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Testbeam data analyses in Krakow

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Data analysis chain (initial part)

1. **Pedestal subtraction** (pedestals calculated for each channel in each event independently from first 15 points)

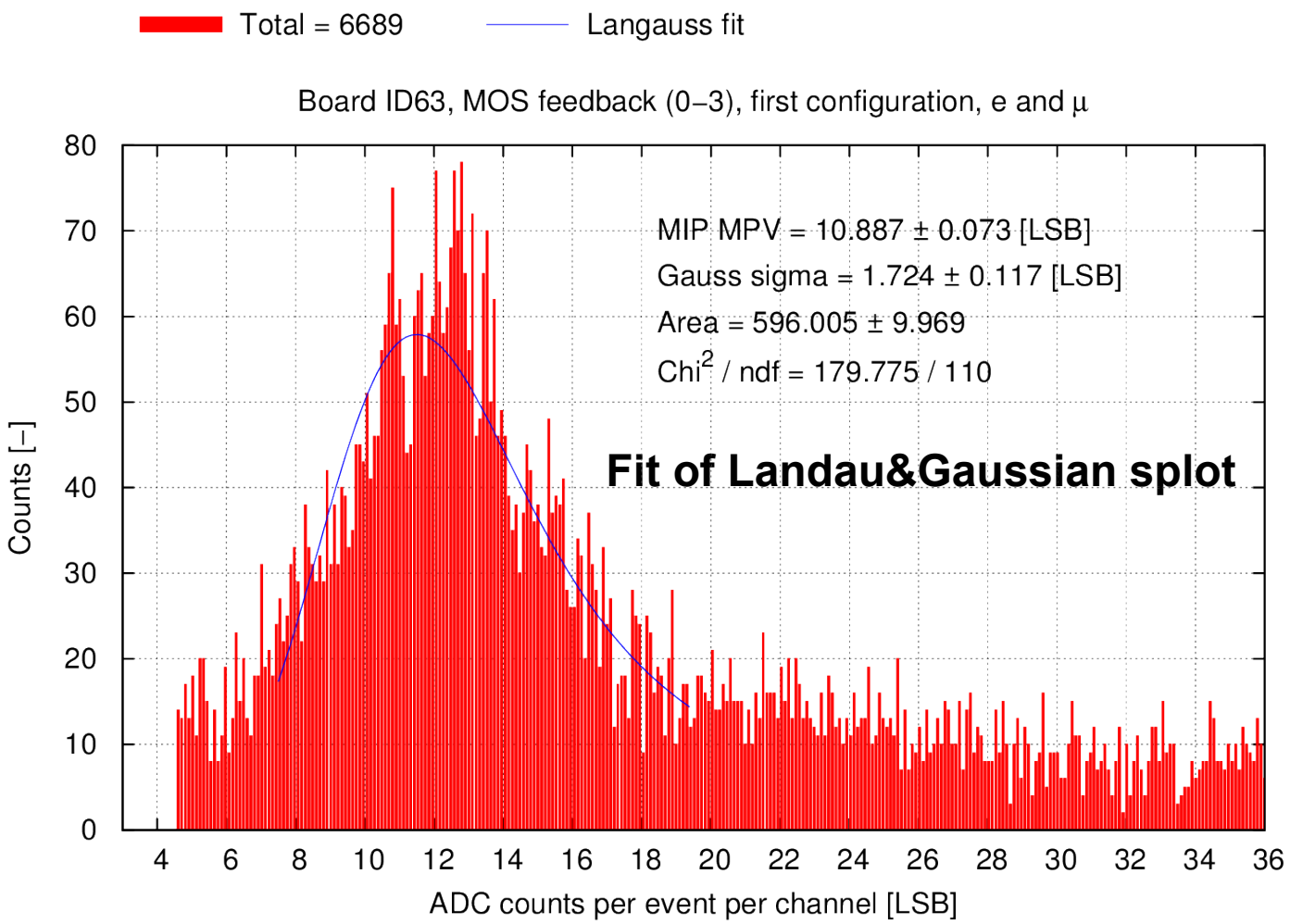
2. **Preliminary signal search** (value of at least two consecutive points > 3*σ) – to eliminate signals from CMS procedure

3. **CMS subtraction** (CM calculated separately for 4-channel groups with different gains in each ASIC) – low CM statistic (4 channels only) but the best CM suppression...

