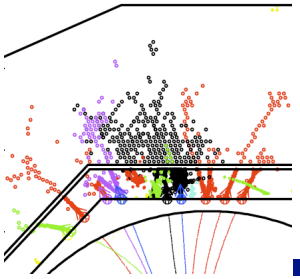
AHCAL for DBD: Follow-up from Matsumoto

Felix Sefkow

CALICE pre-meeting
ILD workshop at Kyushu, May 22, 2012

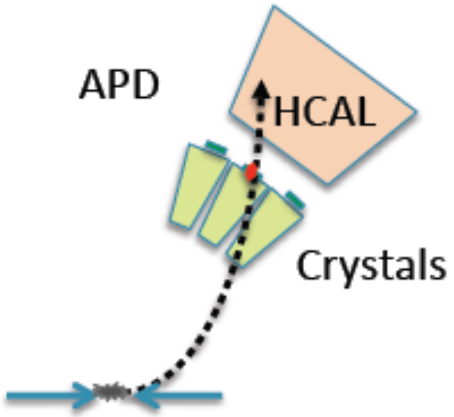


This talk

- DBD input for the AHCAL is based on the material presented by Mark Terwort at Matsumoto
- Until fall, expect
  - results from technological demonstrator slab tests
  - some publications to be finalized
- Here only comment on two issues from the discussion there
  - Nuclear counter effect
  - Scintillator uniformity

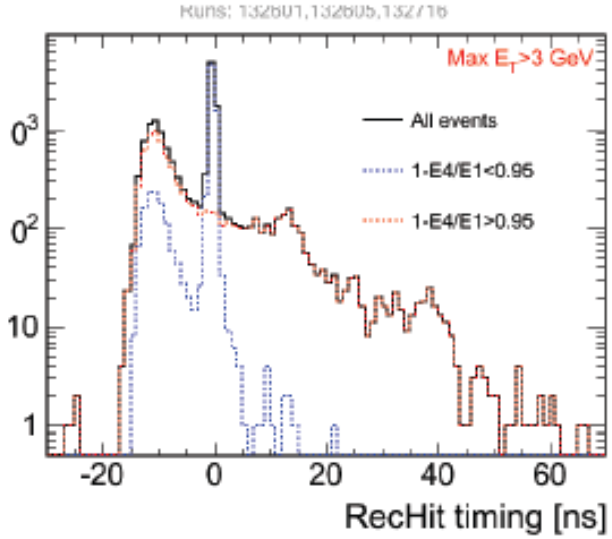
Anomalous signals

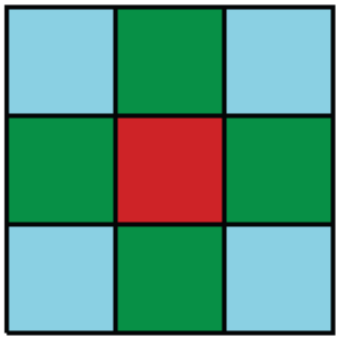
Anomalous high energy signal in single isolated channel have been observed during the collisions. This is due to direct energy deposition in the depleted bulk of an APD .



They can be identified with:

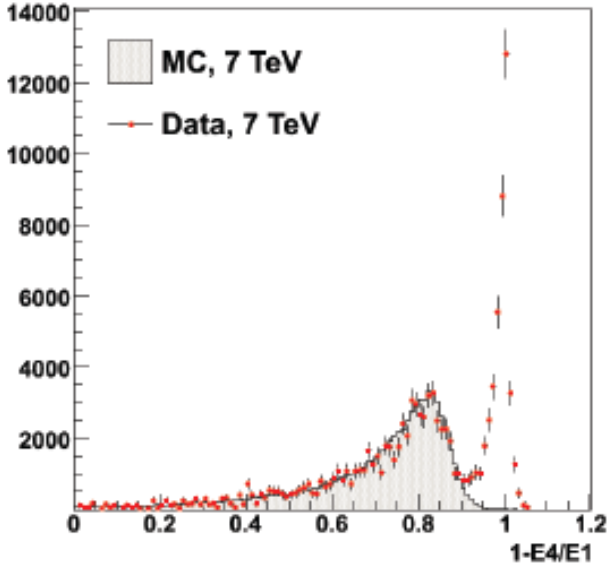
- topological selection → isolated channels
- Different pulse shape (no scintillation) early reconstructed time





