Angular Dispersion with BT Gamma data

Nicola Mazziotta and Monica Brigida

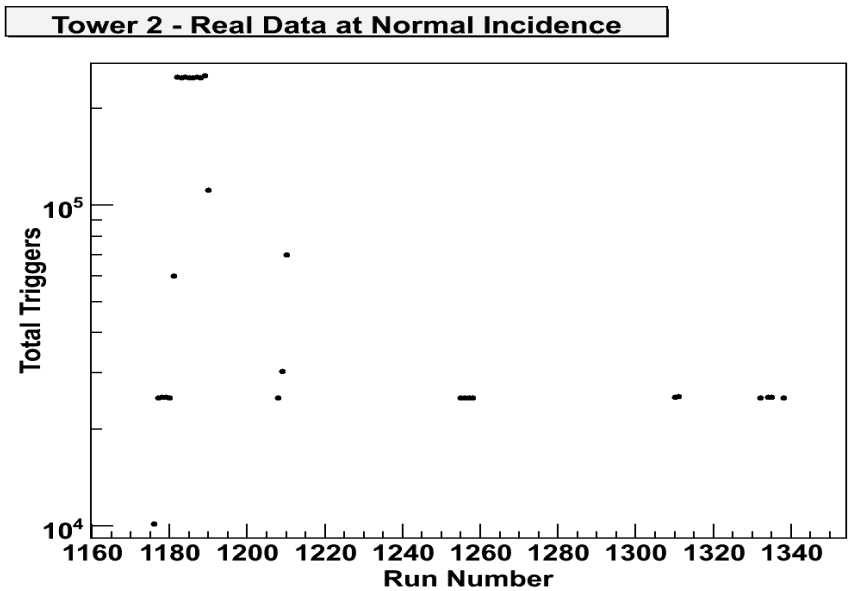
Jan 24, 2007

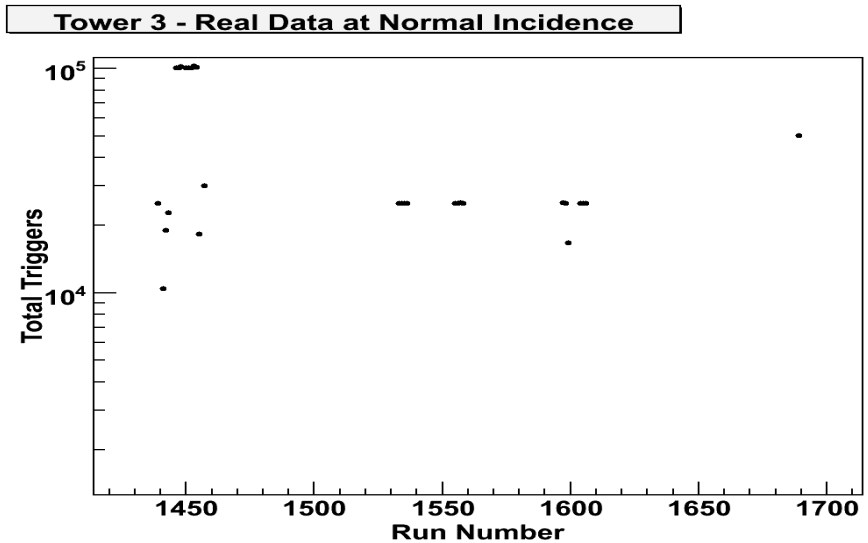
mazziotta@ba.infn.it

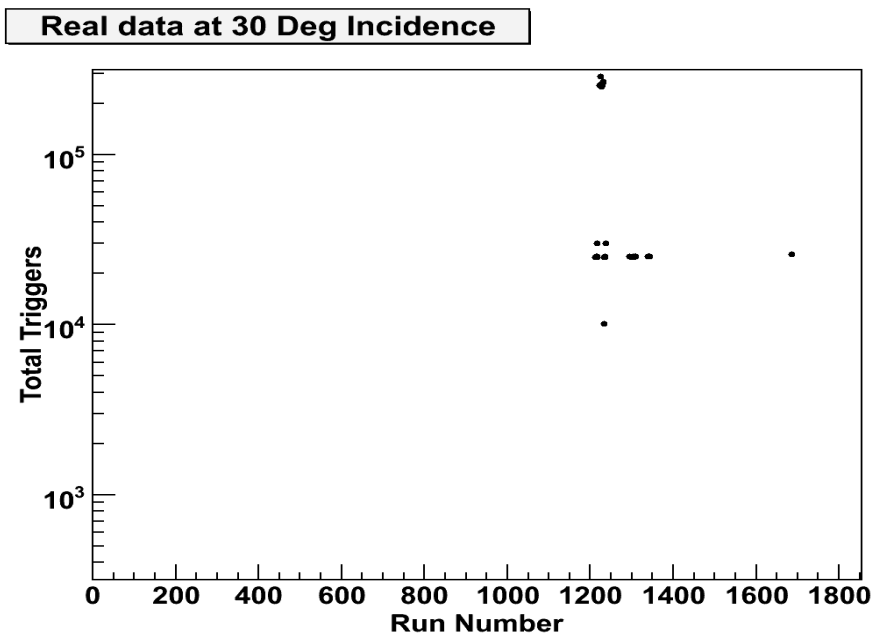
Configurations

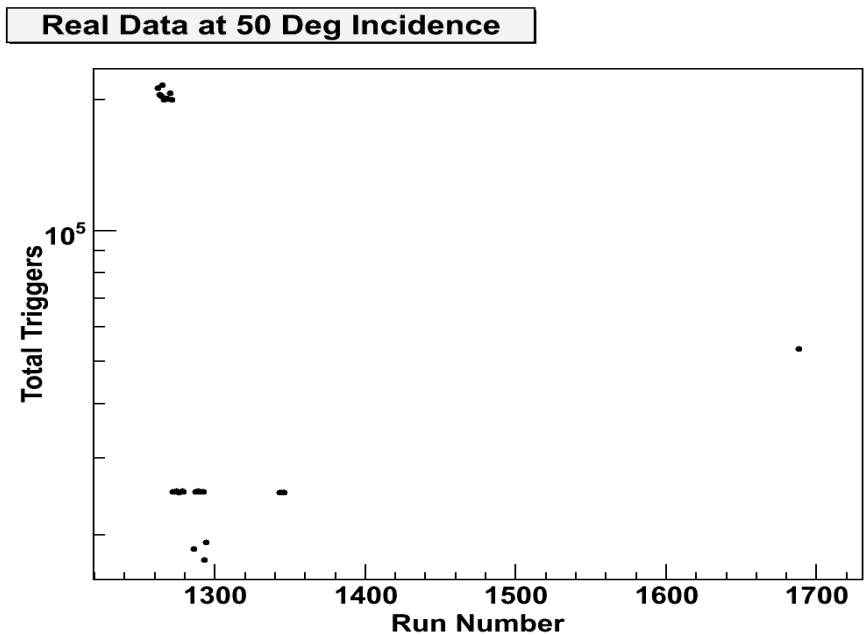
- **Normal incidence**
  - **Tower 2: all gamma runs (both full brems. and tagged) have been used at 0°. The pion contamination has been rejected by requiring the X Vertex position in Tower 2 (VtxX < 350.)**
  - **Tower 3: all gamma runs (both full brems. and tagged) have been used at 0°**
- **30°: all gamma runs (both full brems. and tagged) have been used at 30°**
- **50°: all gamma runs (both full brems. and tagged) have been used at 50°**
- **MC at normal incidence on Tower 3**

Total Triggers Vs. Run









Event classification

Score

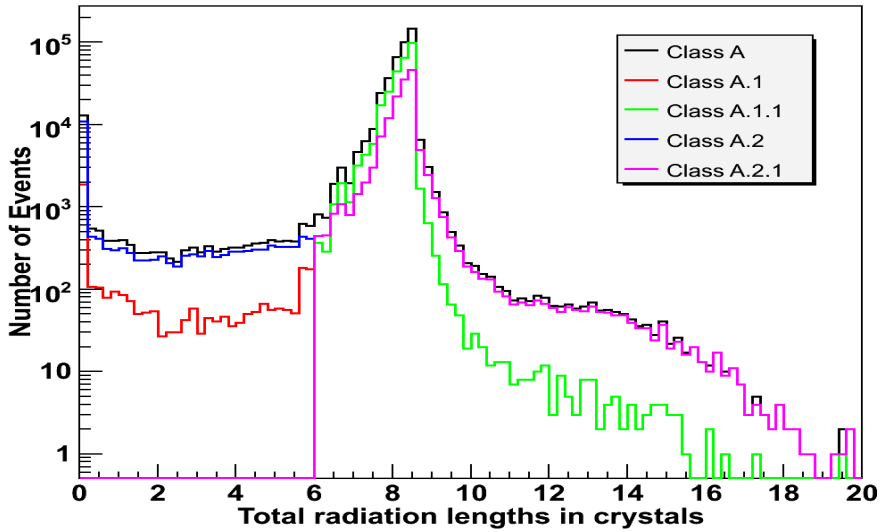
- **Class A: events with 1 vertex**
  - **Class A.1: events with 2 tracks**
    - **Class A.1.1: CalCsIRLn > 6 New**
  - **Class A.2: events with 1 track**
    - **Class A.2.1: CalCsIRLn > 6 New**
- **Class B: events with 2 Vertices**
- **Class C: events with 3 o more Vertices**

