

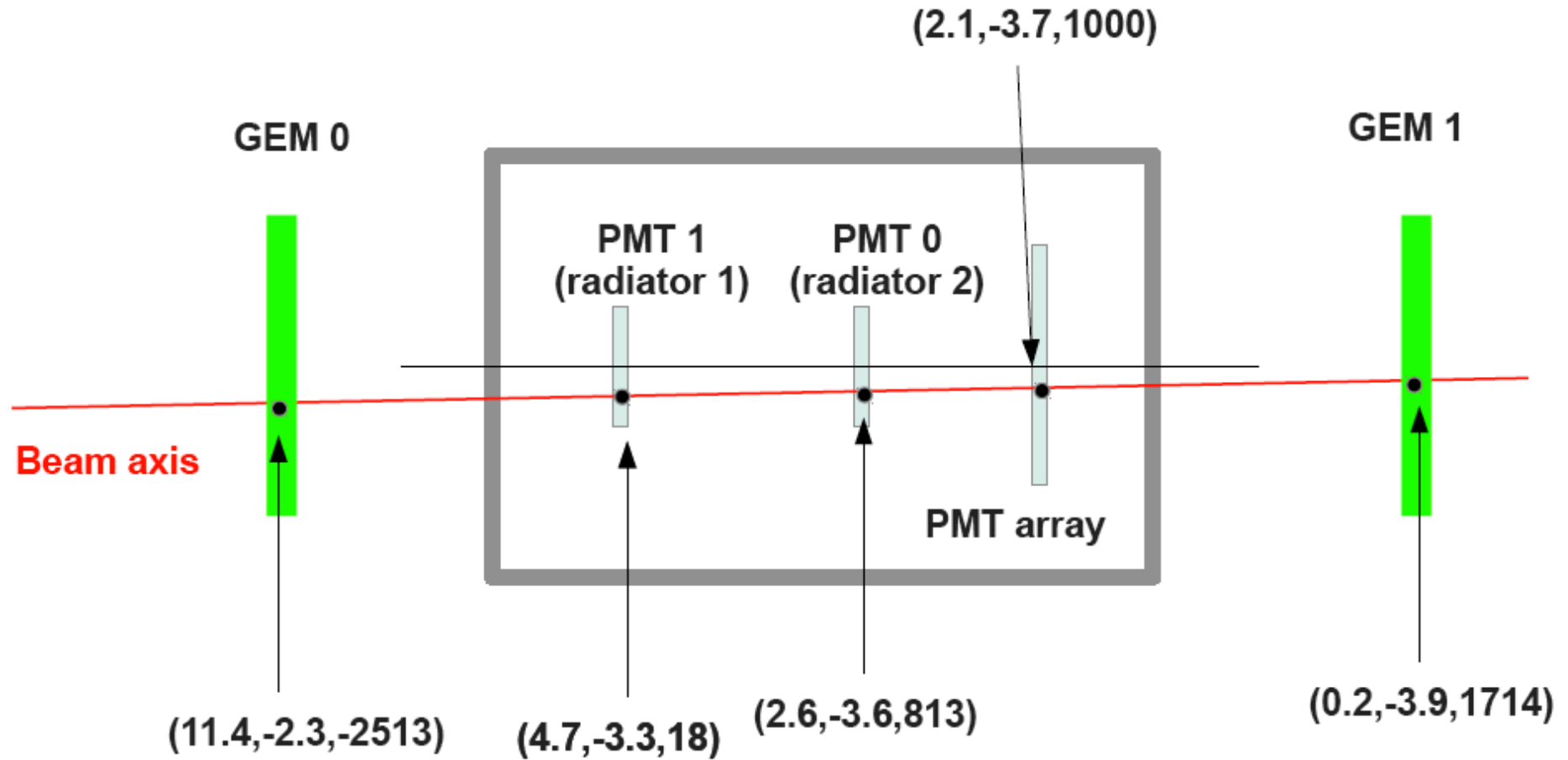
RICH GEMC SIMULATIONS

Contalbrigo Marco, Aram Movsisyan
Luciano Pappalardo, Luca Barion & Paolo Lenisa
INFN Ferrara

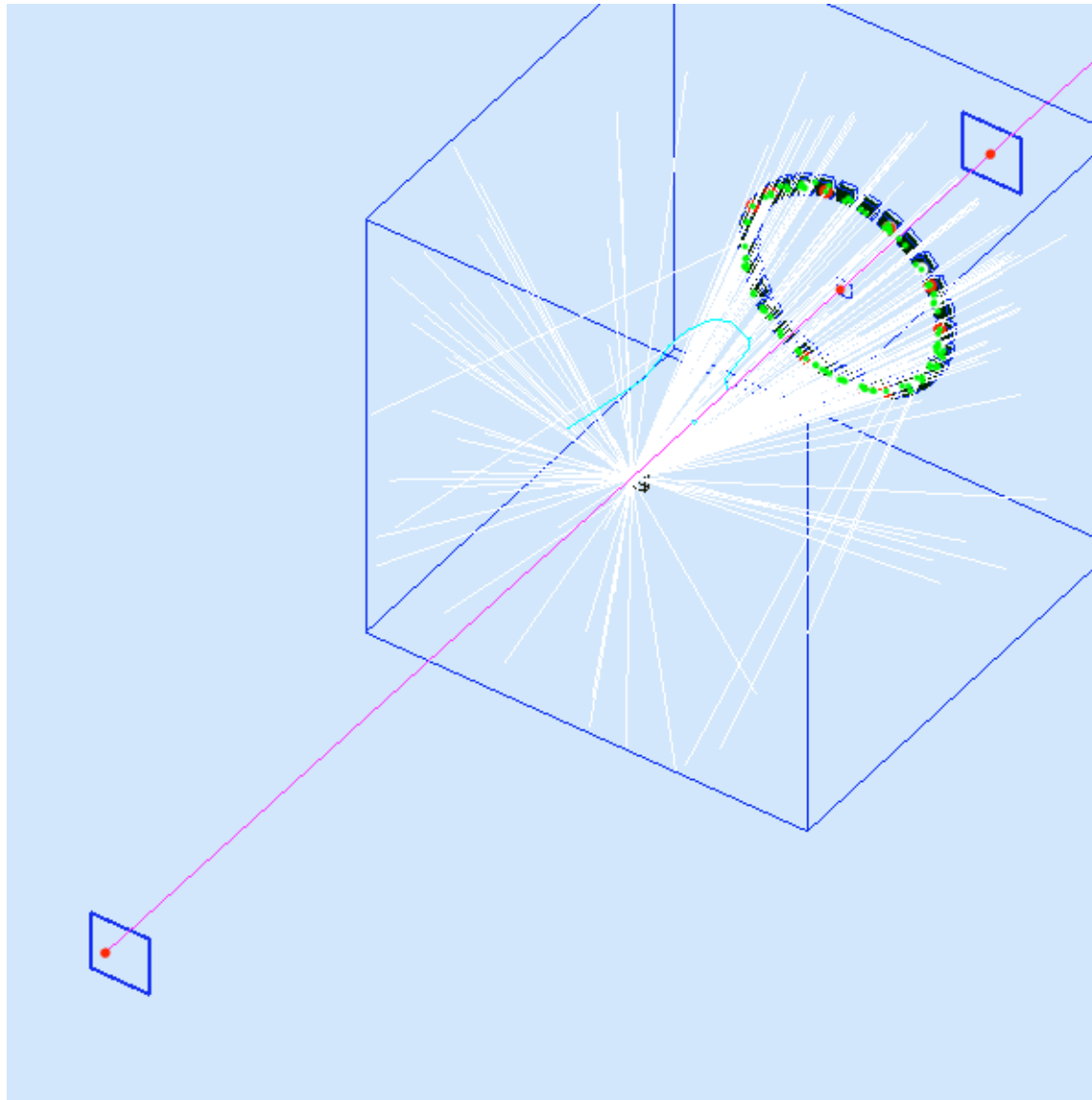
Rich Meeting, 5 April 2013

Alignment

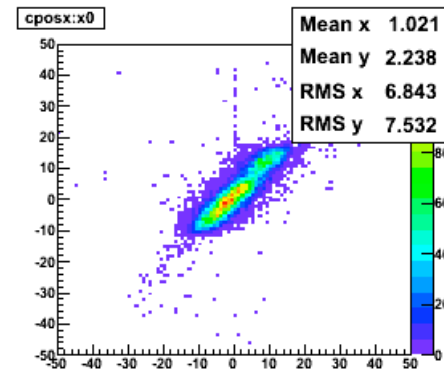
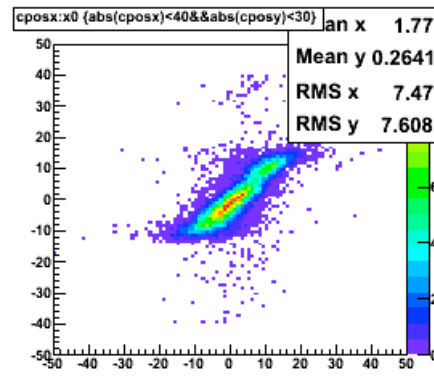
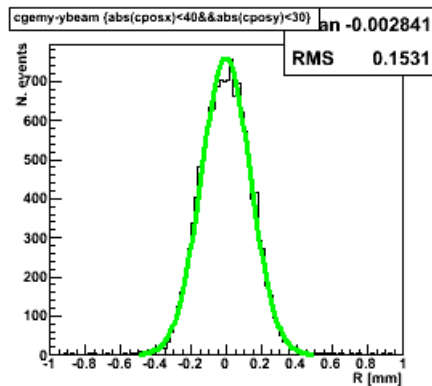
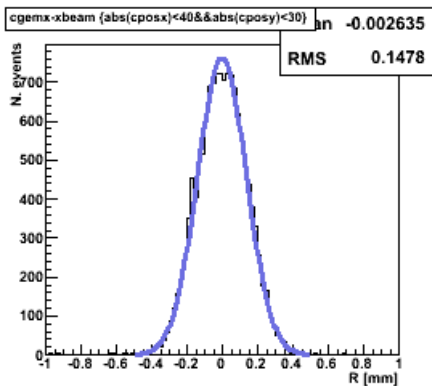
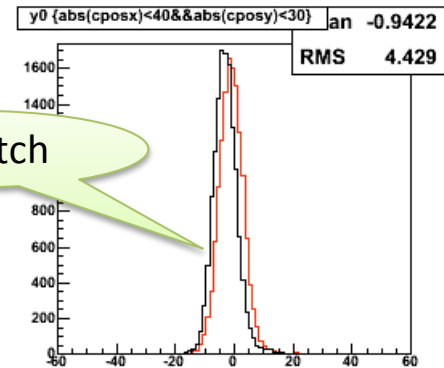
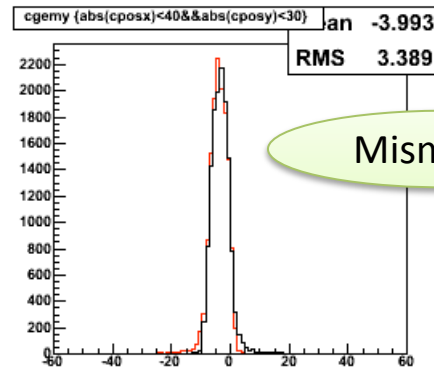
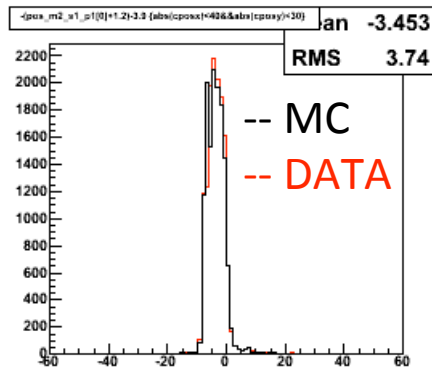
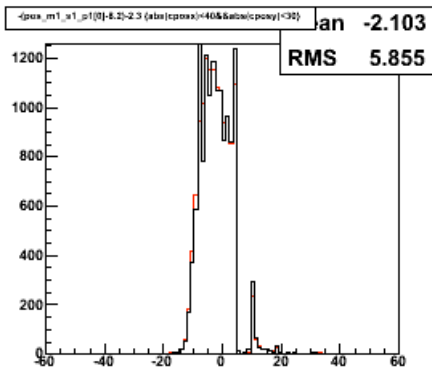
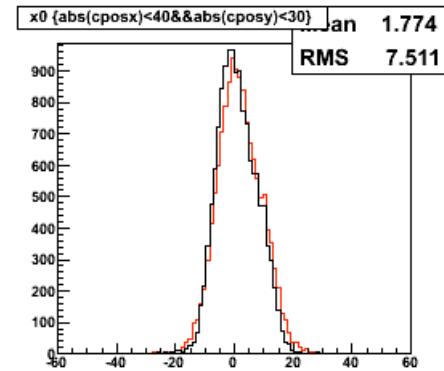
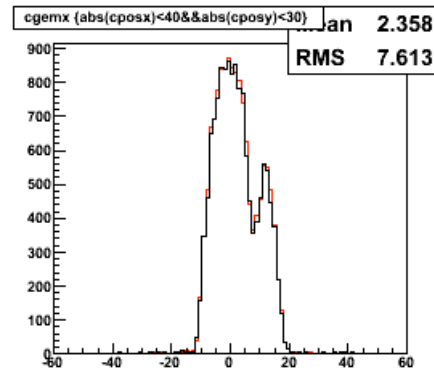
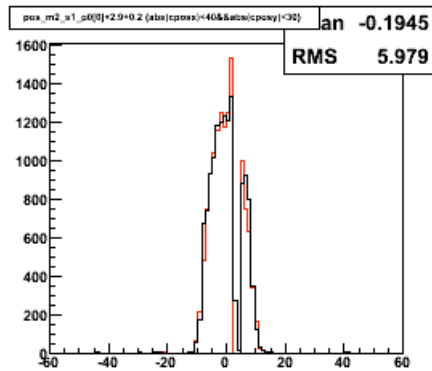
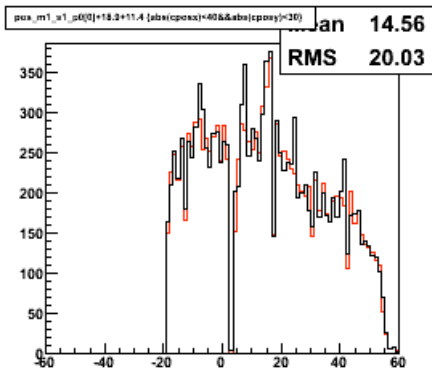
From Marco Mirazita, 15/03/2013



