RICH Test-Beam: MC

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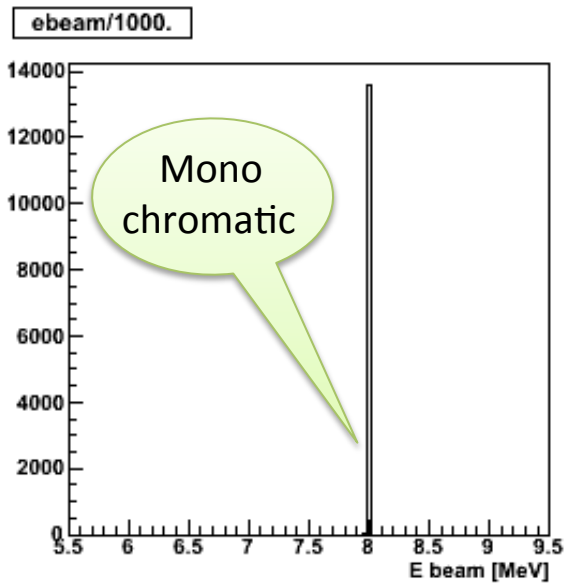
INFN Ferrara

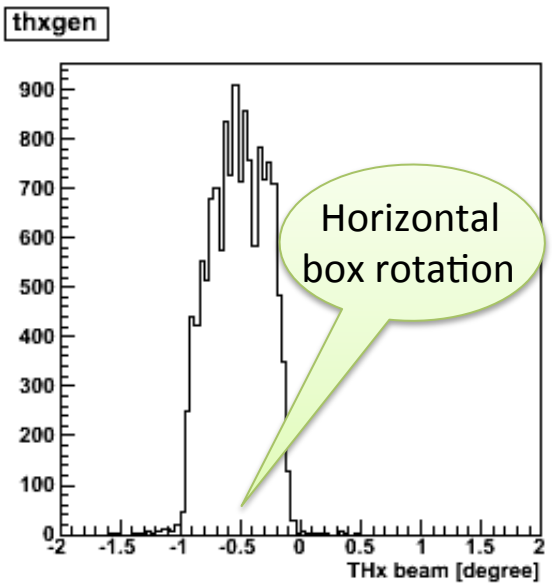
Rich Meeting, Jlab - 20 February 2013

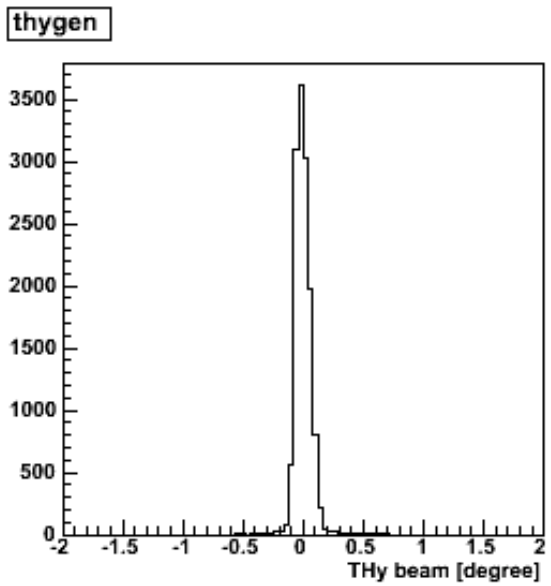
Simulation Optimization

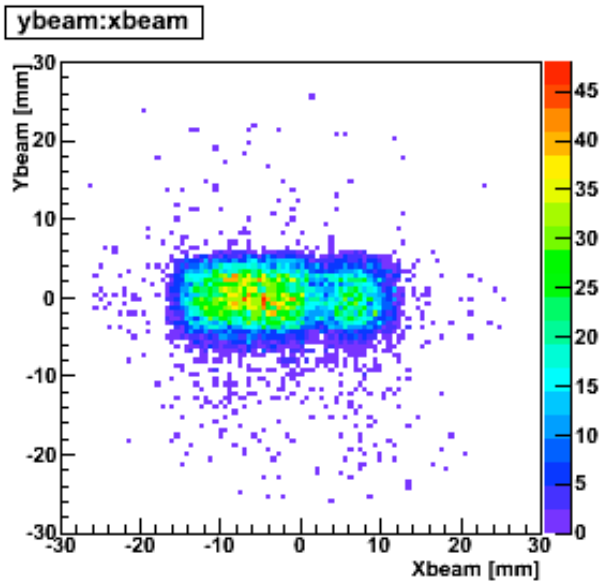
- ✔ Geometry
  - ✔ same PMTs configuration file of DATA
  - ✔ beam trajectory taken from GEMs
  - ✔ box 0.5 degrees rotation with respect to the beam
- ✔ Aerogel optical properties
  - ✔ measured transmission
  - ✔ refractive index
  - ✔ measured dispersion (direct light data with filters)
- ✔ MA-PMTs digitalization
  - ✔ dead area
  - ✔ double hits → take the OR
  - ✔ PMTs global efficiency
  - ✔ cross-talk
  - ✔ gain

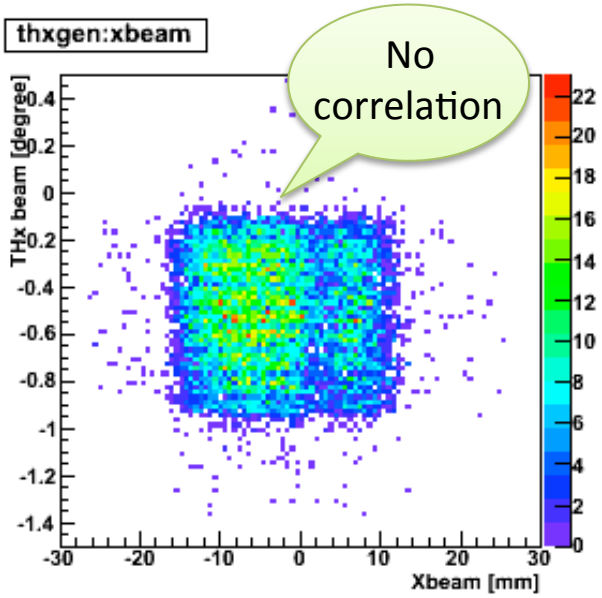
Beam Tracks

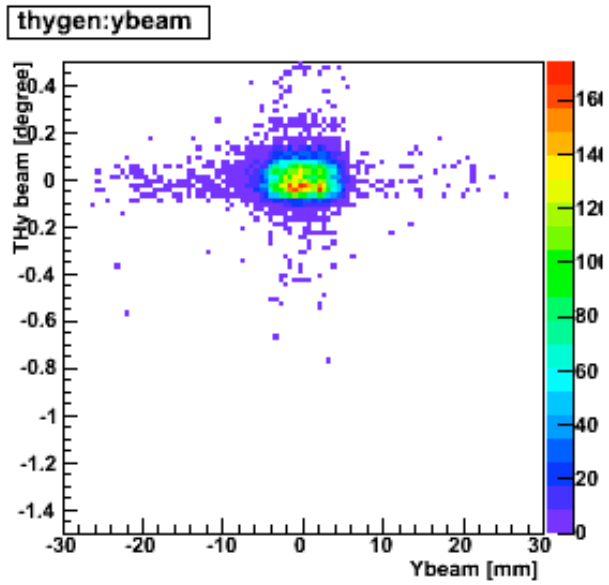

ebeam/1000.
Mono chromatic
E beam [MeV]


thxgen
Horizontal box rotation
THx beam [degree]

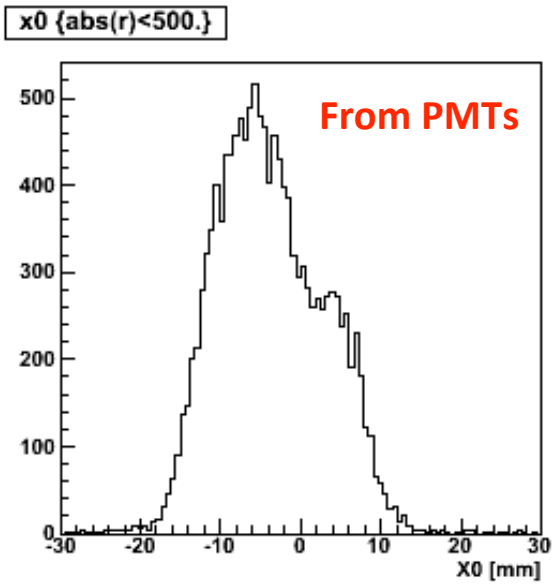

thygen
THy beam [degree]

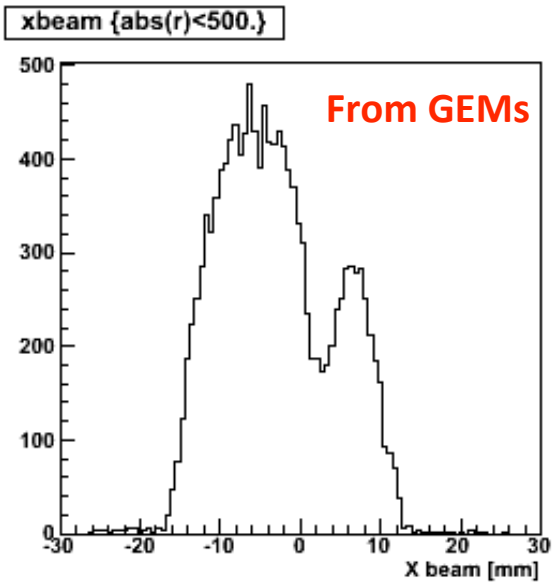

ybeam:xbeam
Ybeam [mm]
Xbeam [mm]

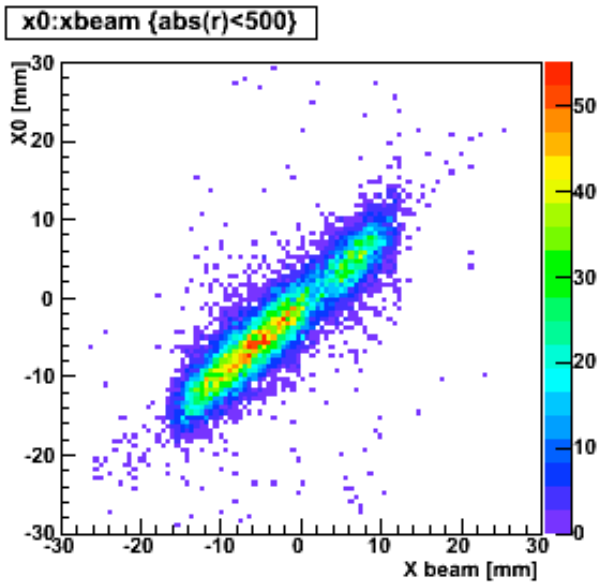

thxgen:xbeam
No correlation
THx beam [degree]
Xbeam [mm]

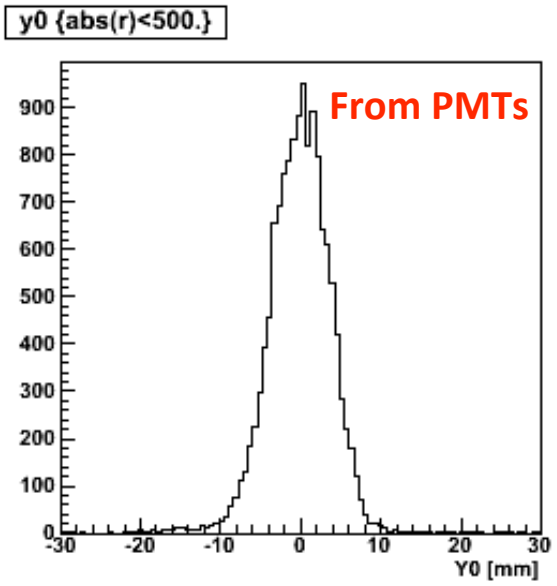

thygen:ybeam
THy beam [degree]
Ybeam [mm]