The CU has been used as standalone detector

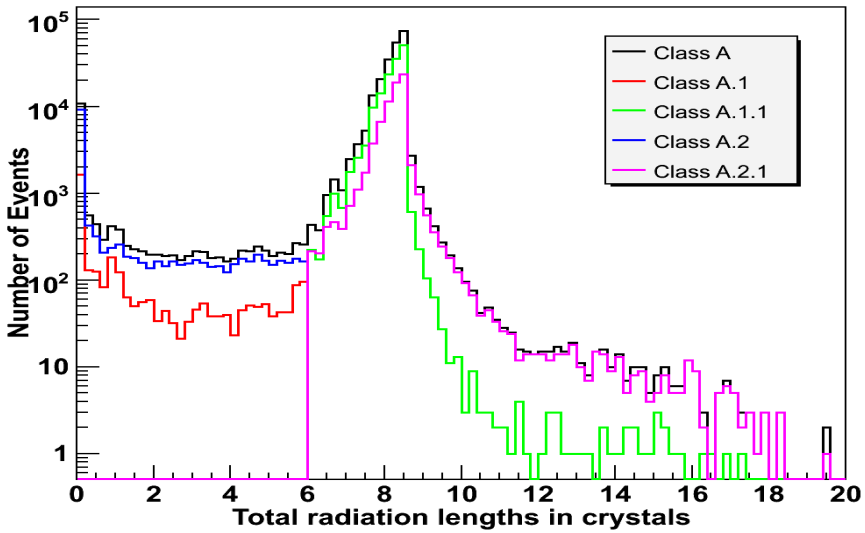
Level 0 Cut: CalEnergyRaw > 0

Total Radiation Length in crystals

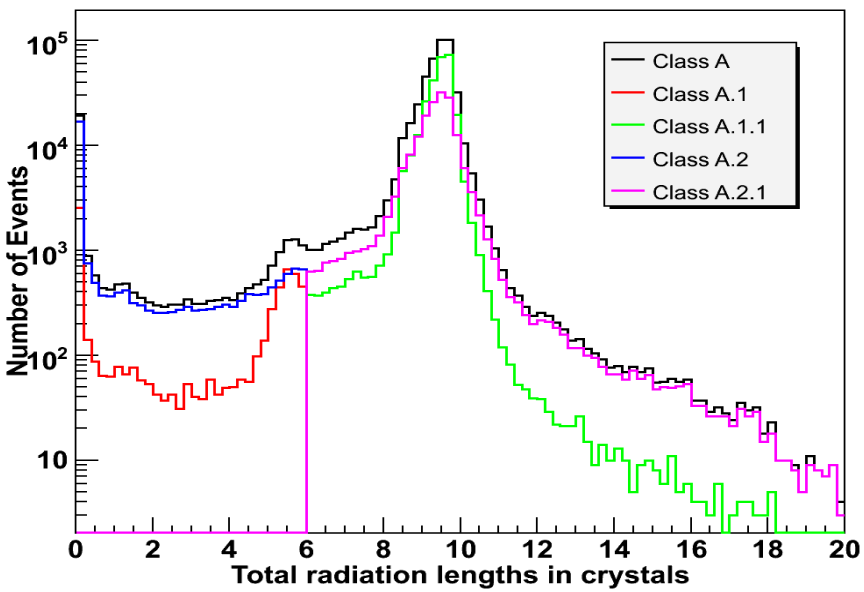
Tower 2 - Real Data at Normal Incidence



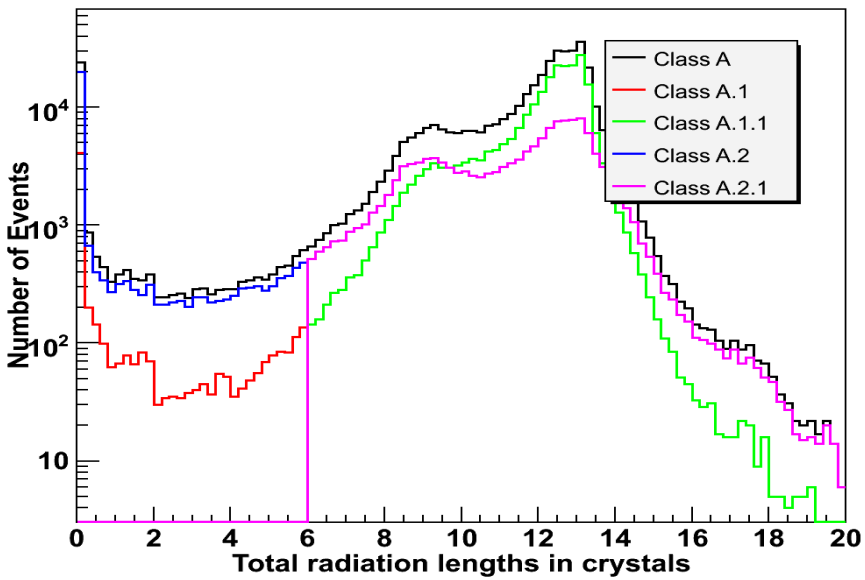
Tower 3 - Real Data at Normal Incidence



Real data at 30 Deg Incidence

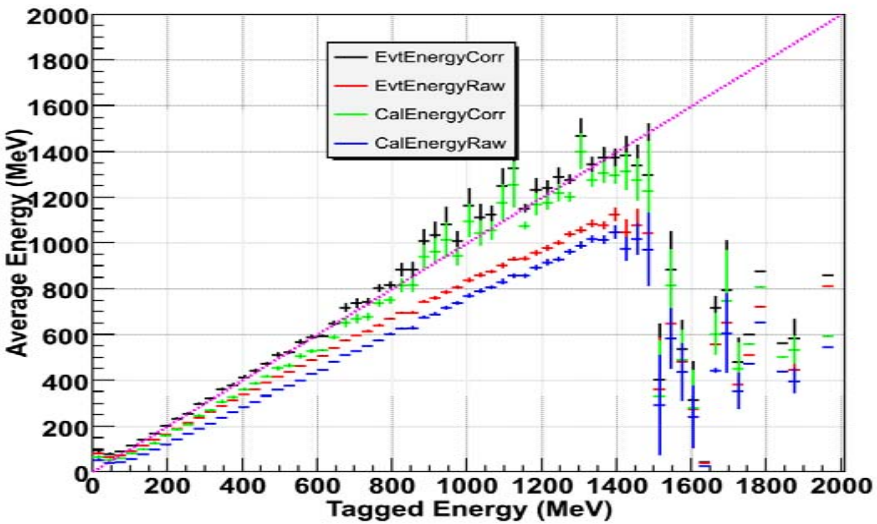


Real Data at 50 Deg Incidence

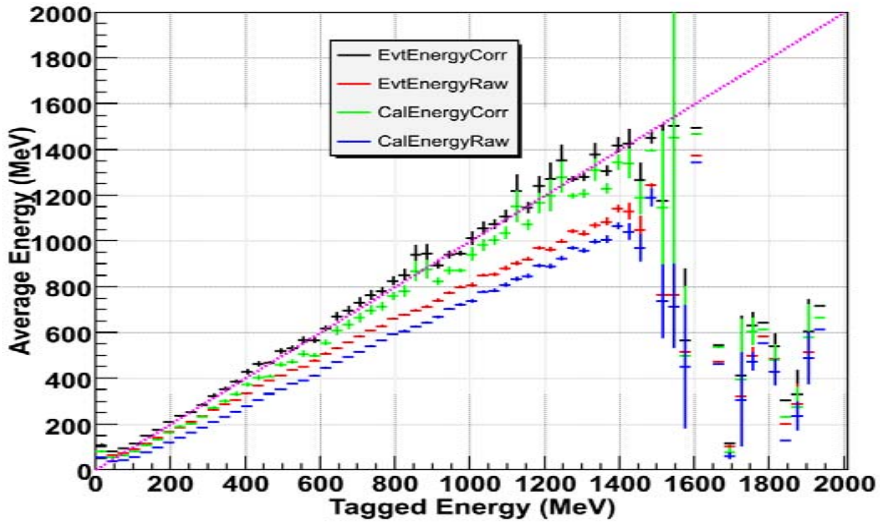


Energy calibration - Class A events

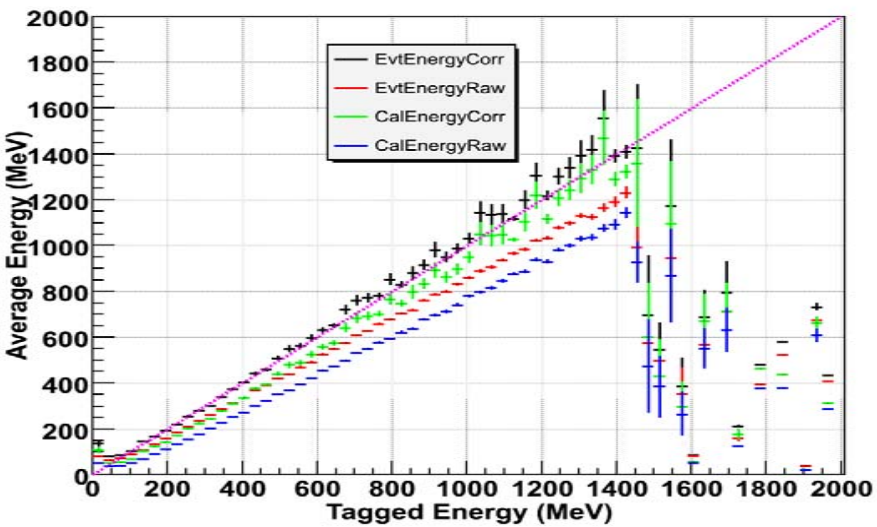
Tower 2 - Real Data at Normal Incidence



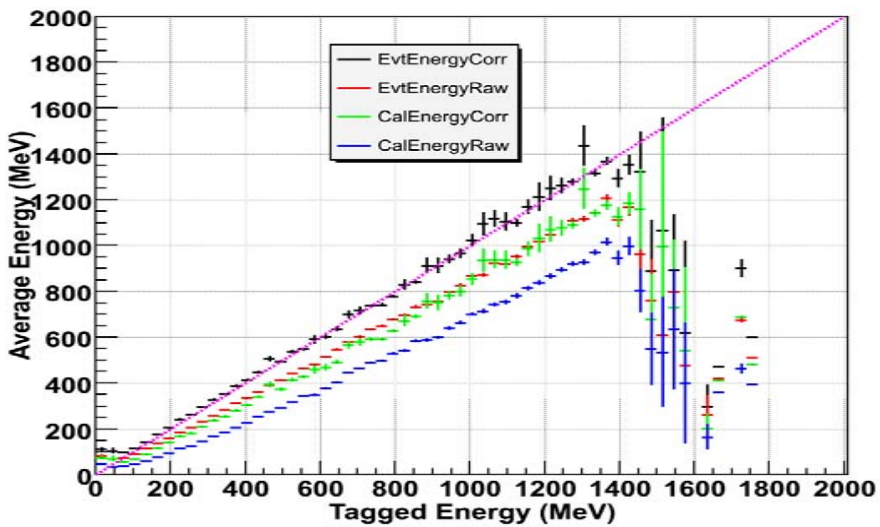
Tower 3 - Real Data at Normal Incidence



Real data at 30 Deg Incidence

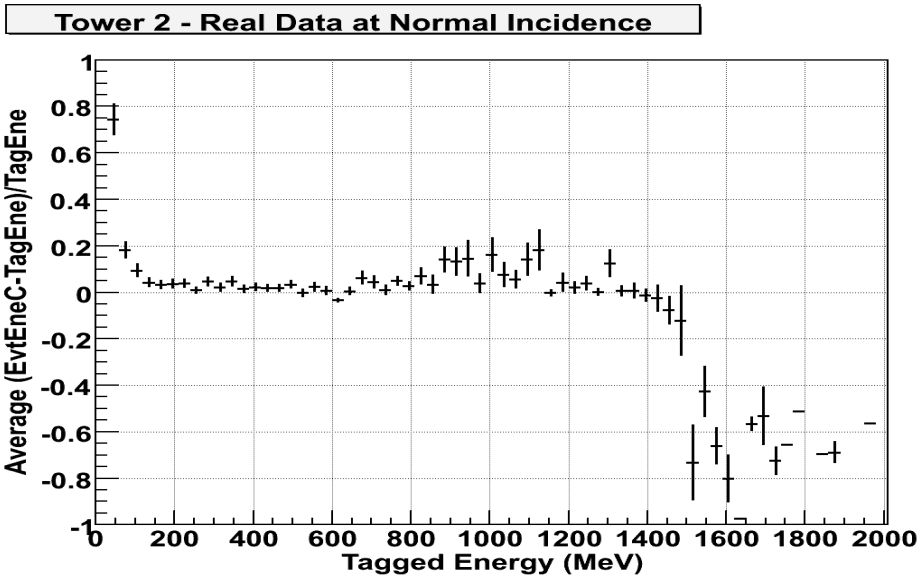


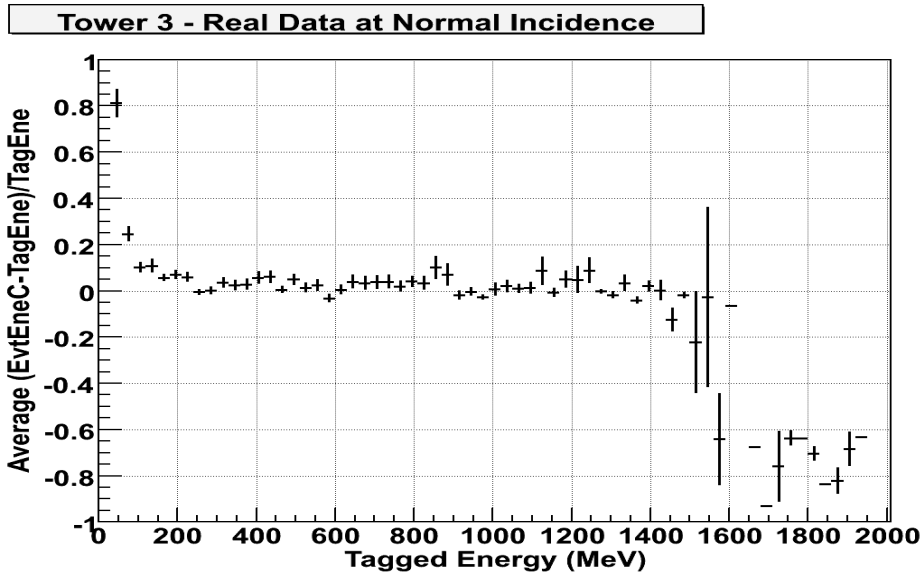
Real Data at 50 Deg Incidence

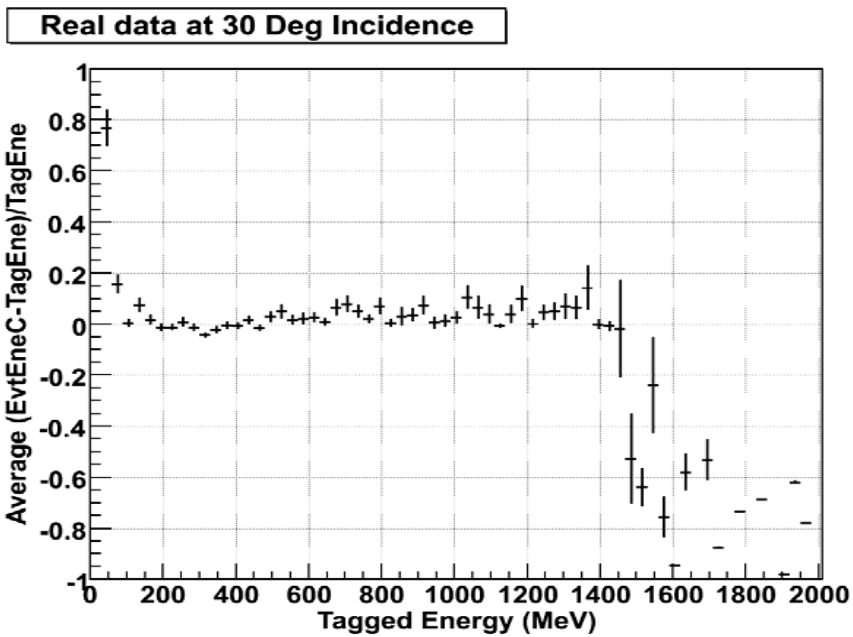


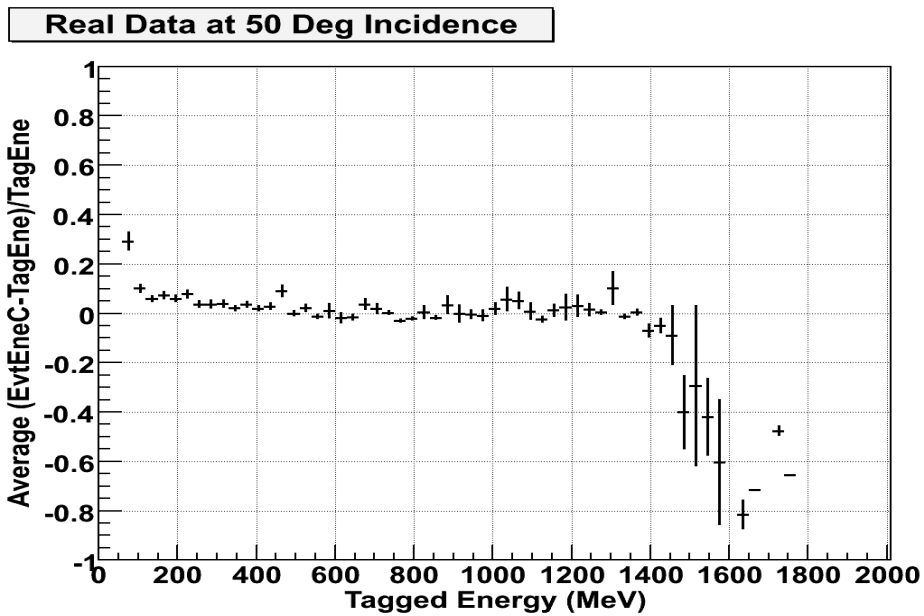
The plots shown last week have the axis exchanged!