GEM Tracking Simulation

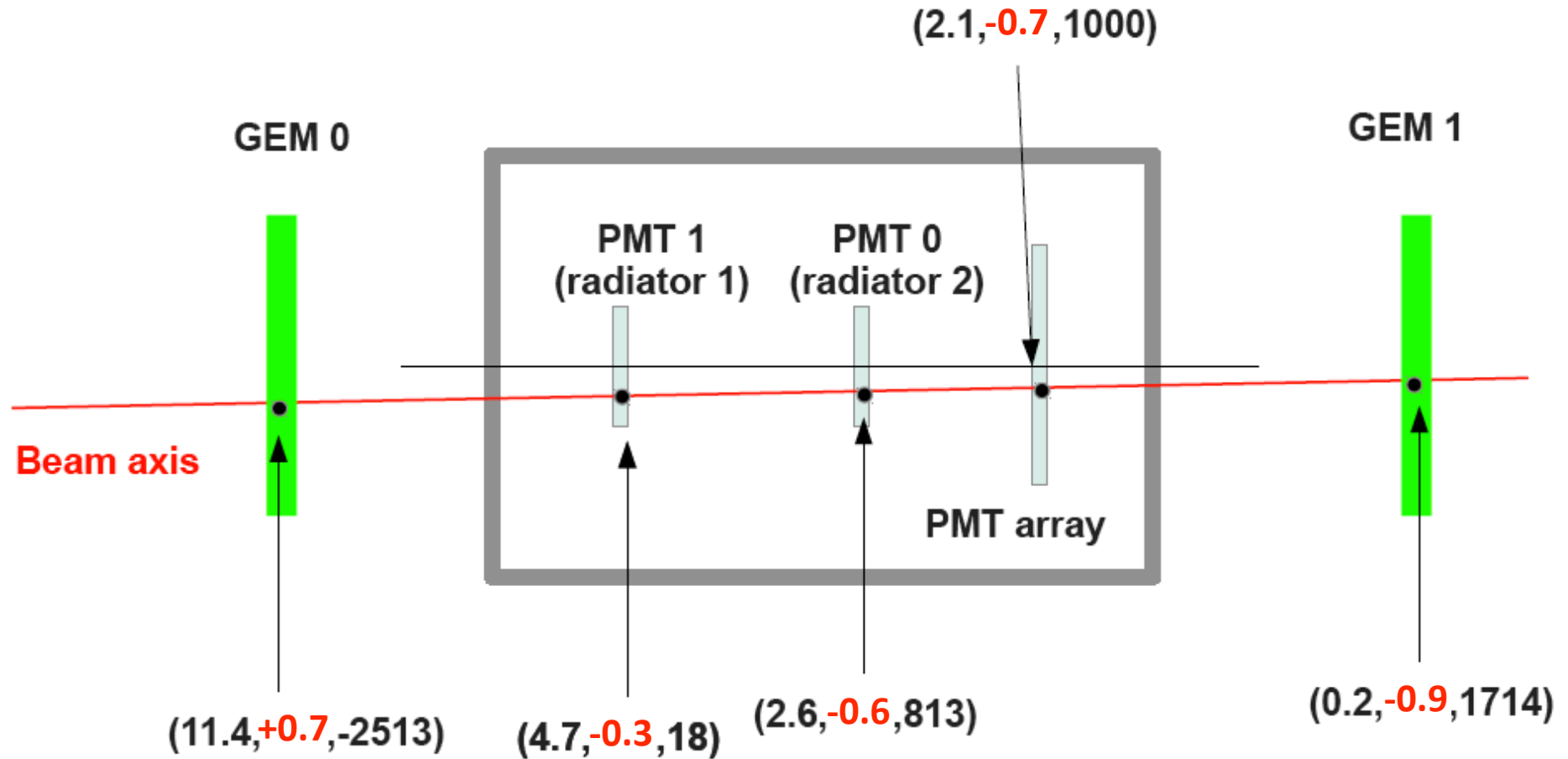


Direct Light, n=1.05 (run 1051)

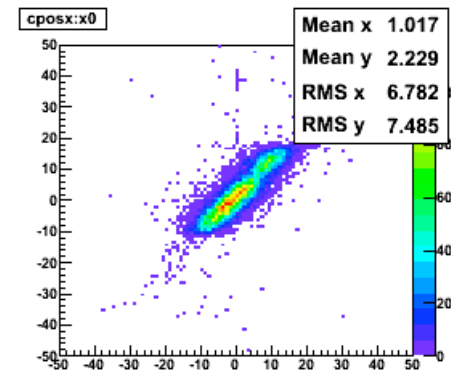
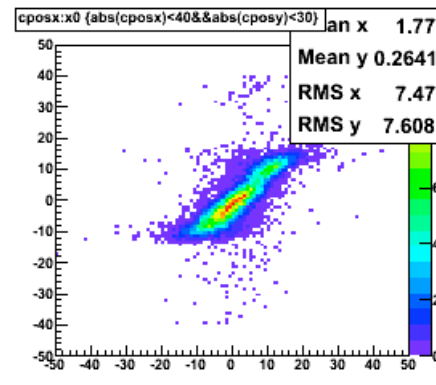
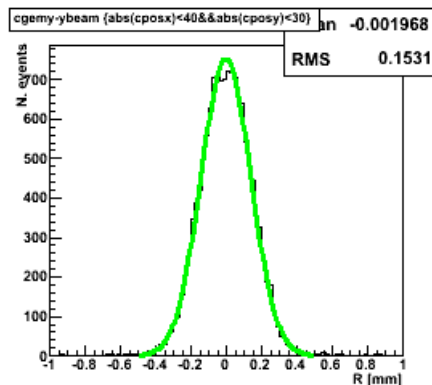
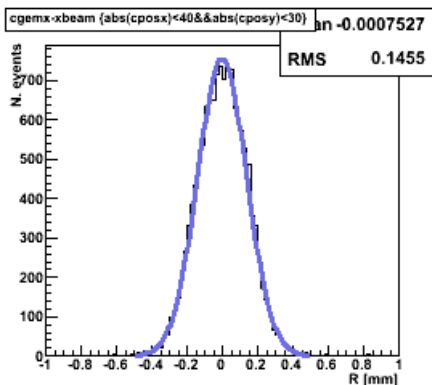
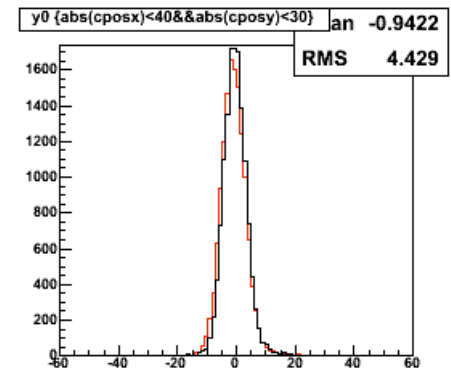
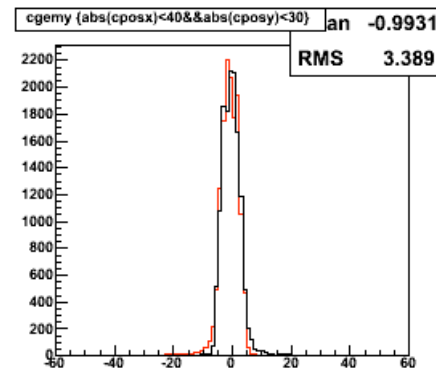
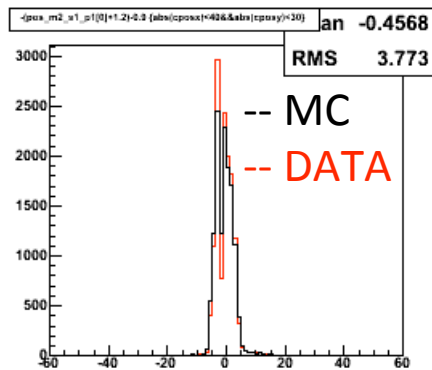
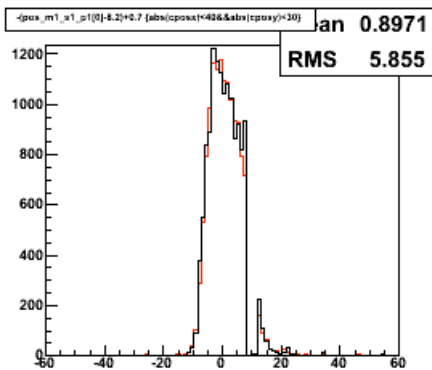
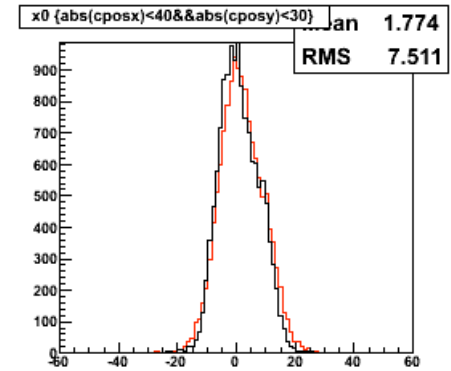
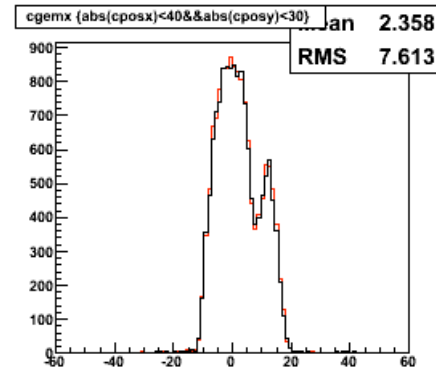
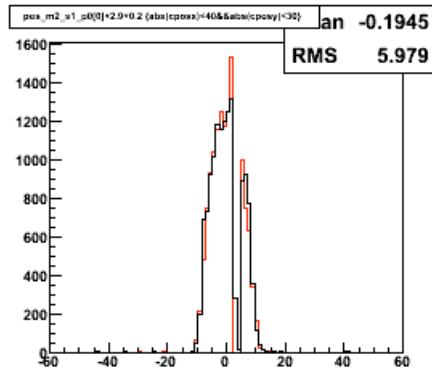
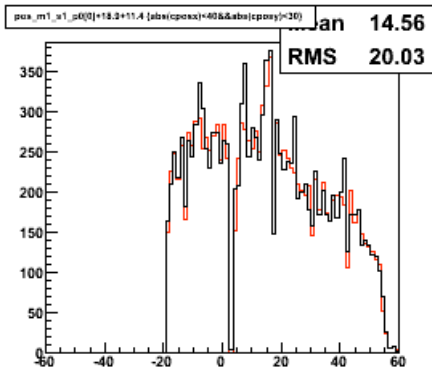