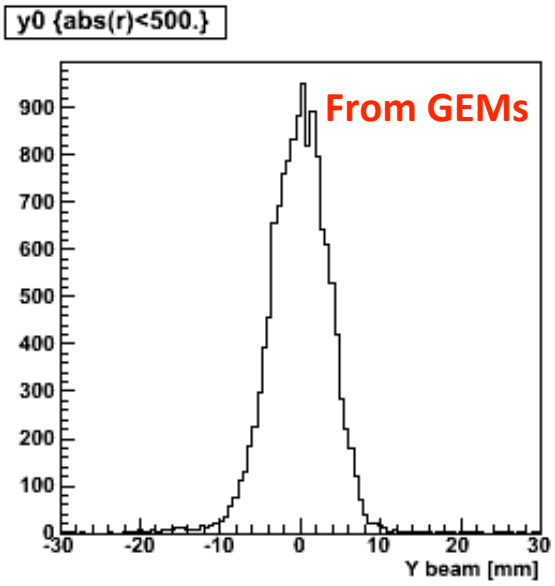
Beam Profile

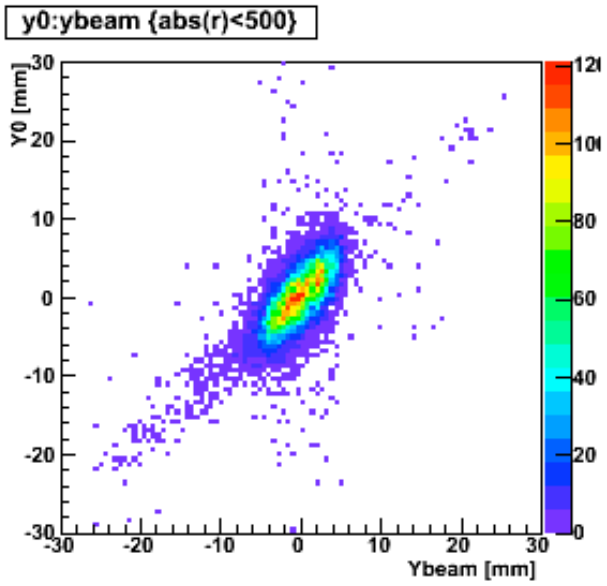




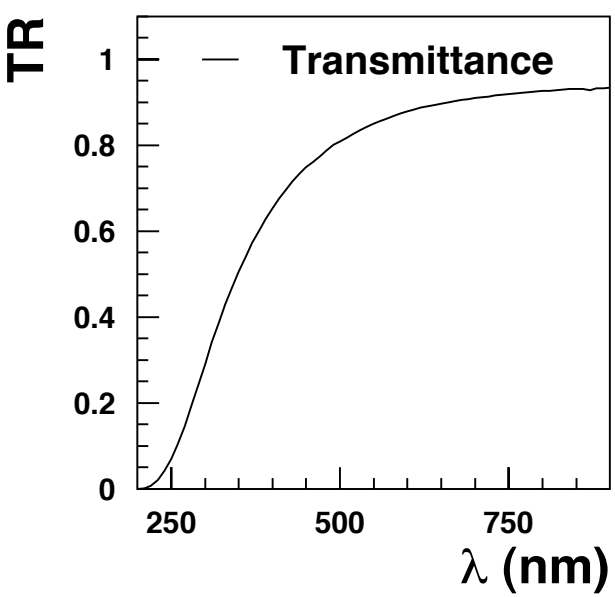


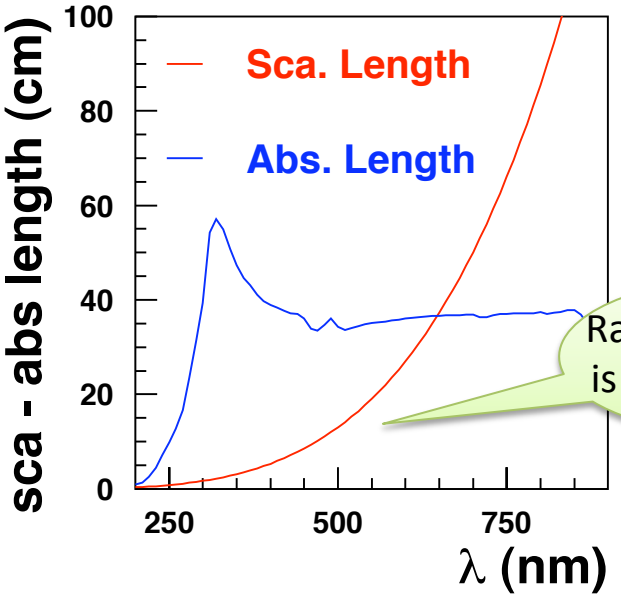




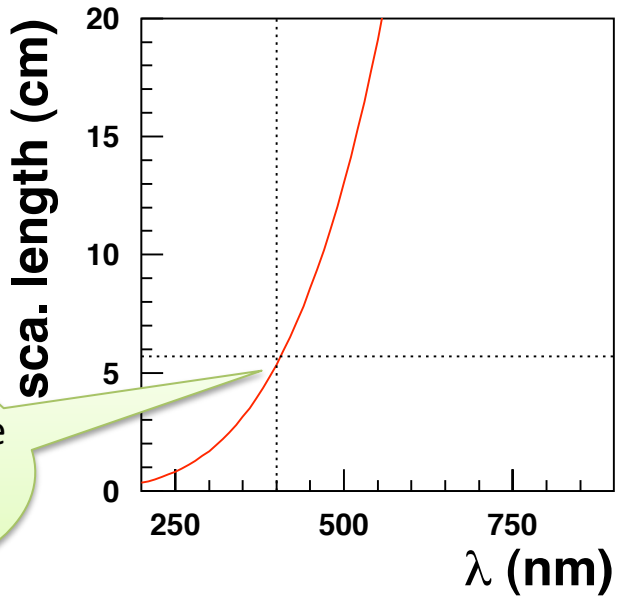


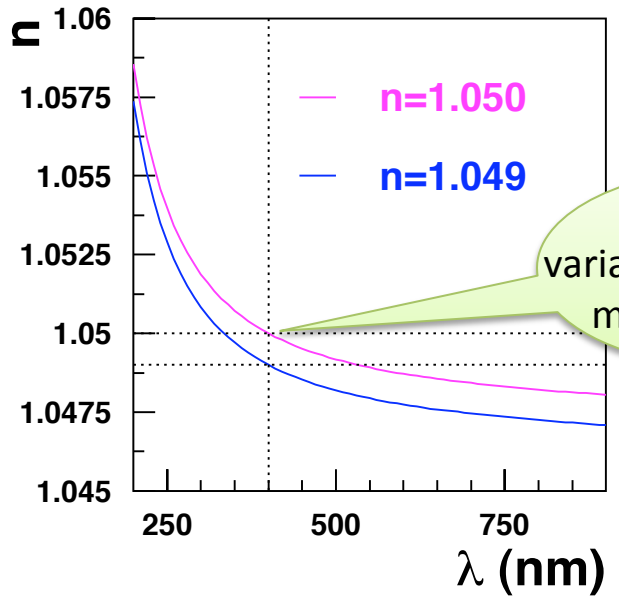
Aerogel Characterizartion





Rayleigh scattering is the major effect



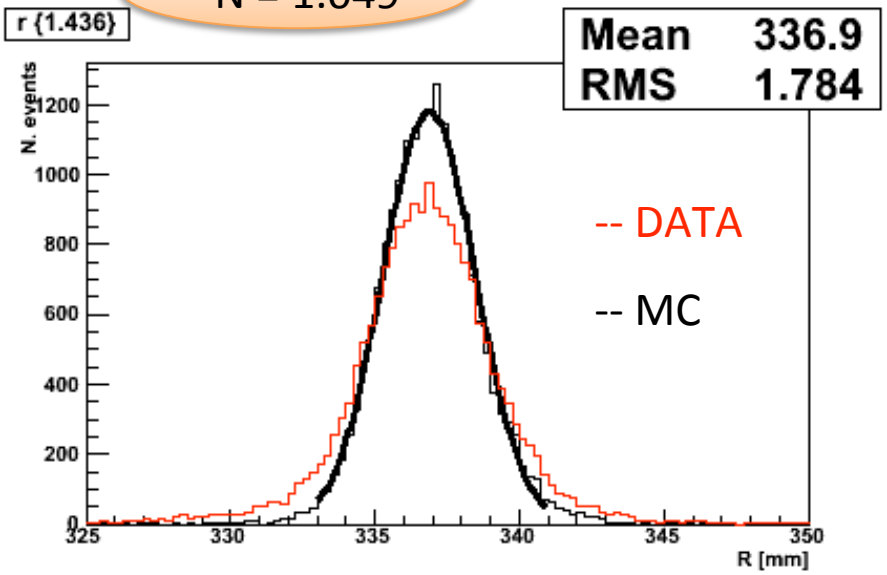


Ref. index variation to match the measured radius

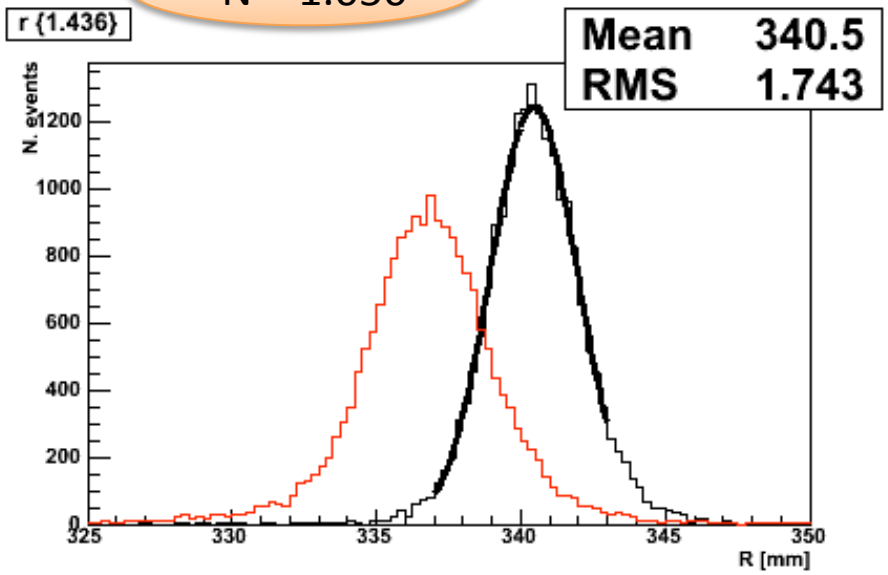
Goal transmittance assumed for CLAS12 !!!

Mean Radius

N = 1.049



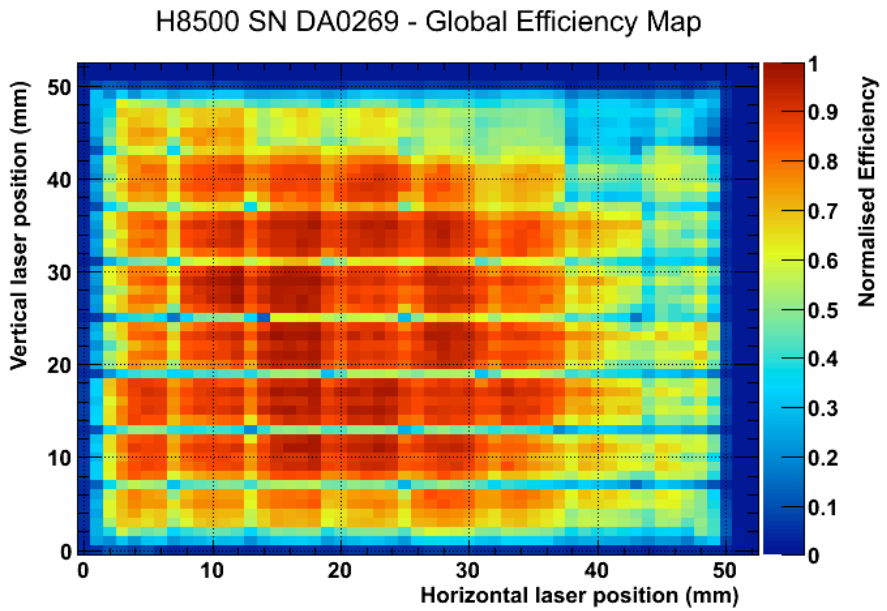
N = 1.050

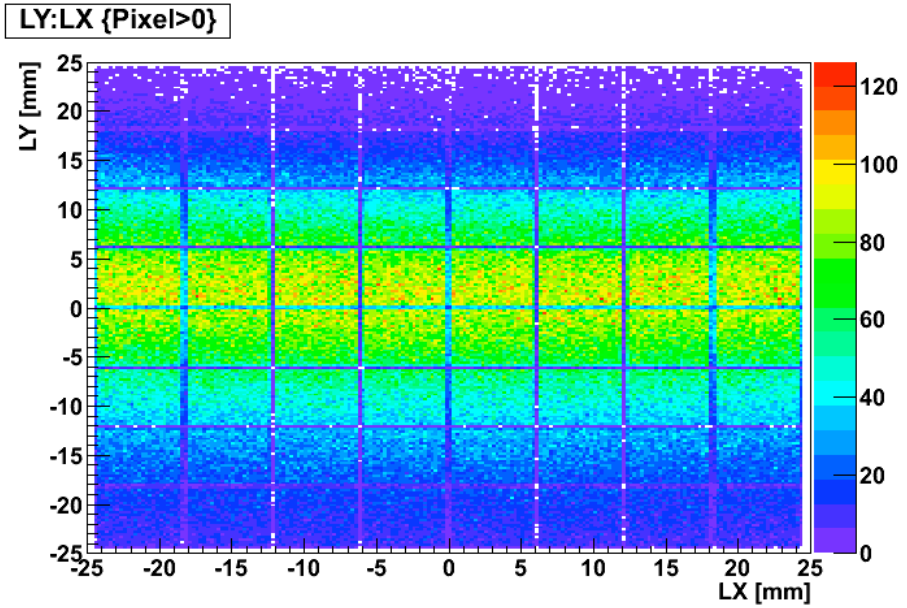


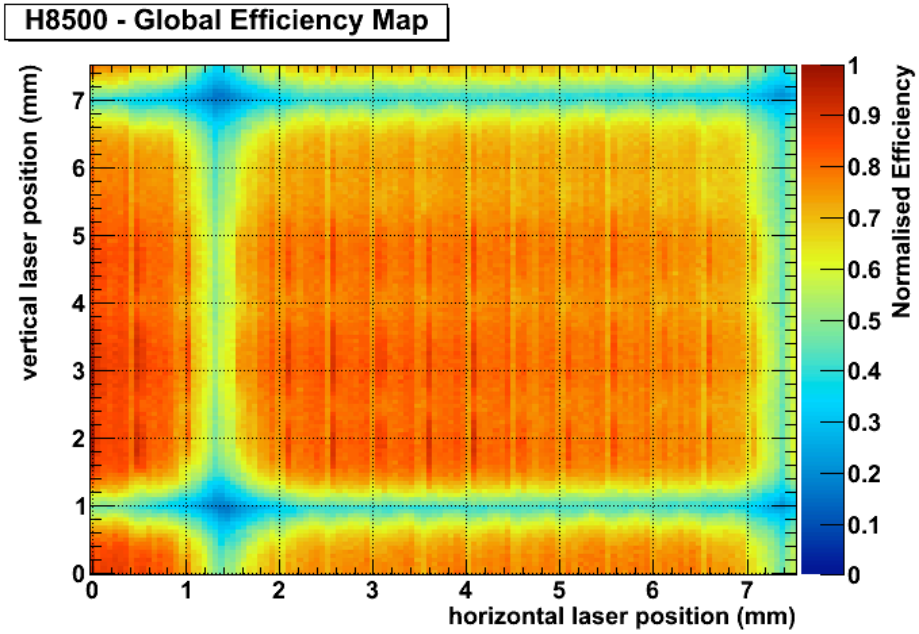
Novosibirsk defines: n^2 (at 400 nm) $=1+0.438*\rho$

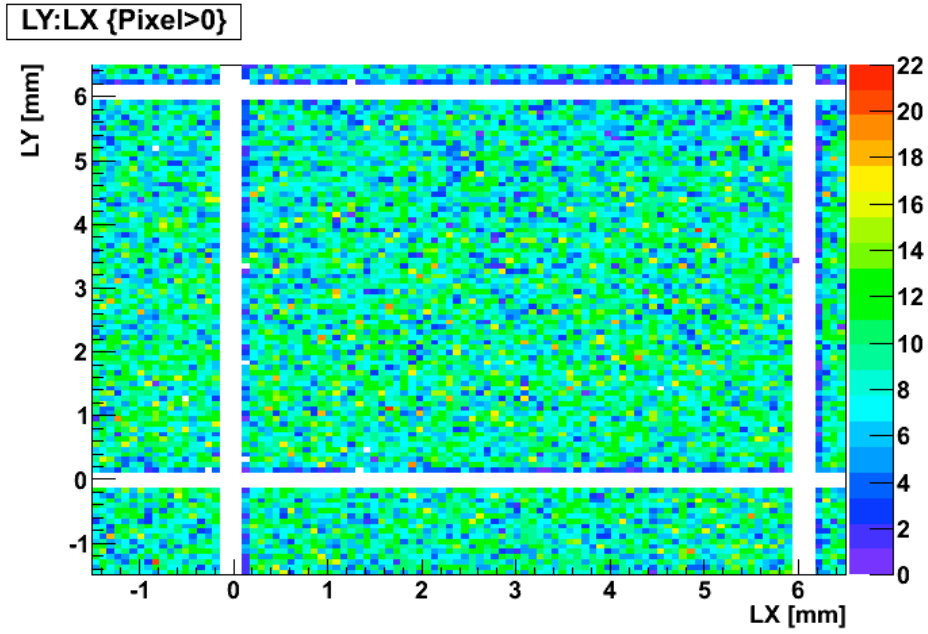
The tile used has $\rho = 0.230$ g/cm^3 → $n = 1.0492$