Energy bias – Class A events

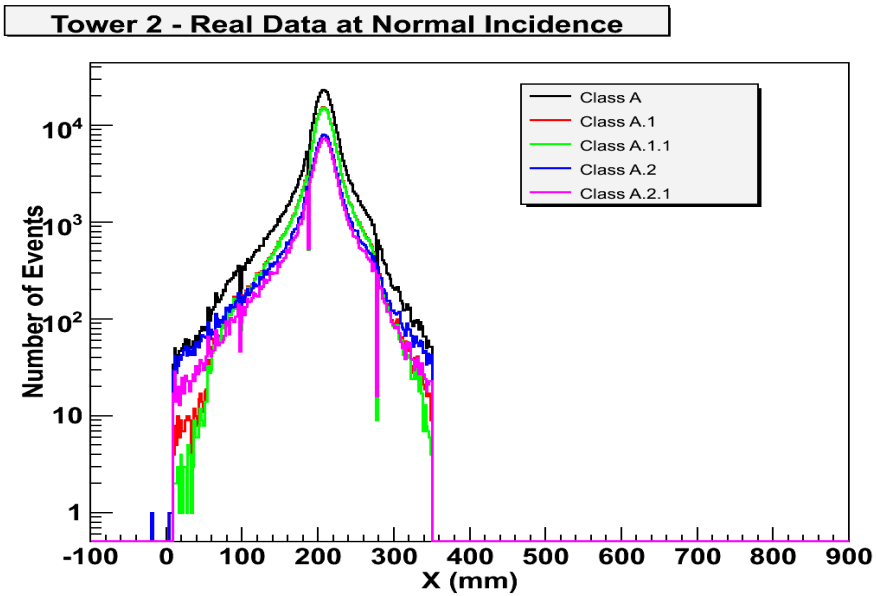


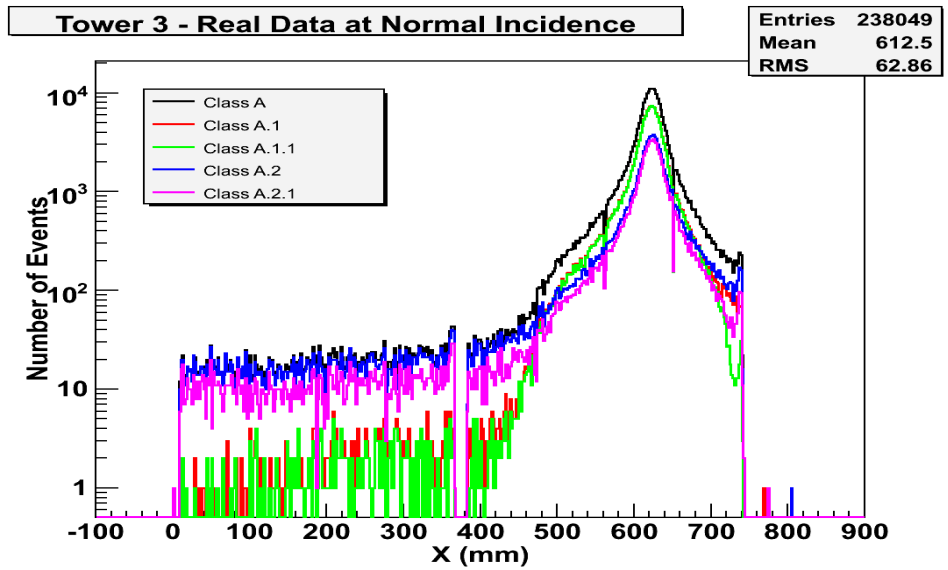


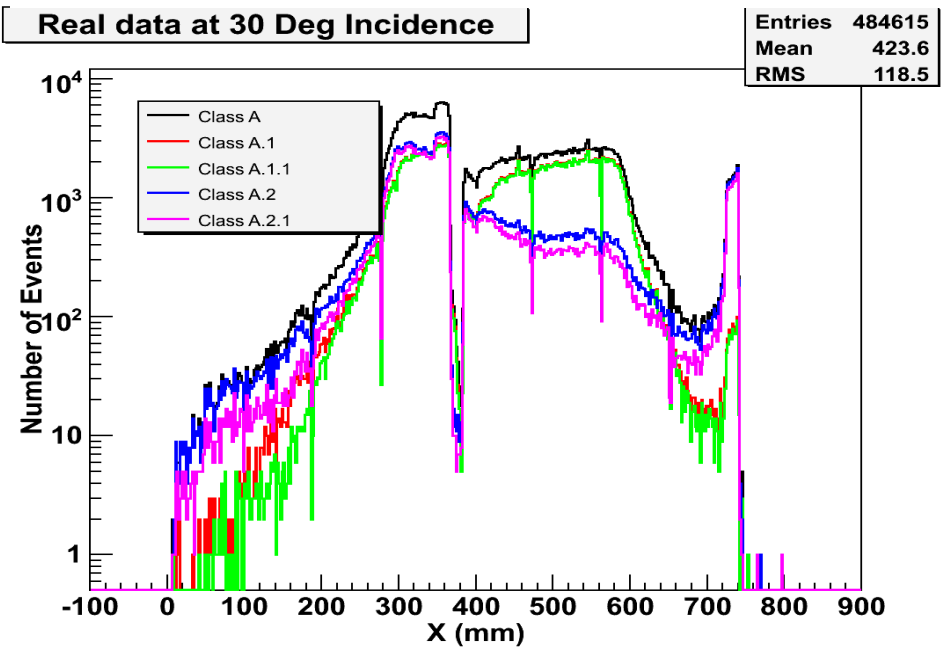


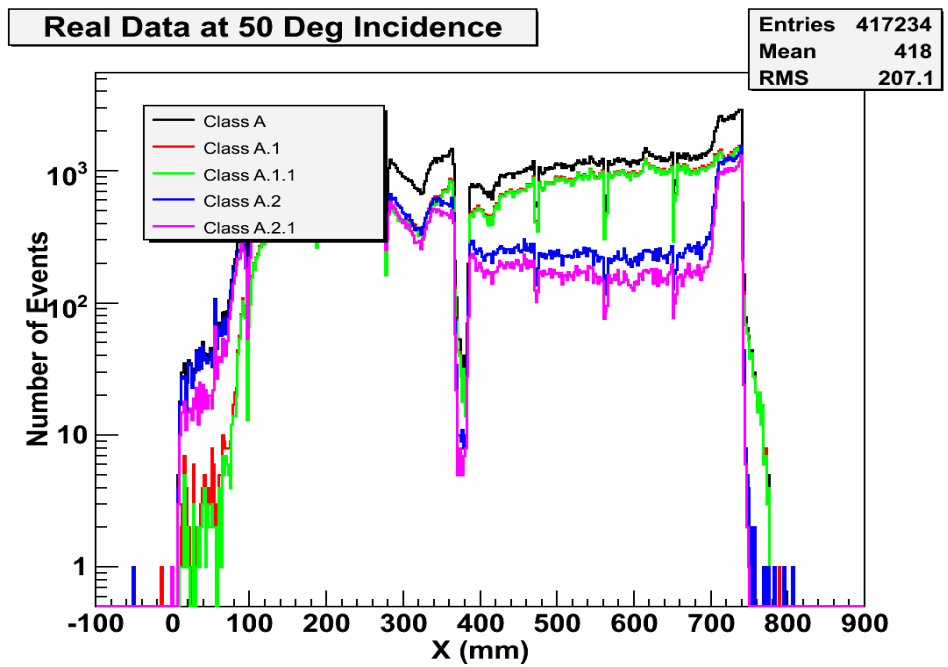


X Vertex position

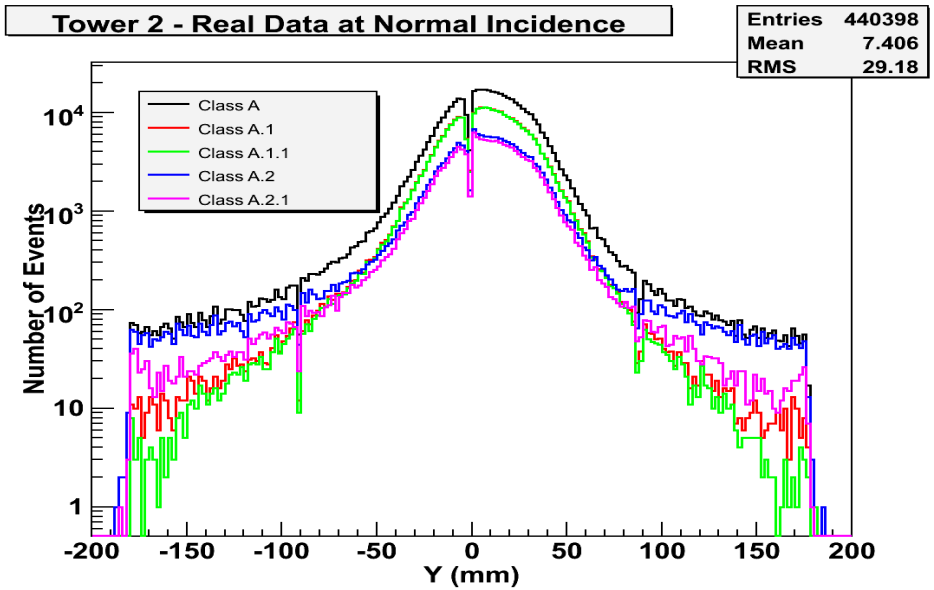


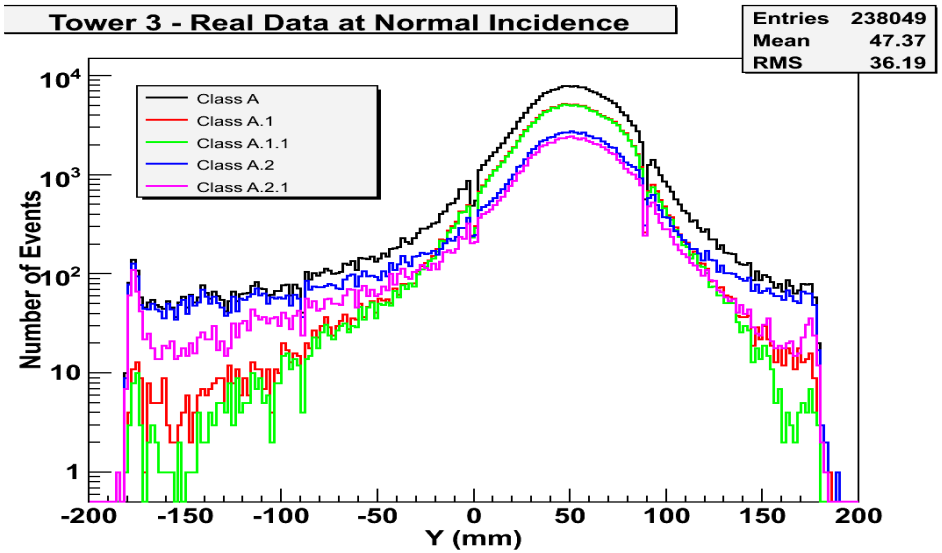


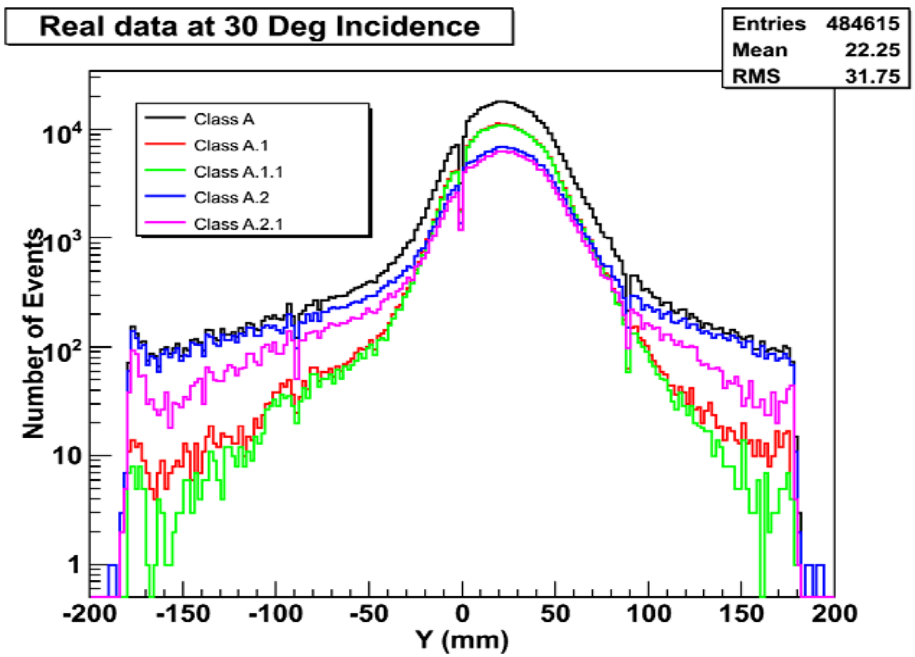


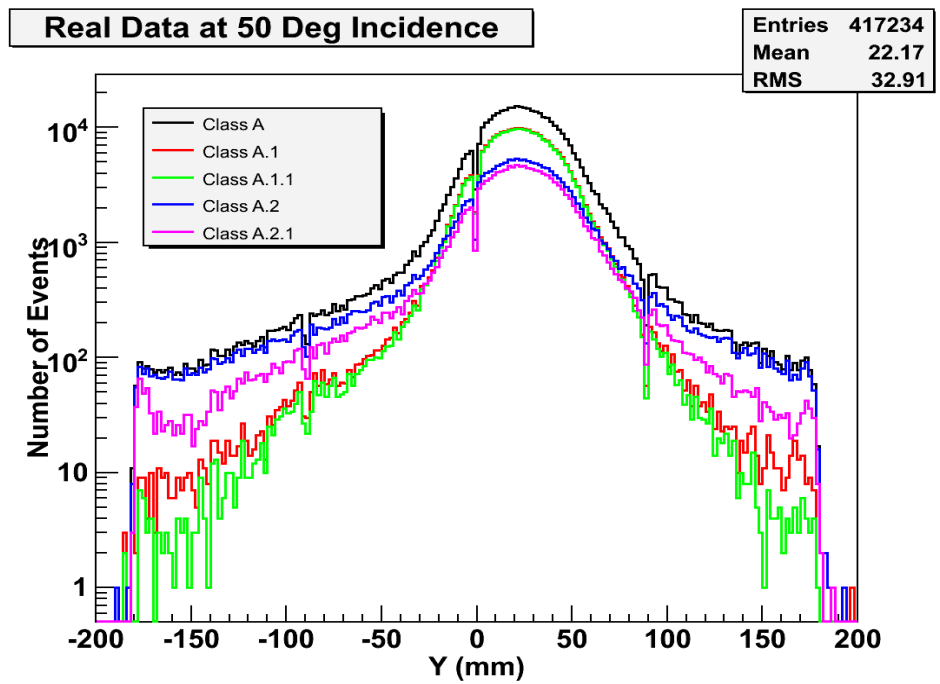


Y Vertex position