4. **Deconvolution –** with time correction if time reconstruction is within +/- 1 sample, or as sum of samples (up to 20% error)

5. **Board gain calibration –** amplitude / gain = charge [pC]

Data analysis chain
6. Energy spectrum - done separately for all boards in all configurations



Using the splot of Landau&Gaussian shifted the Landau peak systematicallly to the left,
in comparison to previous “only Gaussian” fit results

Data analysis chain
6. Energy spectrum – gain tuning

Configuration	1	2	3
Board – channel type			
63 MOS	10.919	11.613	11.395
64 MOS	11.457	11.559	11.945
67 MOS	11.021	9.920	10.861
76 MOS	9.916	11.165	---
63 R	5.144	5.032	5.104
64 R	5.036	5.081	5.053
67 R	4.619	4.249	4.551
76R	4.879	4.907	---

6. **Board gain tuning –** ADC counts [LSB] / MIP MPV = charge [MIPs]

Data analysis chain
7. Beam profile

7. **Beam profile:**

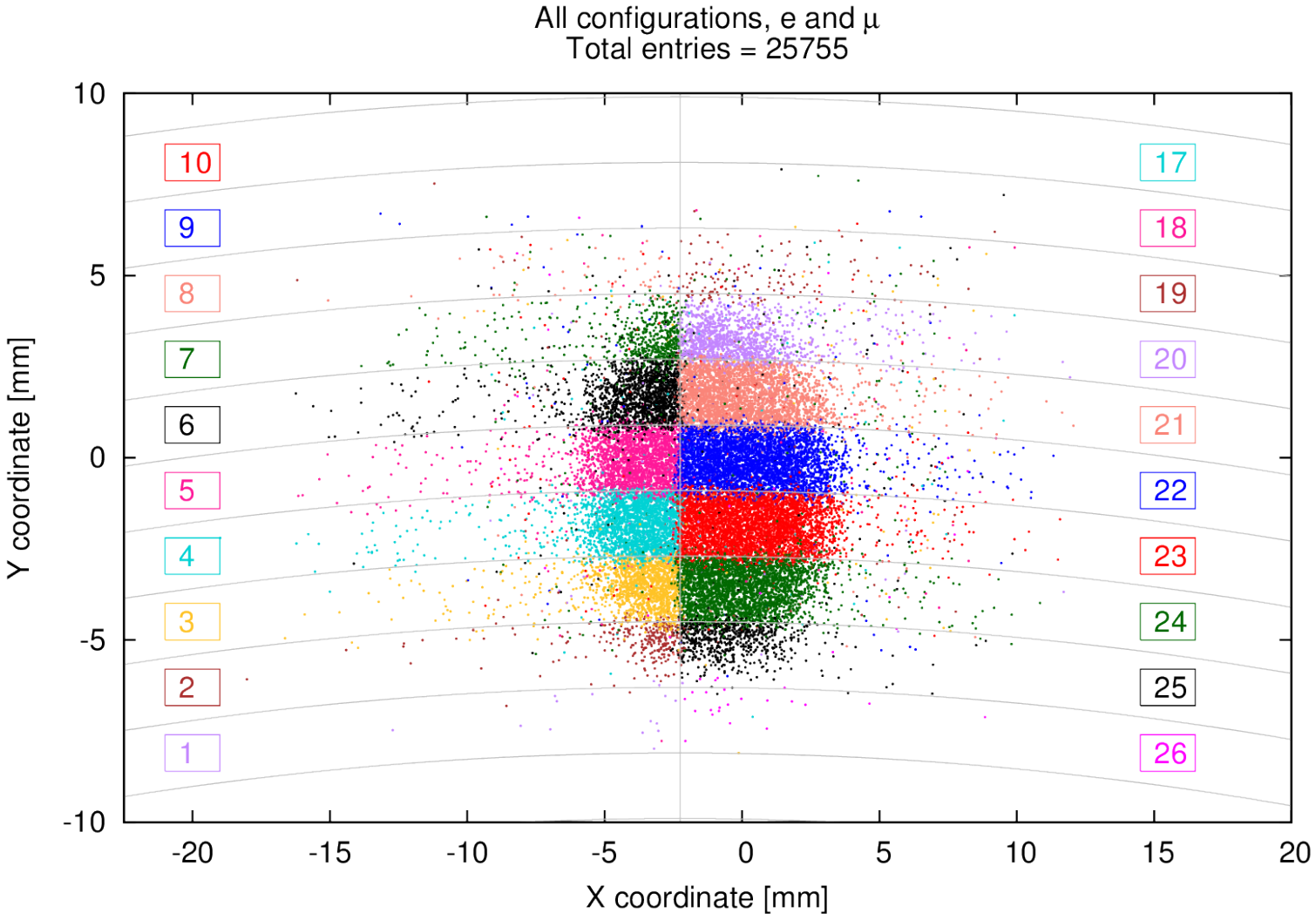
a) Telescope events binded with LumiCal events