Alignment

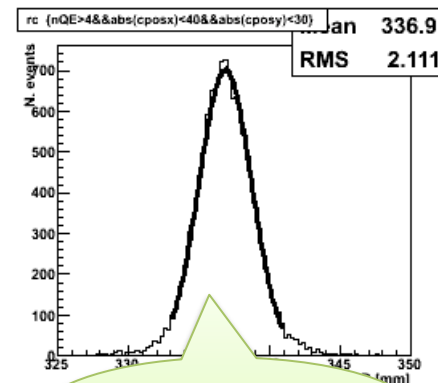
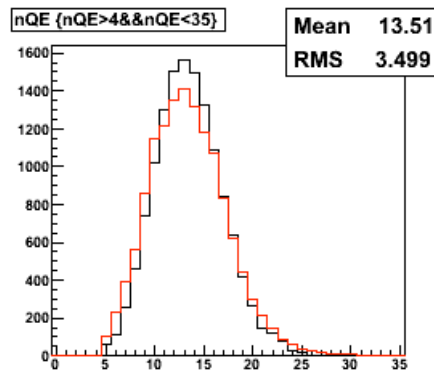
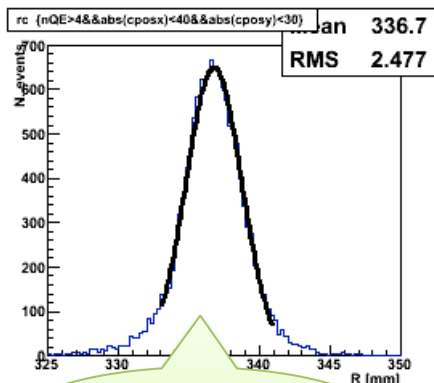
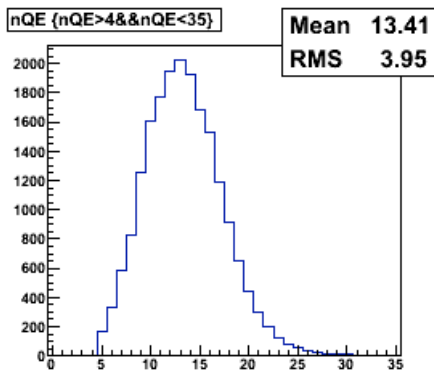
Add +3 mm to the beam vertical position to match PMT fit center



Direct Light, n=1.05 (run 1051)

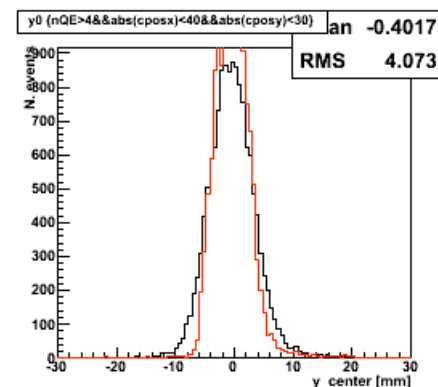
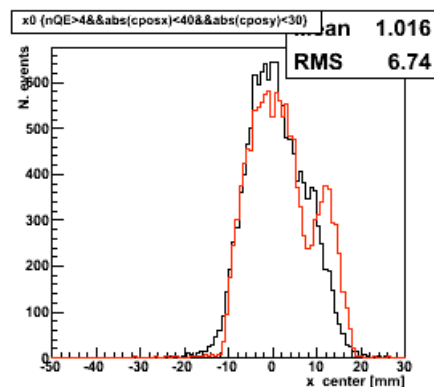
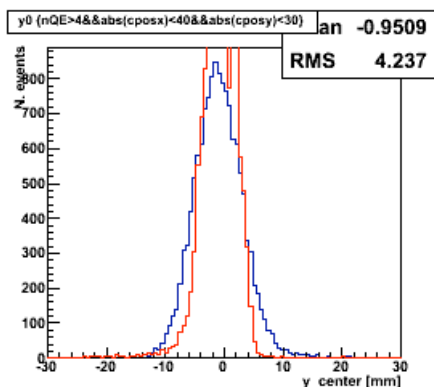
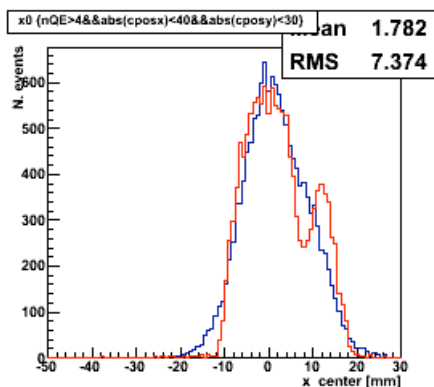
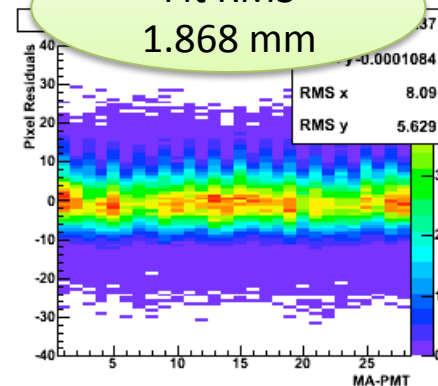
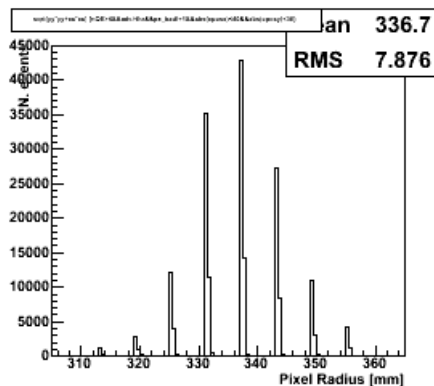
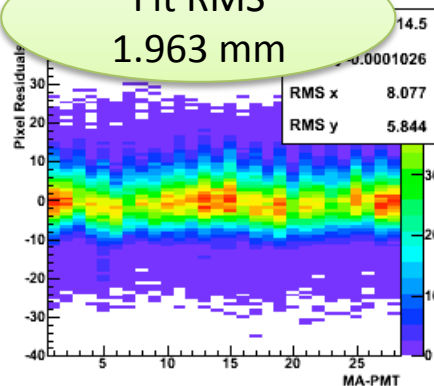
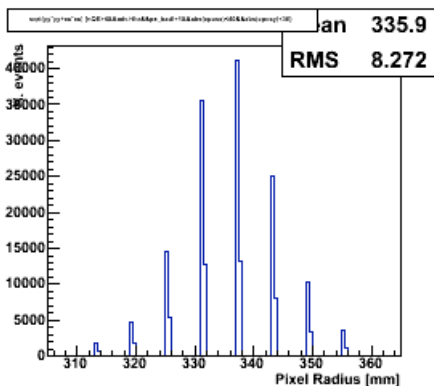


Direct Light, n=1.05 (run 1051) Fit center

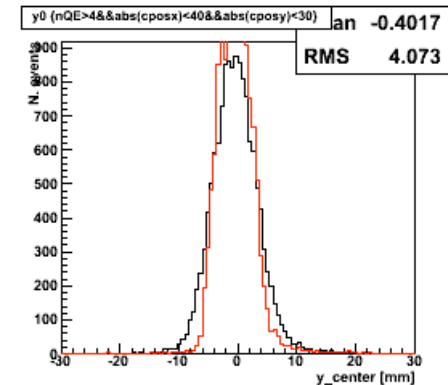
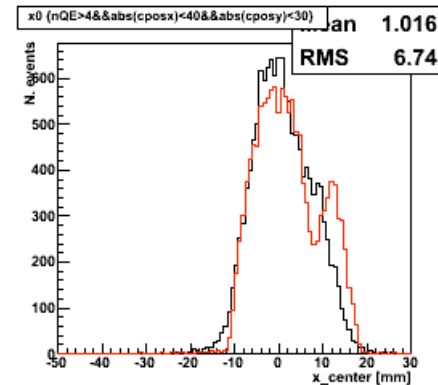
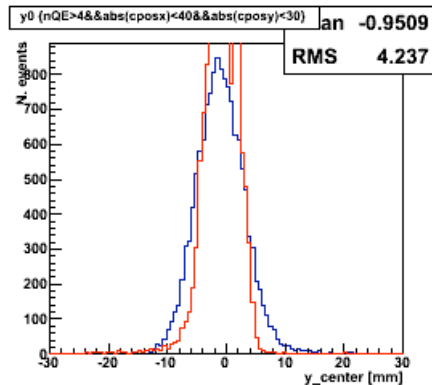
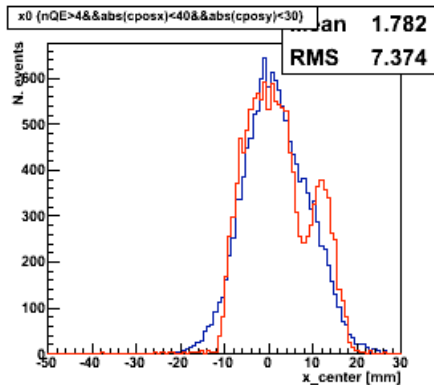
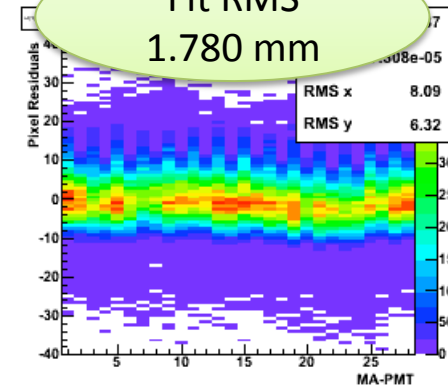
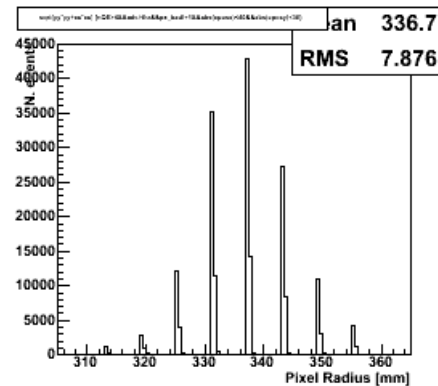
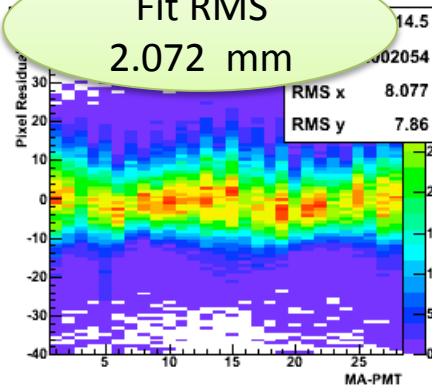
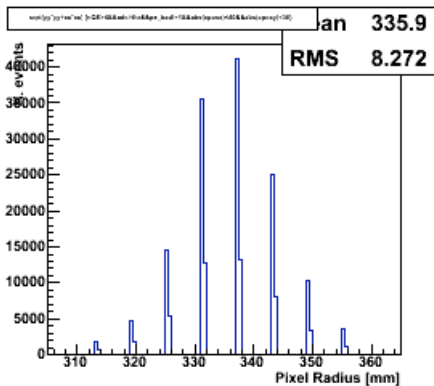
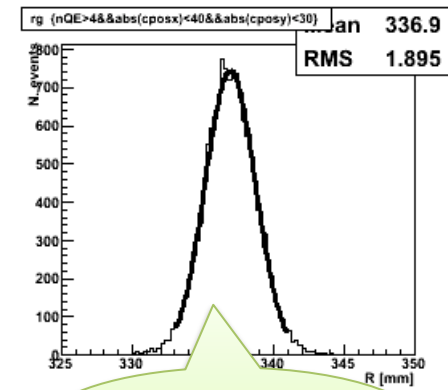
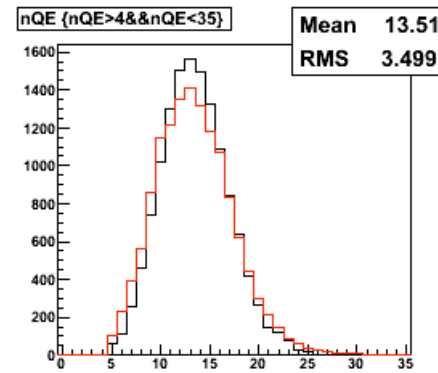
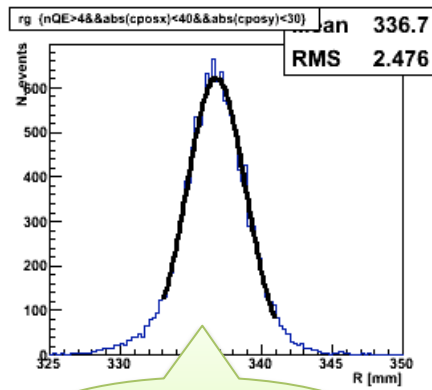
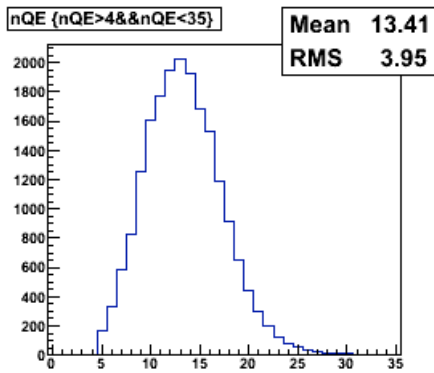