For anomalous signals

1-E4/E1 ~ 1



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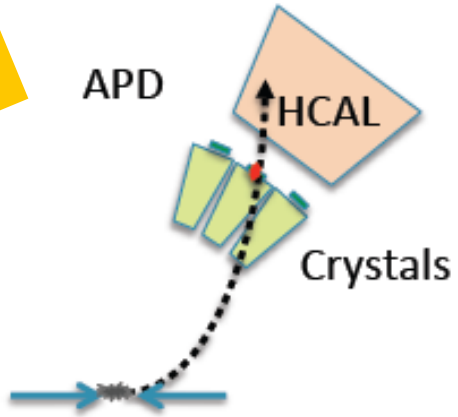

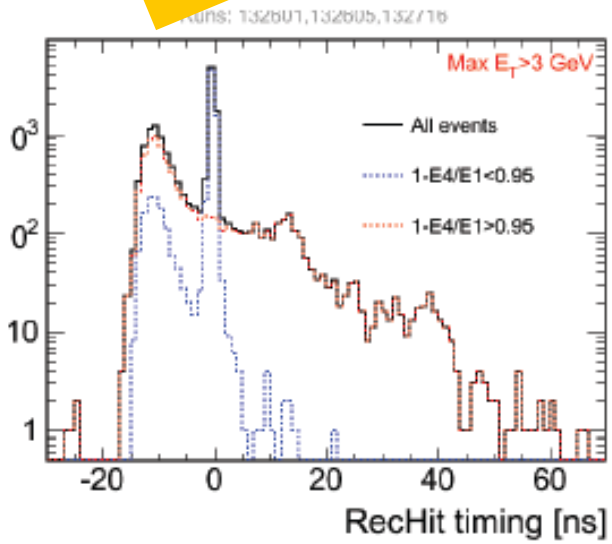

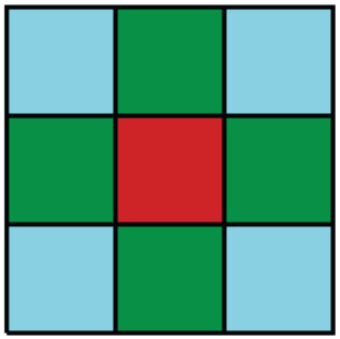

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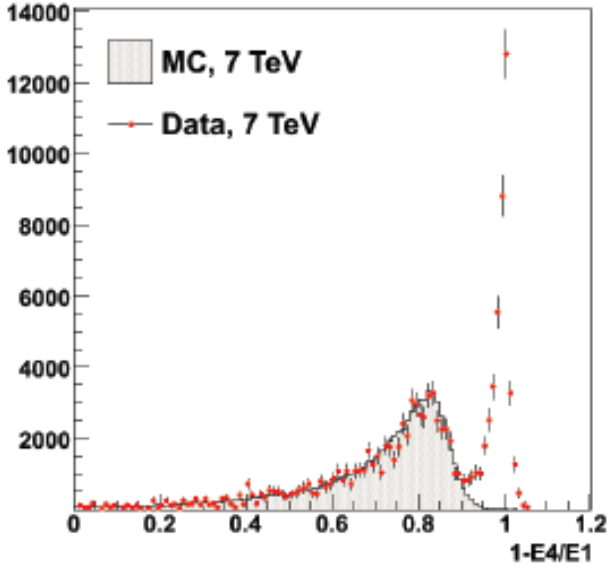
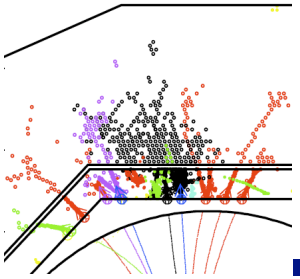