b) For simplicity – only first LumiCal layer (ID63) considered

c) Only single hit events selected (only one channel with charge deposition > 3*σ in whole board)

d) Hit position, projected to the first LumiCal layer from Telescope track, plotted with channel color assigned by the LumiCal hit reconstruction

Data analysis chain
7. Beam profile



Data analysis chain
8. Shower development

8. **Shower development:**

a) Sum of depositions from all 32 channels in each event calculated for each plane (board) in each configuration independently

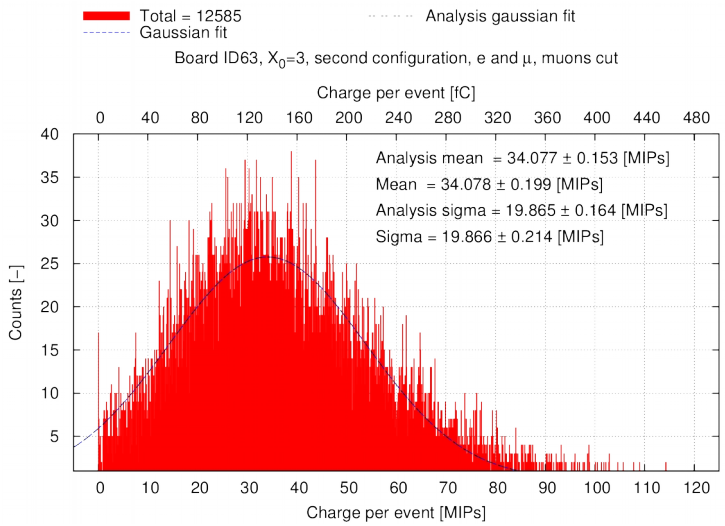
b) Distribution without any cuts done to check the muons peak position (=1MIP – calibration done properly...)

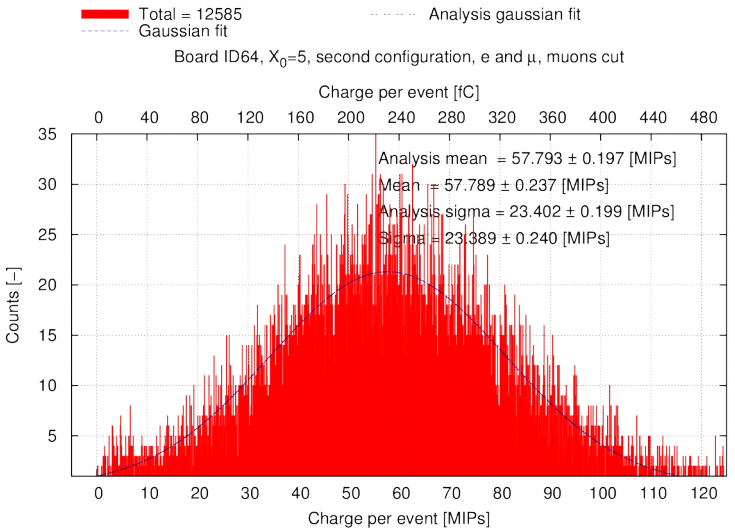
c) Muon cut – events with charge deposition in (n-1) boards less than 3MIPs dropped (n=4 for first and second configurations and n=3 for the third one)

