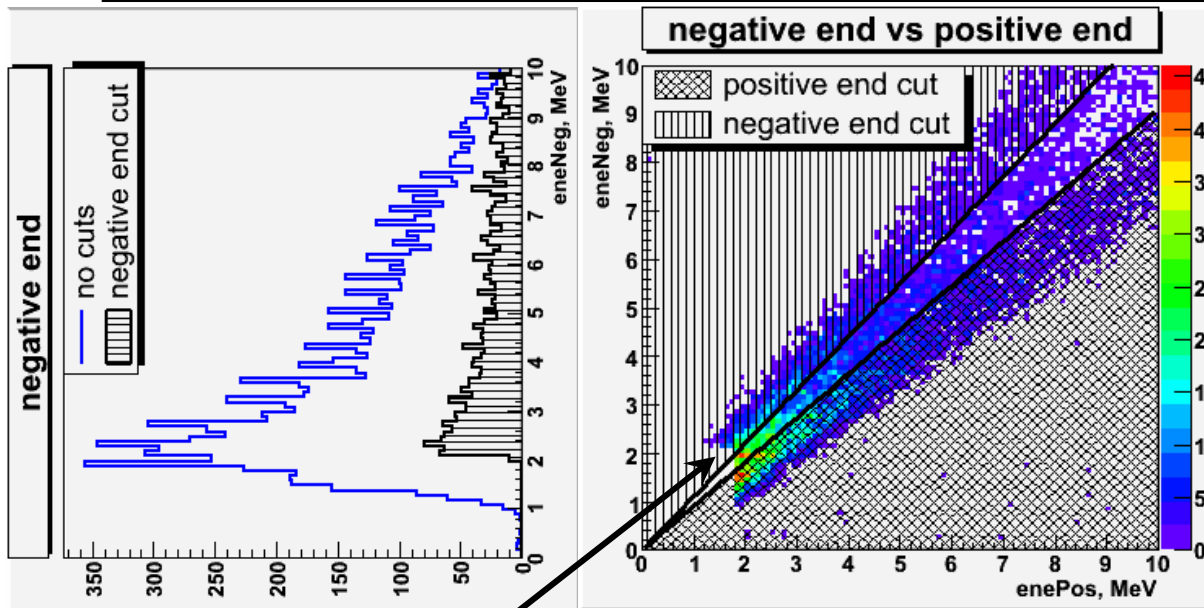


## CAL LAC thresholds calibration using OktoberTest data.

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# LAC calibration procedure



- On 1-d histograms for the energy measured at each crystal end without selection the LAC threshold is washed out and biased, because of interference of the opposite crystal end
- To avoid this interference the events should be selected by the cuts:

- For measurement of LAC threshold at positive end:
  - $enePos > k * eneNeg$
- For measurement of LAC threshold at negative end:
  - $eneNeg > k * enePos$

where  $k$  is the ratio of LAC thresholds at two ends of the crystal.

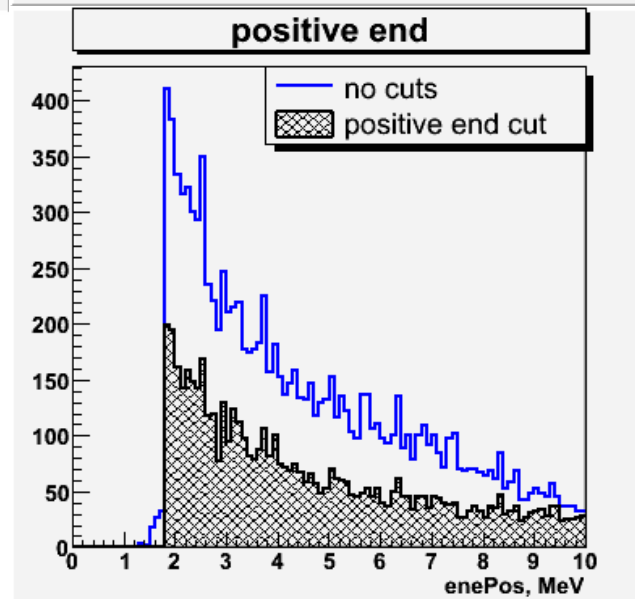
- As  $k$  is not know at the beginning, I used  $k=1.1$  in all cases, considering that the spread of LAC thresholds is less than 10%.
- After LAC thresholds are defined for the first approximation, the selections could be improved individually for each channel.