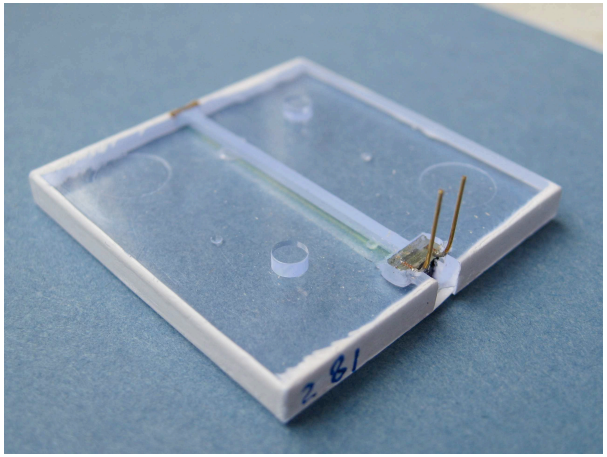
Nuclear counter effect in SiPMs

- The insensitivity to nuclear counter effects is one of the first-mentioned advantages of the SiPM technology
  - The SiPM is about 100x smaller than the CMS APDs
  - The charge amplification takes place in a few micron thin region only
  - Due to the Geiger mode operation the response to a highly ionizing hadron is the same as to an optical photon
  - The GeV equivalent of a fired pixel or fake photon is small - one particle creates a signal corresponding to 0.06 MIP or 1.5 MeV

- The CMS effect was discovered ex post in the test beam data
- We have checked for anomalous events in our data and did not find any - as expected