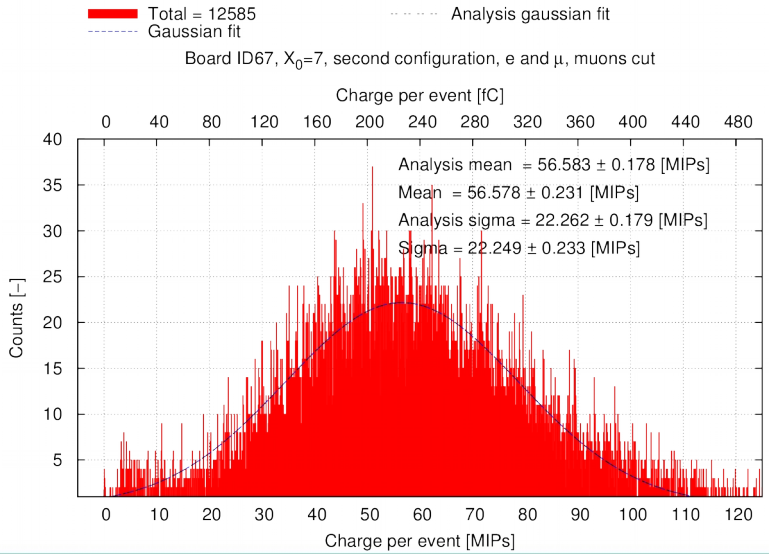
d) Distributions calculated after the muon cut:

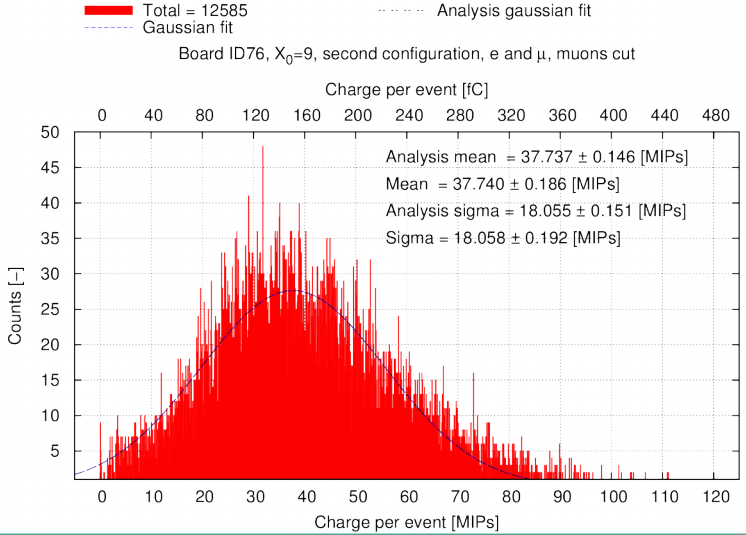
- Average charge
- MPV value from Gaussian fit

Data analysis chain
8. Shower development – example distributions after muon cut (second configuration)