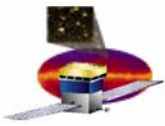
- The black one dimensional histograms on top left and bottom right plots show the result of this selection

- The threshold becomes very sharp and at correct position

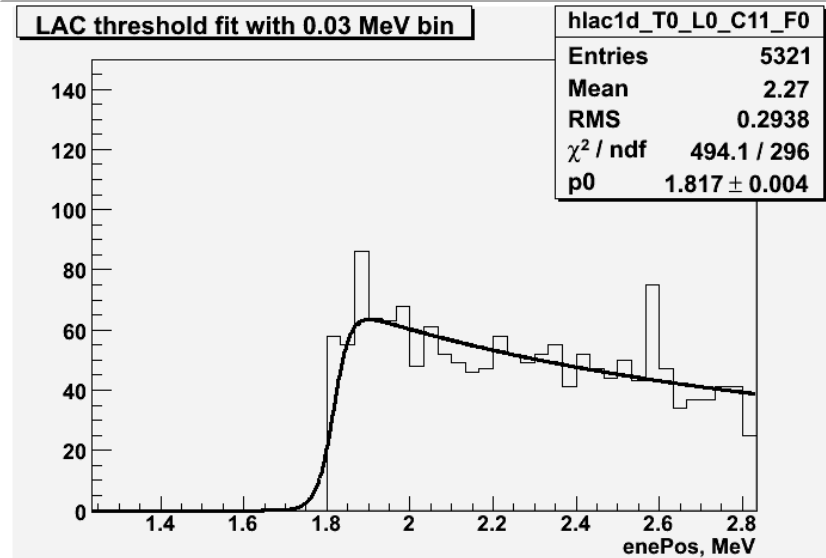
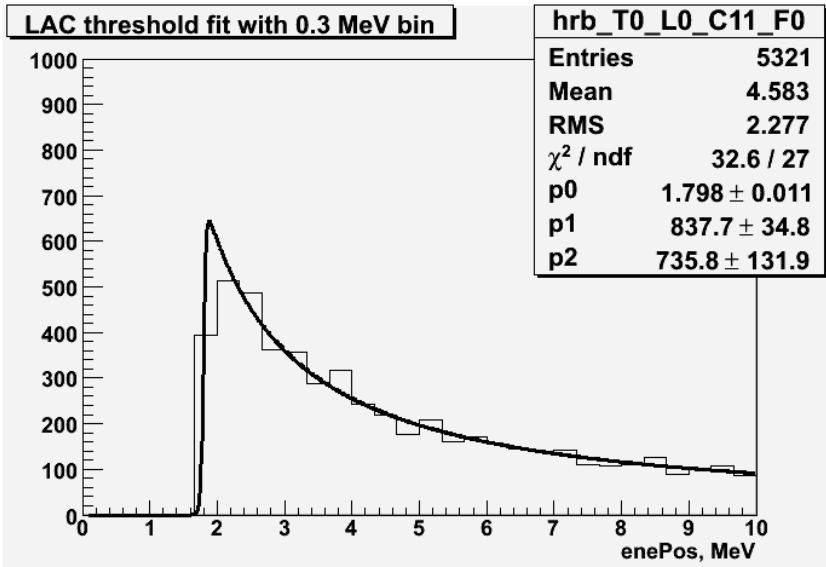
LAC thresholds produce square "shadow" on 2d histogram of energies at negative end versus positive end of the same crystal

To measure LAC thresholds we have to find the position of the edges of this shadow