Fit RMS
1.963 mm

Fit RMS
1.868 mm



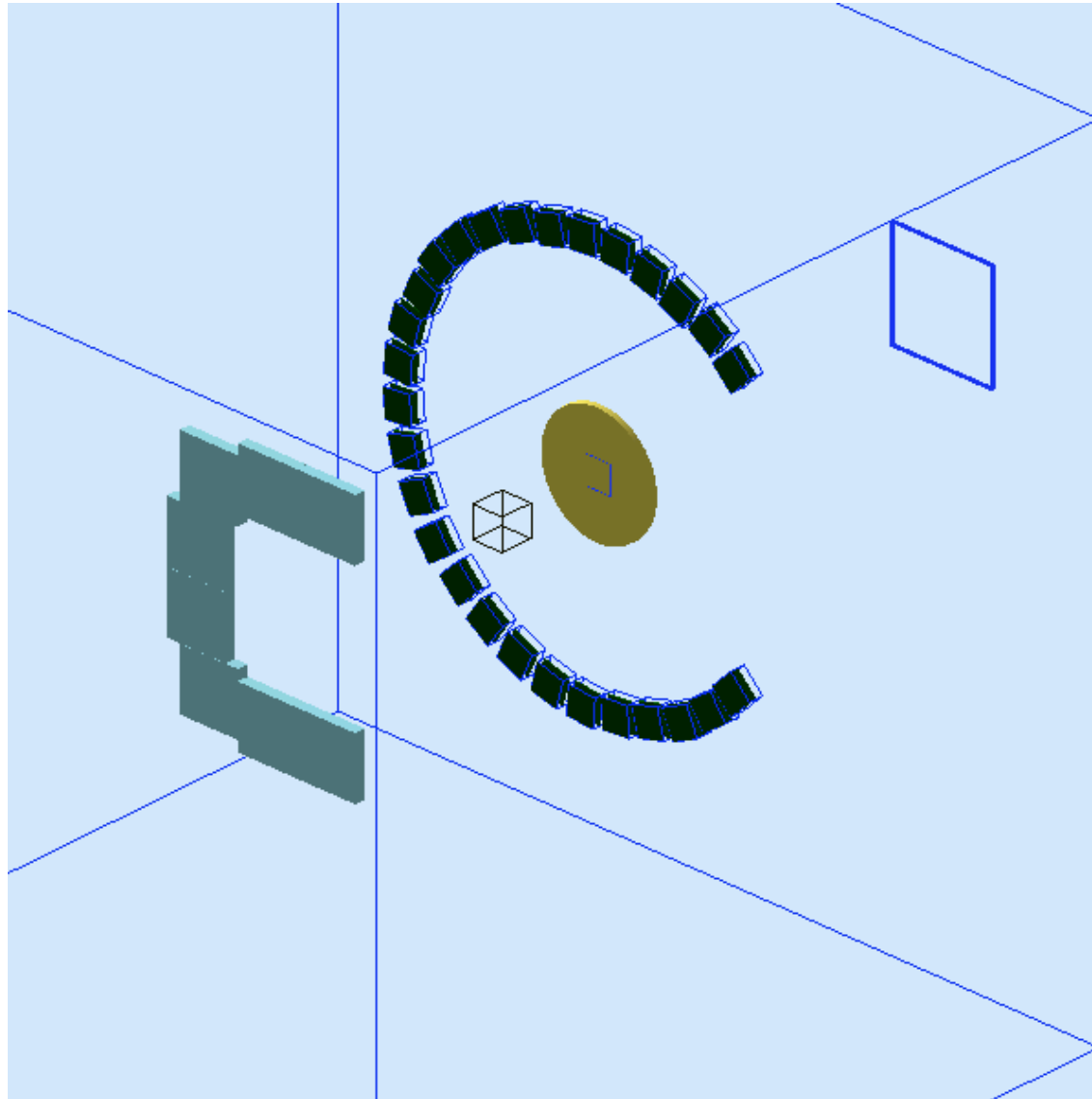
Direct Light, n=1.05 (run 1051) GEM center



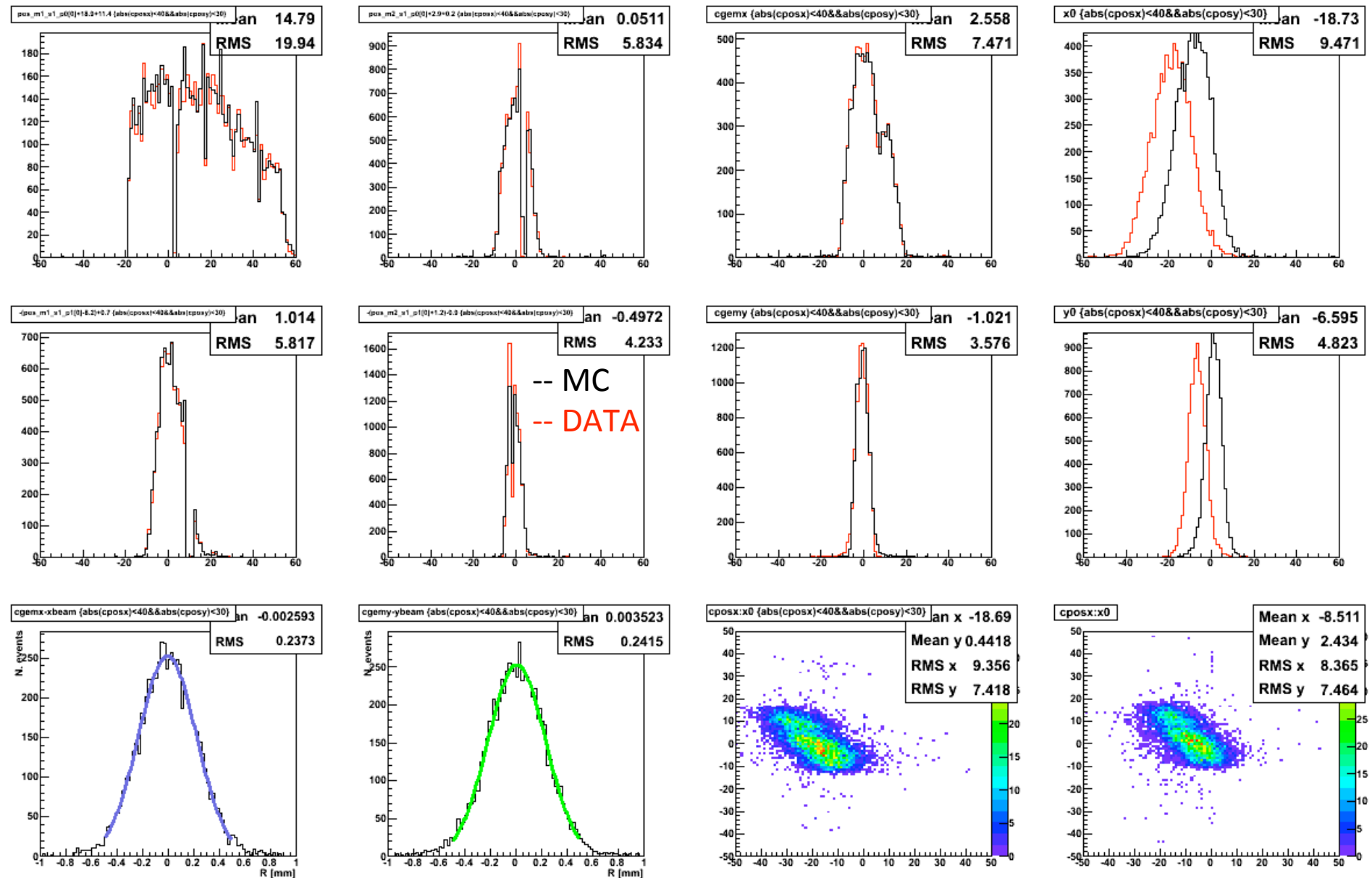
RMS vs misalignment

Ru2n	Beam Misalignment	Center	Rms (DATA)	Rms (MC)
1051	Mirazita	PMTs	1.963	1.874
“	Mirazita + 3mm (y)	PMTs	1.963	1.868
“	0.6° slope in x	PMTs	1.963	1.830
“	Mirazita	GEM	2.079	1.799
“	Mirazita + 3mm (y)	GEM	2.072	1.780
“	0.6° slope in x	GEM		1.753