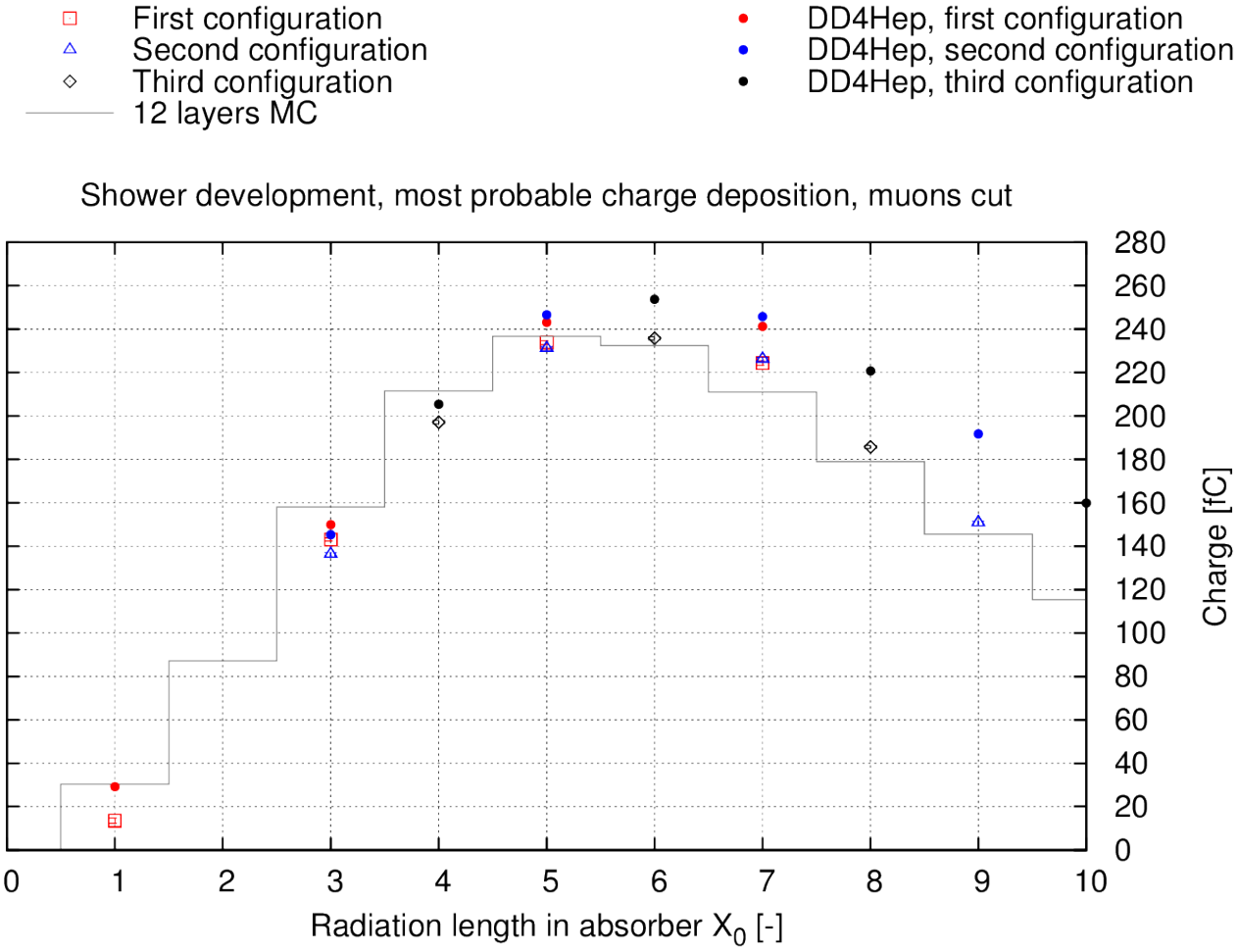




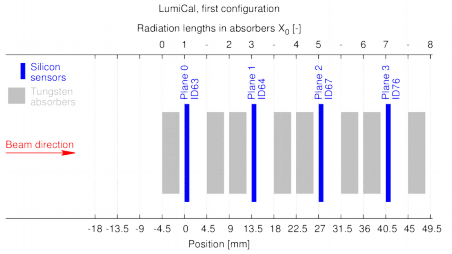




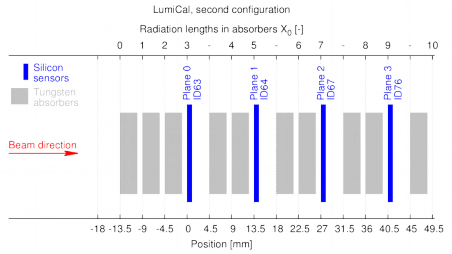
Data analysis chain
8. Shower development – MPV charge per plane



