Comparison of LumiCal Test Beam Data
With MC   Simulation

![diagram](top-left schematic)

30mm

okienko

wolfram (x0)
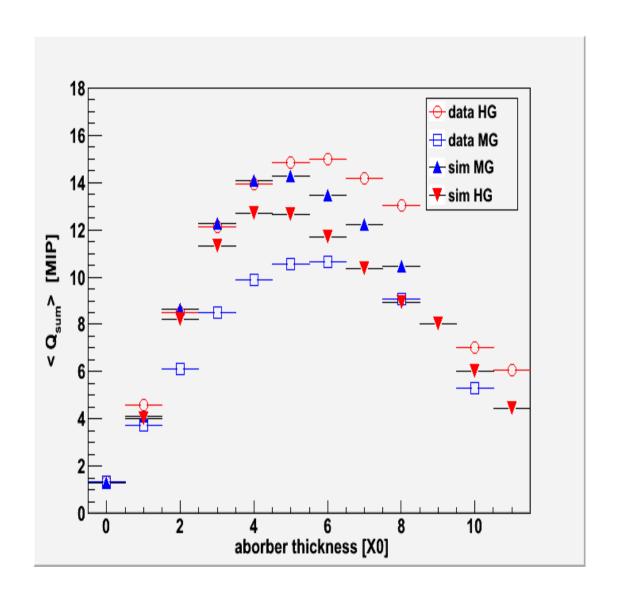
sensor

22.5mm

x

27mm

PCB   box   stojak

thicknes	high-gain	low-gain
1X0	51.5	45.5
2X0	48.	42.
3X0	44.5	38.5
4X0	41.	35.
5X0	37.5	31.5
6X0	34.	28.
7X0	30.5	24.5
8X0	27.	22.
9X0	22.	?
10X0	22.	?
11X0	22.	?

Moliere Radius

Beam Spot Center
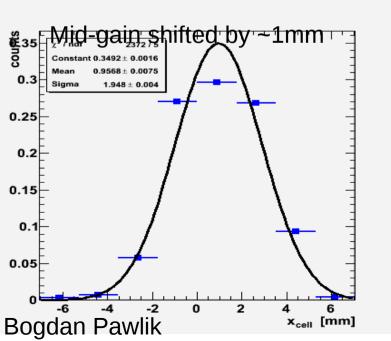(center of instrumented area)
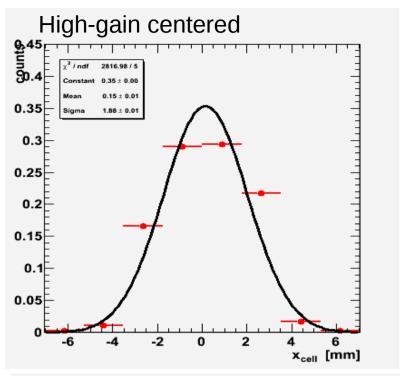
Critical for simulation results:
– size of the air gap
– position of beam w.r.t sensor center
– beam profile (σ_X and σ_Y)

sensor
pads centers
beam centers

15 14 13 12 11 10 9 8 7 6 5 4 3 2

First attempt to reproduce data
With the parameters reported
By test beam team failed.

- It seems that MG parameters
  Better fit HG data

- MG data simulations fail practically
  for all runs

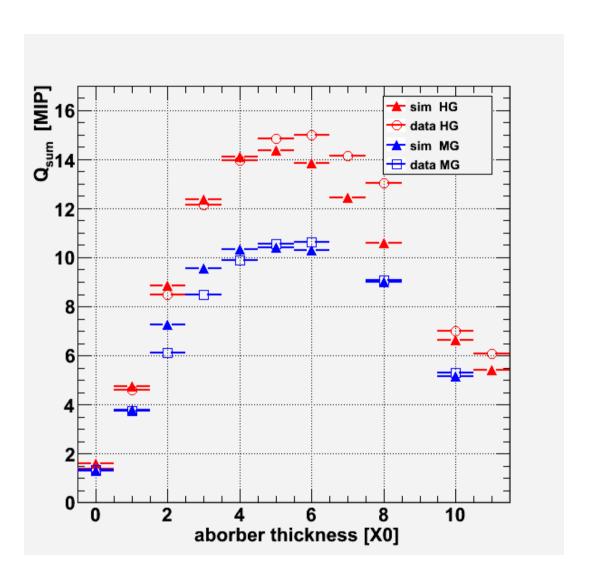- HG data points are higher then MG
  Contrary to simulations