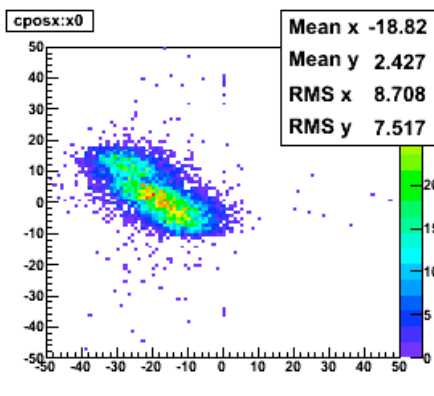
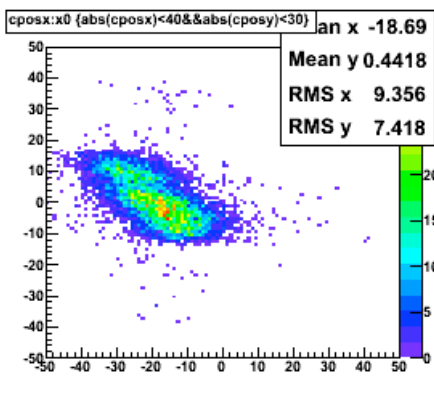
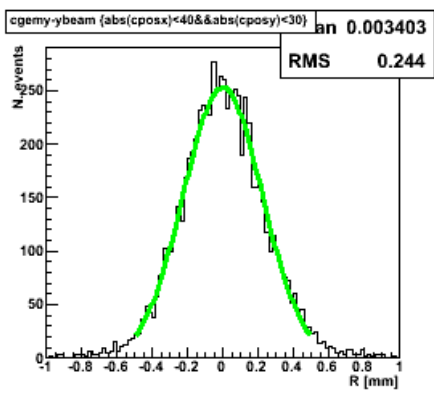
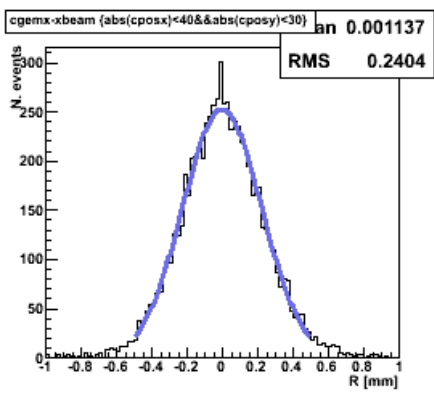
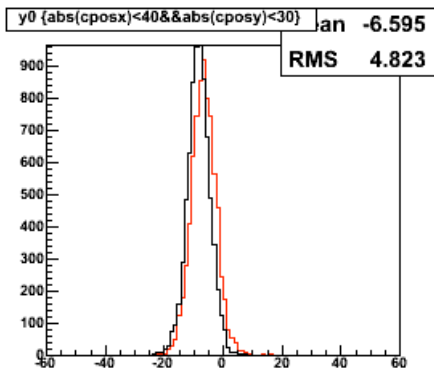
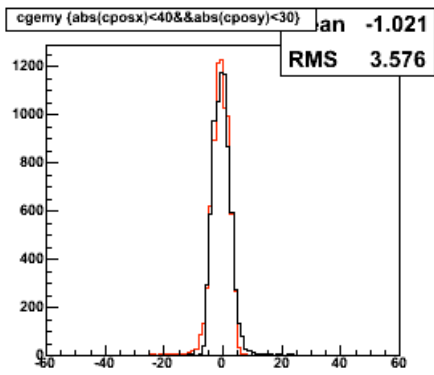
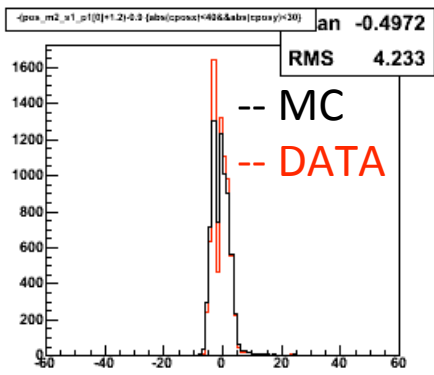
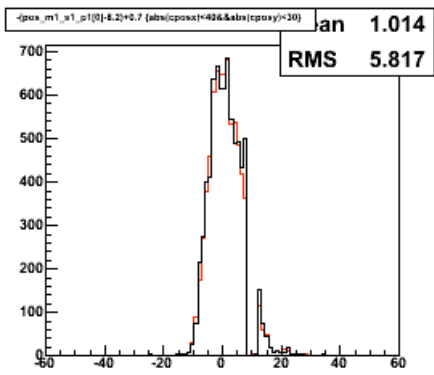
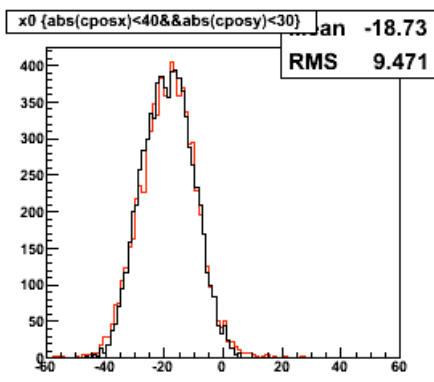
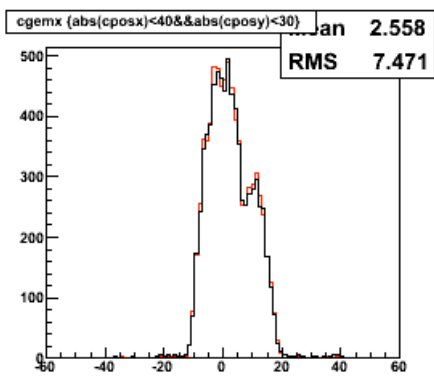
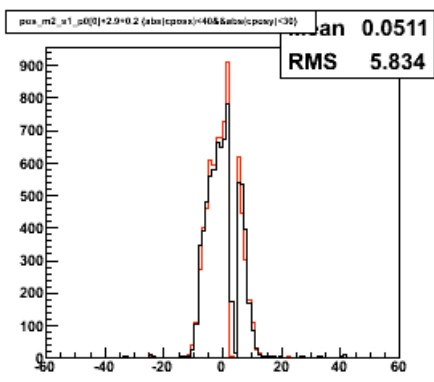
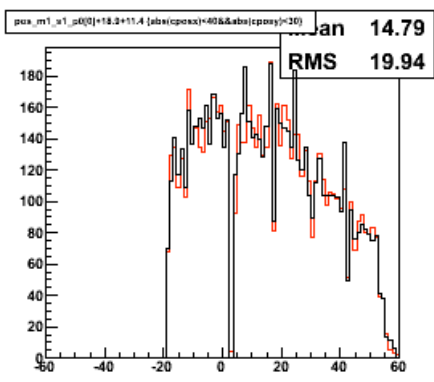
Reflected Light, $n=1.05$ (run 822)



Reflected Light, n=1.05 (run 822)



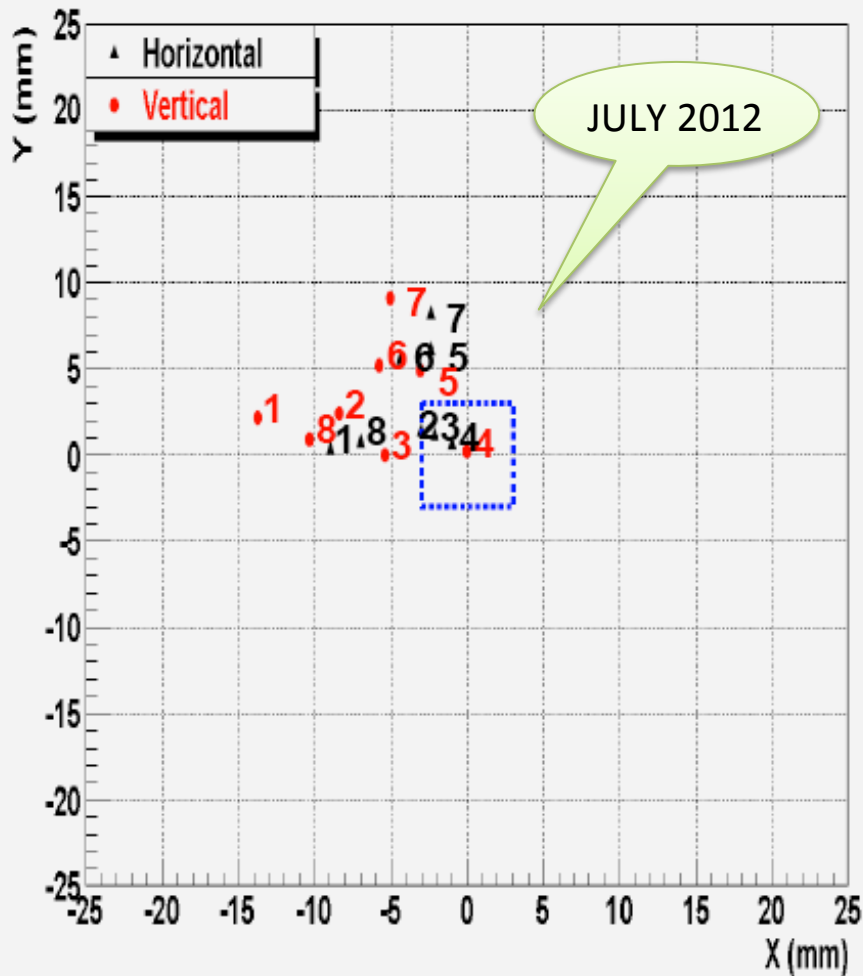
Reflected Light, n=1.05 (run 822) Tilted mirror