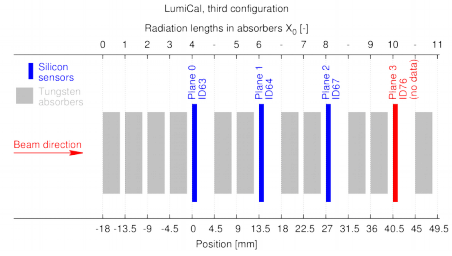
First configuration



Second configuration



Third configuration

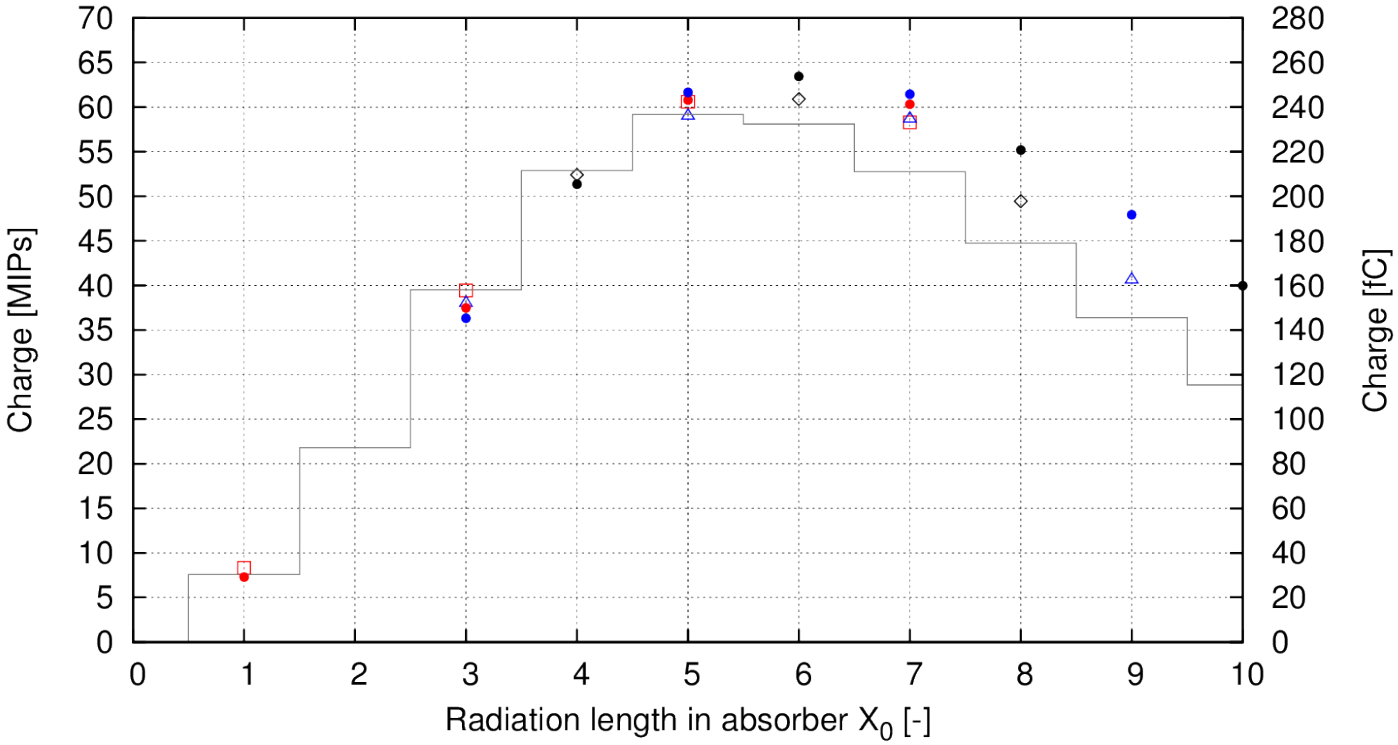


Data analysis chain
8. Shower development – average charge per plane

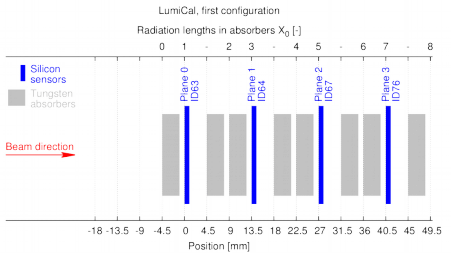
First configuration
Second configuration
Third configuration
12 layers MC

DD4Hep, first configuration
DD4Hep, second configuration
DD4Hep, third configuration

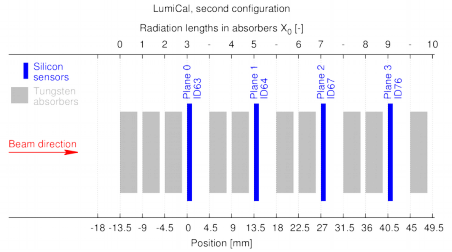
Shower development, average (mean) charge, muons cut