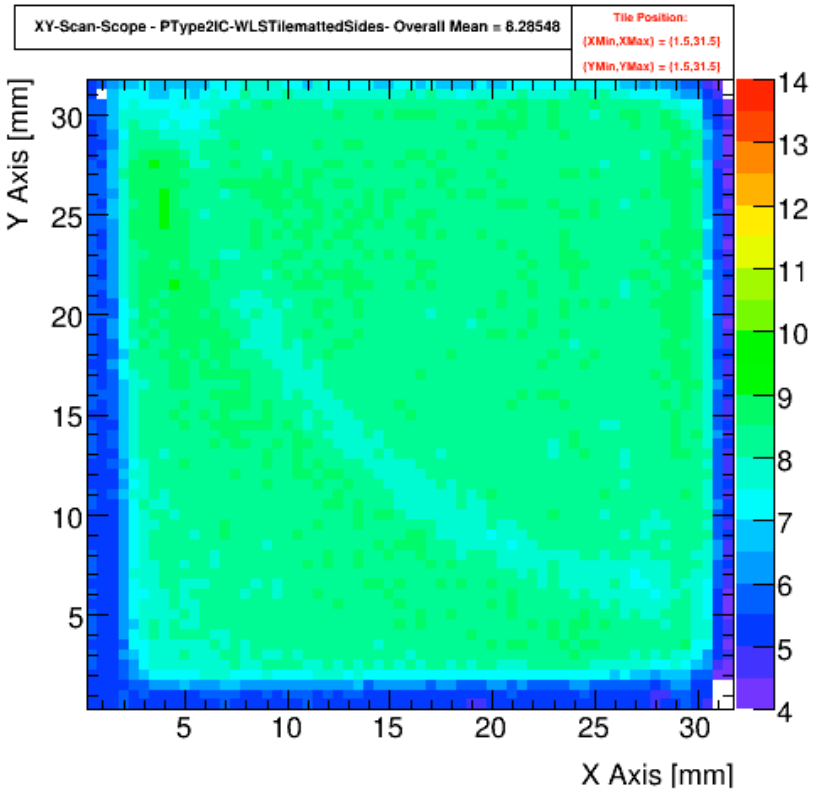
Tile non-uniformity

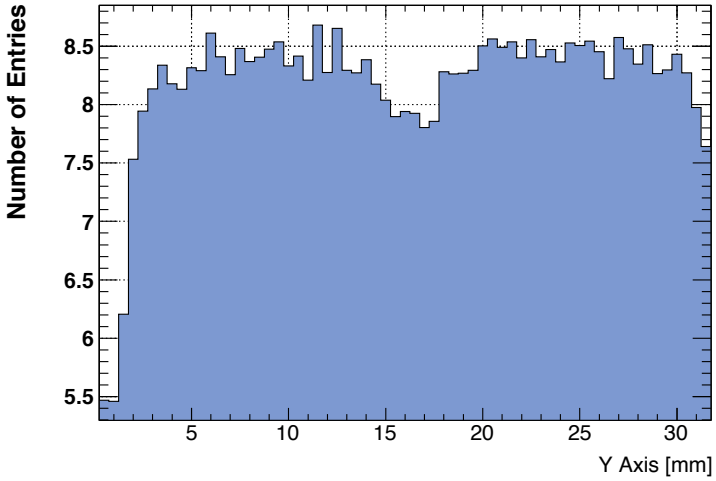
- Response variations are due to
  - Dead space between the tiles
  - The edges etched for diffuse reflection
  - The WLS fibre
  - The SiPM and mirror cut-outs



Measurements at MPI-M

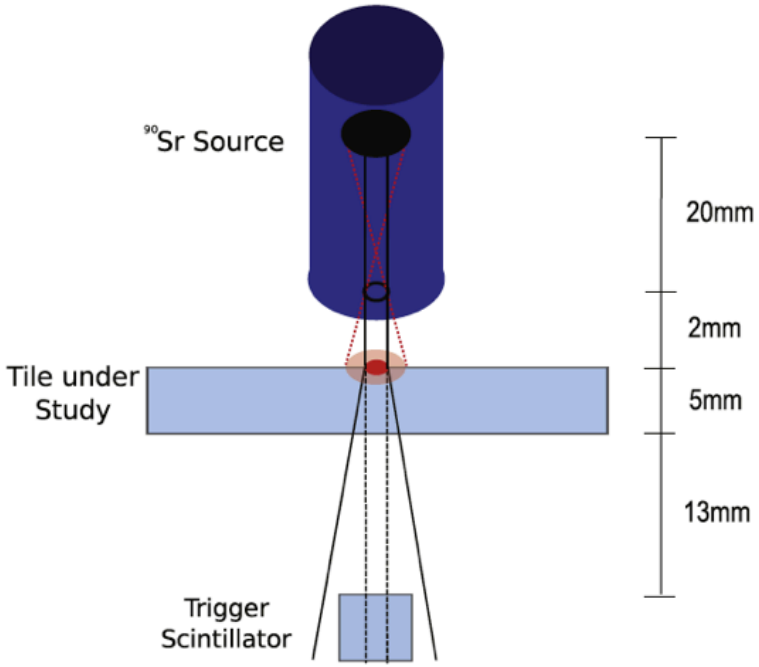
- like most others, using a source (Sr)
- apparent 1mm wide edge region