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High-gain centered

χ^2 / ndf	2816.98 / 5
Constant	0.35 ± 0.00
Mean	0.15 ± 0.01
Sigma	1.88 ± 0.01

Mid-gain shifted by ~1mm

χ^2 / ndf	2372 / 5
Constant	0.3492 ± 0.0016
Mean	0.9568 ± 0.0075
Sigma	1.948 ± 0.004

Bogdan Pawlik

Attempt to reduce discrepancy:

- The only difference in simulation between High and Mid Gains is the size of the air gap (distance absorber-sensor) larger for HG by 6mm .

- Air gaps reported by Test Beam Team as MG used as HG and modified to get better agreement between simulation and Measurement

- Beam profile approximated by gaus with sigma_X = 1.9 sigma_Y = 2.3 mm

- Position of the beam center for MG shifted By 1 mm off the sensor center along x and and up to 4 mm along y (depending on the run)
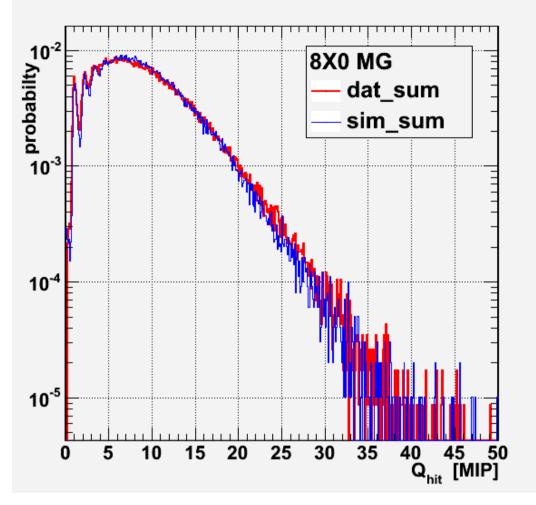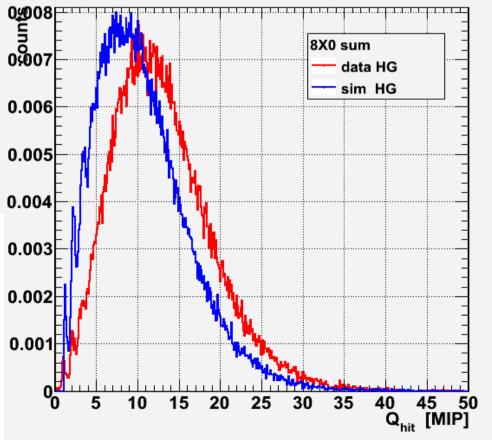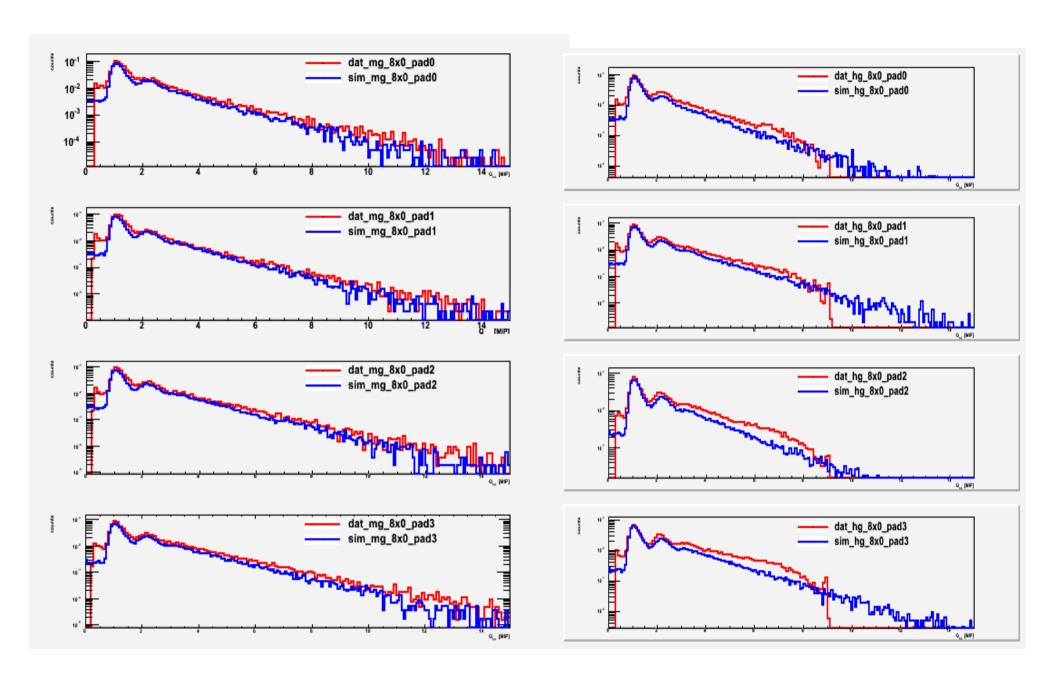
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"Tuning procedure"