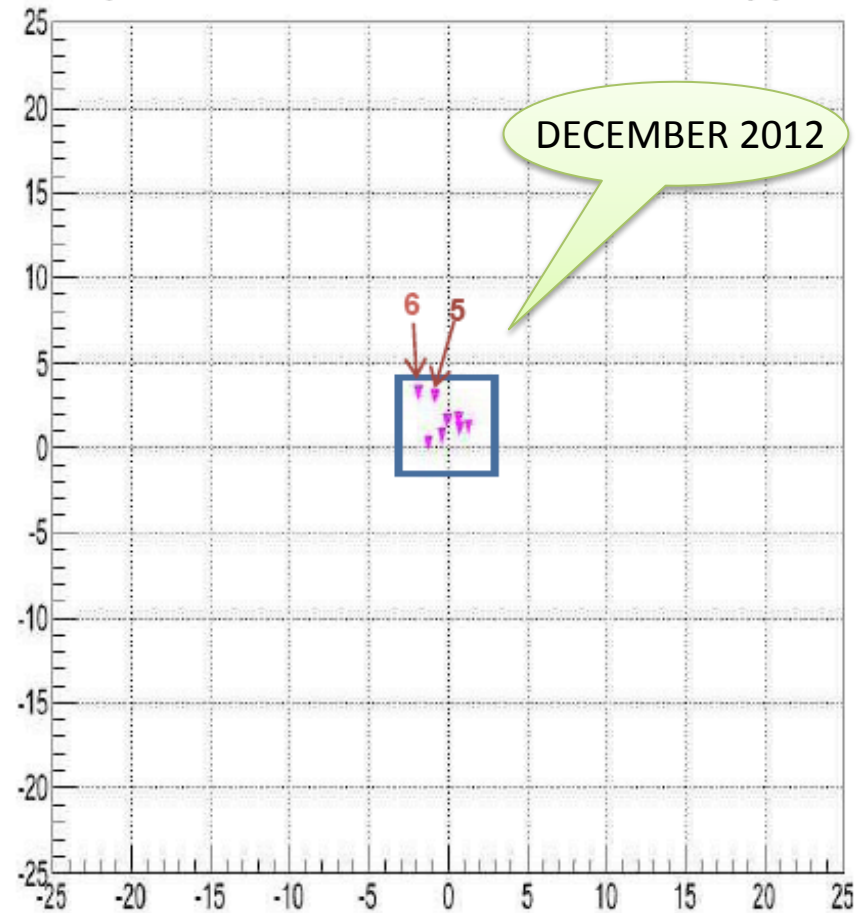
Mirror Planarity

From Vincenzo Lucherini , 26/10/2012

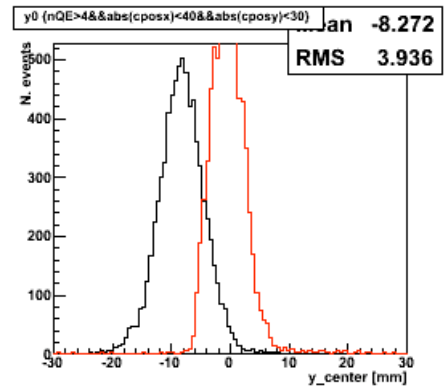
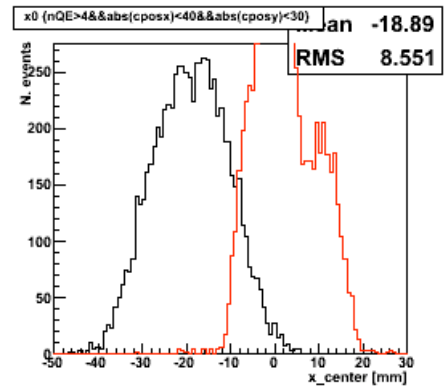
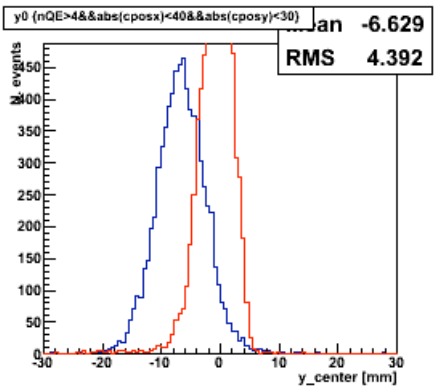
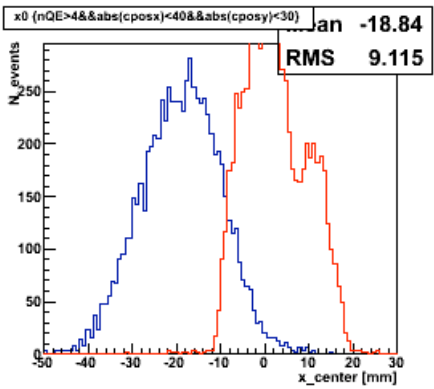
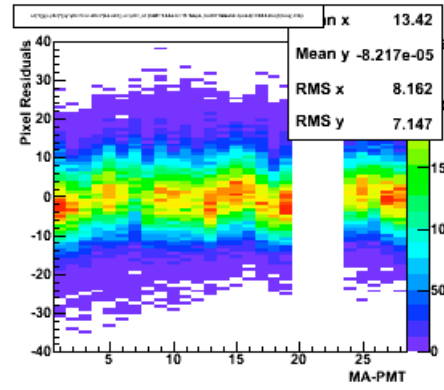
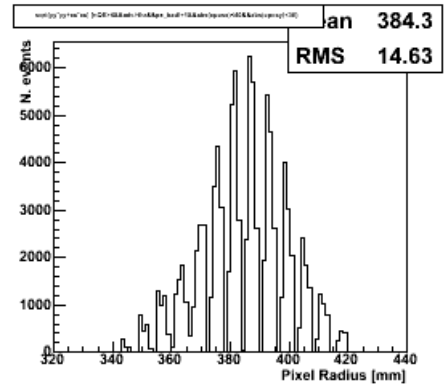
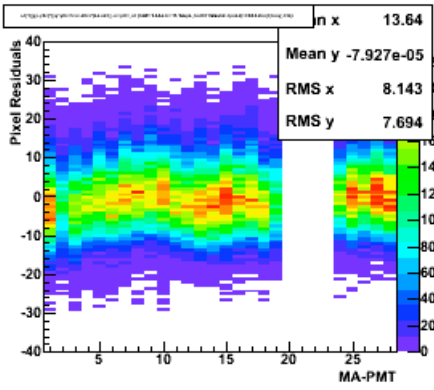
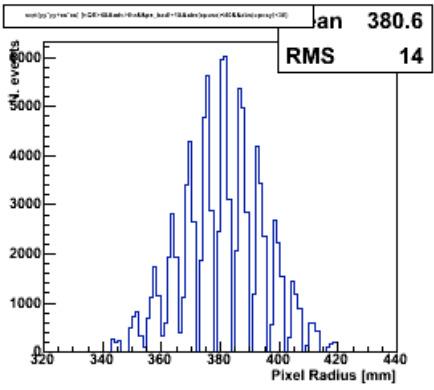
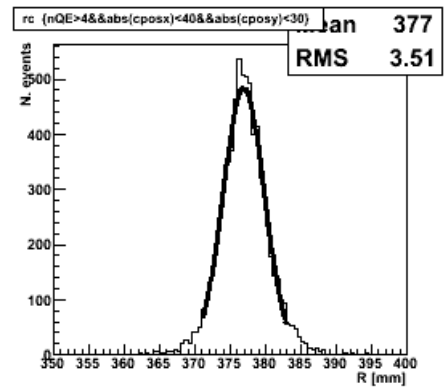
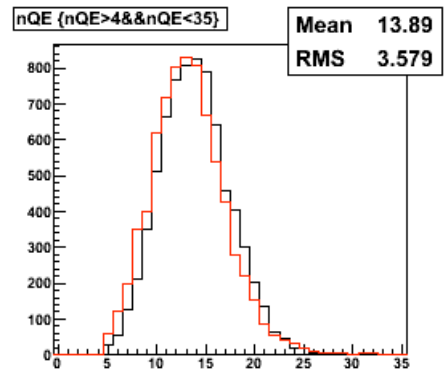
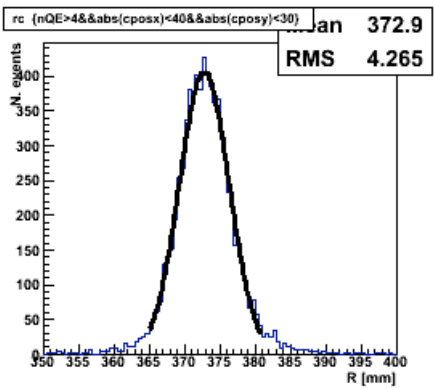
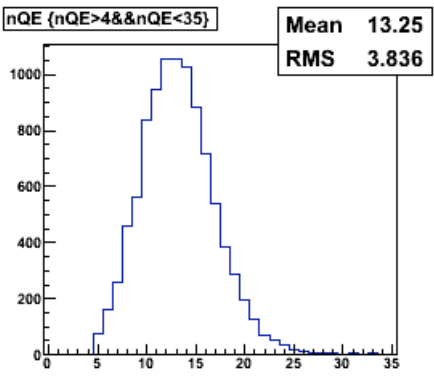
Displacement from the vertical after 600 mm



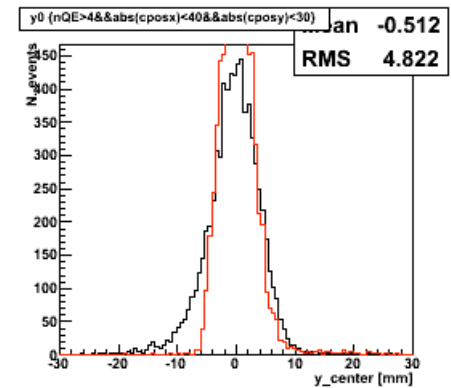
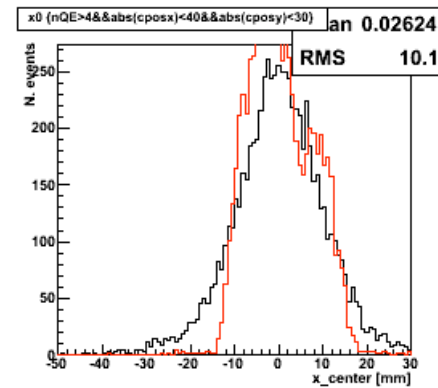
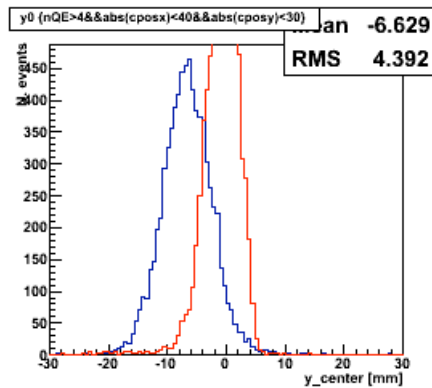
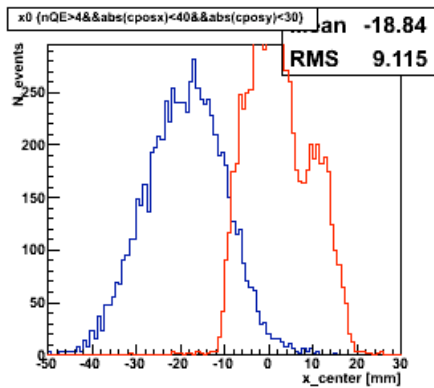
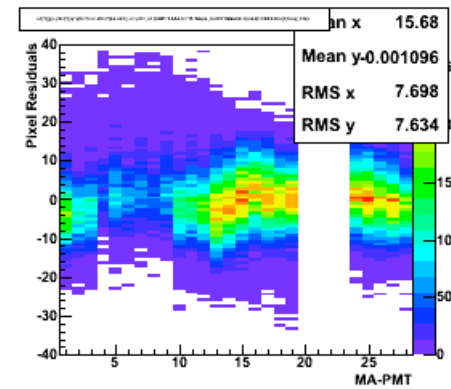
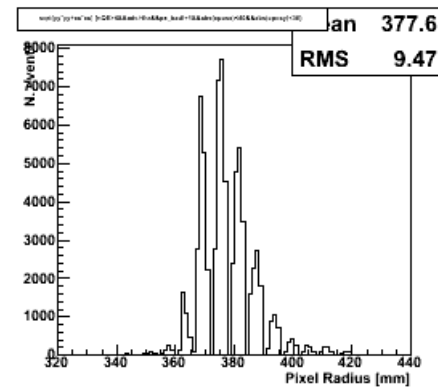
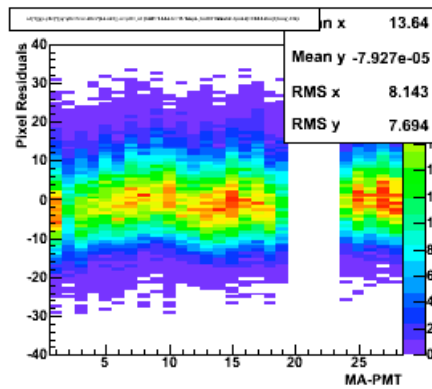
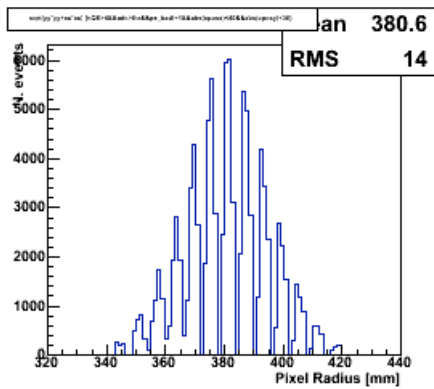
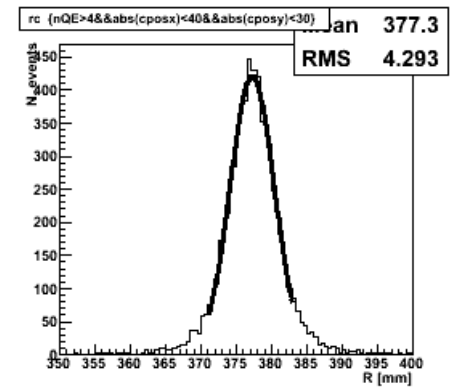
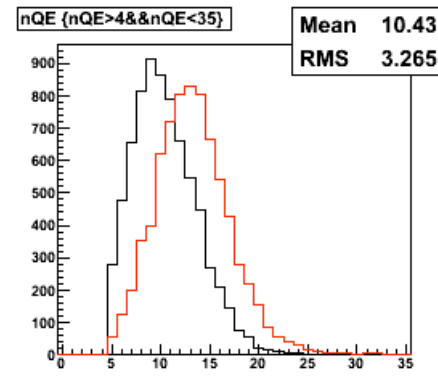
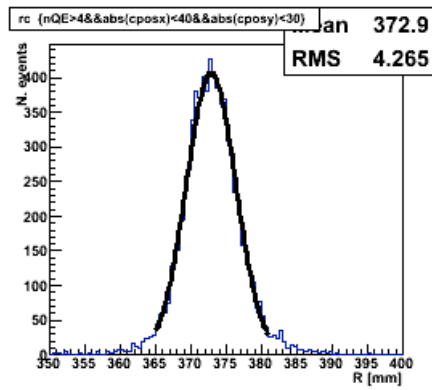
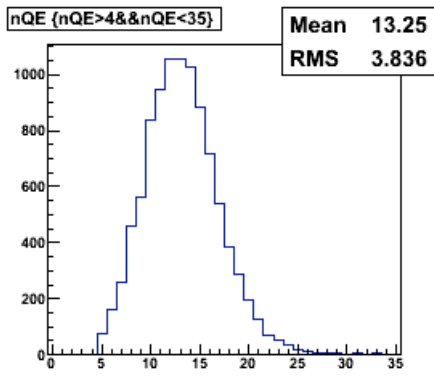
Displacements with the stiffened support