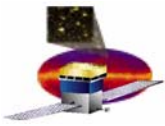




# LAC threshold fit

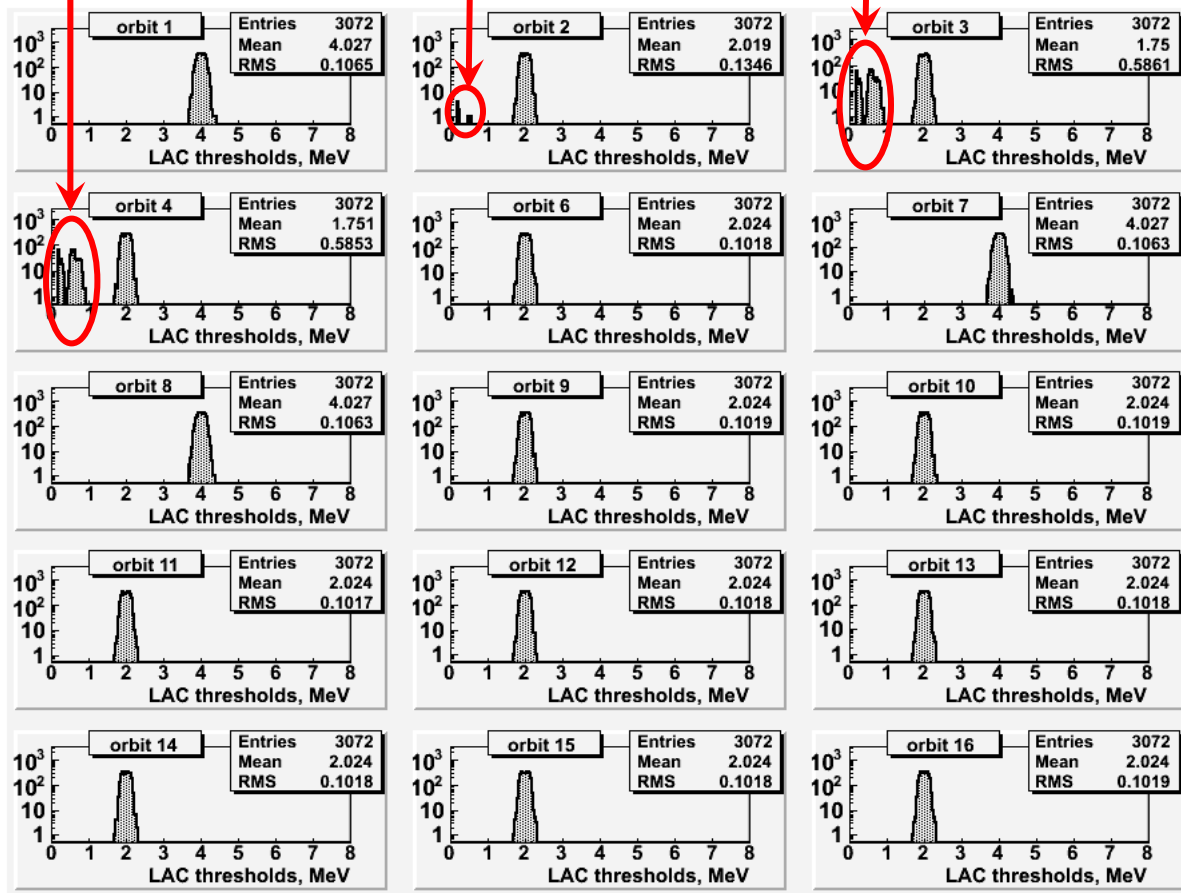


- Fit of 1-d histogram to determine LAC threshold was done with the function:
  - $Y = (p1/x + p2/x^2)/(1+\exp((p0-x)/0.02))$
- Top plot shows the fit of a histograms with coarse binning (0.3 MeV).
- Then parameters p1 and p2 defining the background energy spectrum were fixed and the fine binned histogram (binsize=0.03 MeV) was fitted with the same function
  - See bottom plot
- Fit works well and the LAC threshold is very sharp (simulated events !)
- In the fitting function the LAC threshold width parameter is set to 0.02 MeV - because otherwise fit doesn't converge.