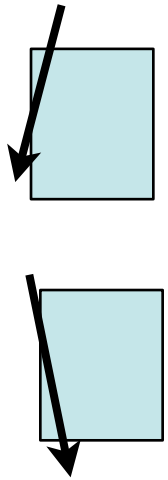


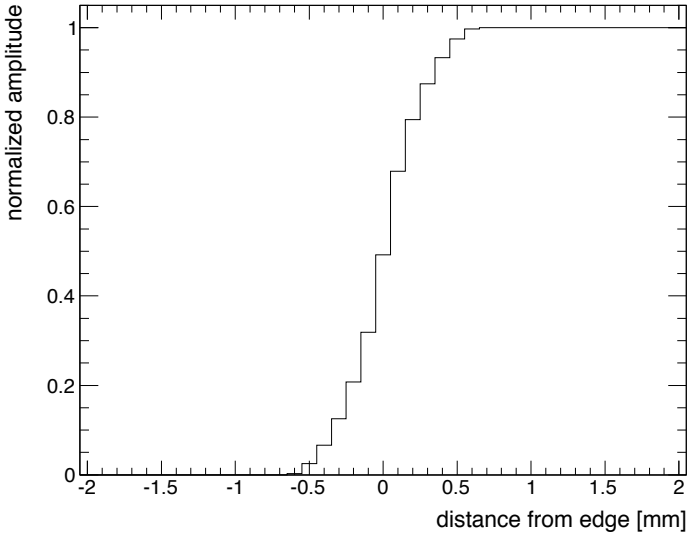


Scan resolution

- set-up: divergence 25 mrad
- simulations fully explain observed edge effects



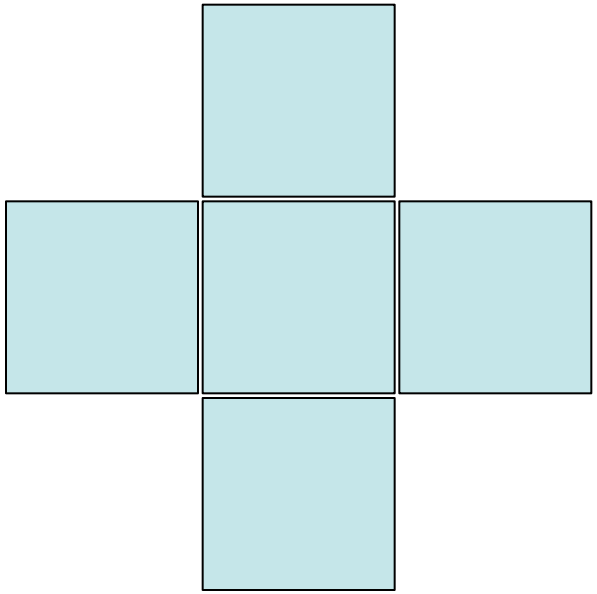




Edge: 1 mm wide
(w/o effects from multiple scattering!)

Measurements

- Performed at the ITEP test beam with hadrons
- Wire chamber tracking system
  - ~ 1mm resolution
- Neighbouring tiles
  - Add the response to compensate for tracking uncertainty



Results

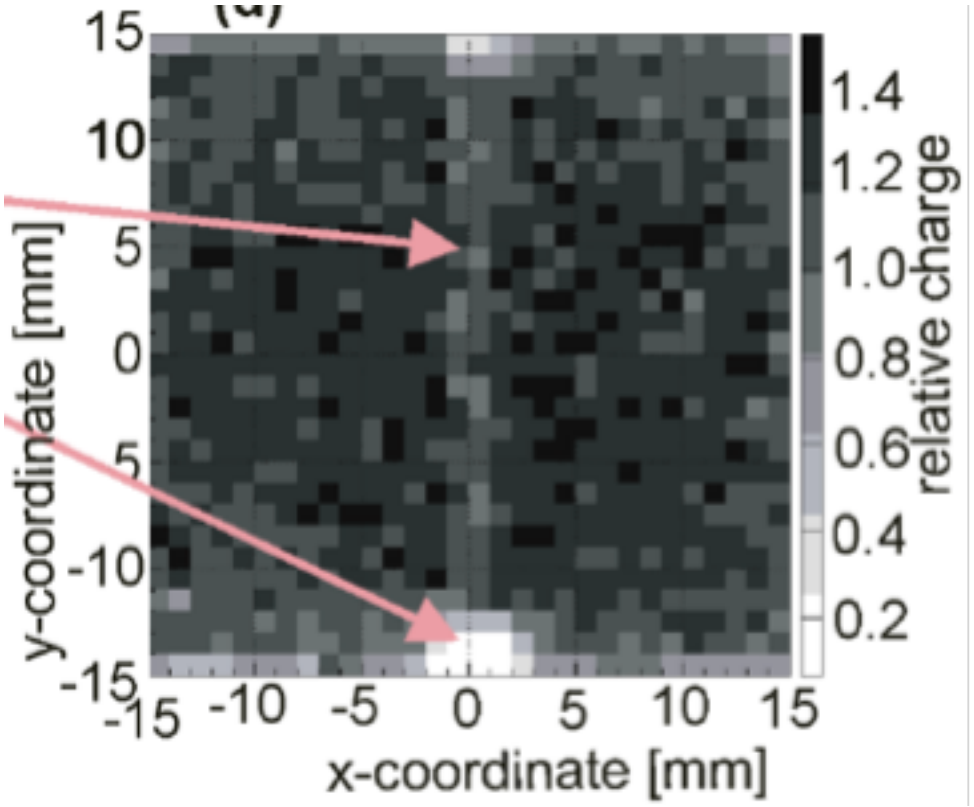
- Mean response in 1x1mm^2 bins

- Top and bottom edges not useful
- Left and right: 10% lower average response
- Fibre: 20% lower response
- Mirror and SiPM: very low response