Reflected Light, n=1.05 (run 822) Tilted mirror



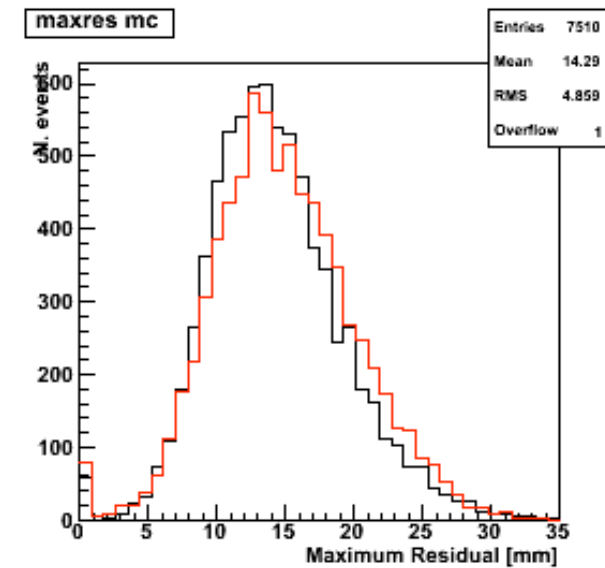
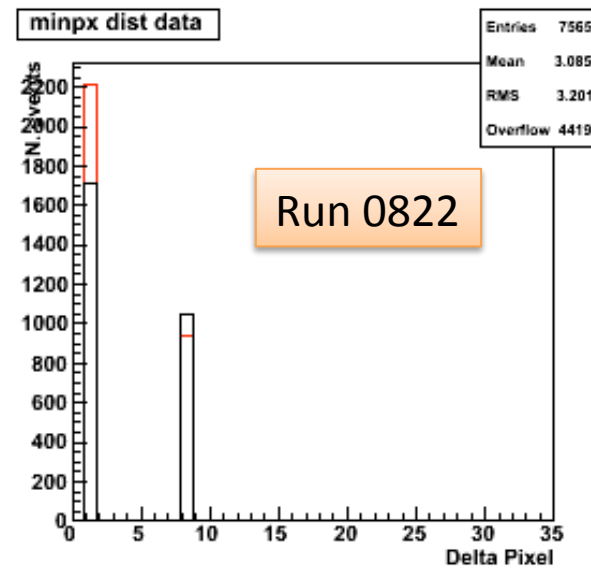
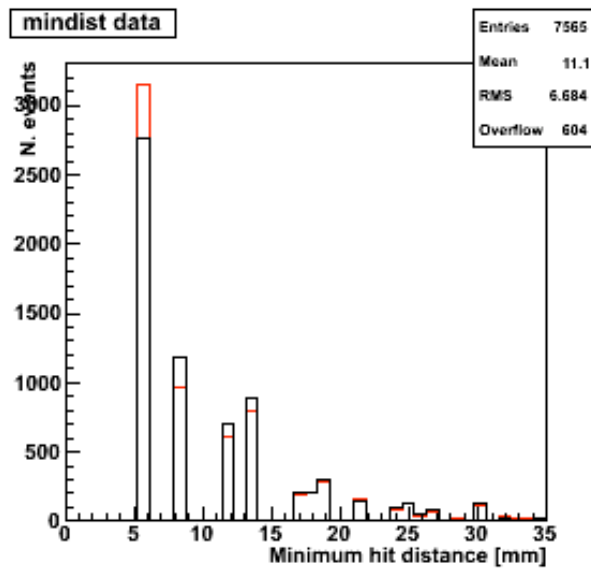
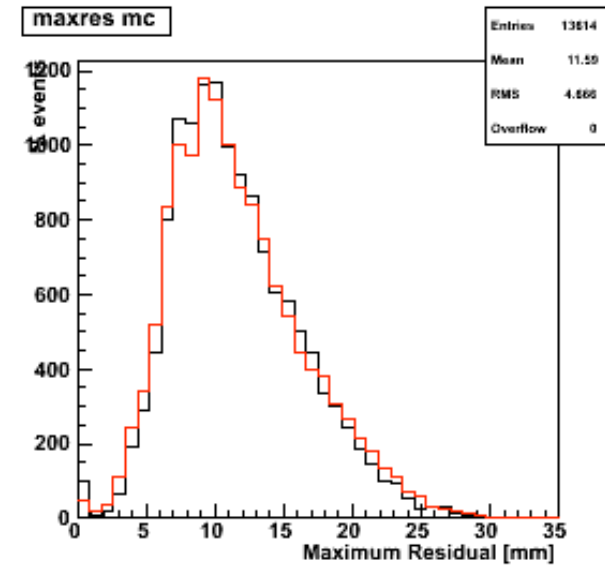
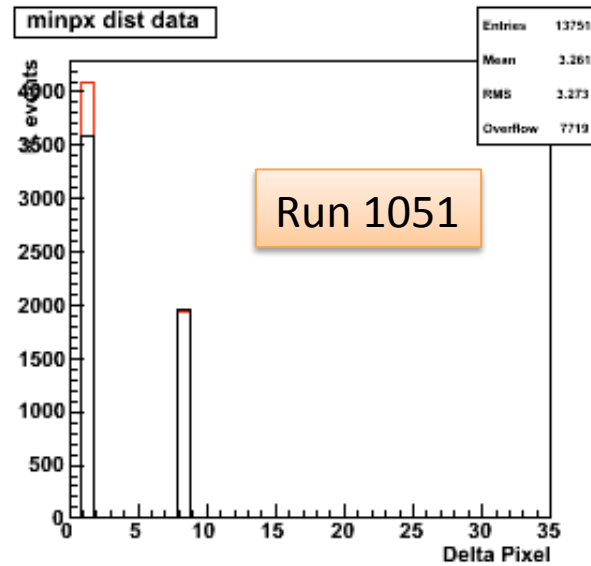
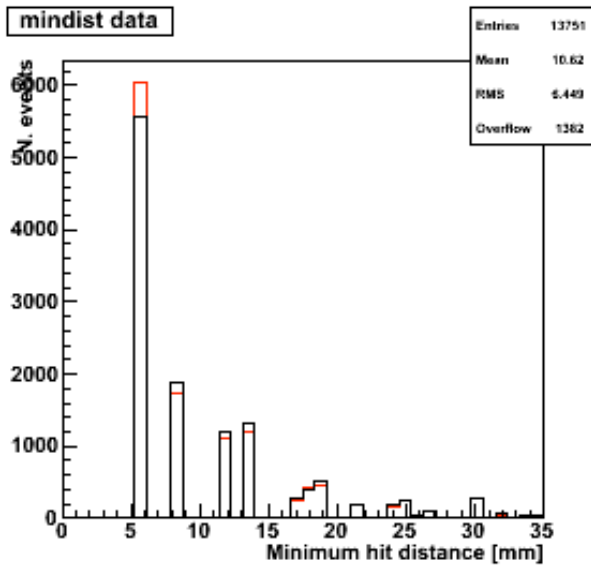
Reflected Light, n=1.05 (run 822) Beam slope



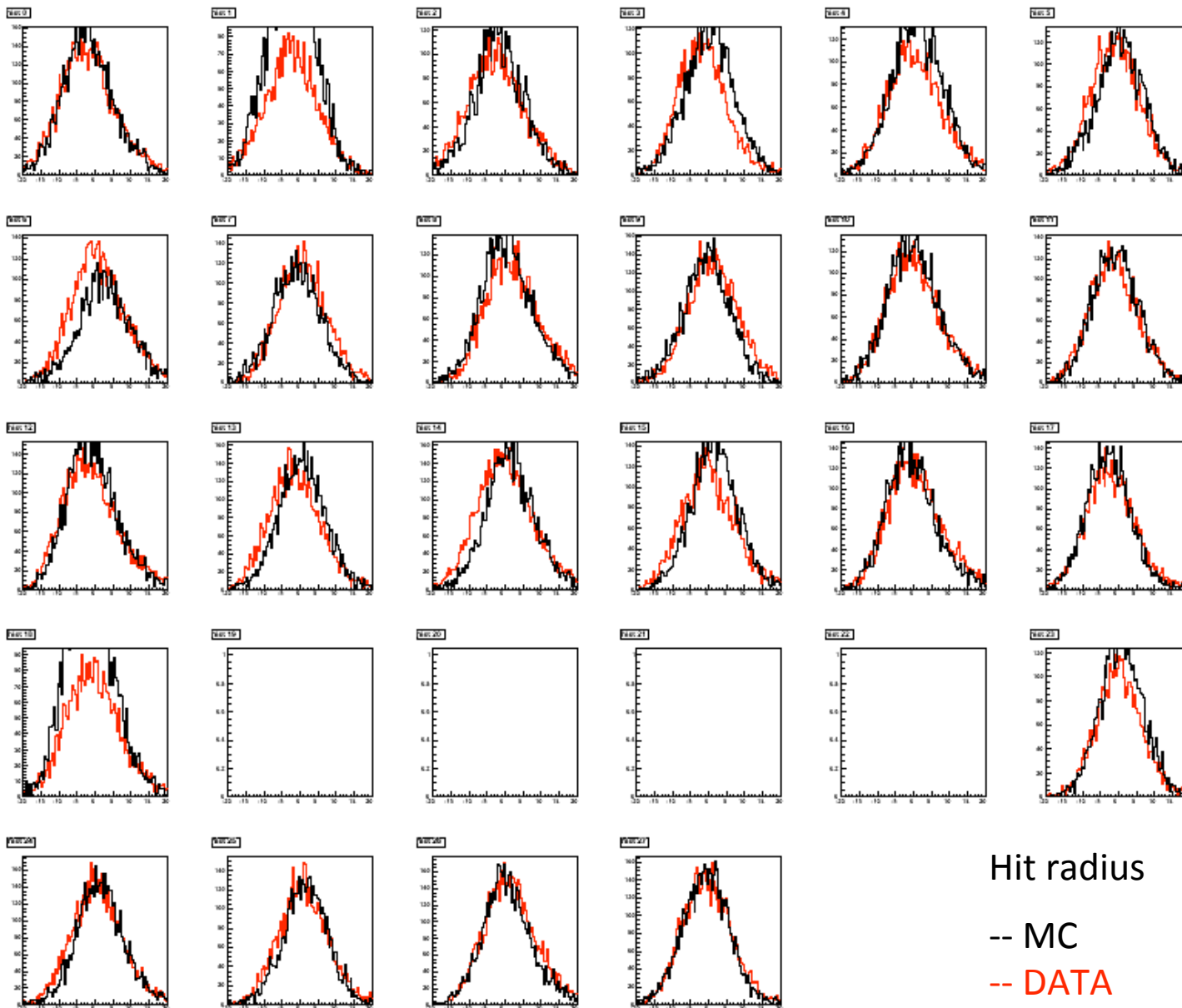
RMS vs misalignment

Ru2n	Beam Misalignment	Center	Rms (DATA)	Rms (MC)
1051	Mirazita	PMTs	1.963	1.874
"	Mirazita + 3mm (y)	PMTs	1.963	1.868
"	0.6° slope in x	PMTs	1.963	1.830
"	Mirazita	GEM	2.079	1.799
"	Mirazita + 3mm (y)	GEM	2.072	1.780
"	0.6° slope in x	GEM		1.753
822	Mirazita	PMTs	3.514	2.902
"	Mirazita + 3mm (y)	PMTs	3.514	2.917
"	0.6° slope in x	PMTs		3.123

Cross-Talk (4%) & Dark Count ($3 \cdot 10^{-4}$)