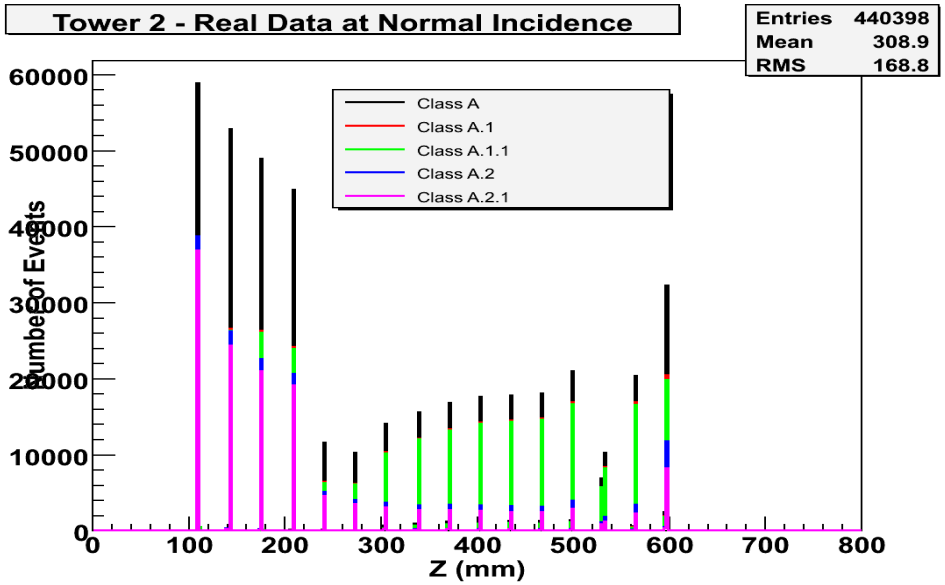


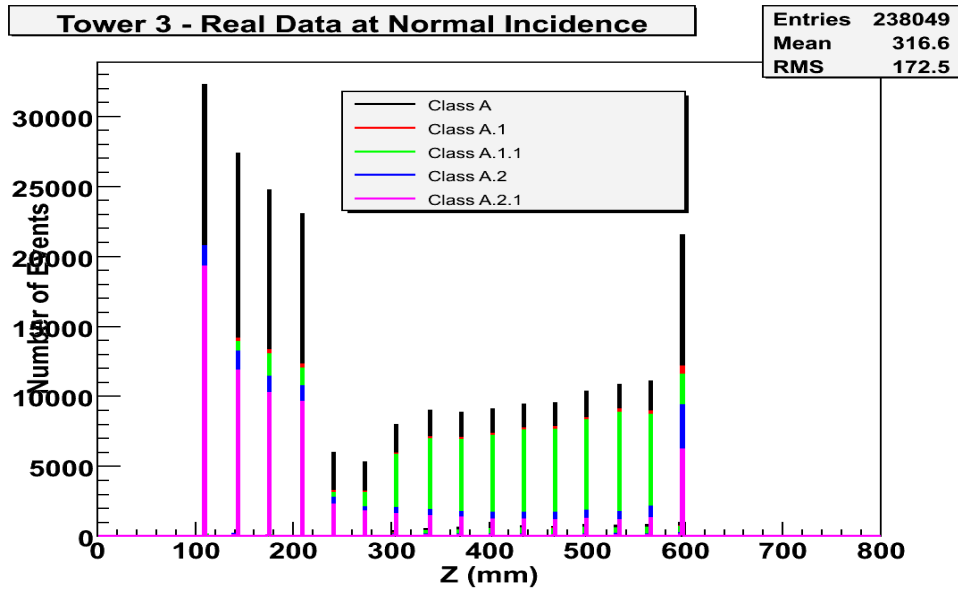


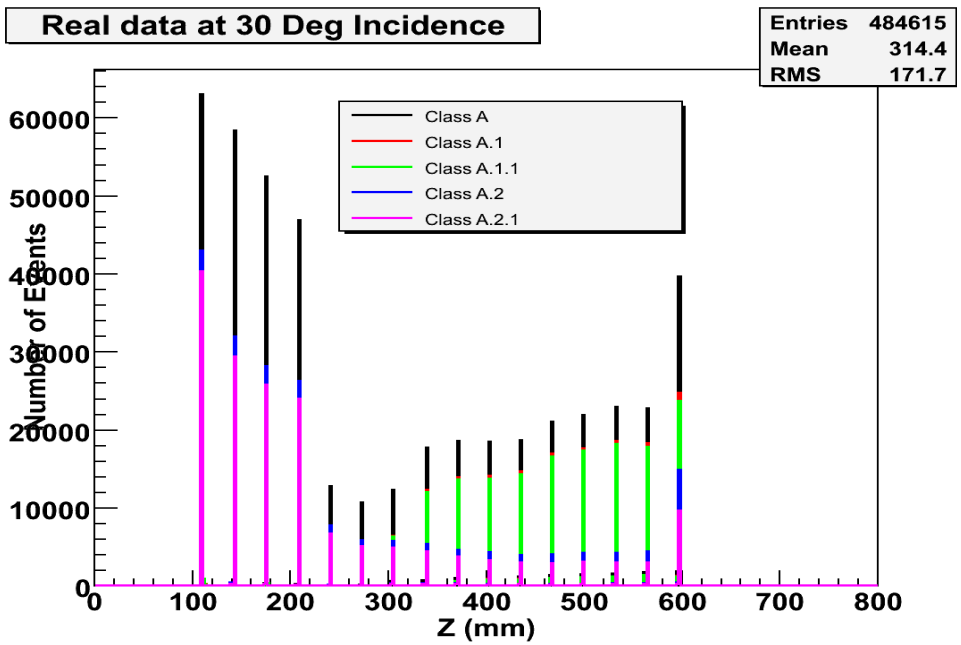


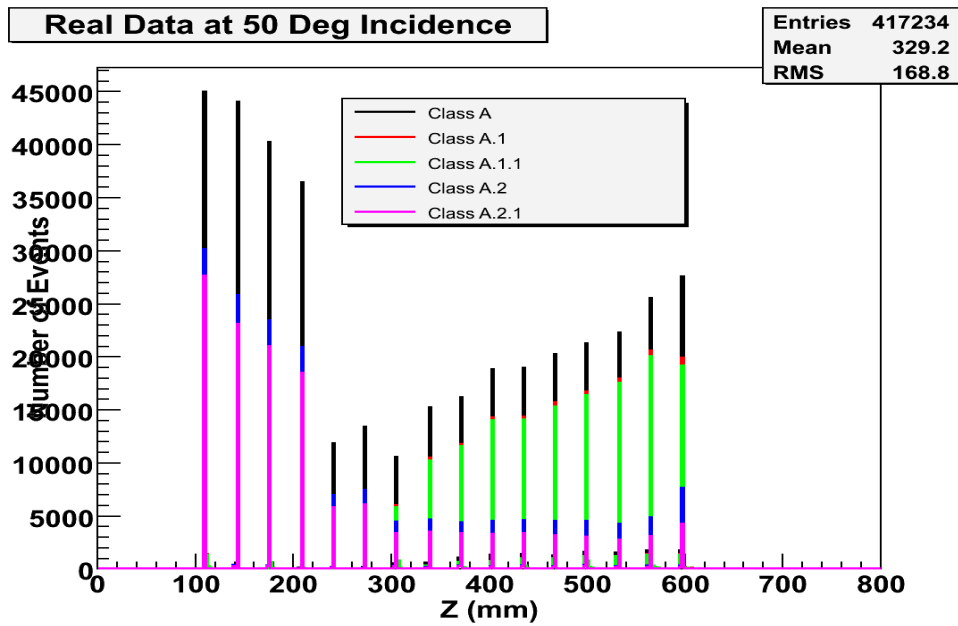


Z Vertex position



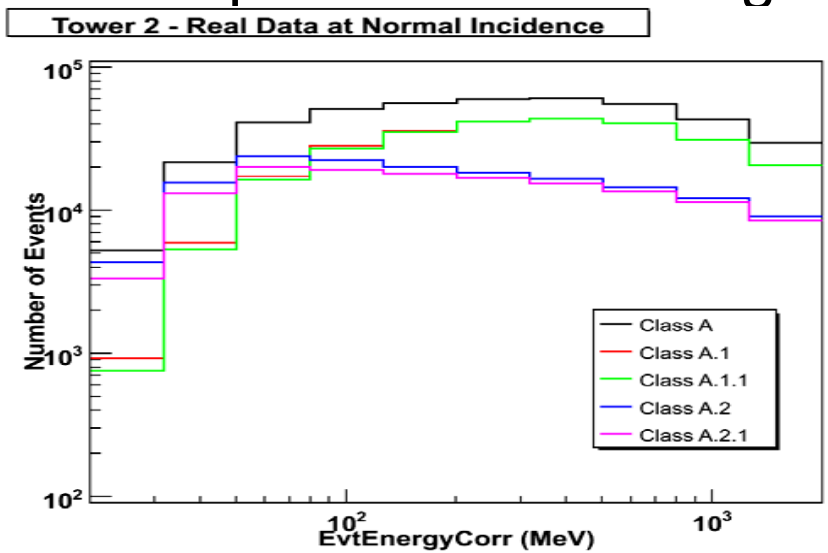


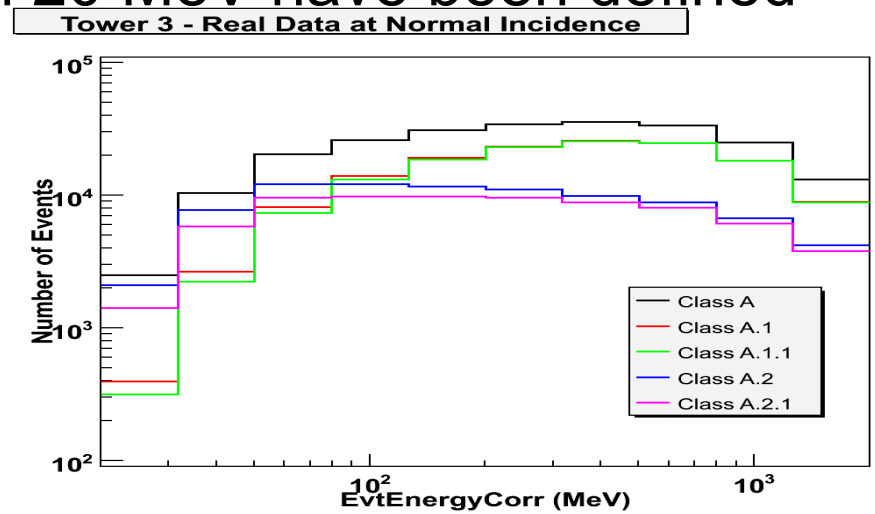


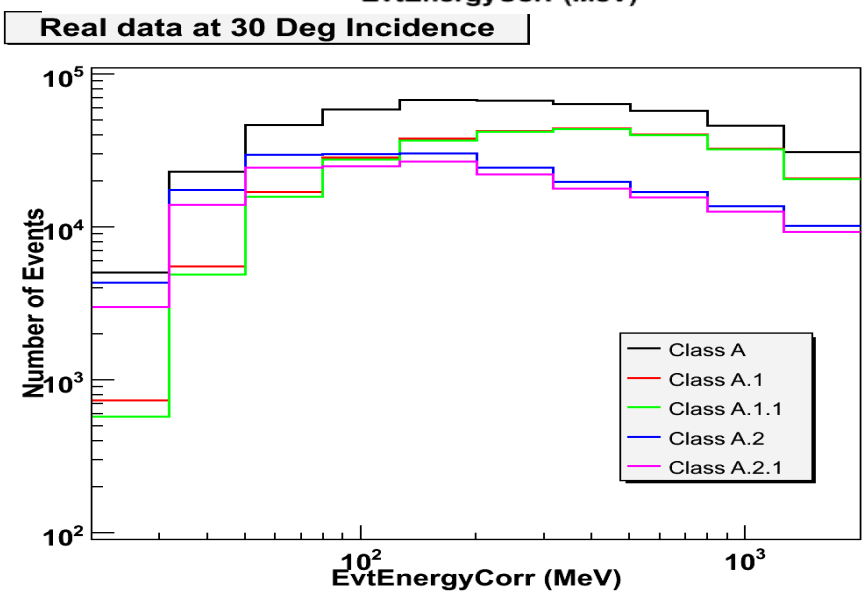


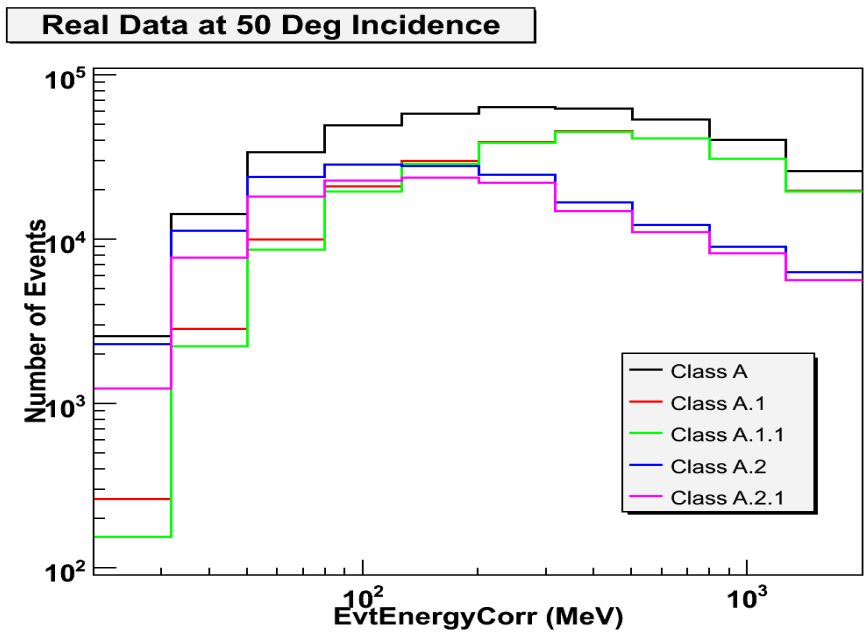
Energy distribution

5 bins per decade starting from 20 MeV have been defined