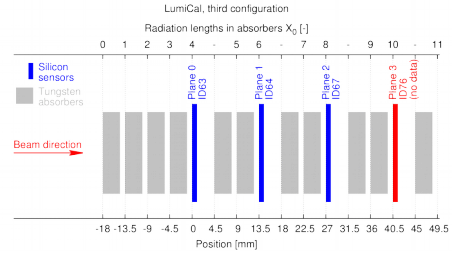
First configuration



Second configuration



Third configuration



Data analysis chain
9. Longitudinal shower profile

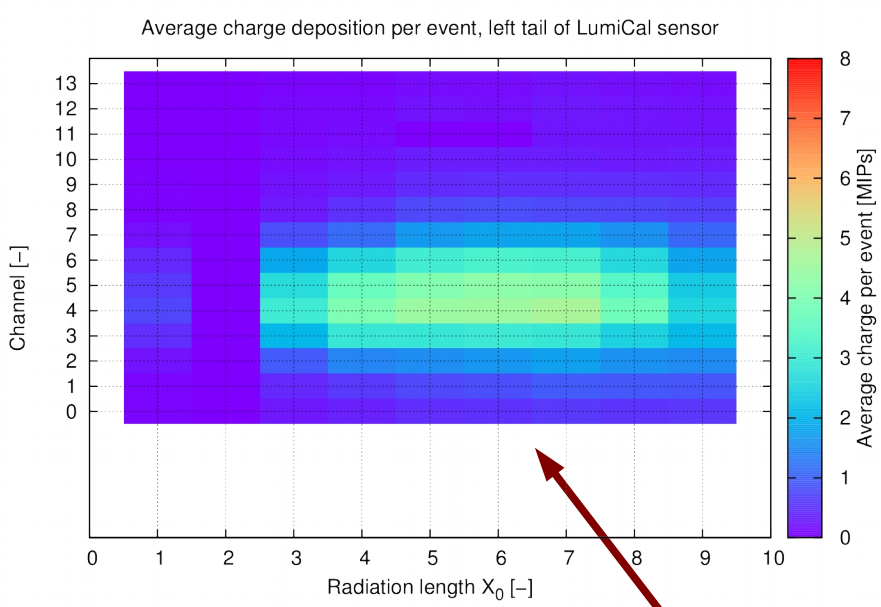
9. **Longitudinal shower profile:**

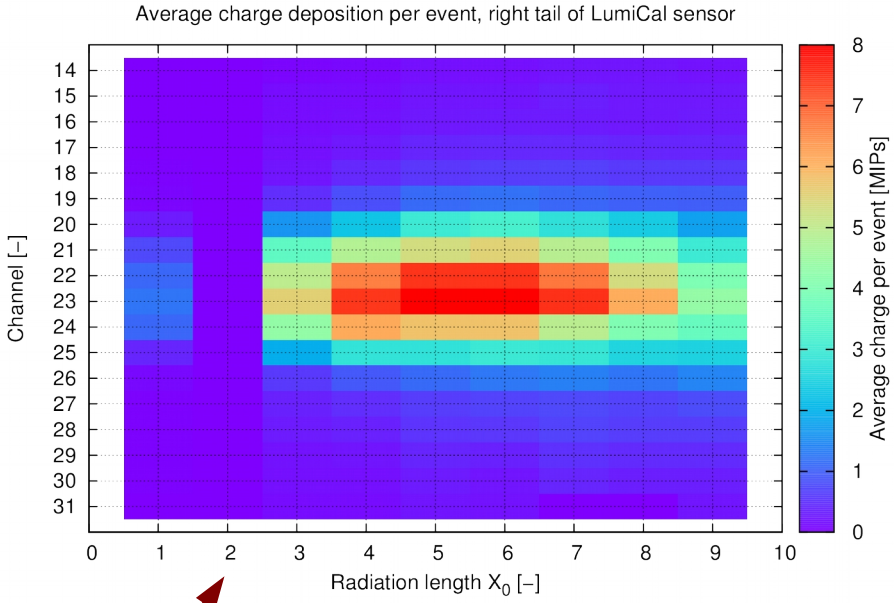
a) Sum of depositions from events after muon cut calculated for each channel in each board in each configuration independently. Average charge = sum / no. of events