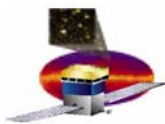


# LAC thresholds for all 15 orbits

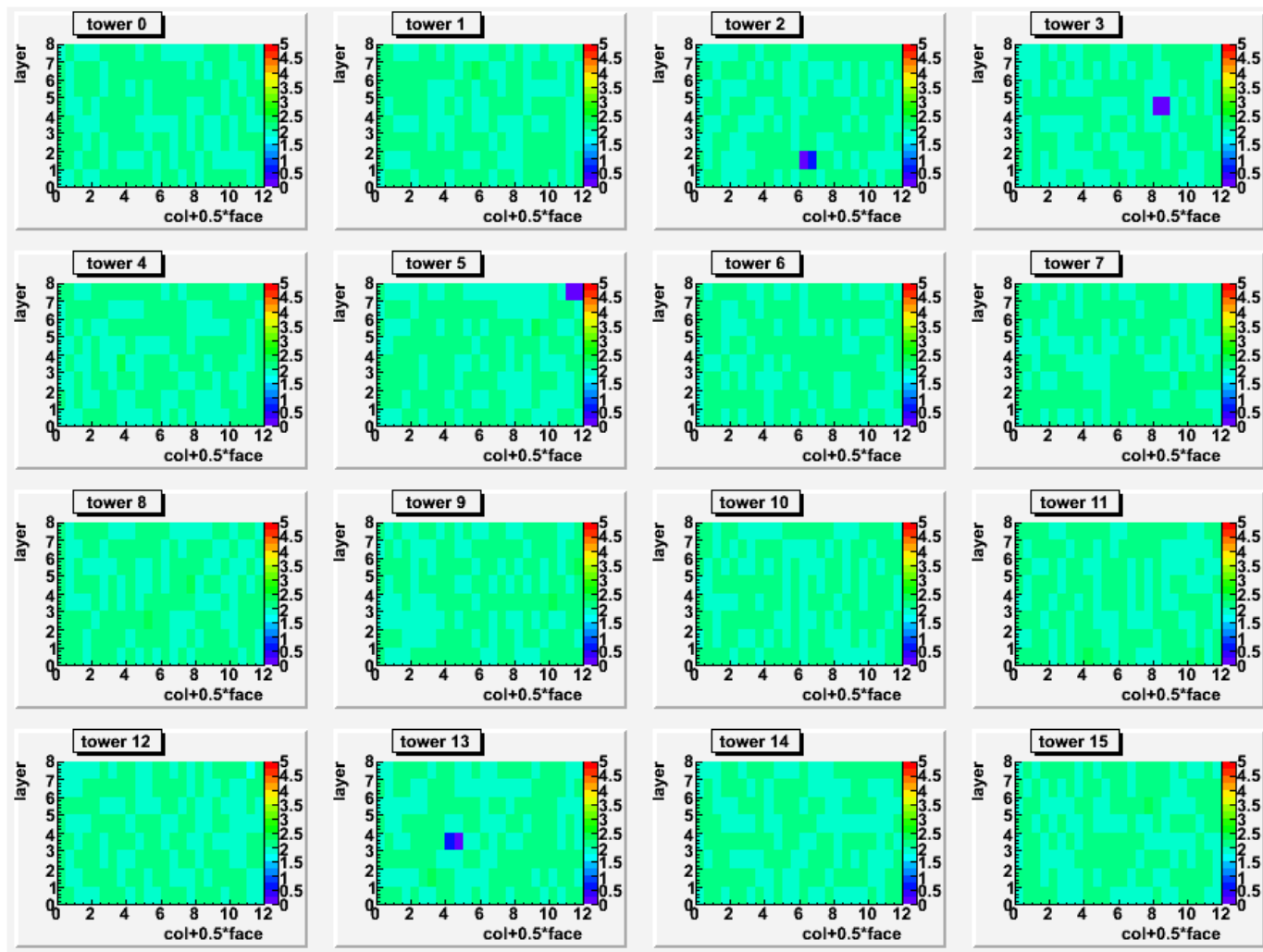
## Anomaly !!