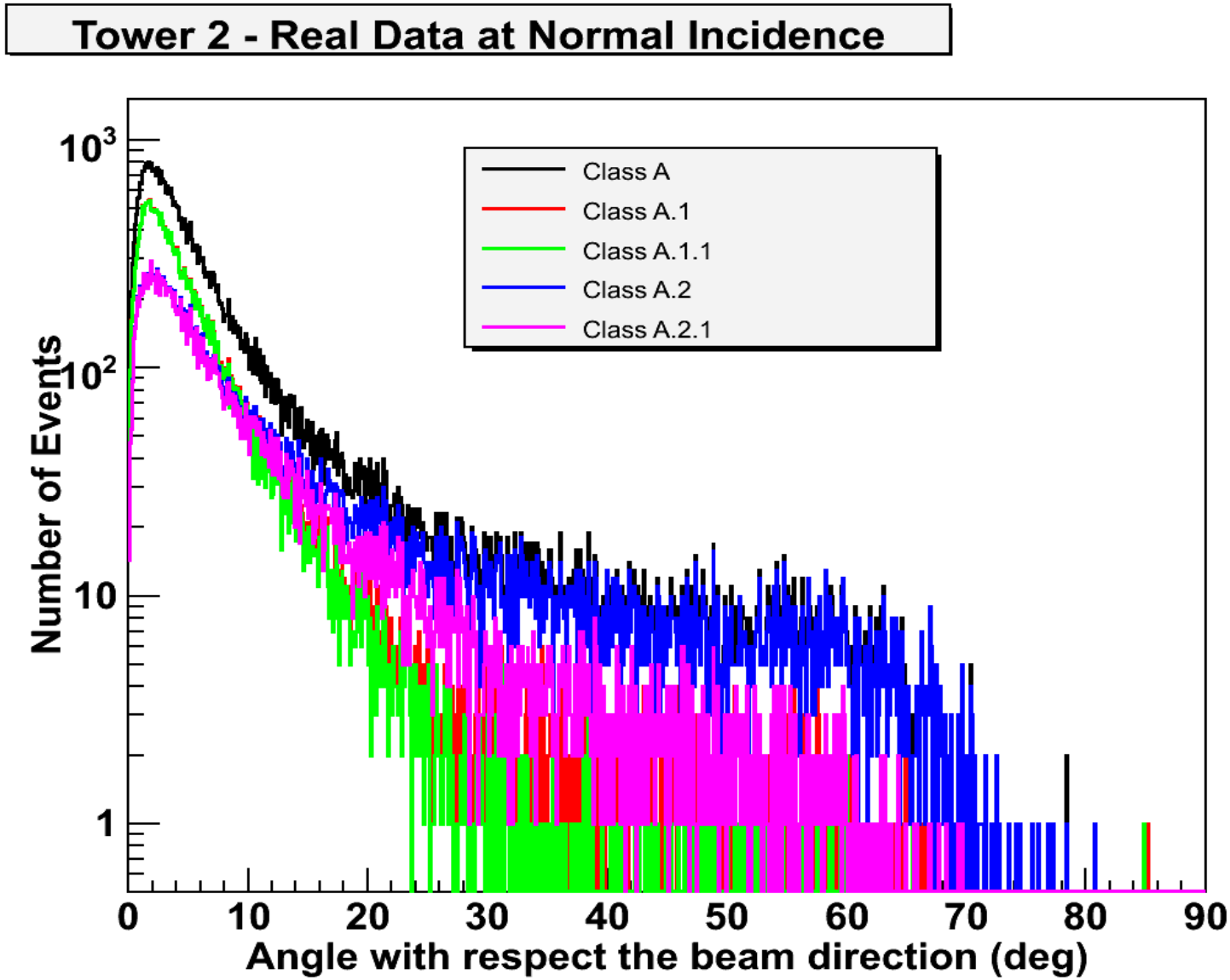




Angular dispersion evaluation

- The gamma angle has been calculated with the respect the nominal beam direction
  - Beam direction: (-Sin(theta), 0, -Cos(theta)) where theta is the tilted angle of the CU
  - Measured direction: Vertex direction in the root files
- For each bin energy, the angular dispersion distribution is filled in a histogram with 0.1° bin width