Pixelization

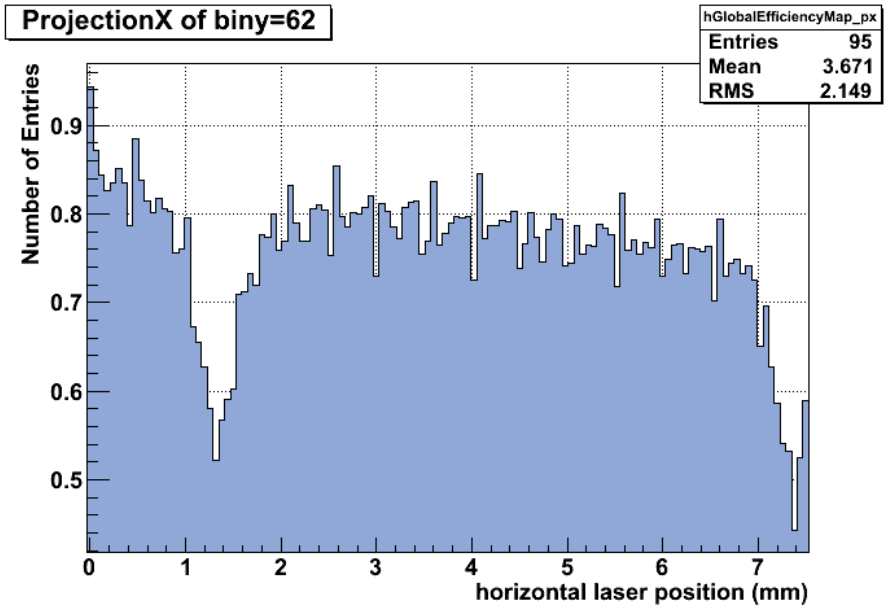


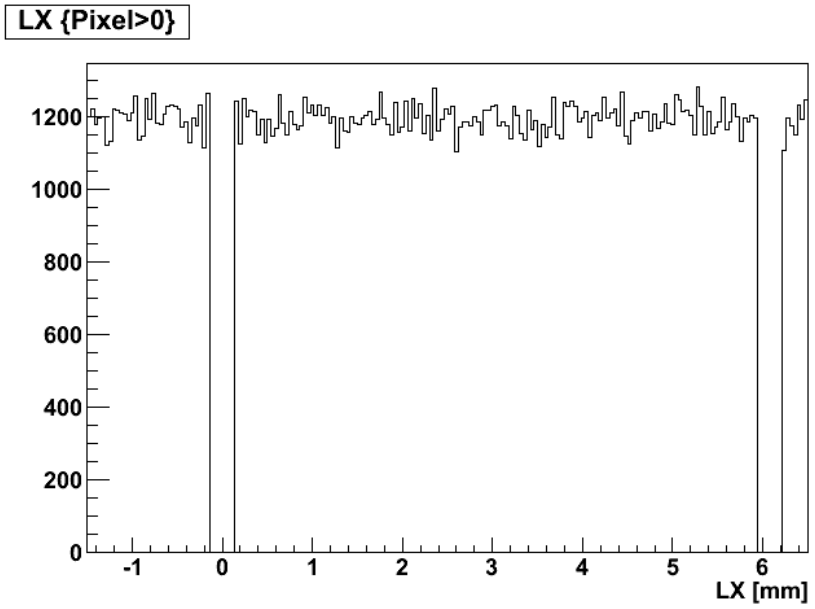


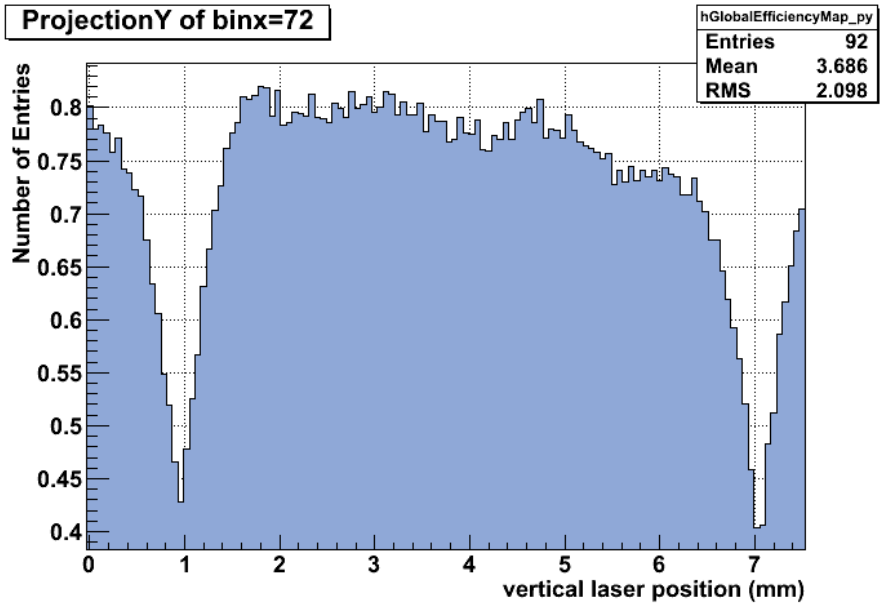


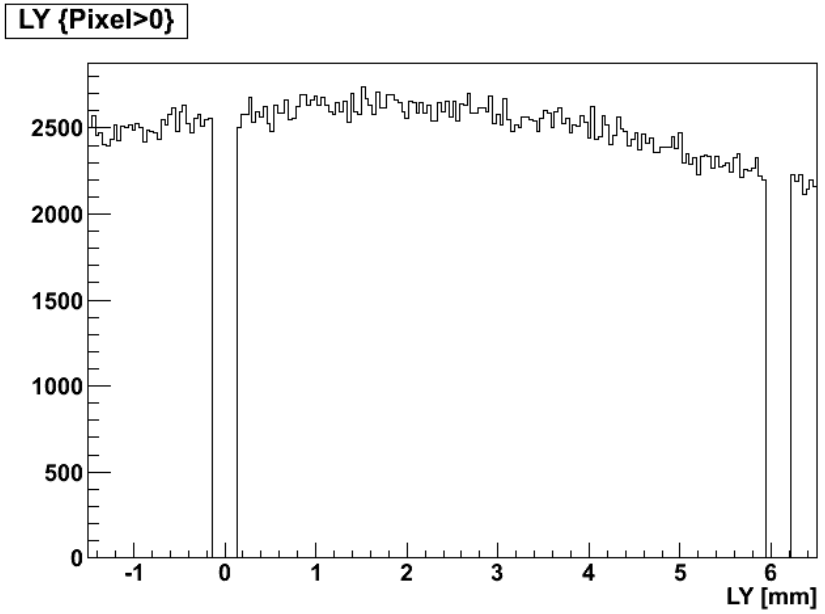


Pixelization



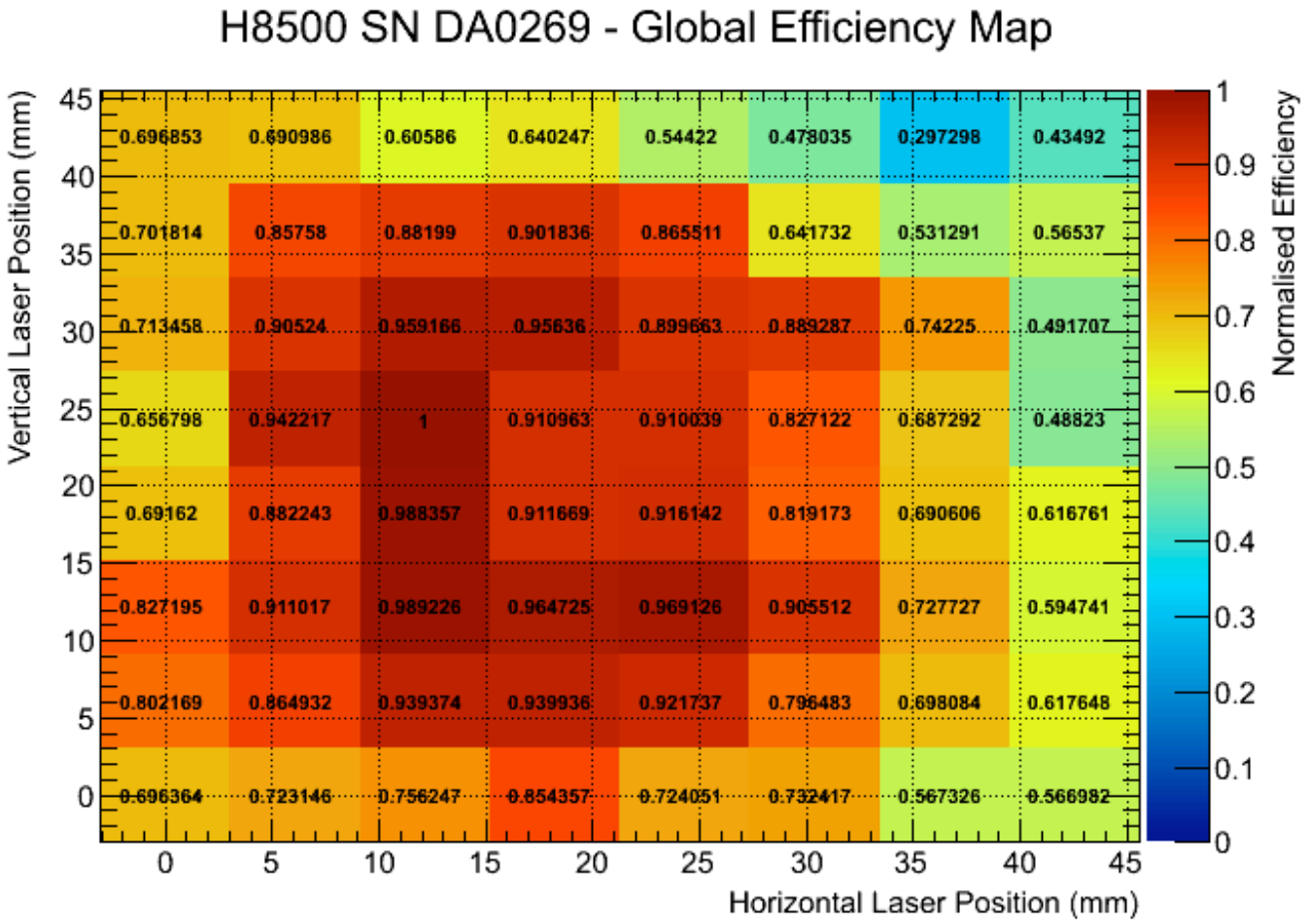




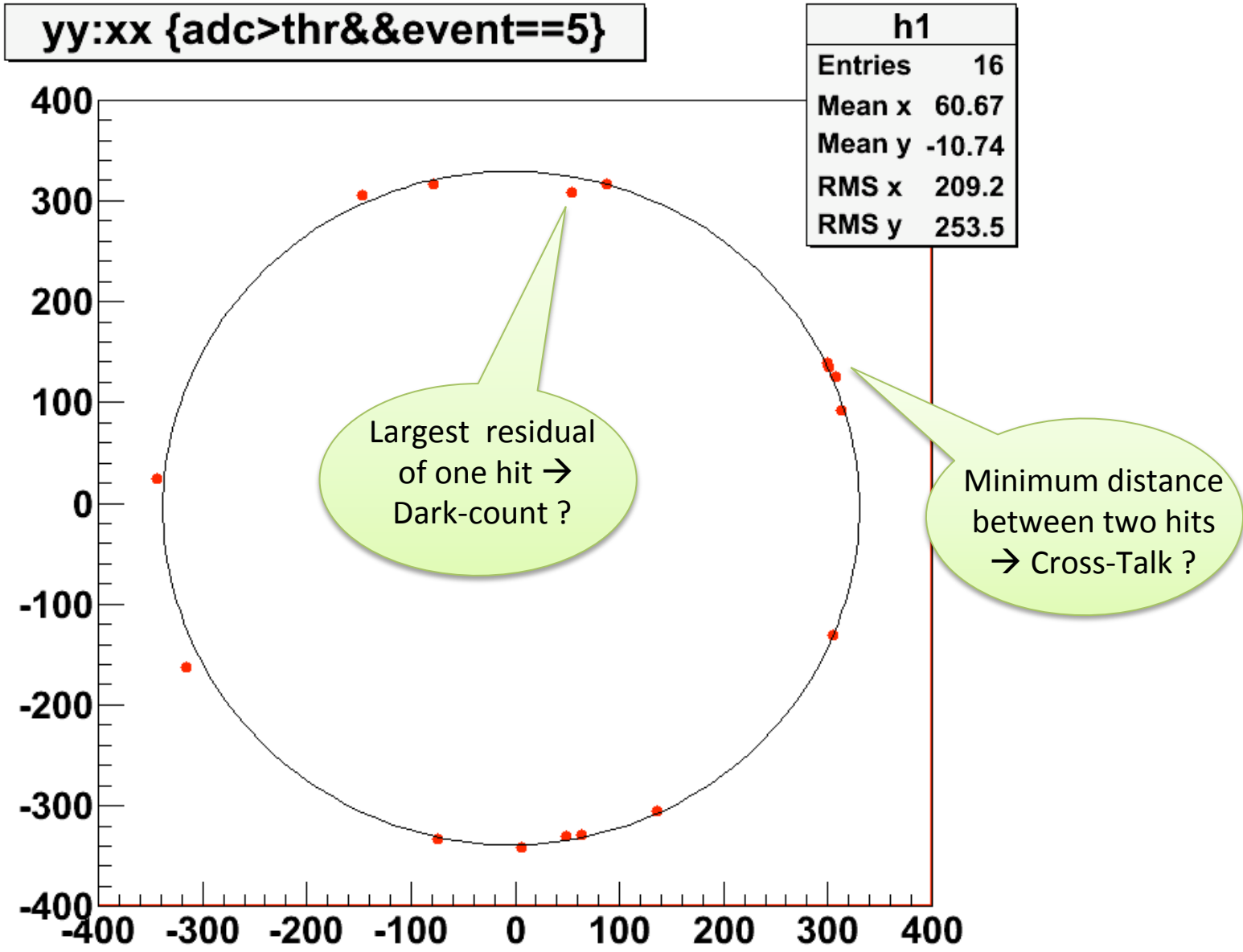


Gain Spread

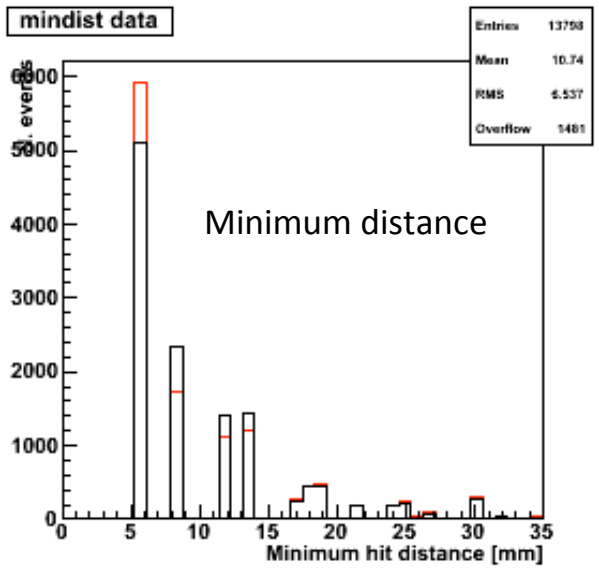
Accounted only at PMT (not pixel) level so far