- was successful for MG data except (2X0 and 3X0)

- failed for HG data in the range (5X0 - 8X0)

possible reason for failures :

- improper description of the beam profile (is not really gaus)

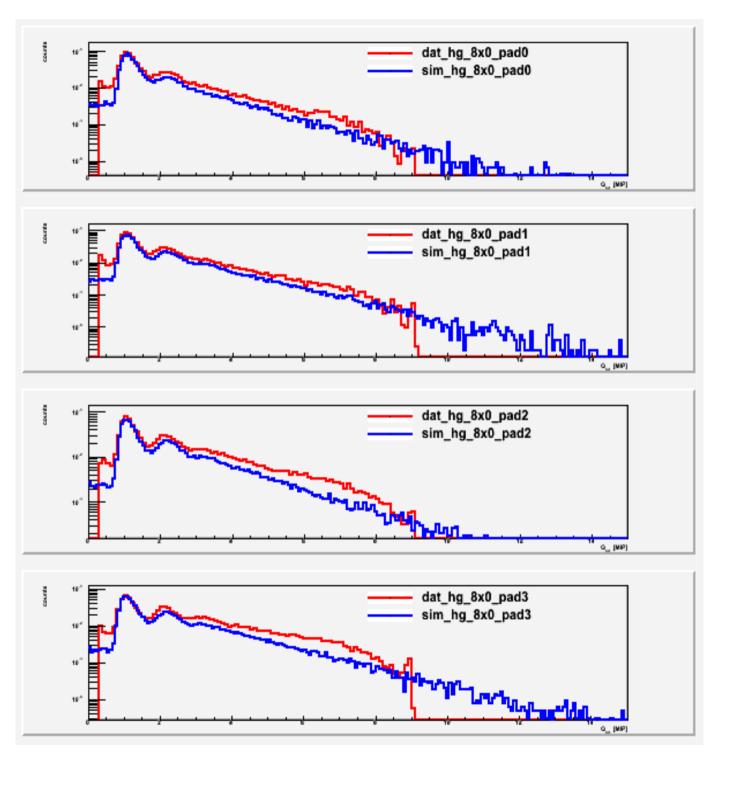- Lack of charge sharing (charge diffusion) between adjacent pads

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MID-Gain - OK   High-Gain   BAD

HG 6X0 - 8X0

- Saturation seen in data
  But not in MC

- Higher tails seen in data

Summary :

– in most runs agreement between measured and simulated detector response
   was achieved. It proves proper modeling of the detector in Geant4
– proper modeling of the beam profile may lead to further improvement
– crucial for simulation is accurate knowledge of sensor position and
   beam parameters

– for the future TB :
   – positioning and logging need to be automatized
   – larger instrumented area (2 sectors, 32 pads) needed to
      cover shower
   – air gap between absorber and sensor must be constant and reduced
      do minimum

MIP Signal