Angular distribution, 79.6 < E(MeV) < 126.2



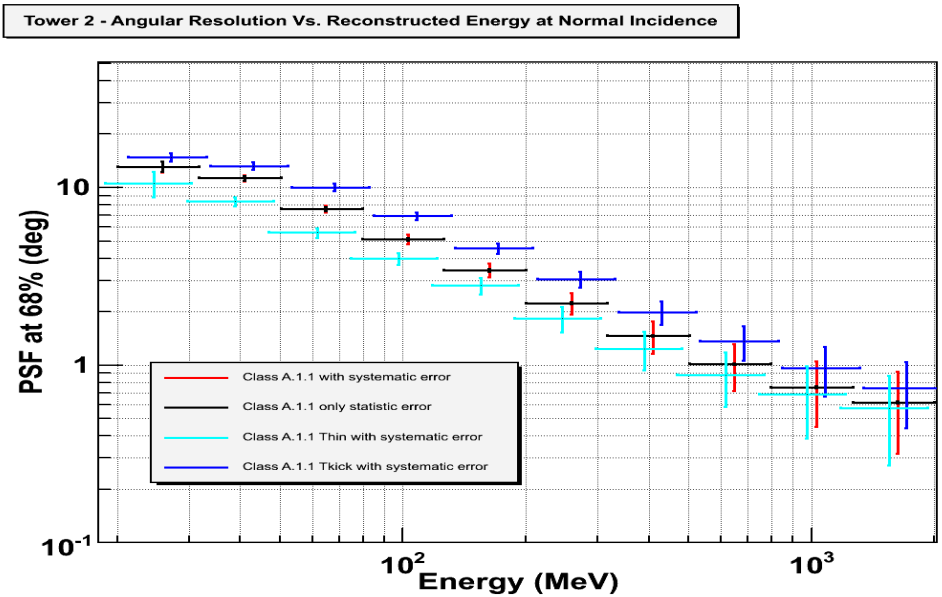
PSF evaluation

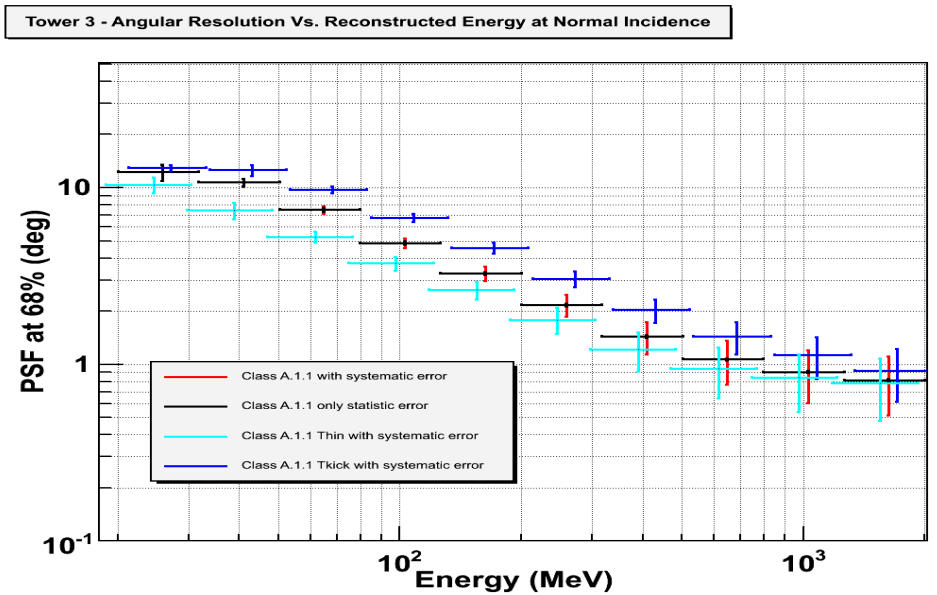
- At given fraction, f, (e.g. 68% or 95%), the angular bin number i is found such that the integral of events, P_i, is $P_i < f\,N < P_{i+1}$, where N is the total number of entries.
- The angle, θ_f, at the fraction f is evaluated as $\theta_f = \theta_i + h\,(f\,N - P_i)/(P_{i+1} - P_i)$, where h is the angular bin step (0.1°)
- The statistical error $\delta\theta_f$ has been evaluated by taking only the error (Poisson) for the number counts N, P_i *and* P_{i+1}, i.e. $\delta\theta_i = 0$ *and* $\delta h = 0$

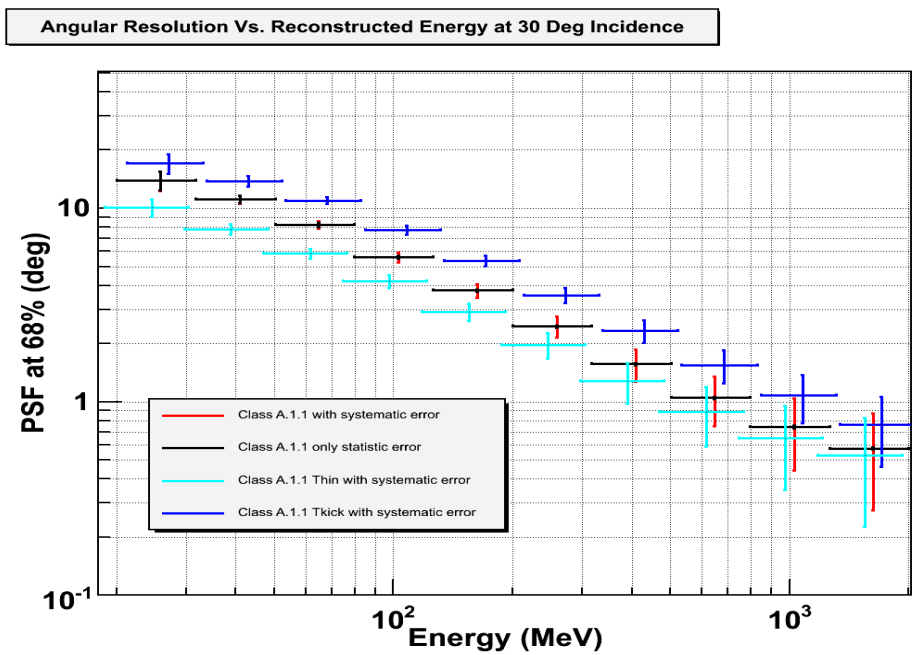
Systematic errors

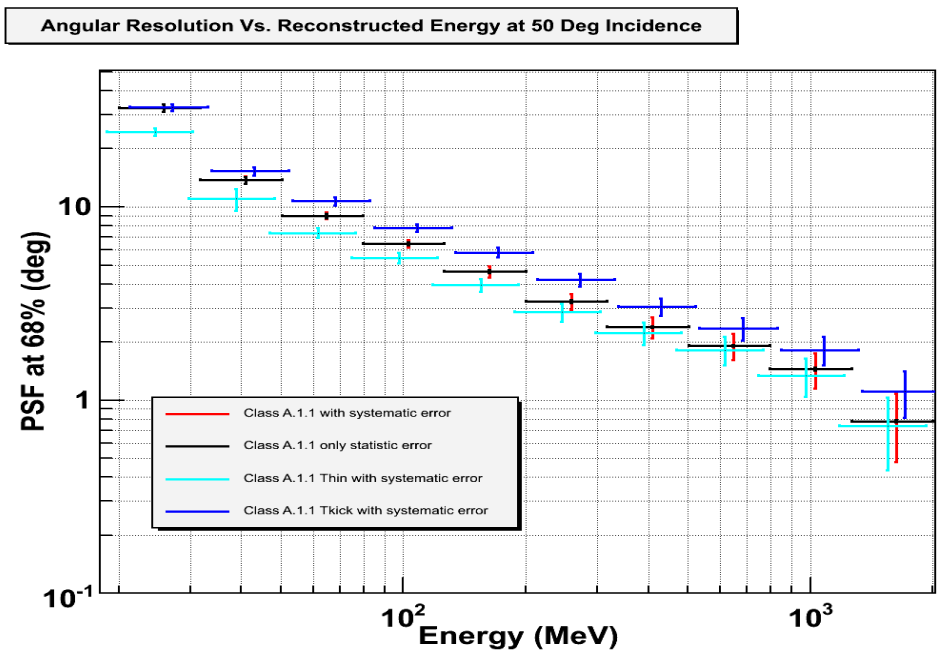
- Beam divergence: few mrad, $\delta\theta_f \sim 0.1°$
- CU position with respect to the beam: $\delta\theta_f \sim 0.1°$
  - We have studied the angular distribution in the few electron runs taken just before/after the photon runs with B off.
- Gamma production angle by bremsstrahlung with respect to the electron: few mrad, $\delta\theta_f \sim 0.1°$
  - The quoted value comes from the cross section used in Geant code