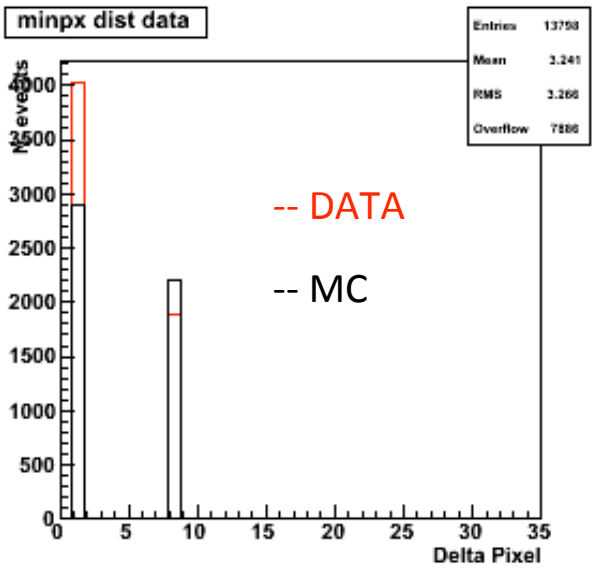


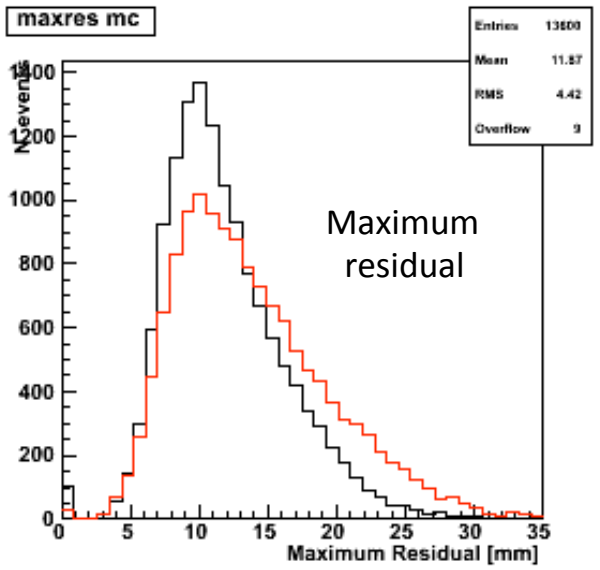
PMTs Hit Pattern

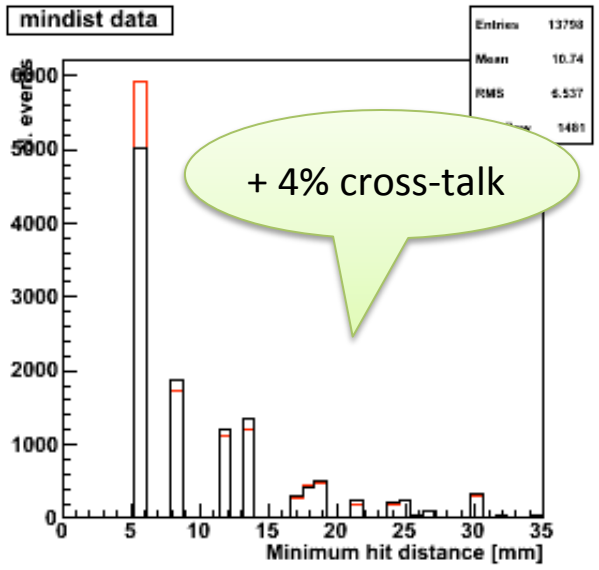


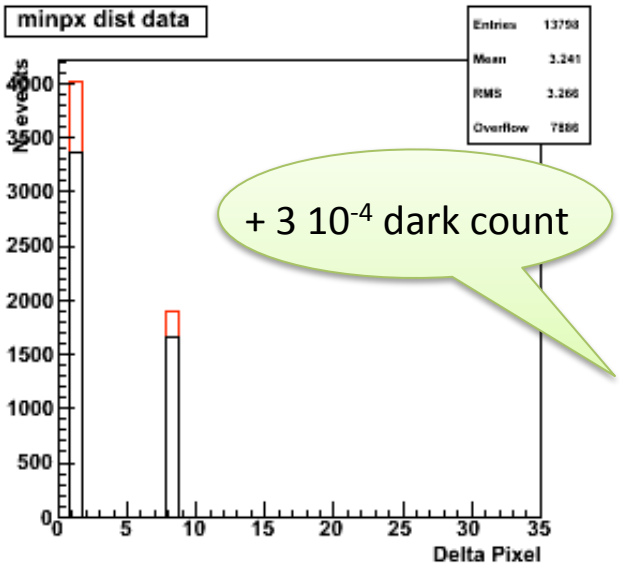
Backgroun Hits

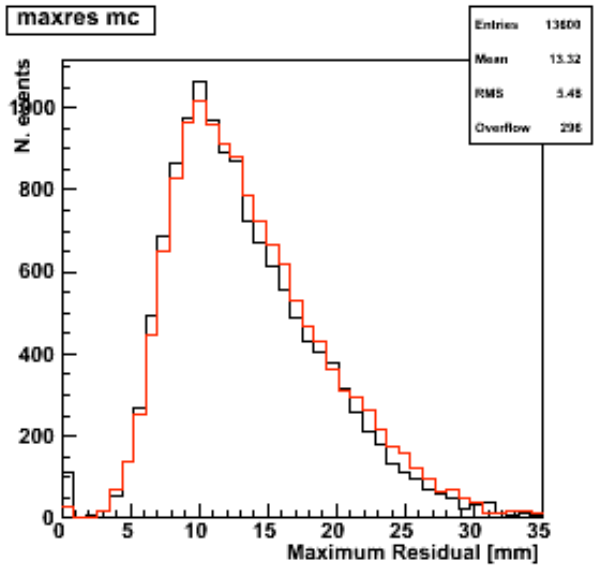






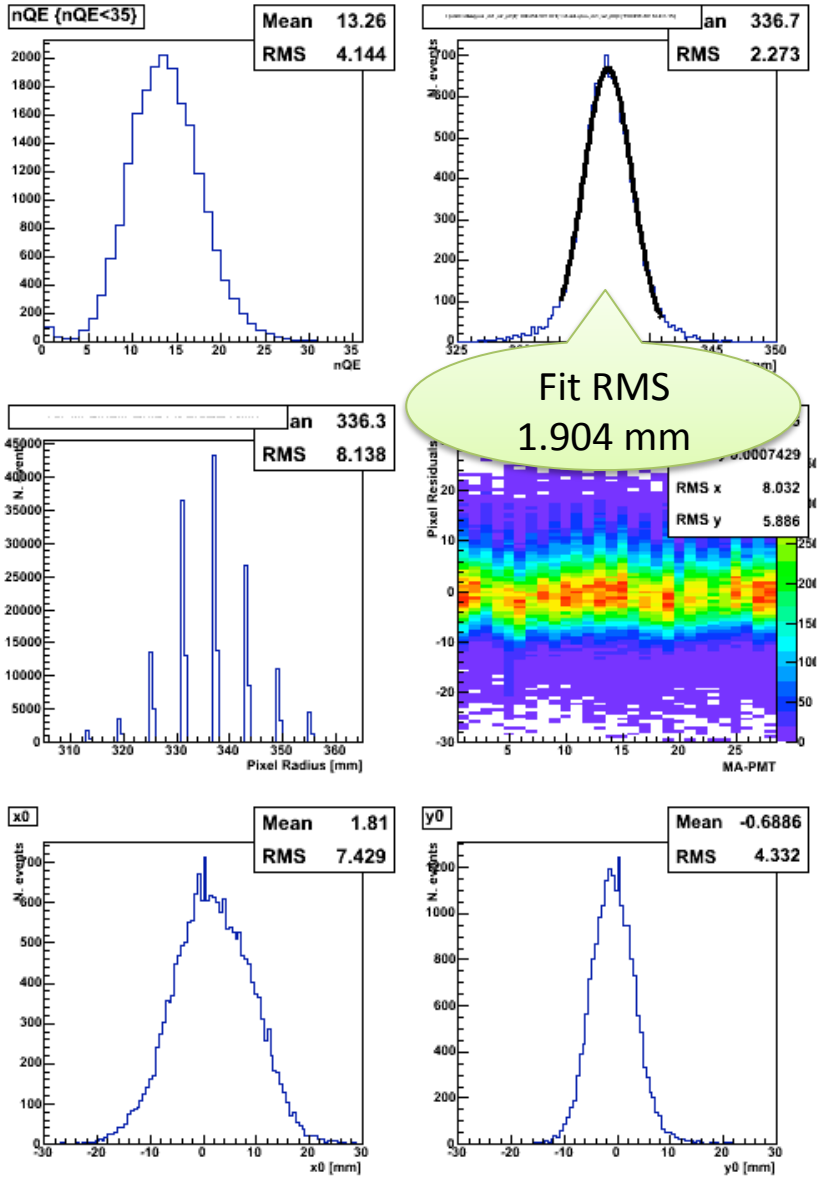






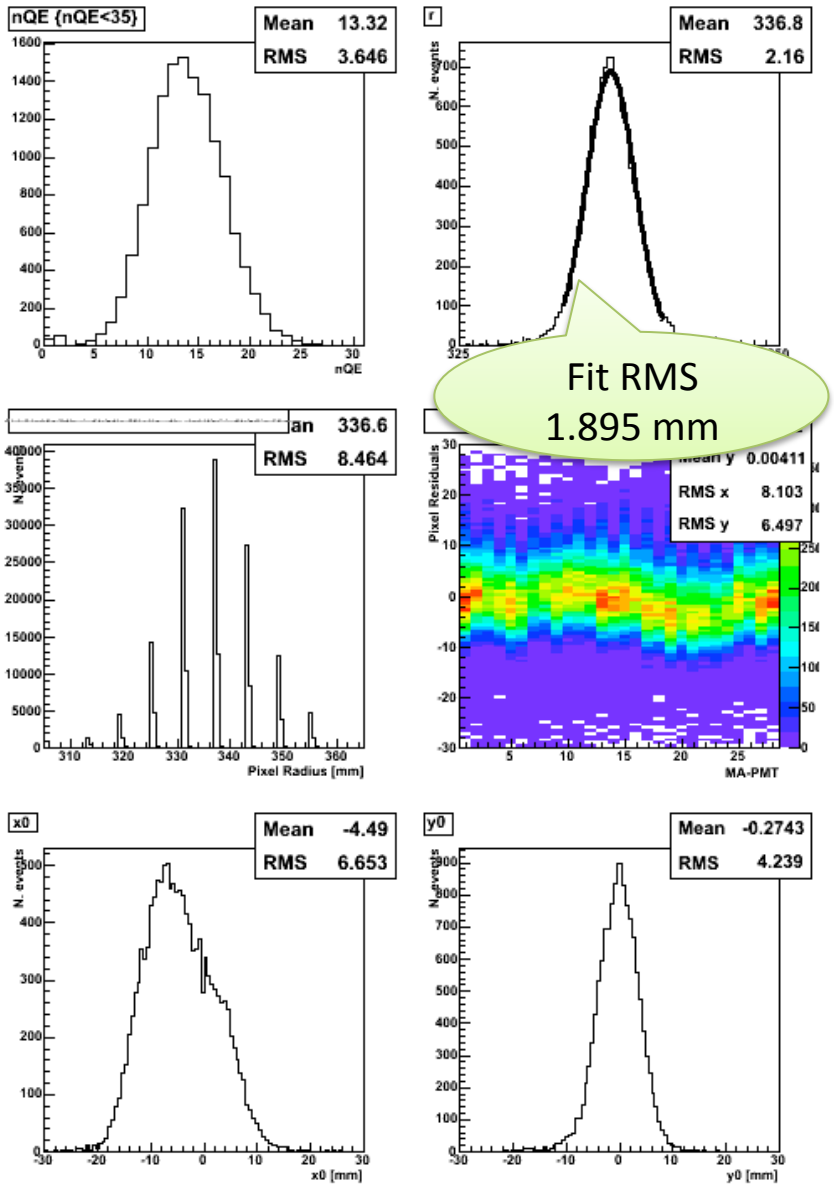
DATA vs MC

DATA (Run 1051)



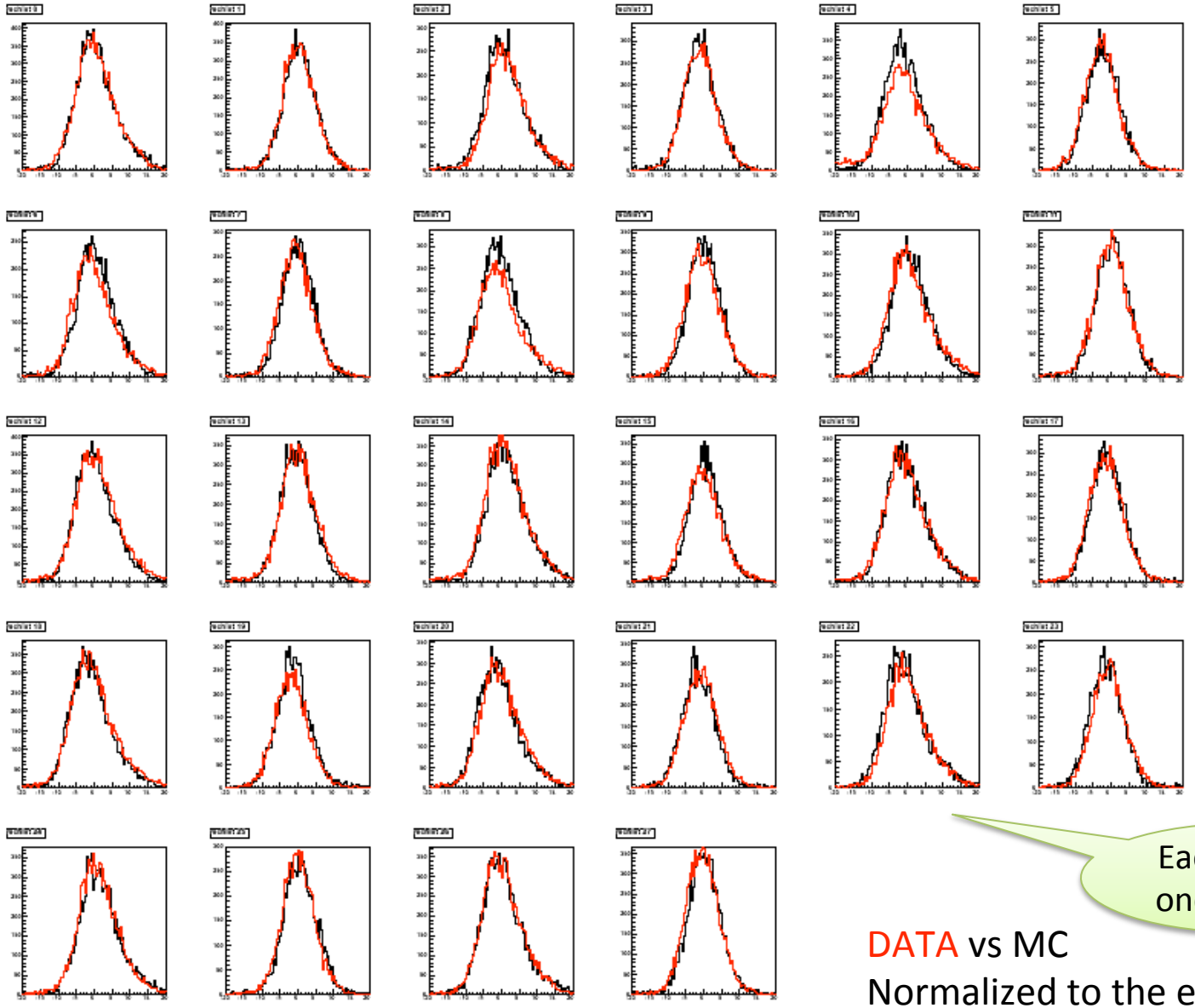
Fit RMS
1.904 mm

MC (GEM values)