- There are secondary peaks with incorrectly low LAC thresholds for orbits 2,3 and 4
- For all other orbits all 3072 LAC thresholds are inside the one peak
- For all orbits position of the main peak corresponds to the expected LAC threshold for each configuration:
  - 4 MeV for orbits 1,7,8
    - "Conservative thresholds"
  - 2 MeV for orbits 2-3 and 9-16
    - "Nominal thresholds"

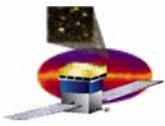


# LAC thresholds for orbit 2

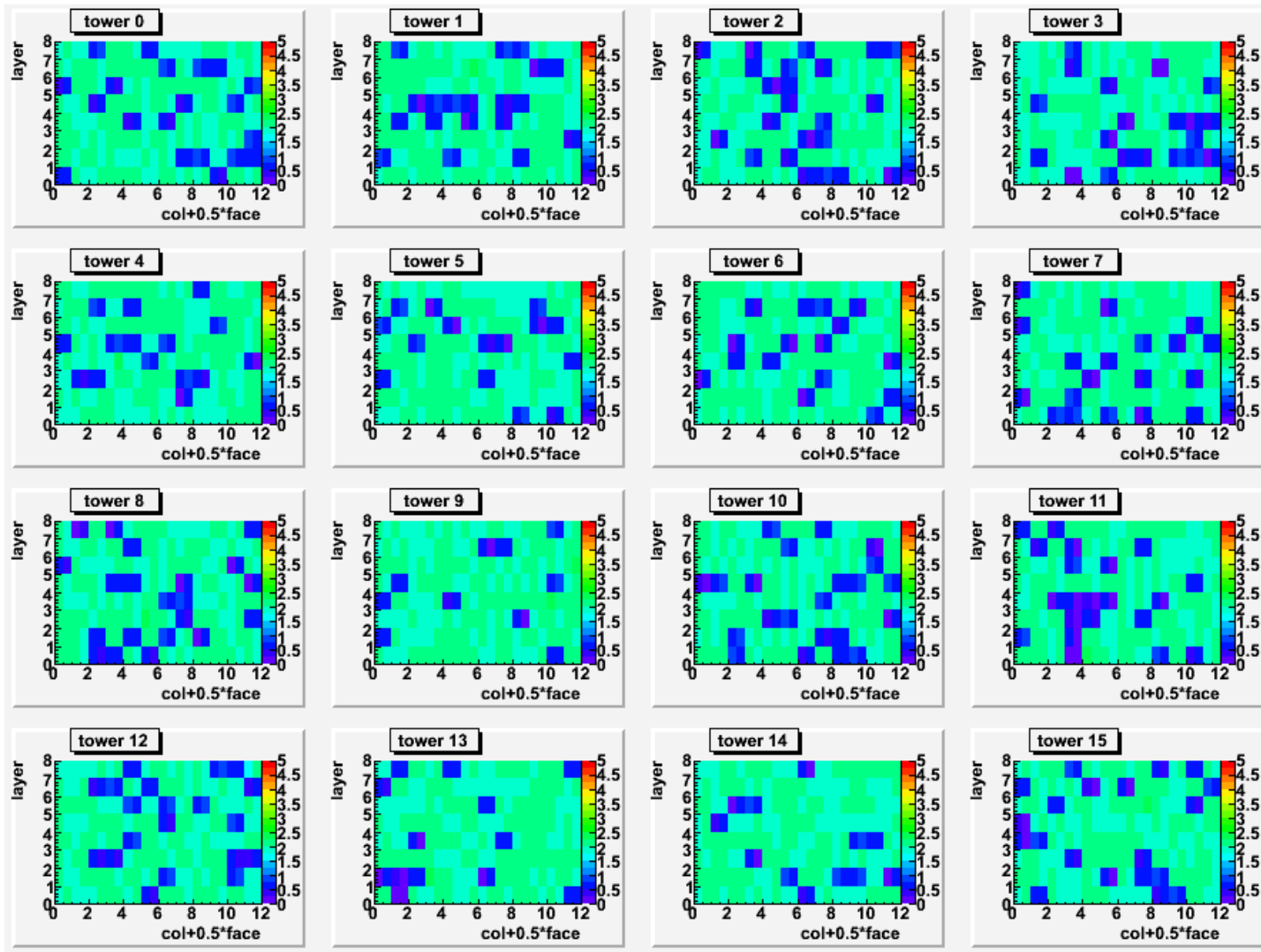


Incorrectly low LAC thresholds for both ends of 4 crystals:

- $twr=2, lyr=1, col=6$
- $Twr=3, lyr=4, col=8$
- $Twr=5, lyr=7, col=11$
- $Twr=13, lyr=3, col=4$

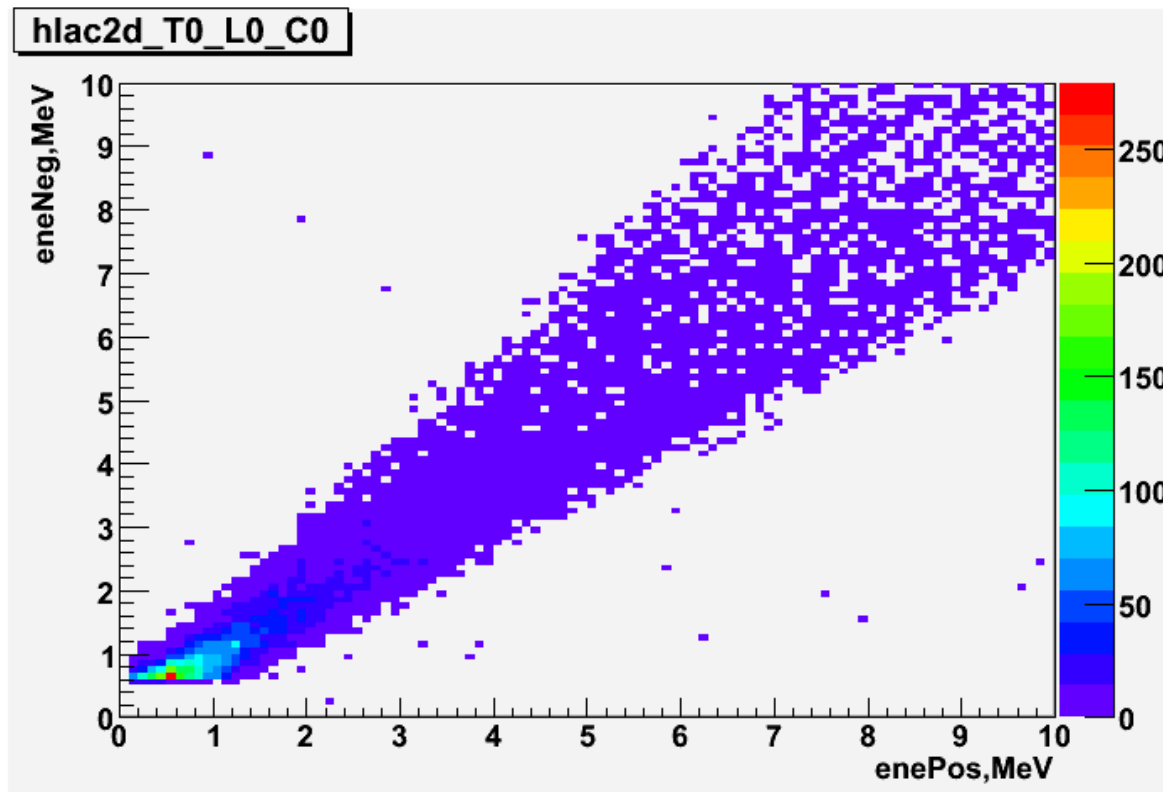


# LAC thresholds for orbit 3

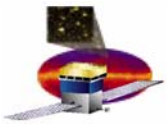


- Multiple channels with incorrectly low LAC thresholds