Residuals - run 822

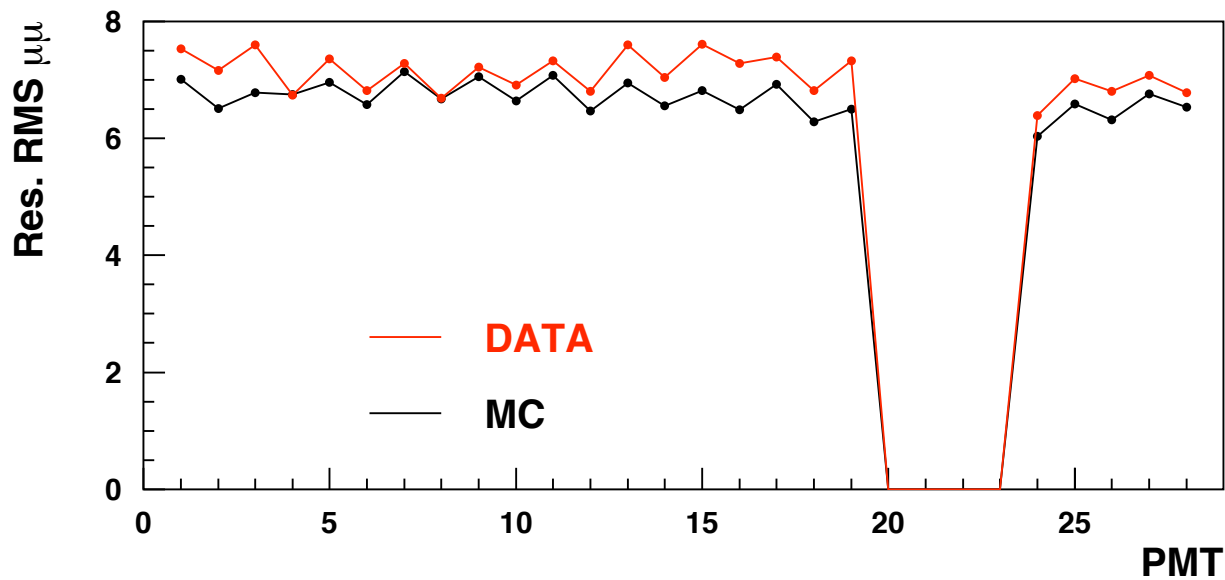
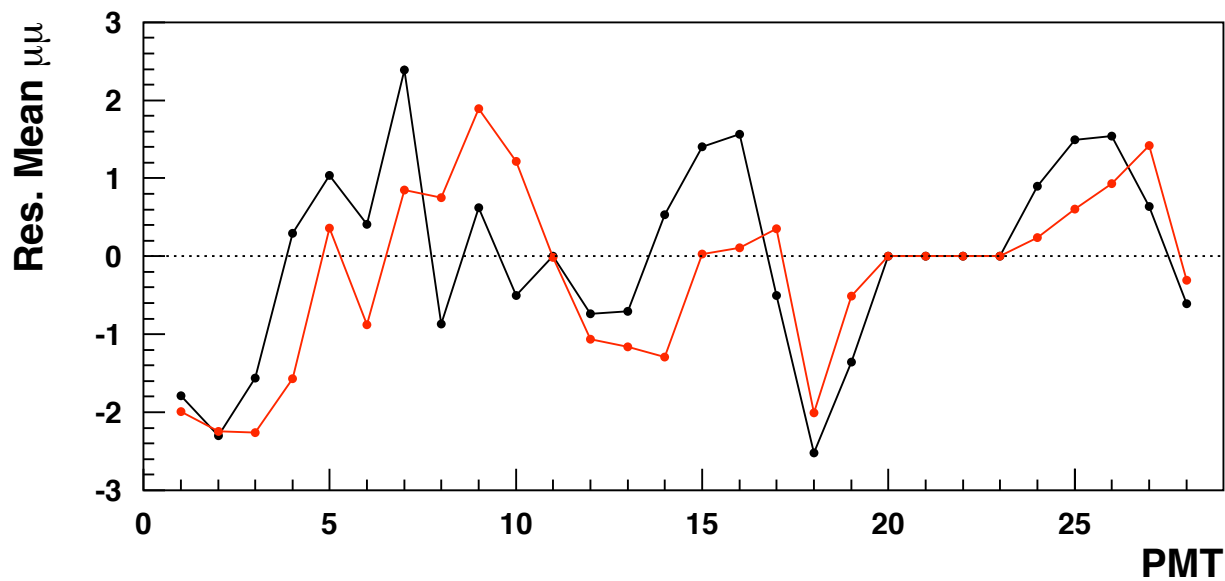


Hit radius

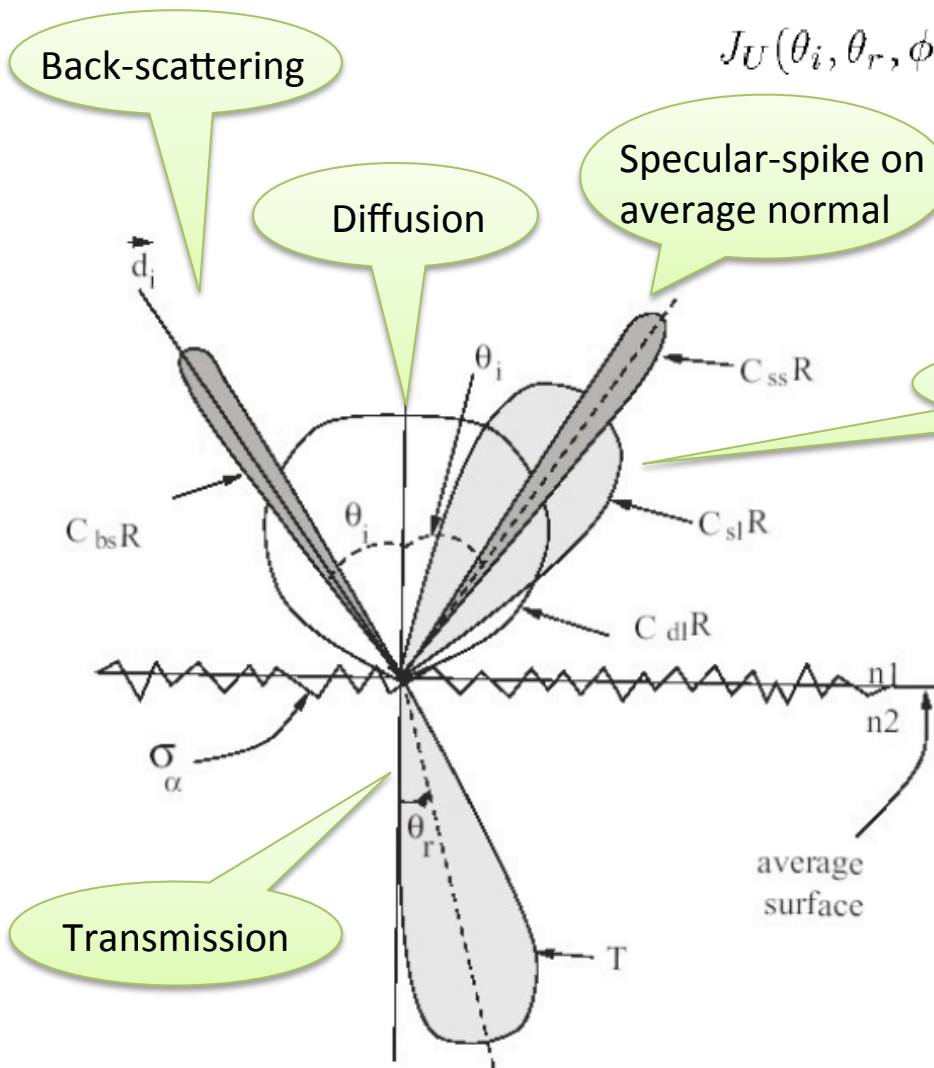
-- MC

-- DATA

Residuals - run 822



G4 Unified Model



$$J_U(\theta_i, \theta_r, \phi_r) \approx R(\theta'_r, n_1, n_2) [C_{sl} g(\alpha_r; 0, \sigma_\alpha) + C_{ss} \delta(\theta_i - \theta_r) \delta(\phi_r) + C_{bs} \delta(\theta_i + \theta_r) \delta(\phi_r) + C_{dl} \cos(\theta_r)] + T(\theta'_t, n_1, n_2) g(\alpha_t; 0, \sigma_\alpha),$$

Specular-lobe from microfacets

- C_{sl} , the specular lobe constant, controls the probability of specular reflection about the normal of a microfacet;
- C_{ss} , the specular spike constant, controls the probability of specular reflections about the average normal of the surface;
- and finally, C_{bs} , the backscatter spike constant, controls the probability of backward reflection. This occurs when a photon hits a micro-facet at a normal angle, after several reflections within a deep groove, and is reflected back along its original path. This process is enhanced on very rough surfaces [4].
- C_{dl} , the diffuse lobe constant, controls the probability of internal Lambertian reflection;

Polar plot of the radiant intensity in the UNIFIED model

Scattering vs Roughness

Optical scattering

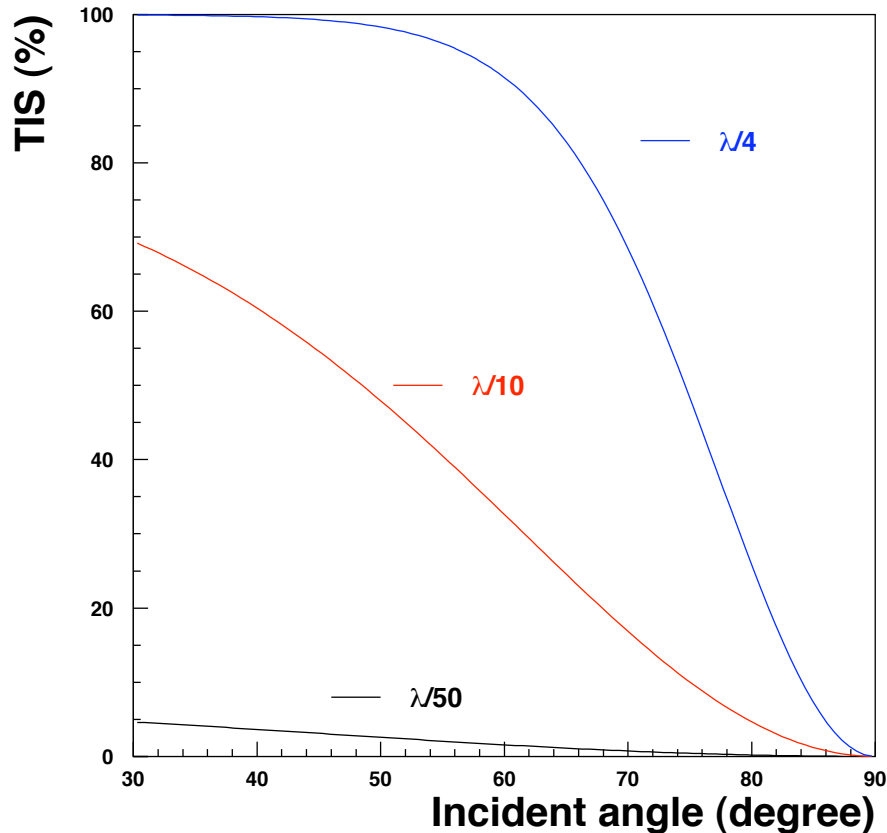
Reflectivity

Roughness RMS

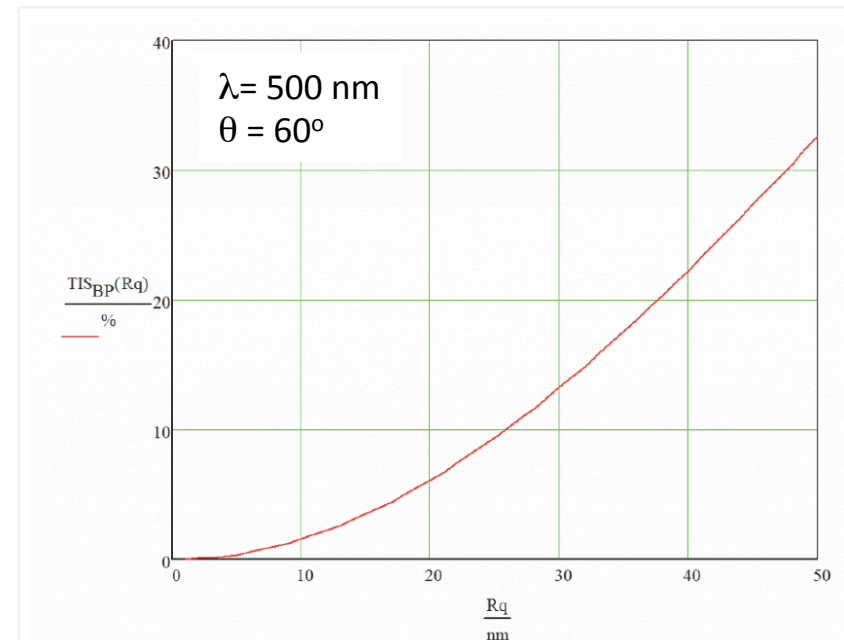
$$TIS_{BP}(R_q) = R_0 \left[1 - e^{-\left(\frac{4\pi R_q \cos \theta_i}{\lambda}\right)^2} \right]$$

Wavelength

Incident angle



Bennet & Porteus, JOSA 51 (1961) 123



Reflected Light, n=1.05 (run 822) Roughness