Fit RMS
1.895 mm

Pixel Residual Distributions

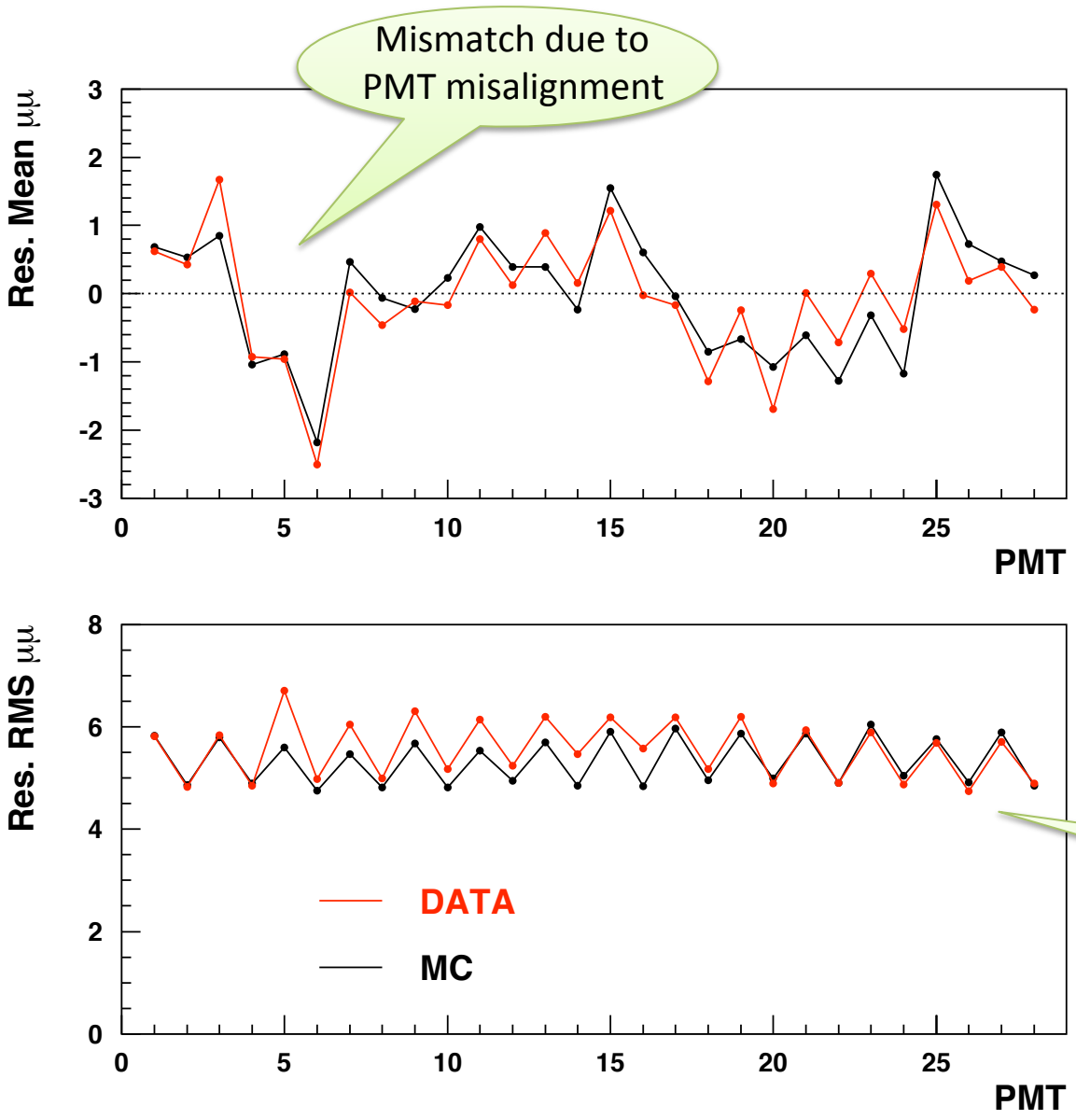


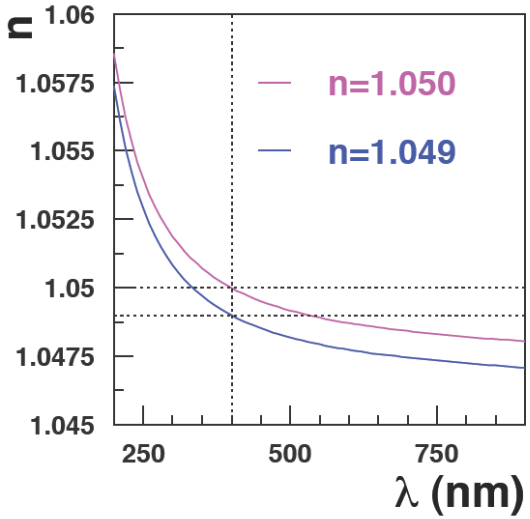
Each panel is one MA-PMT

DATA vs MC

Normalized to the event number

Pixel Residuals

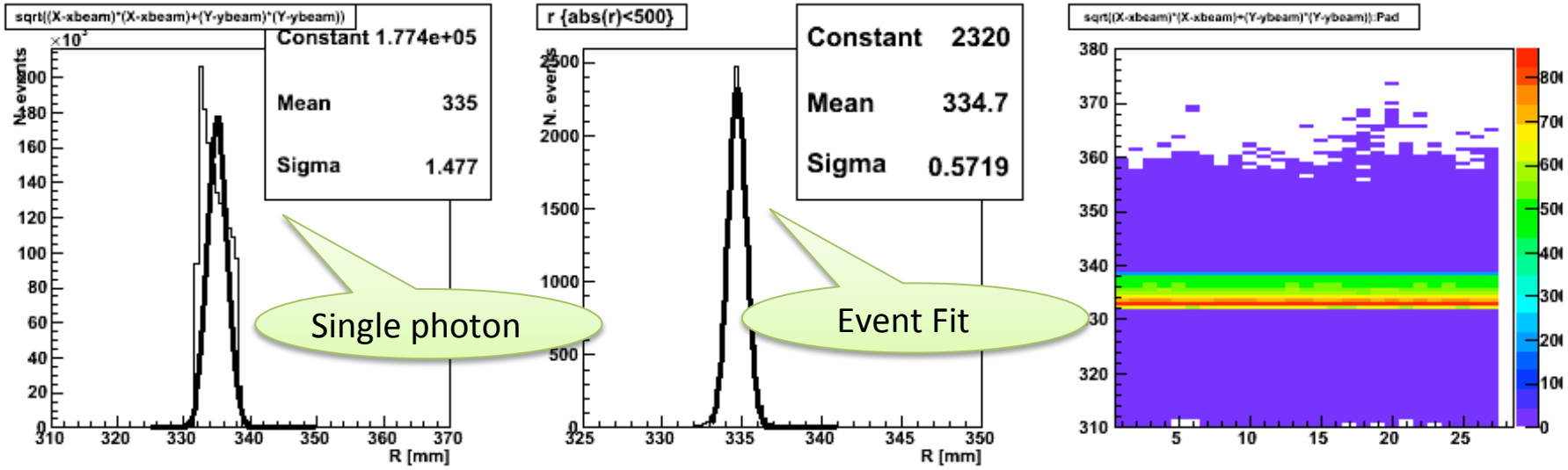


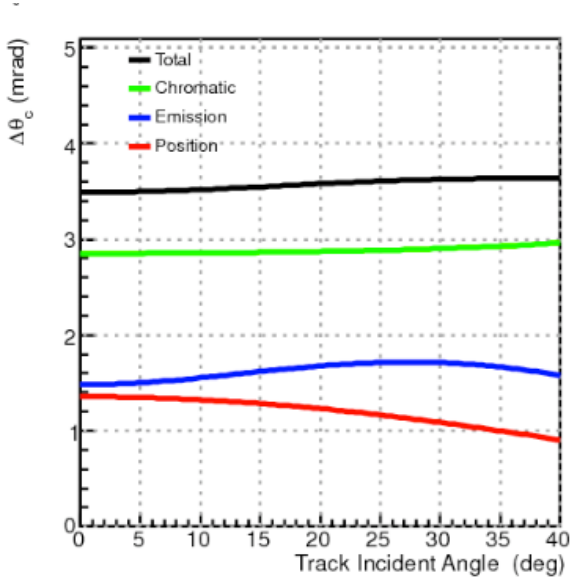


Zigzag pattern
due to UV & not-UV
glass window

Single photon Cherenkov-angle resolution

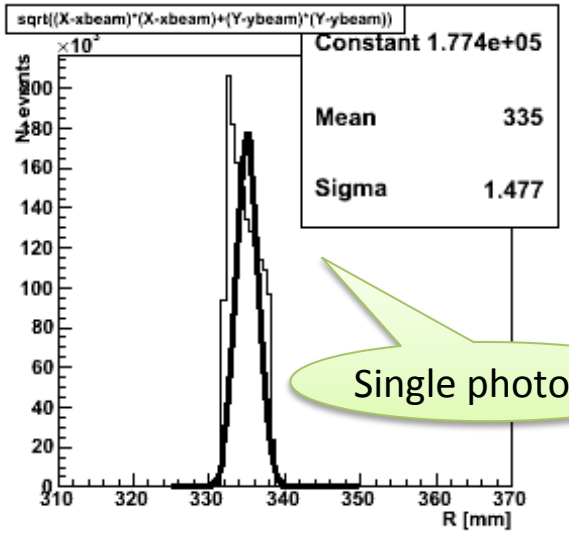
From photon emission point 1.5 mrad



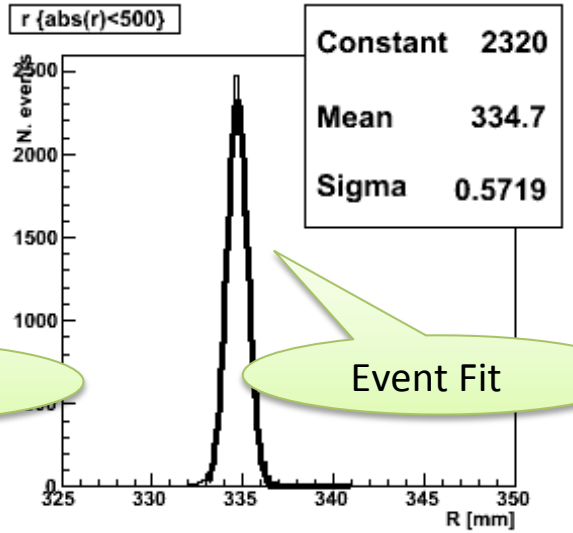


Cherenkov-angle resolution

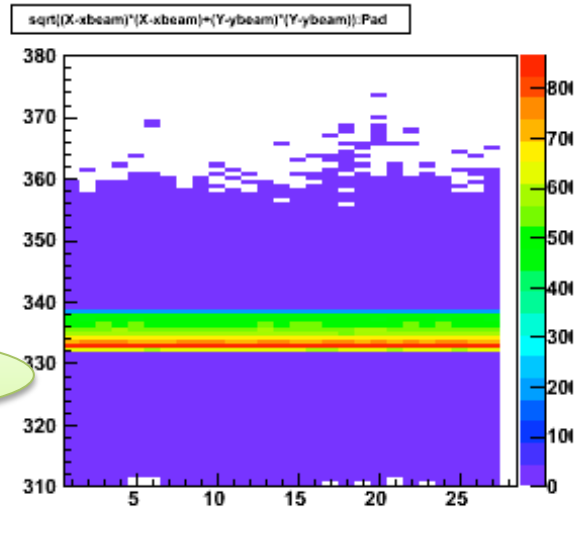
From photon emission point 1.5 mrad



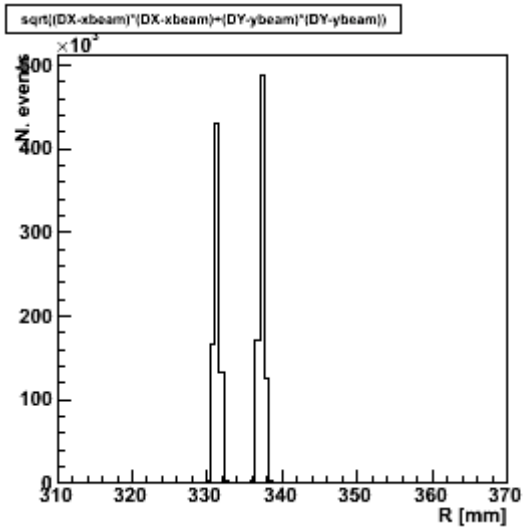
Single photon

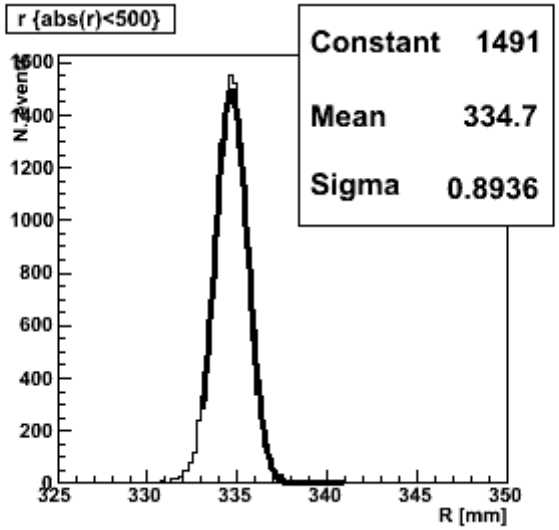


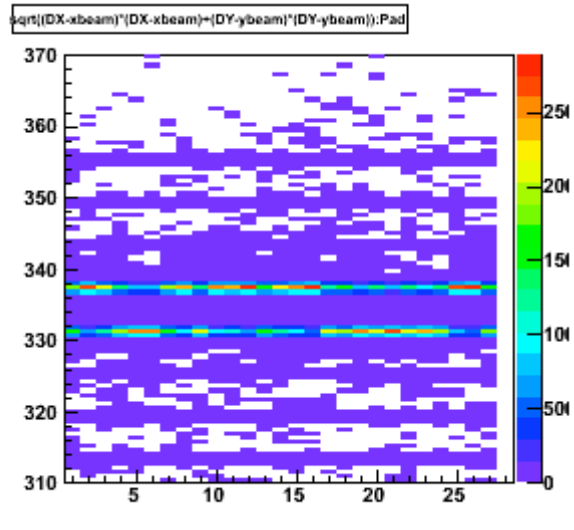
Event Fit



Plus digitalization: 0.6 mrad

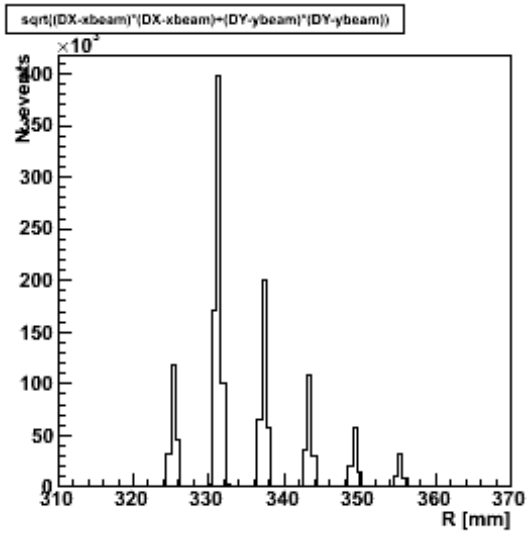