PSF at 68% - Class A.1.1

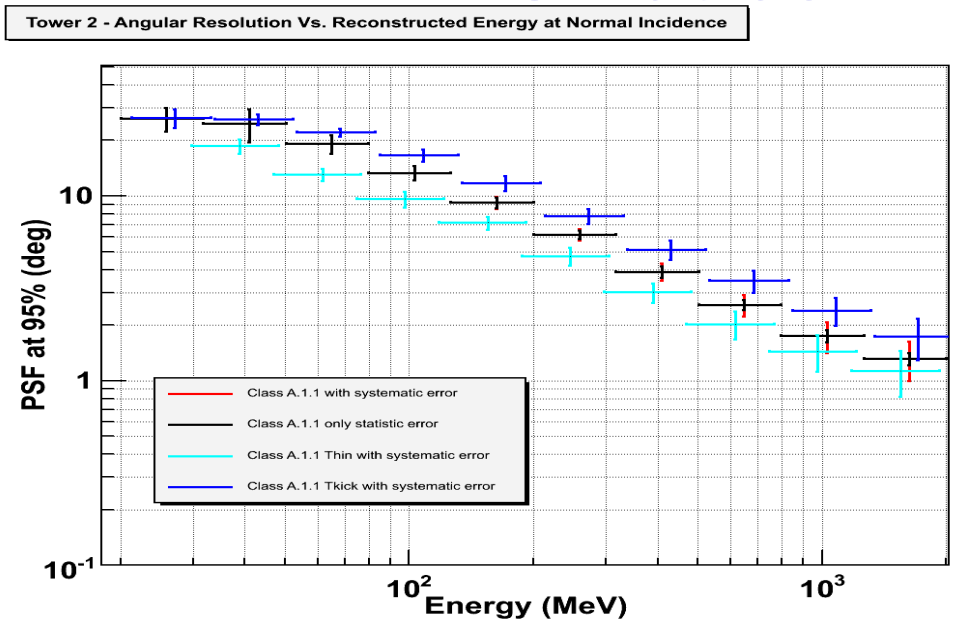


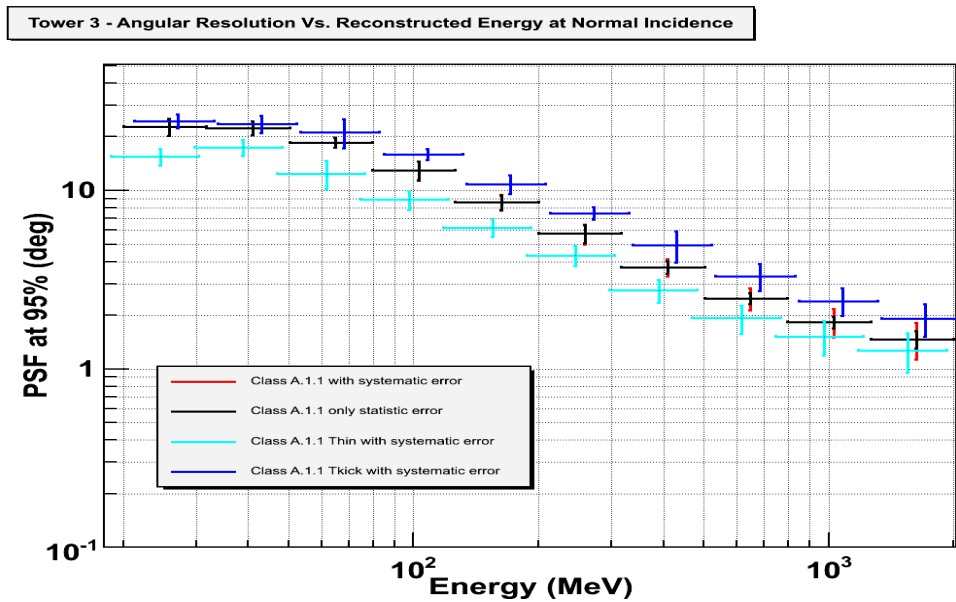


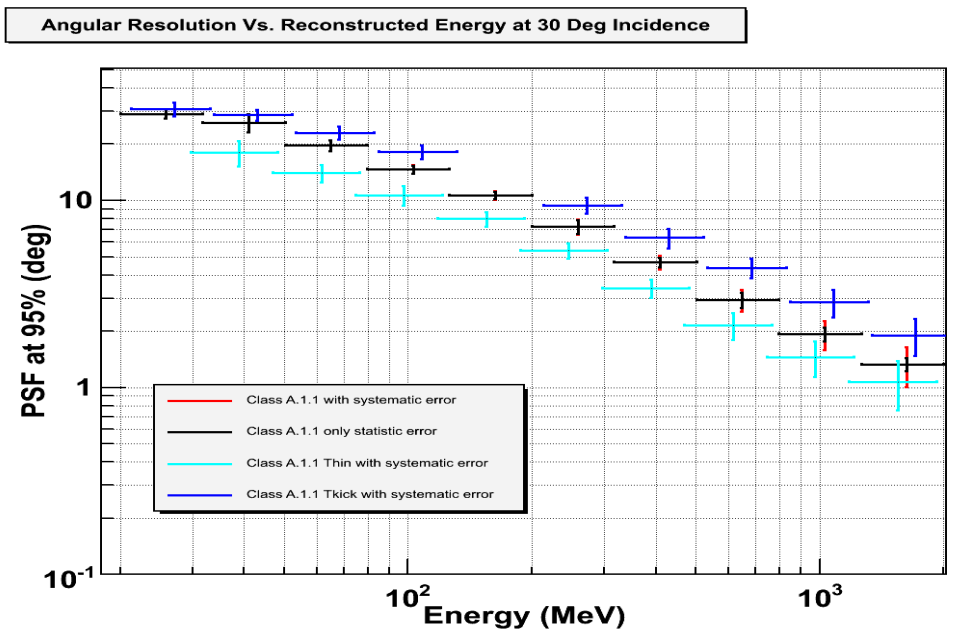


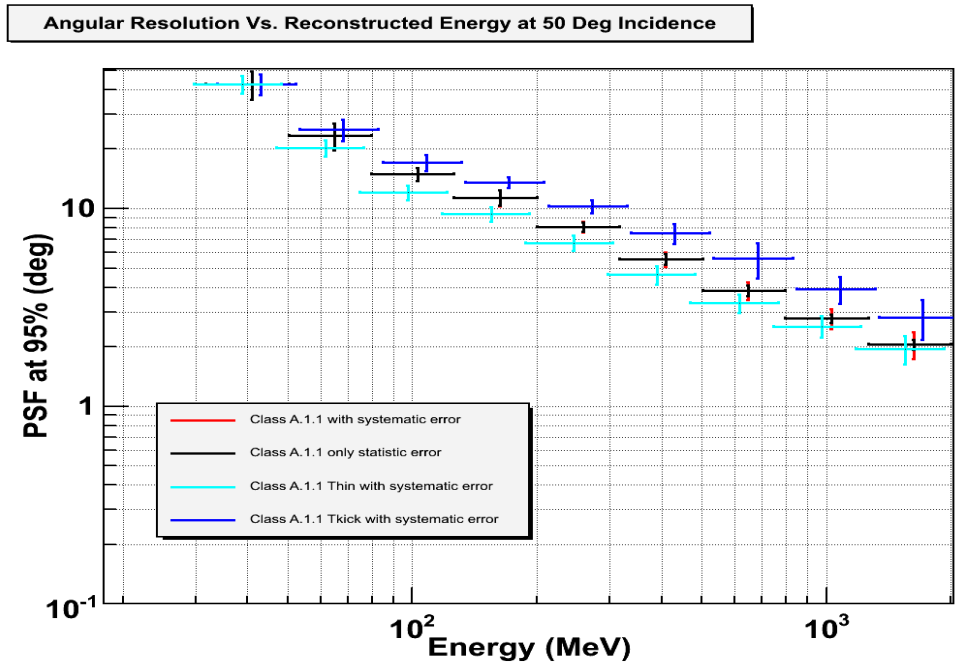


PSF at 95% - Class A.1.1.