Larger gap to top neighbour

WLS fibre

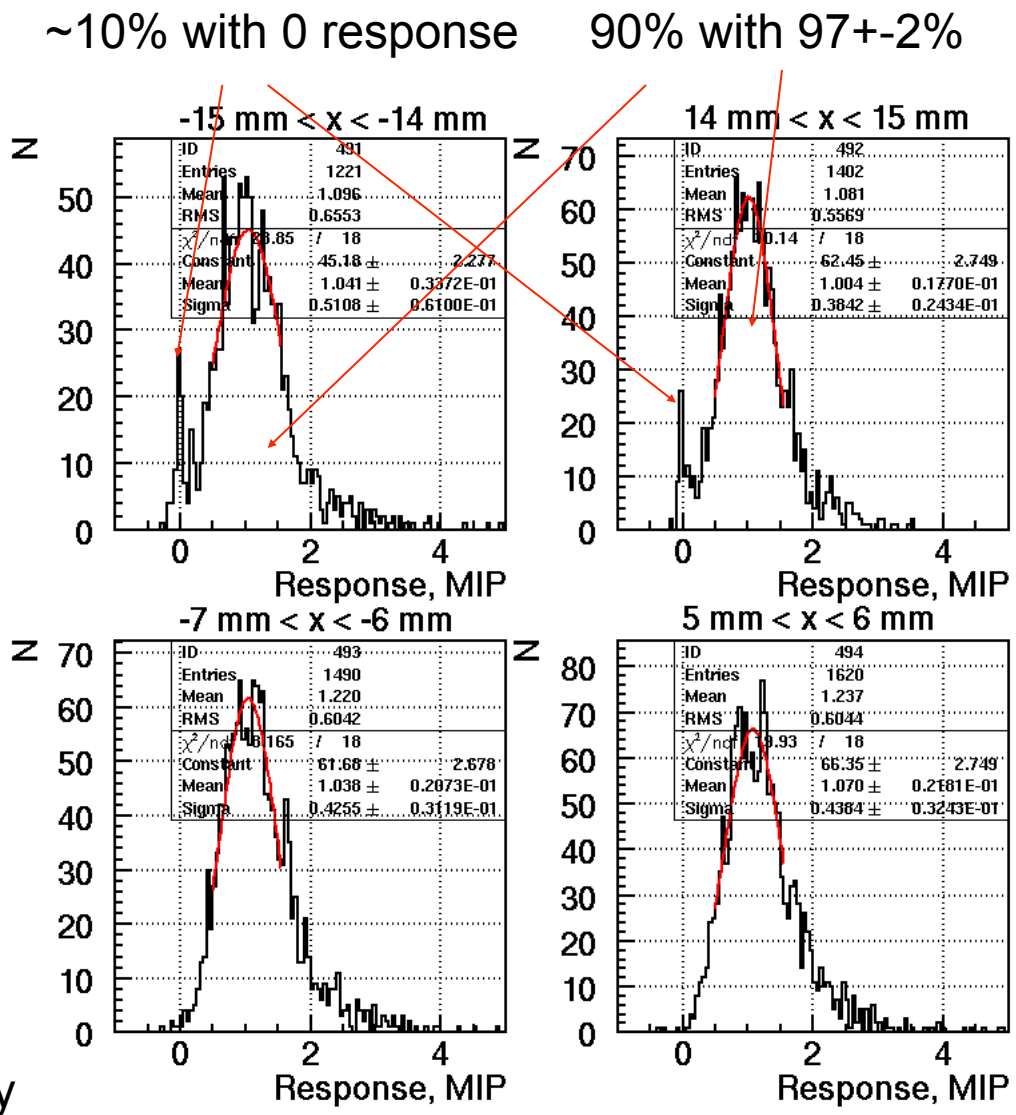
SiPM



Bottom neighbour not read out

Edges

- 10% decrease over one millimeter?
  - Unphysical…
- Or 100% decrease over 1/10 mm?