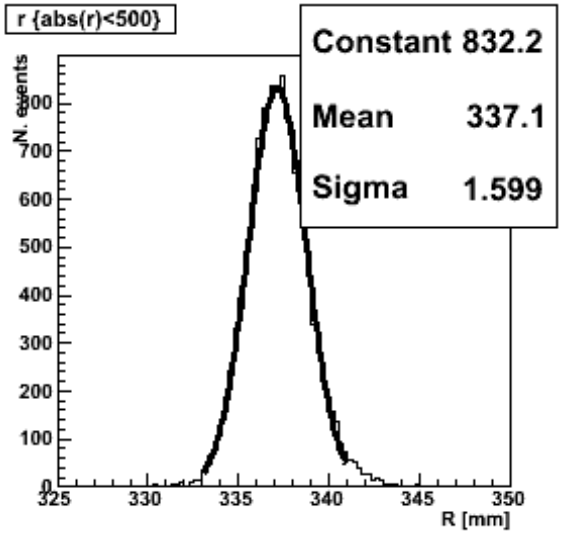


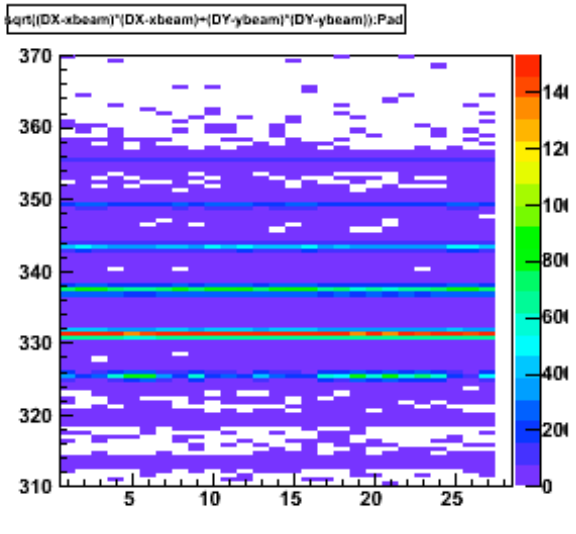


Cherenkov-angle resolution

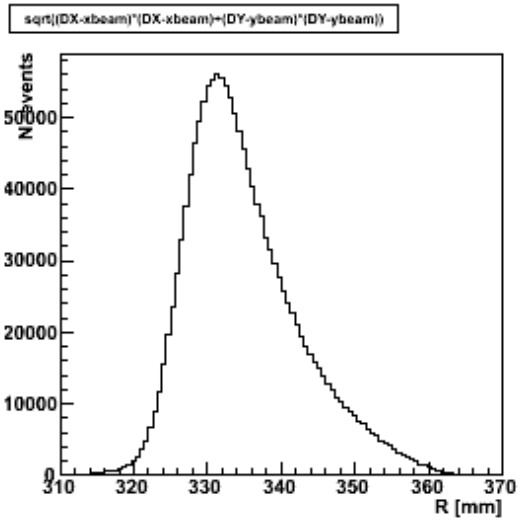
Plus dispersion: 0.6 mrad

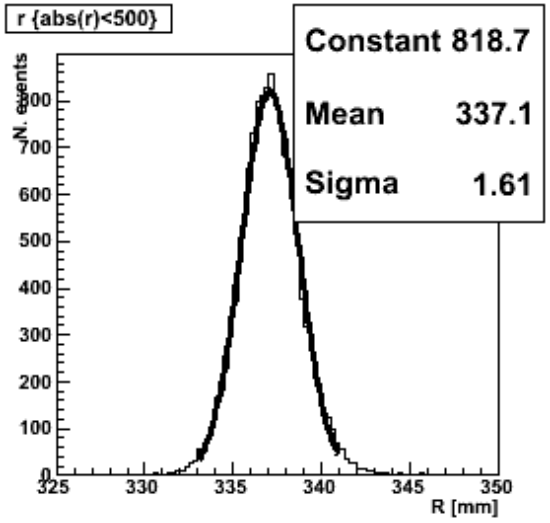


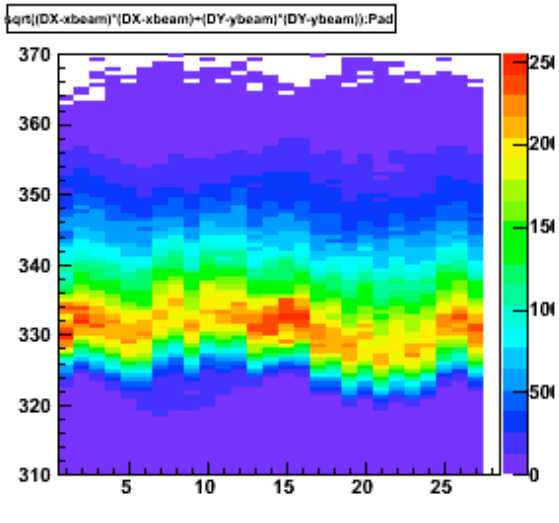




Plus misalignment: 0.6 mrad

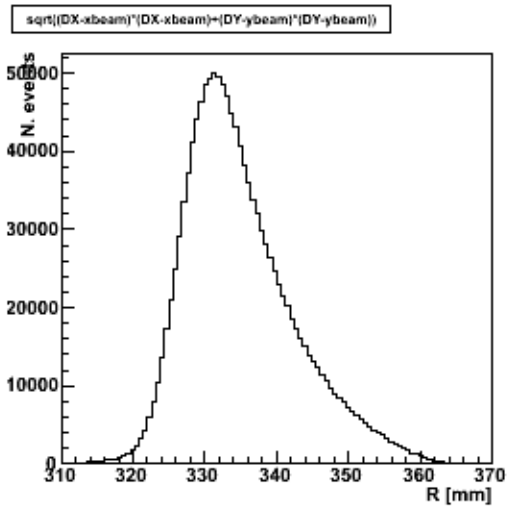


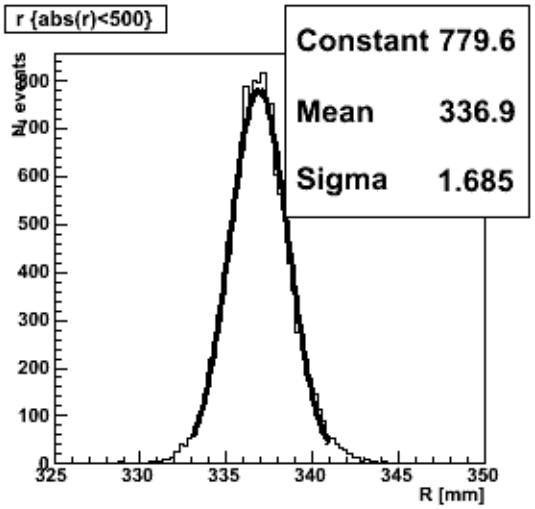


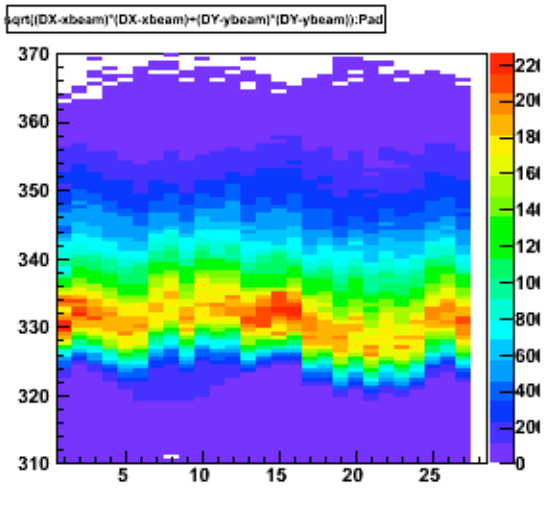


Cherenkov-angle resolution

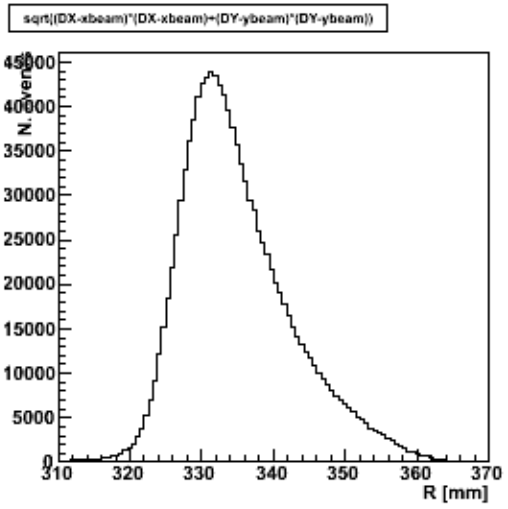
Plus 4% cross-talk: 0.6 mrad

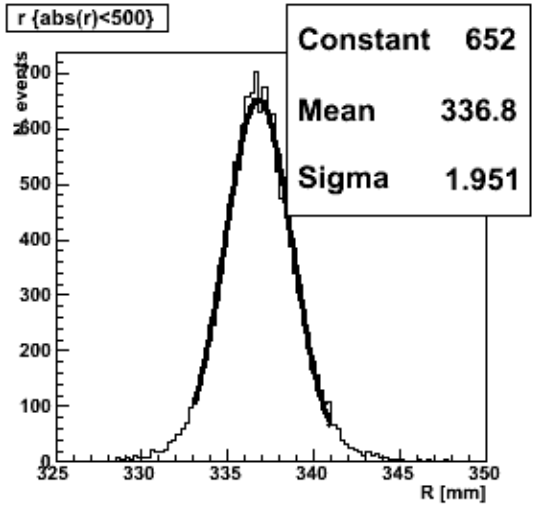


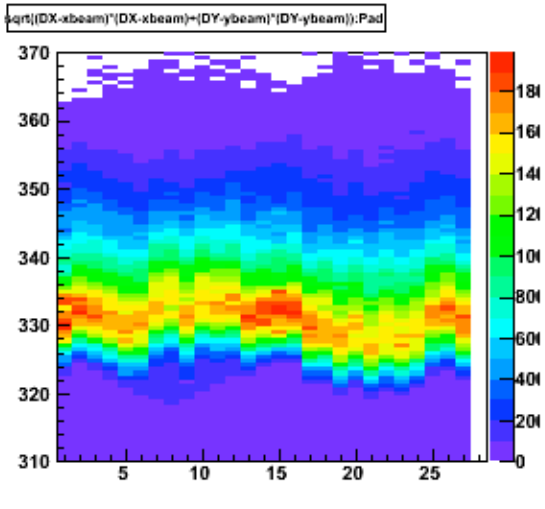




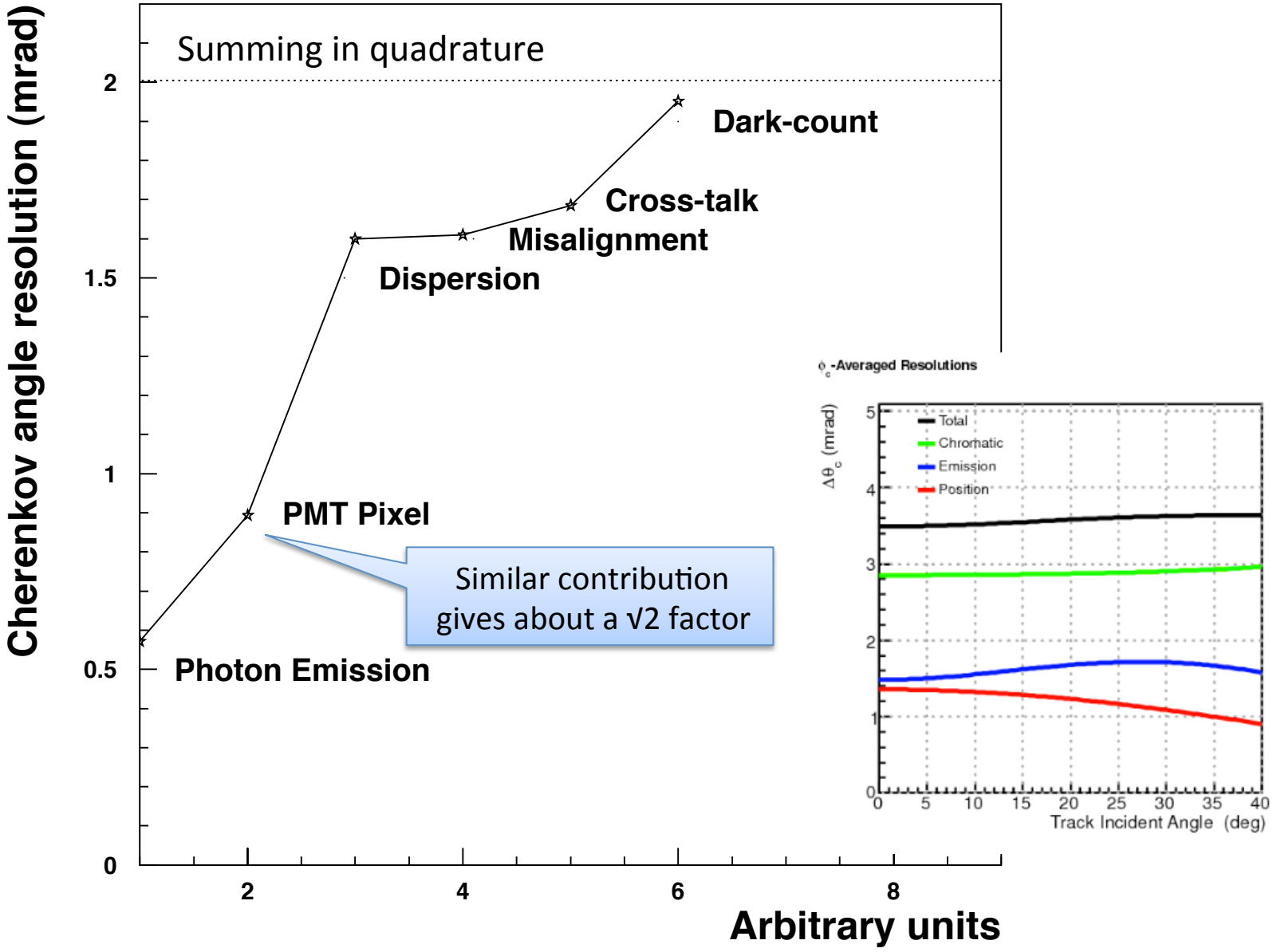
Plus 3 10^{-4} dark count: 0.6 mrad



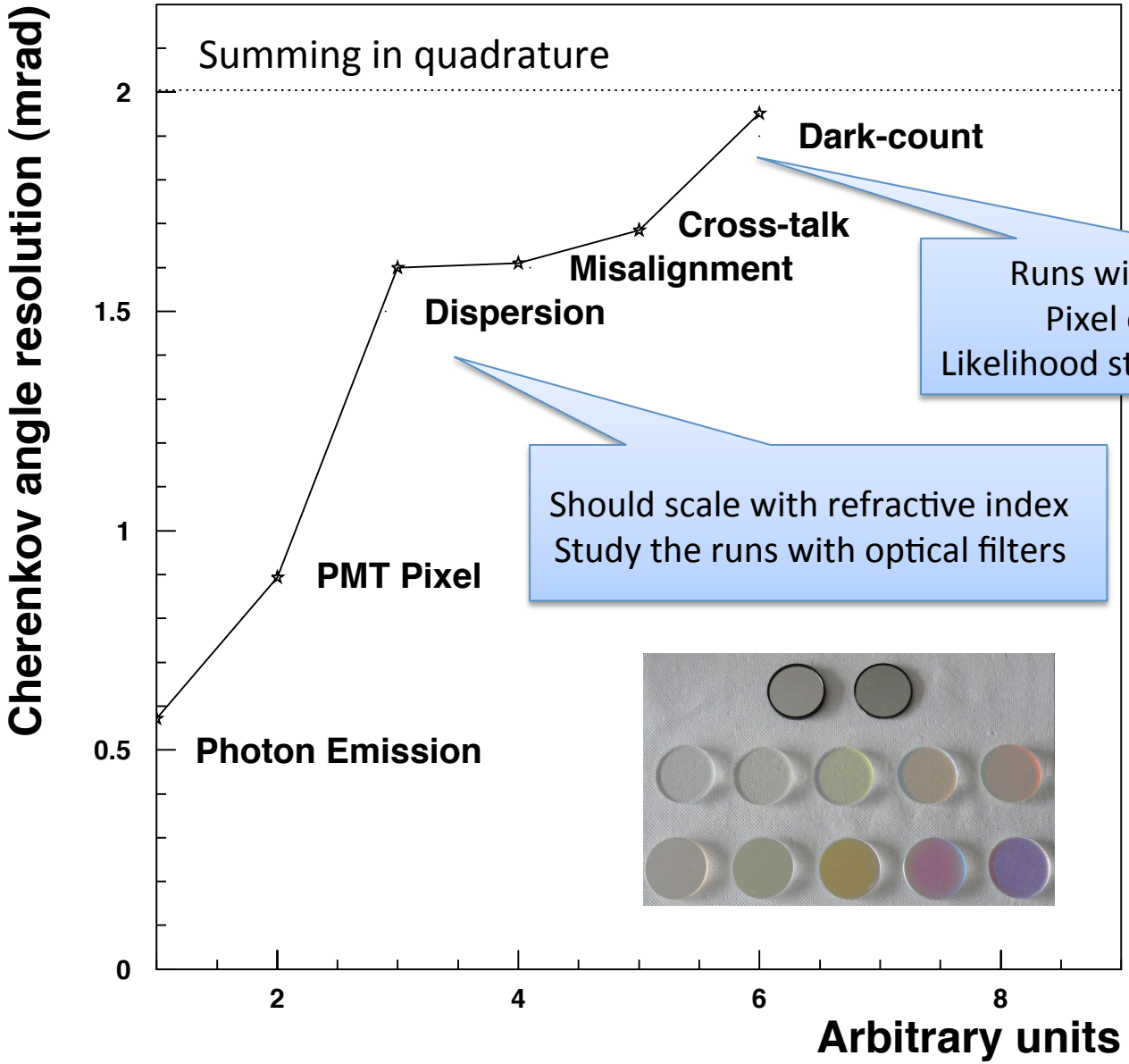




Cherenkov-angle resolution

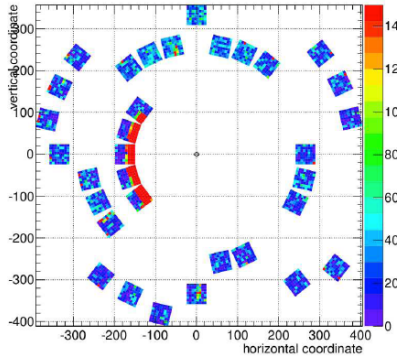


Cherenkov-angle resolution