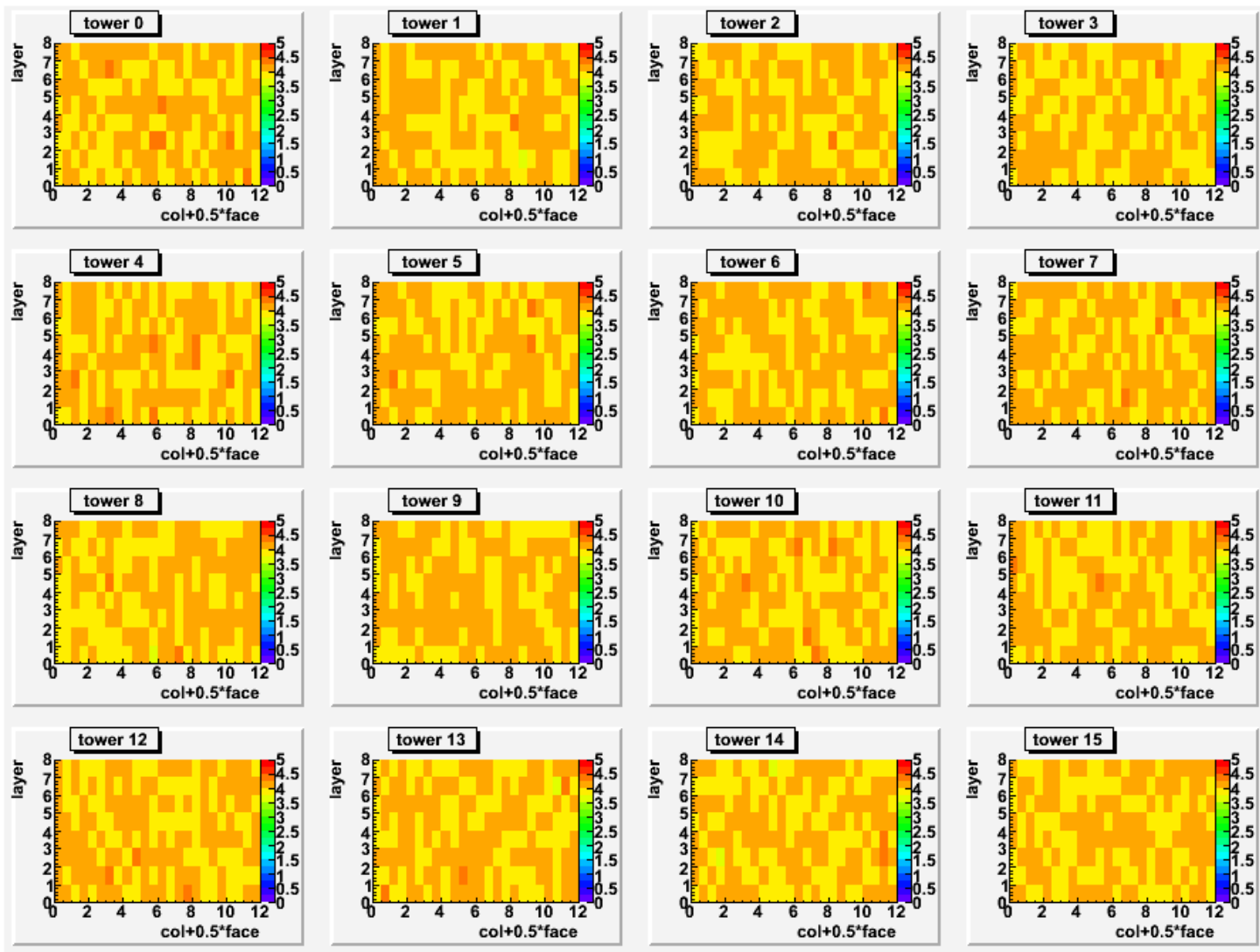
## Example of crystal with “bad” LAC thresholds



- We see only effect of low LAC threshold at negative crystal end
- We are unable to measure the LAC threshold for positive end of the same crystal, when it is more than 1.5 high than one at opposite end