E.Tarkovsky

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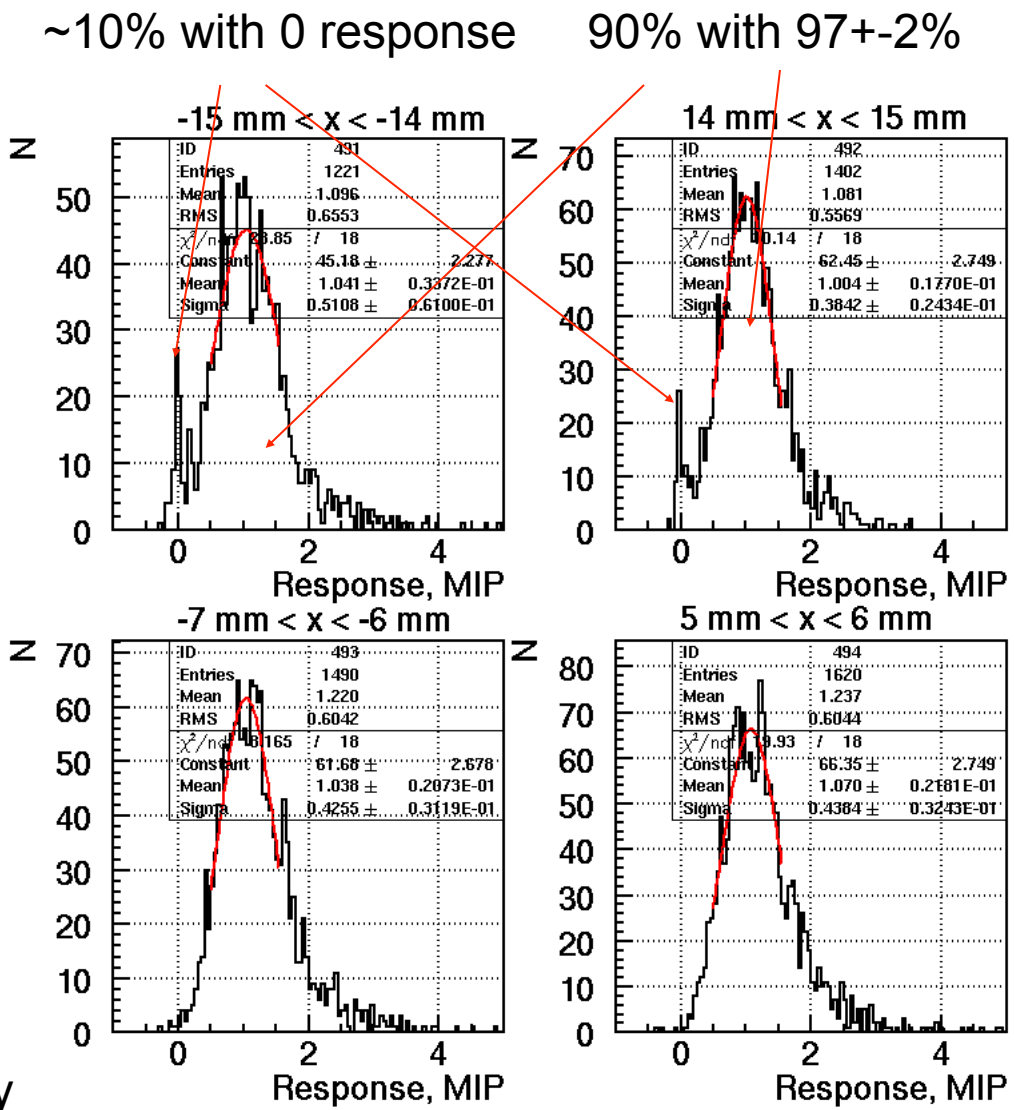
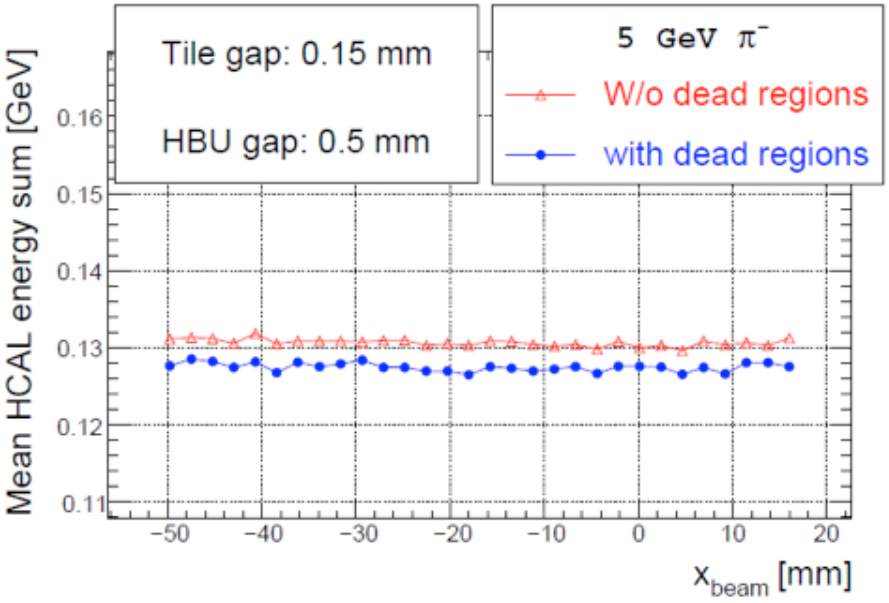
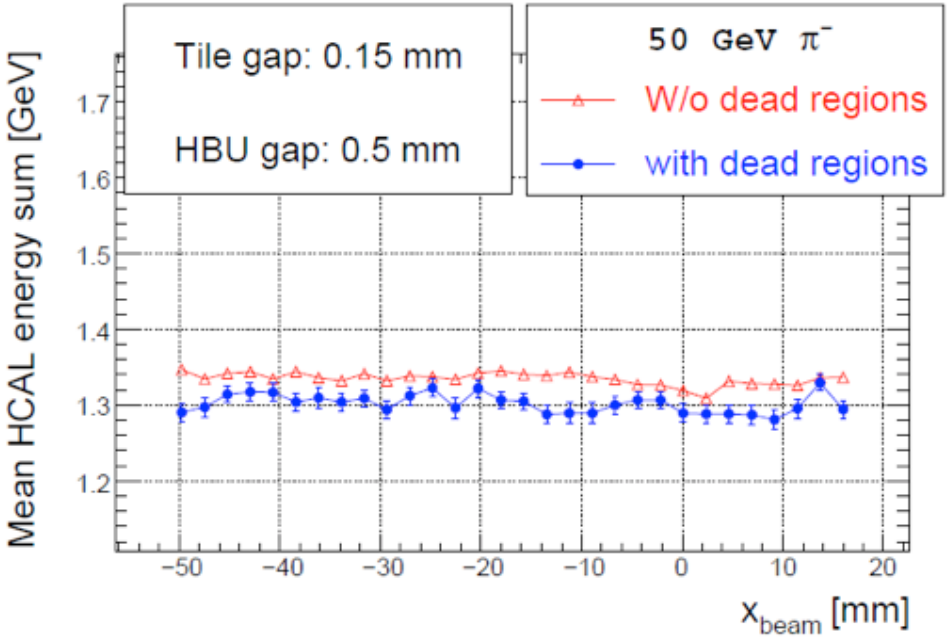


E.Tarkovsky

Understanding the Details - Non-Uniformities

- Impact of non-uniformities on energy reconstruction: detailed simulation studies





- Neither tile nor HBU boundaries affect the energy reconstruction for hadrons (even more true for smaller response variations within the tile area)
  - Only effect of non-uniformities: Overall lowering of response: just calibration!

Documented in arXiv:1006.3662

Back-up slides