Runs with staggered PMTs
Pixel energy sharing ?
Likelihood study accounted for 10^{-4}

Should scale with refractive index
Study the runs with optical filters



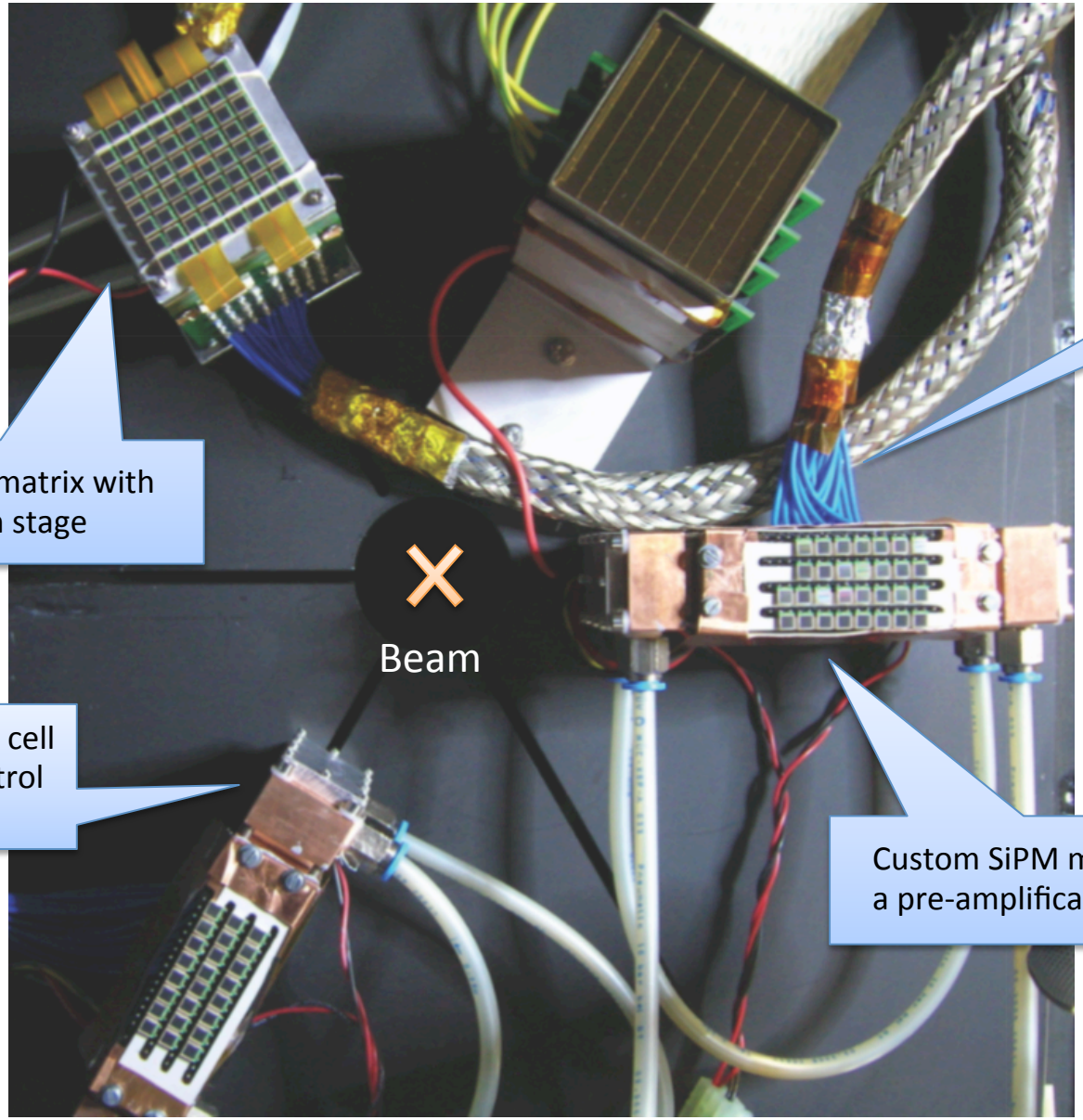
RICH TEST-BEAM: SIPM

Marco Contalbrigo, Luca Barion, Roberto Malaguti, Aram Movsisyan,
Paolo Lenisa, Luciano Pappalardo & Stefano Squerzanti

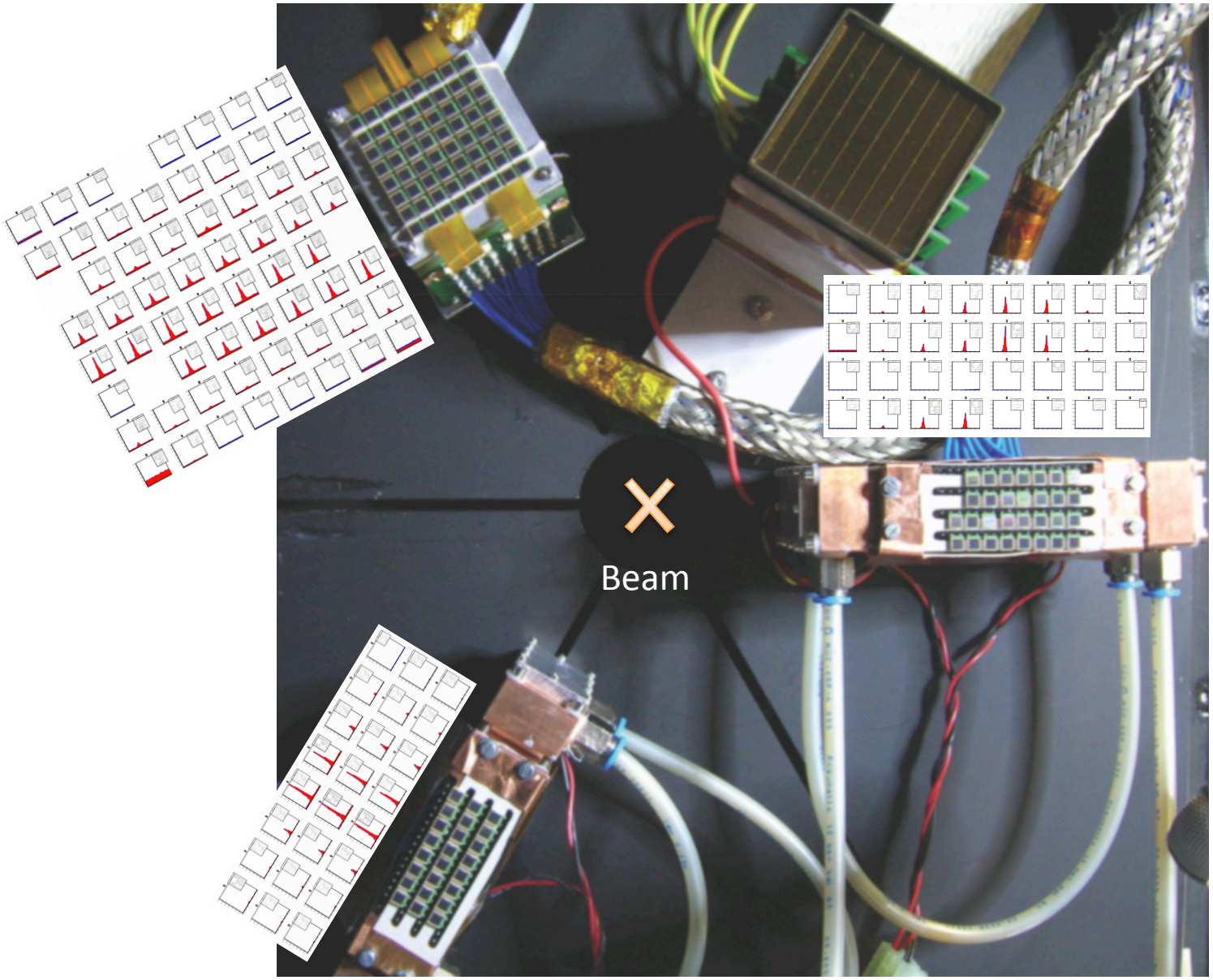
INFN Ferrara

Rich Meeting, Jlab - 20 February 2013

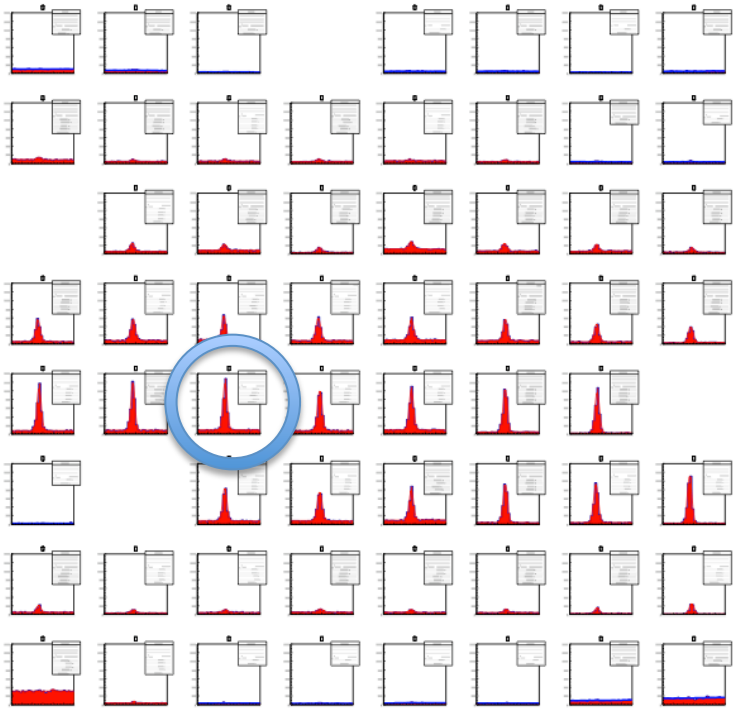
The SiPM Prototype



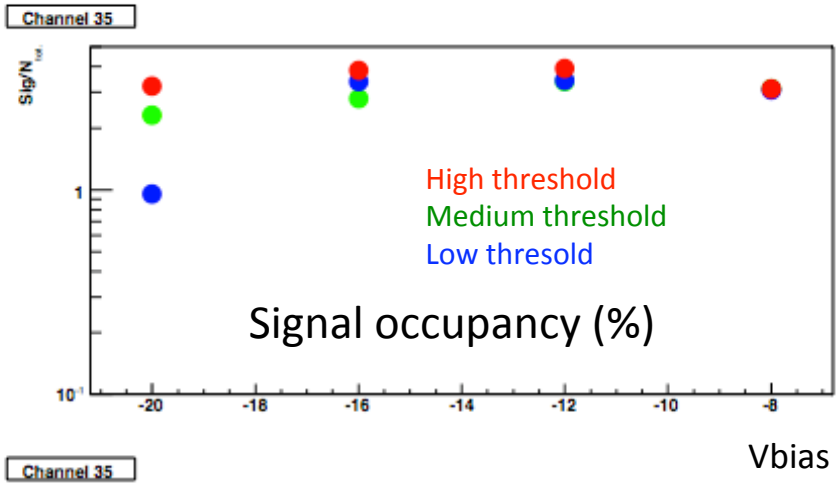
SiPM Signals @ -25°

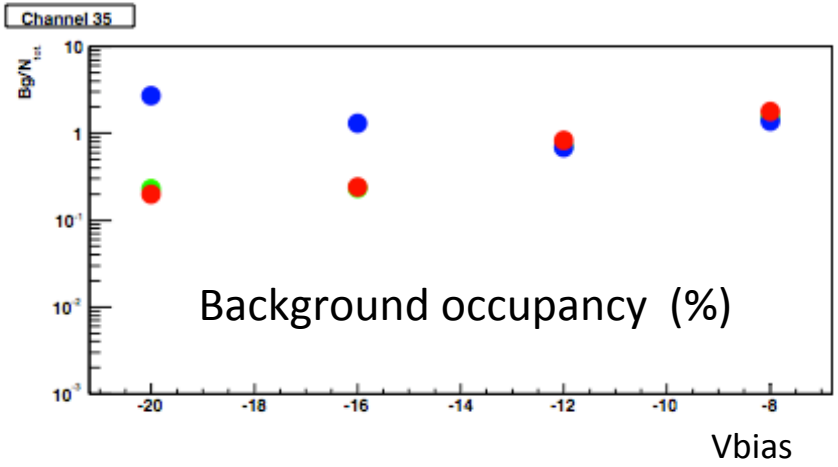


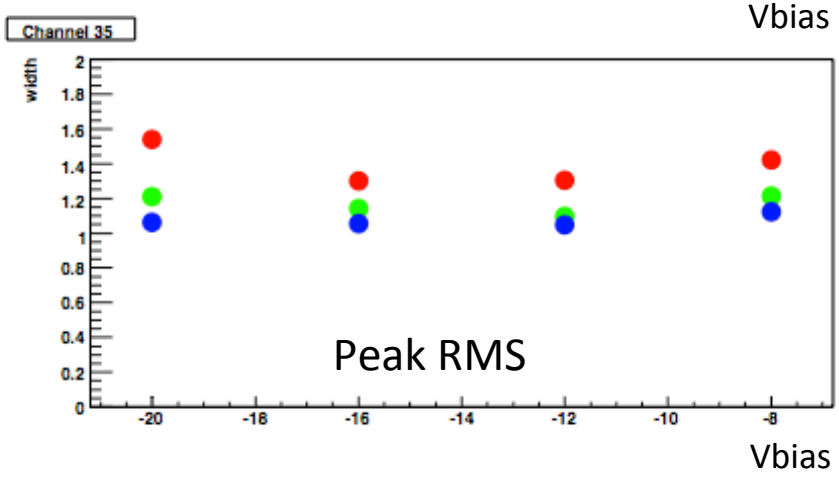
The Commercial SiPM Matrix @ -25°



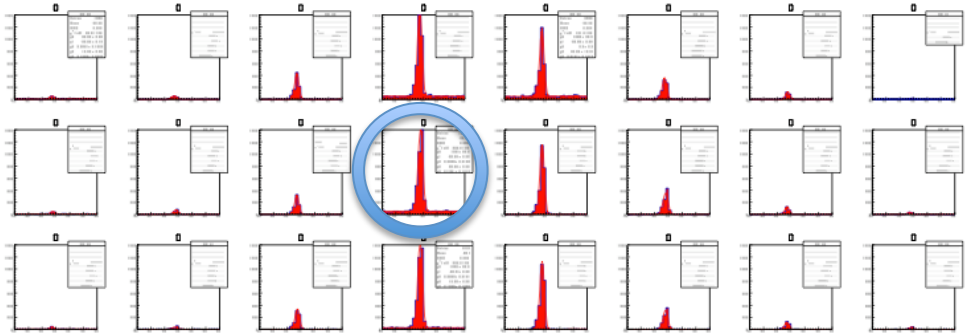
For a 12 cm radius Cherenkov cone and a 3 mm SiPM pixel, an occupancy of 4 % corresponds to about 24 p.e.