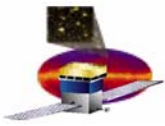


# LAC thresholds for orbit 1

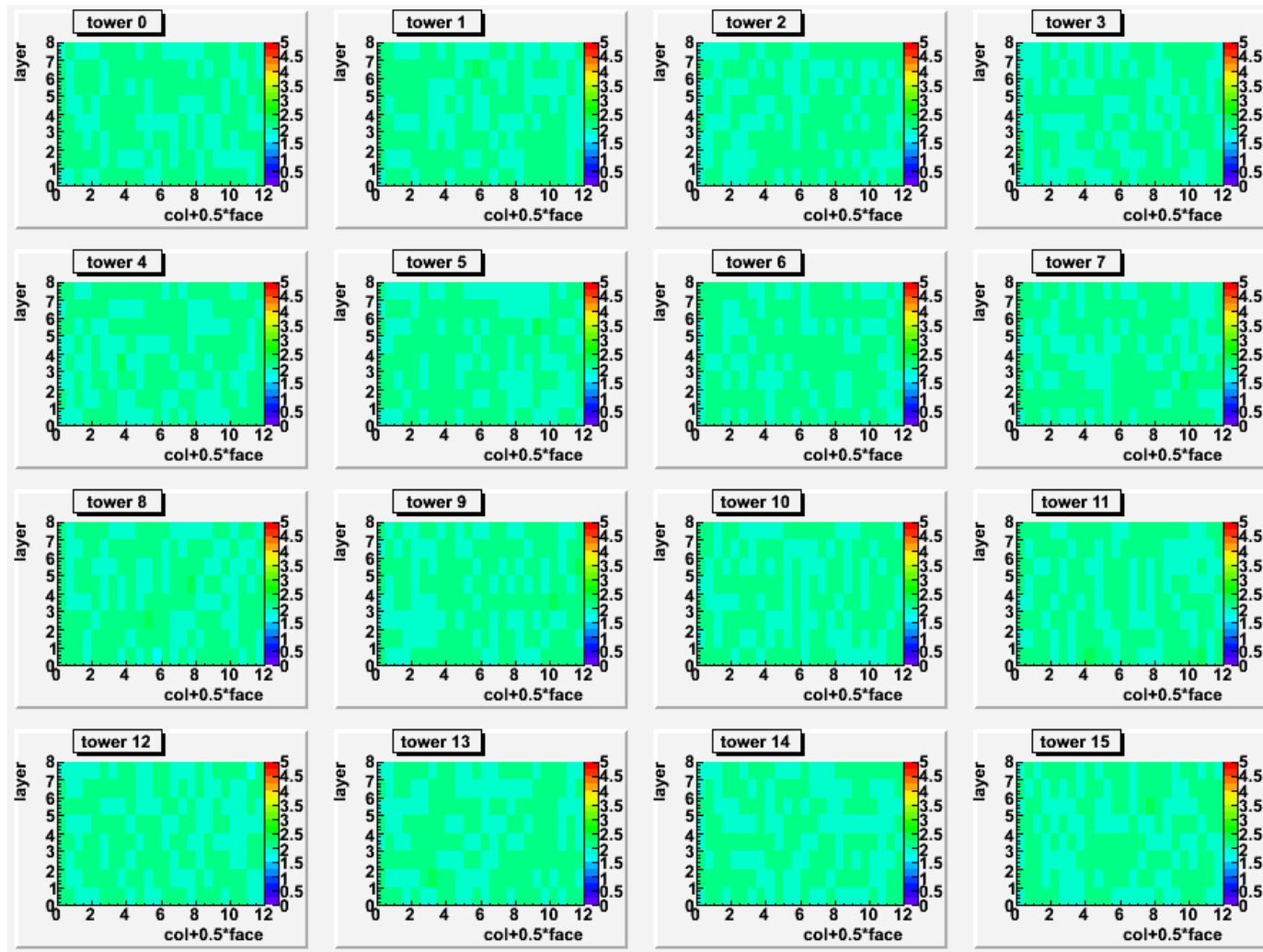


- All LAC thresholds  $\sim 4$  MeV

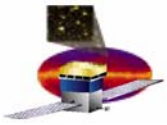




# LAC thresholds for orbit 6



- All LAC thresholds at  $\sim 2$  MeV



# Conclusion

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- The code developed for monitoring LAC thresholds during science data taking.
- The method works when the ratio of LAC thresholds at two ends of the same crystal is between 0.7 and 1.5