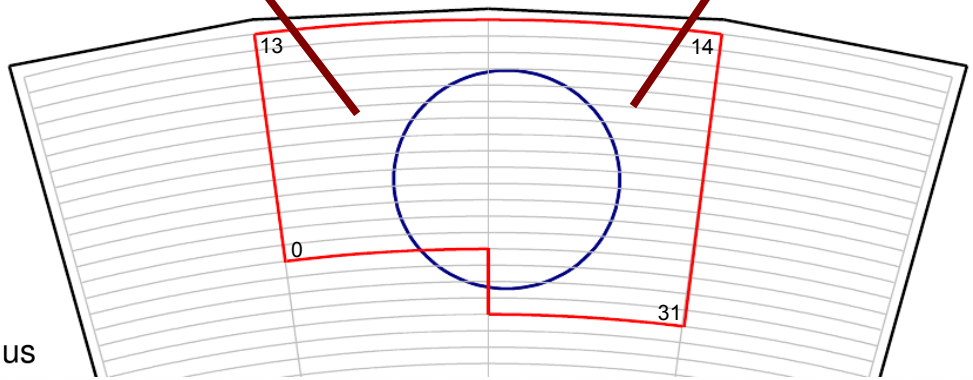
b) Boards assigned to radiation length X_0 – longitudinal profile for left and right sensor tail

	1	2	3	4	5	6	7	8	9
Conf. 1	ID63		~~ID64~~		~~ID67~~		~~ID76~~		
Conf. 2			ID63		ID64		ID67		ID76
Conf. 3				ID63		ID64		ID67	

Data analysis chain
9. Longitudinal shower profile



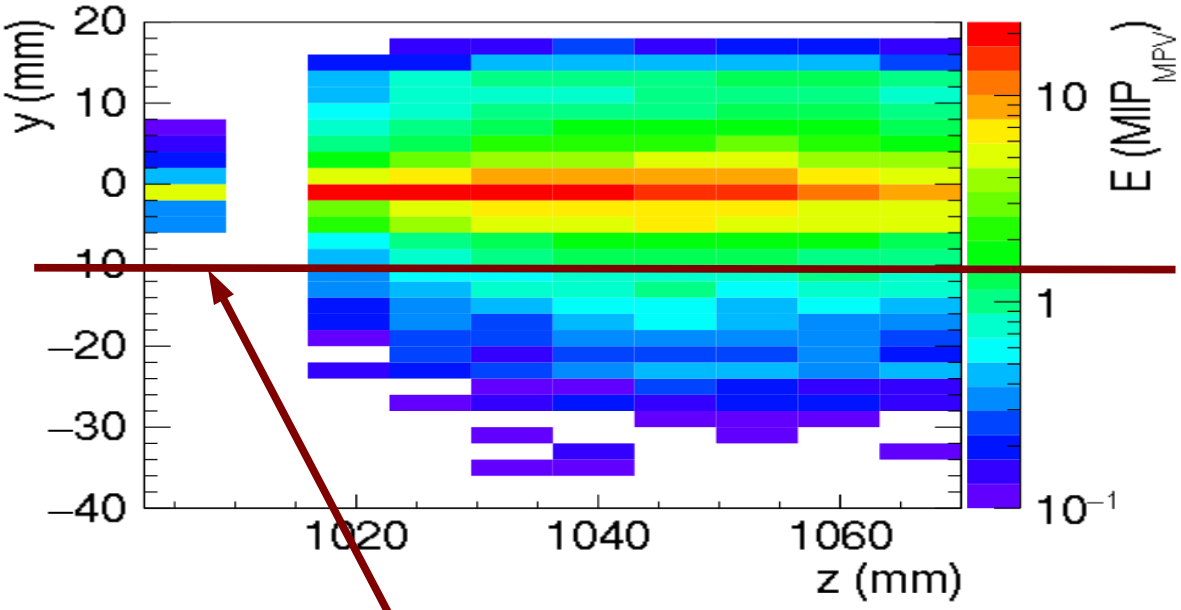




Readable region
Effective Molière radius

Data analysis chain
9. Longitudinal shower profile

*Colors represent energy deposits in the sensitive layers, located at discrete values of z. The volume filling is a graphical simplification.



Readable region
Effective Molière radius

The histogram taken from Strahinja's slides.
- does it include the beam profile ?
- dose it count exactly the pads which were readout ?
- what about dead zones ?

If these effects were not included the MC shower energy depositions should probably be lower... ?