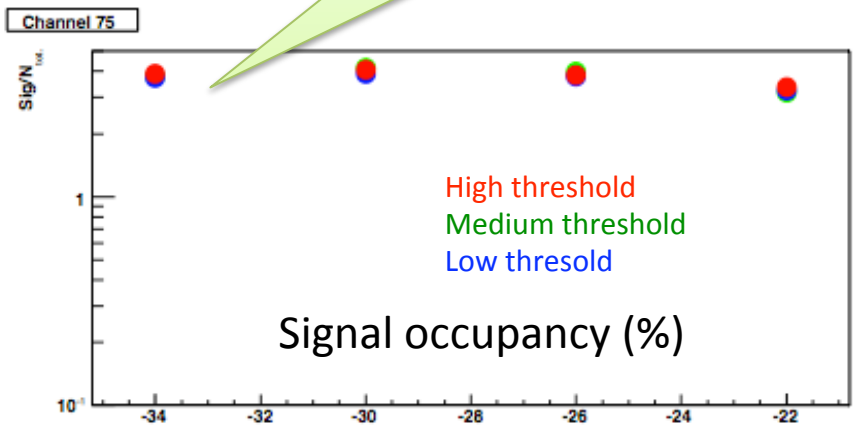




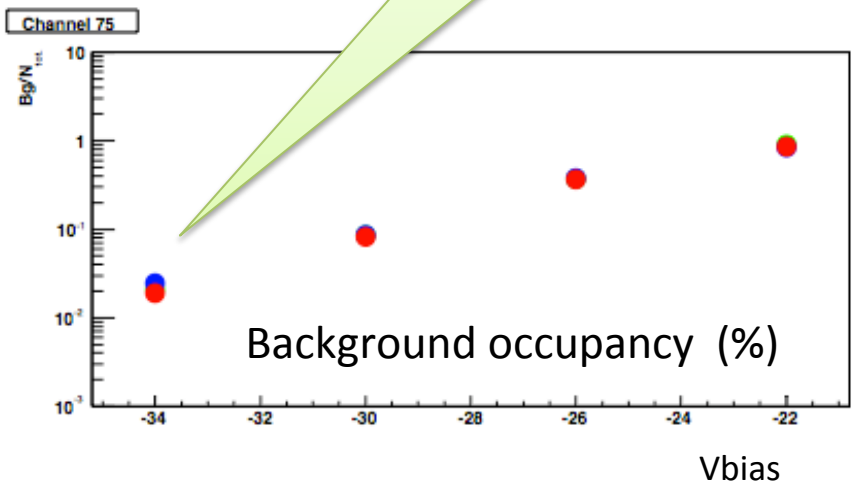
The Custom SiPM Matrix@-25°

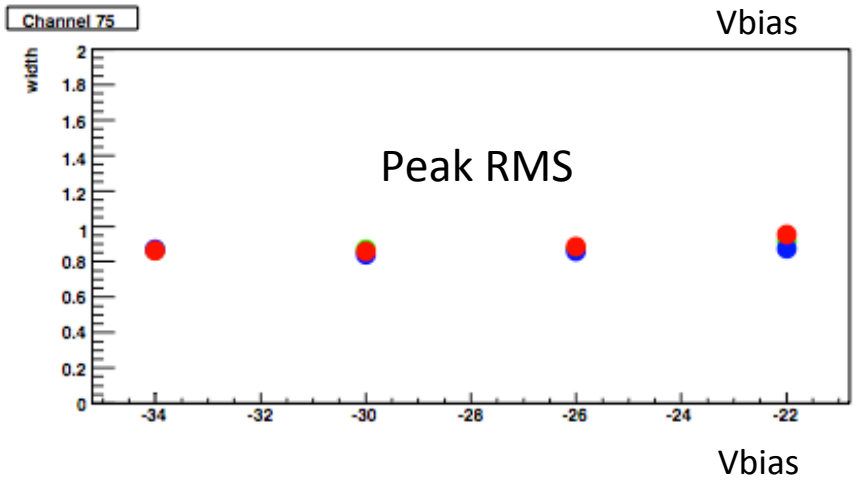


Largely insensitivity to Vbias and discriminator threshold



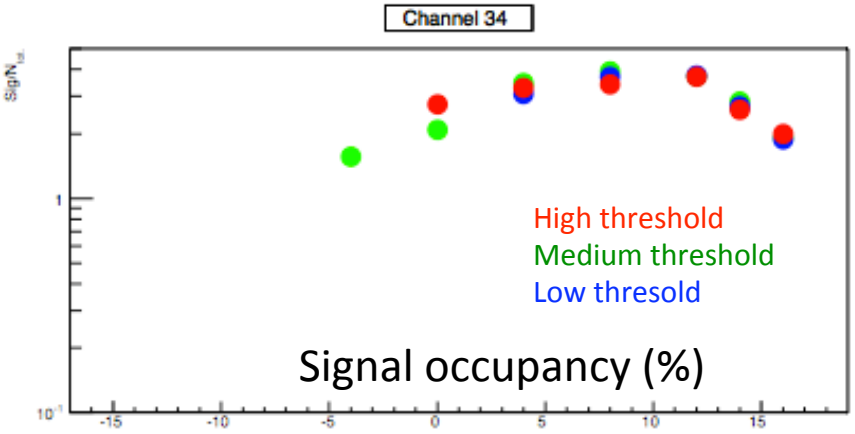
In a +/- 3 ns window
Comparable with H8500

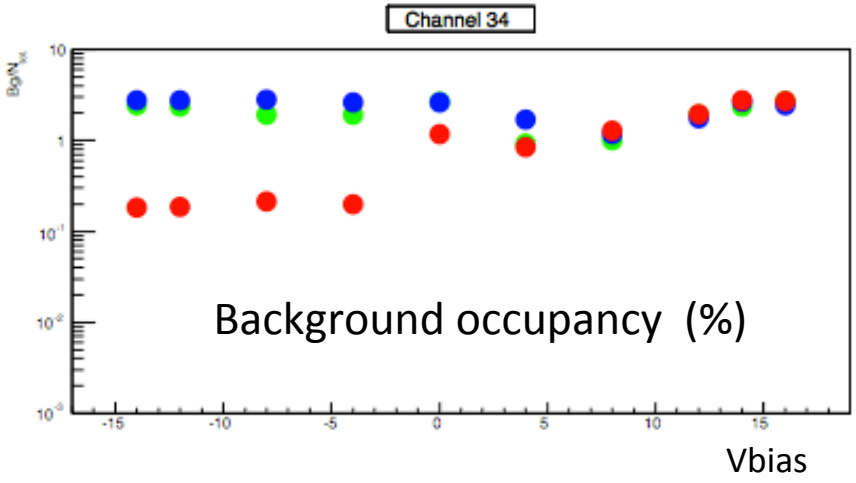


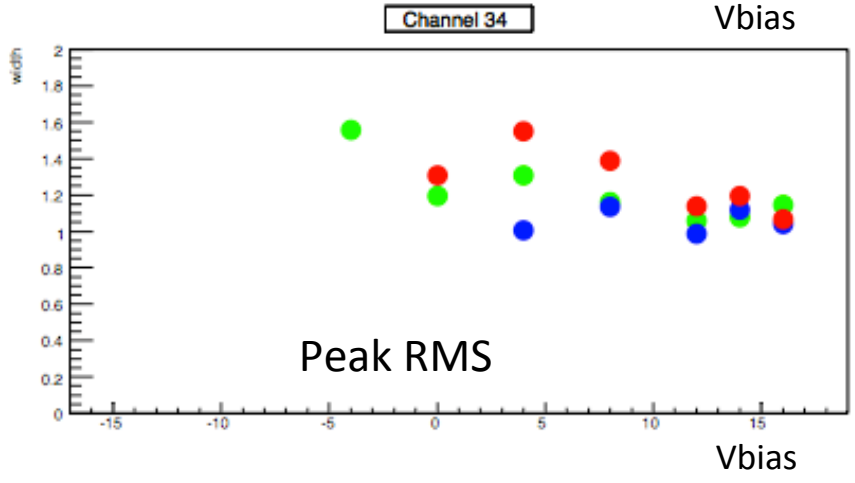


The Commercial SiPM Matrix @ +25°

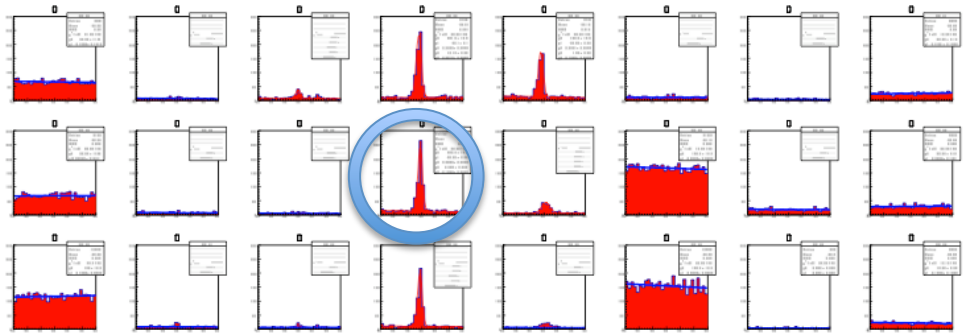
For a 12 cm radius Cherenkov cone and a 3 mm SiPM pixel, an occupancy of 4 % corresponds to about 24 p.e.



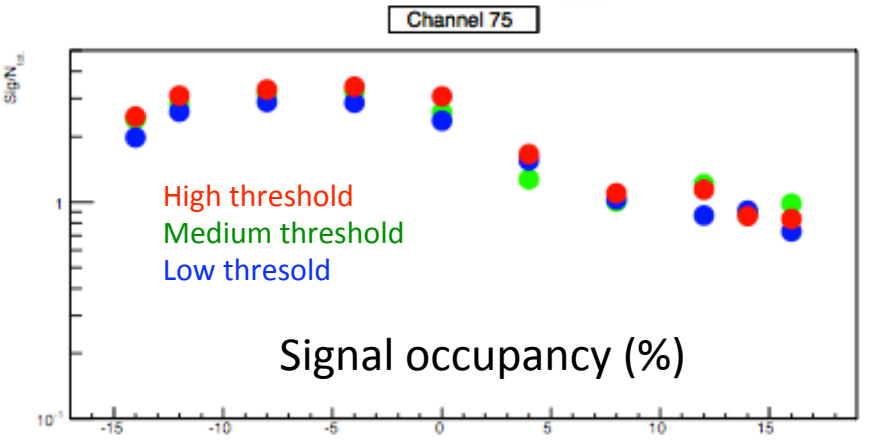




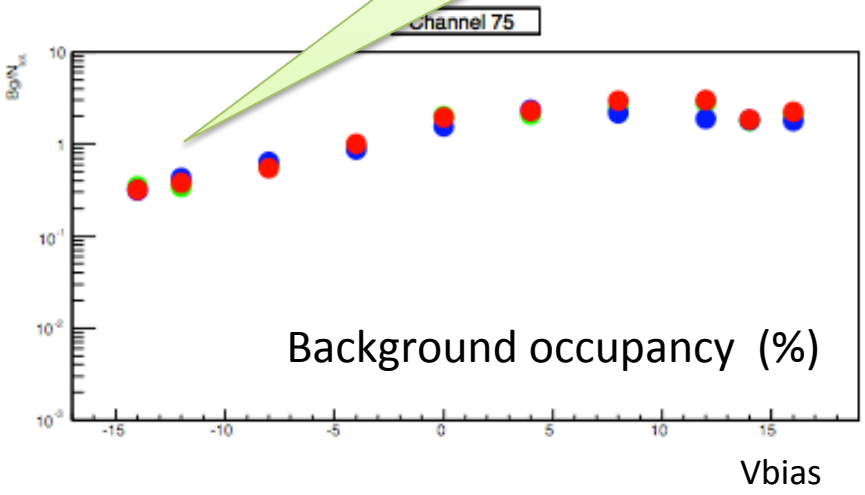
The Custom SiPM Matrix @ +25°

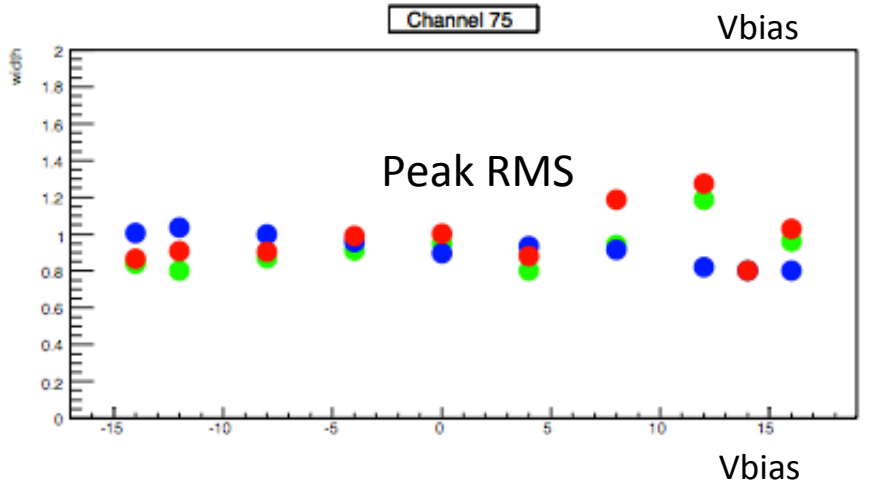


Equalization of the single SiPM is more critical



10^{-3} level is challenging





Average Number of Hits per Event

Device	T	Hits per event	N p.e.
Good Pixels	-25°	0.04	22.6
Good Pixels	+25°	0.04	22.6
Matrix 1	-25°	0.770	24.2
Matrix 2	-25°	0.320	26.8
Matrix 3	-25°	0.223	22.4

Conclusion:
Cooled SiPM are a valid alternative to H8500

Consistent with a factor 2 in QE with respect H8500