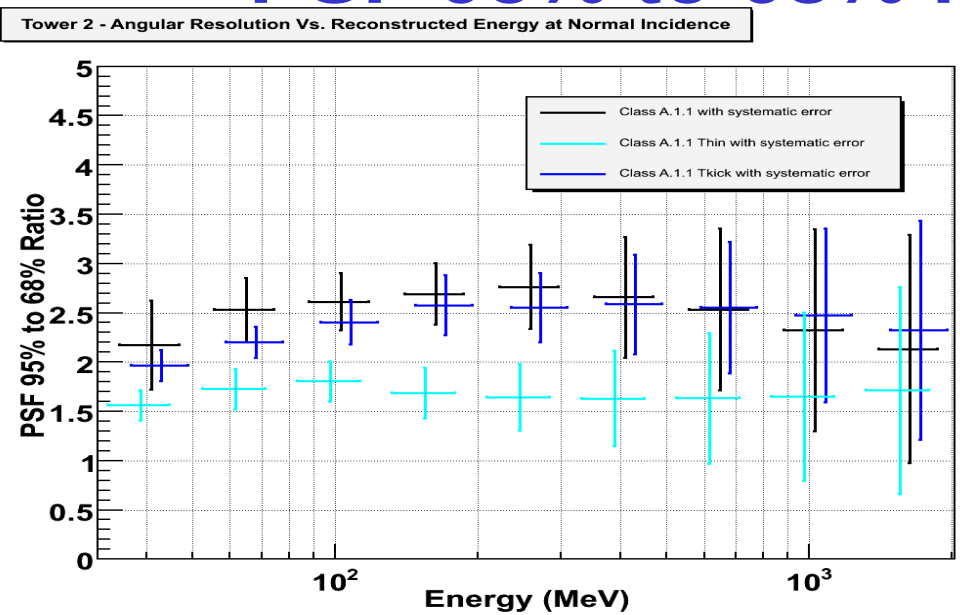


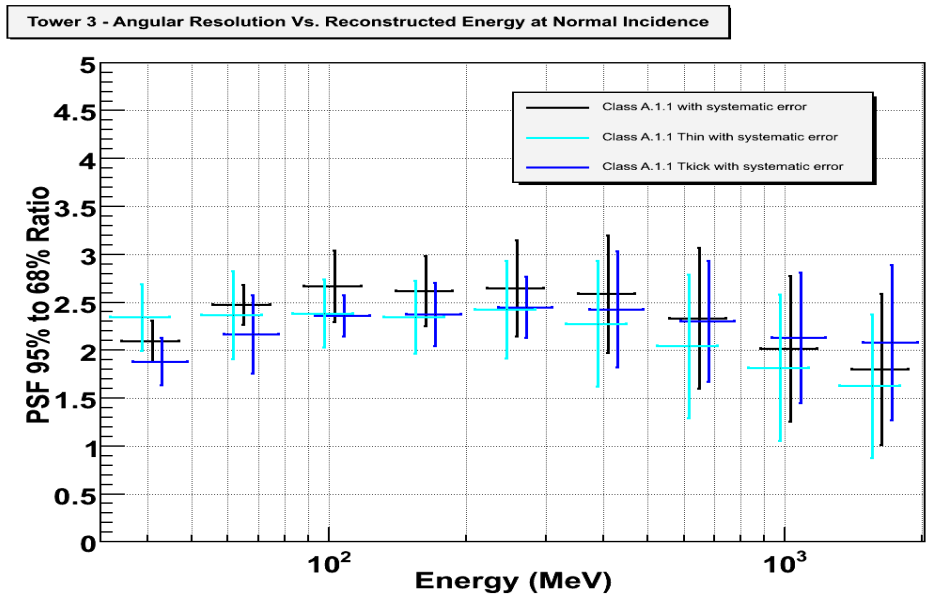


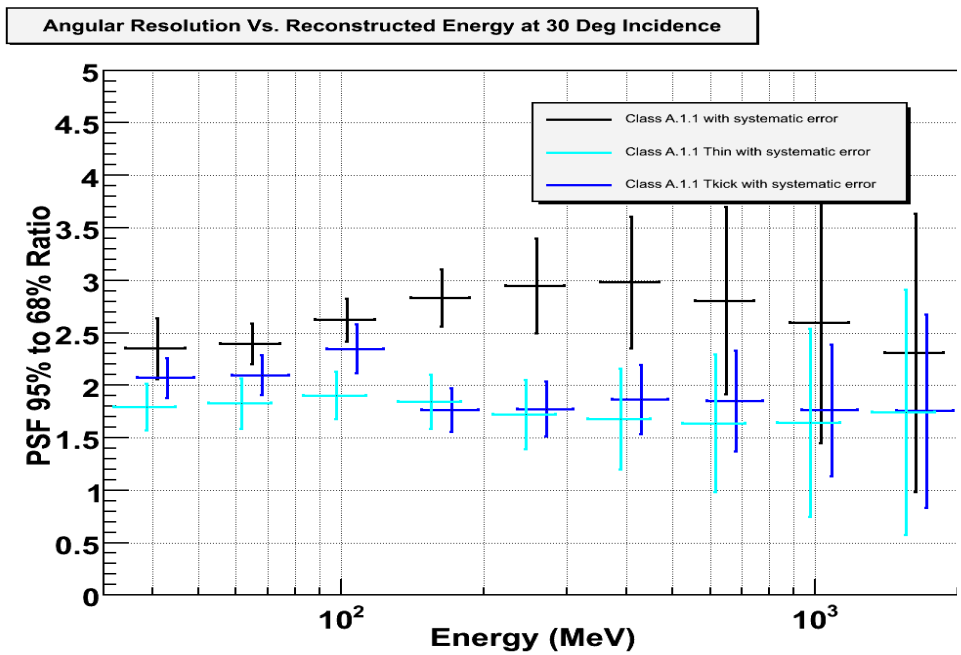


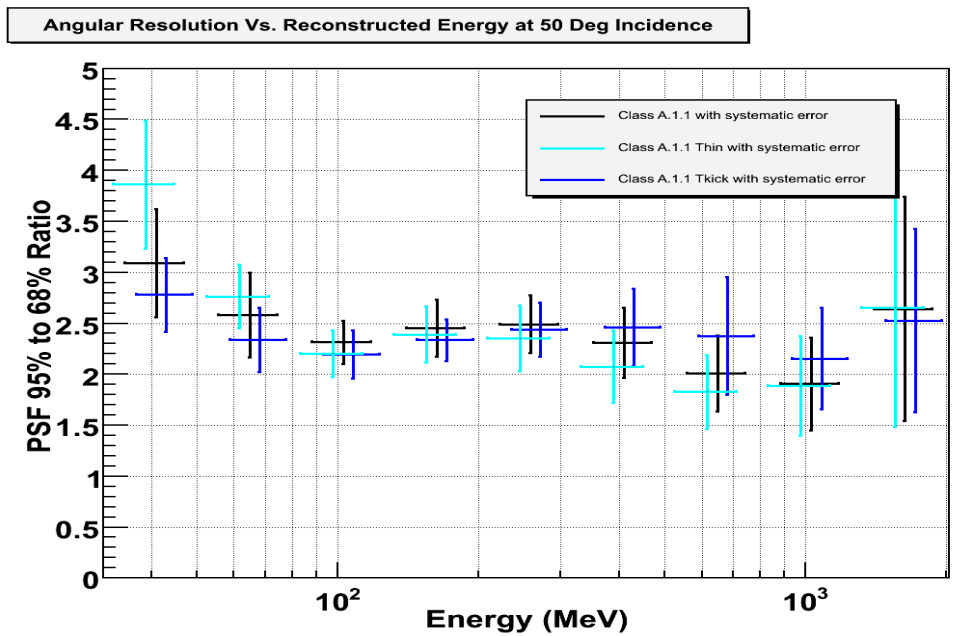


PSF 95% to 68% ratio – Class A.1.1

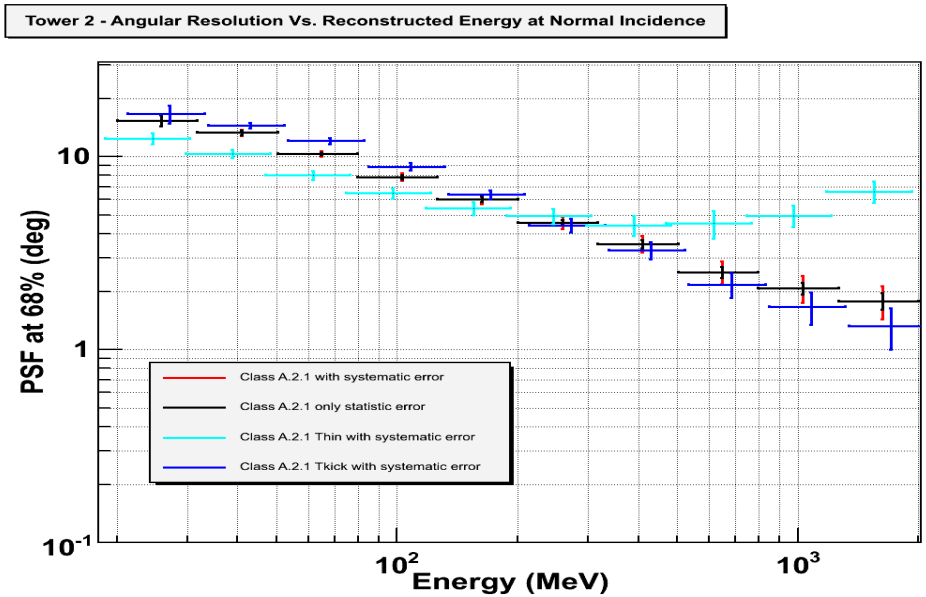


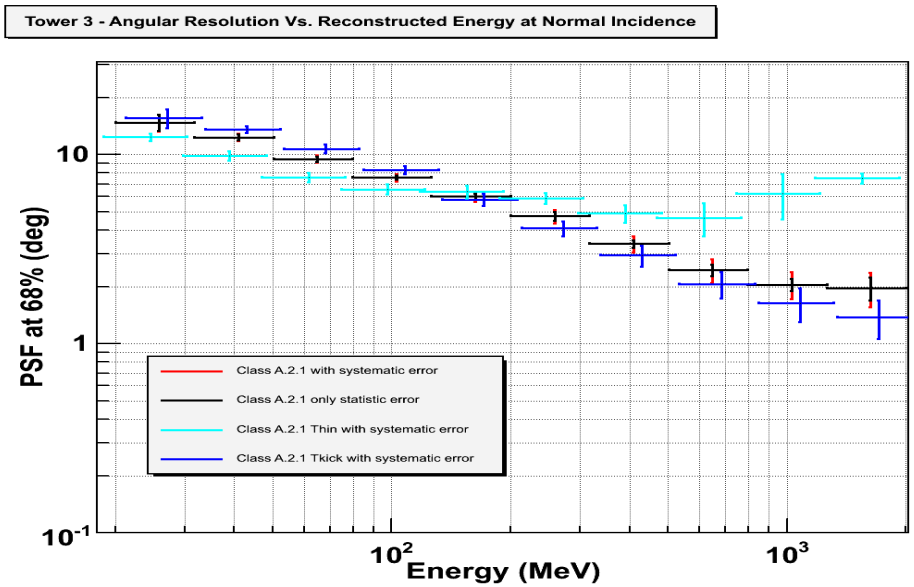


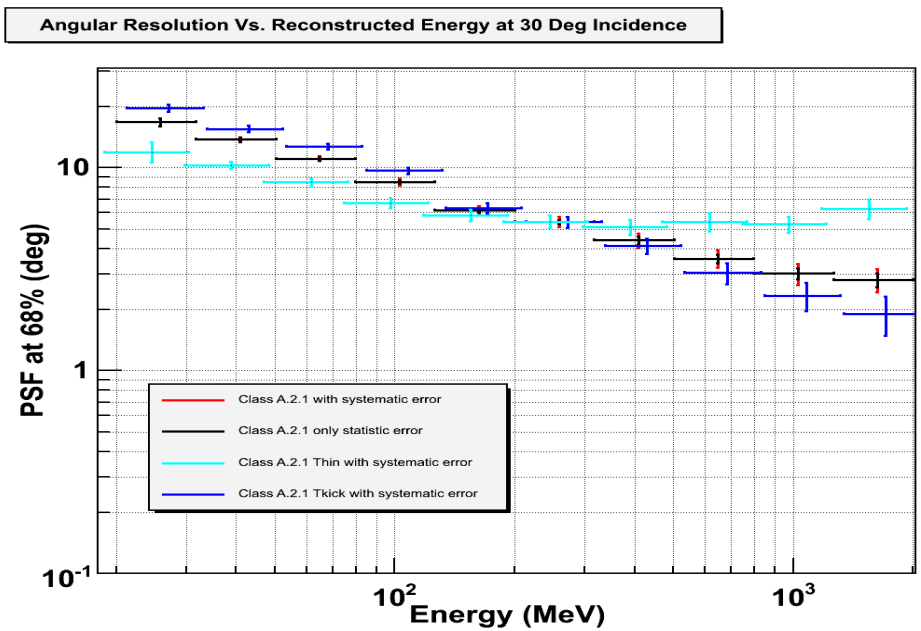


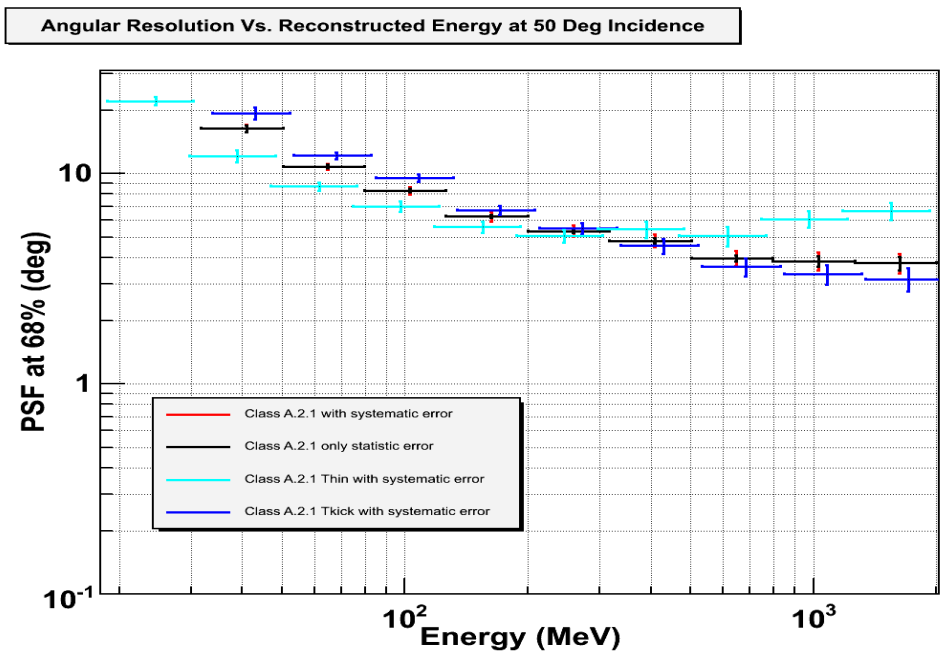


PSF at 68% - Class A.2.1

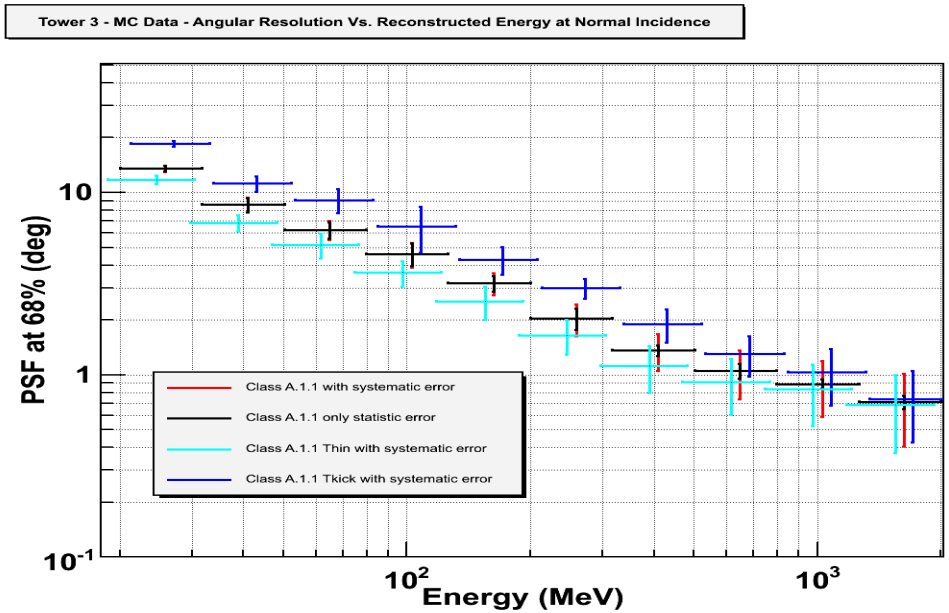


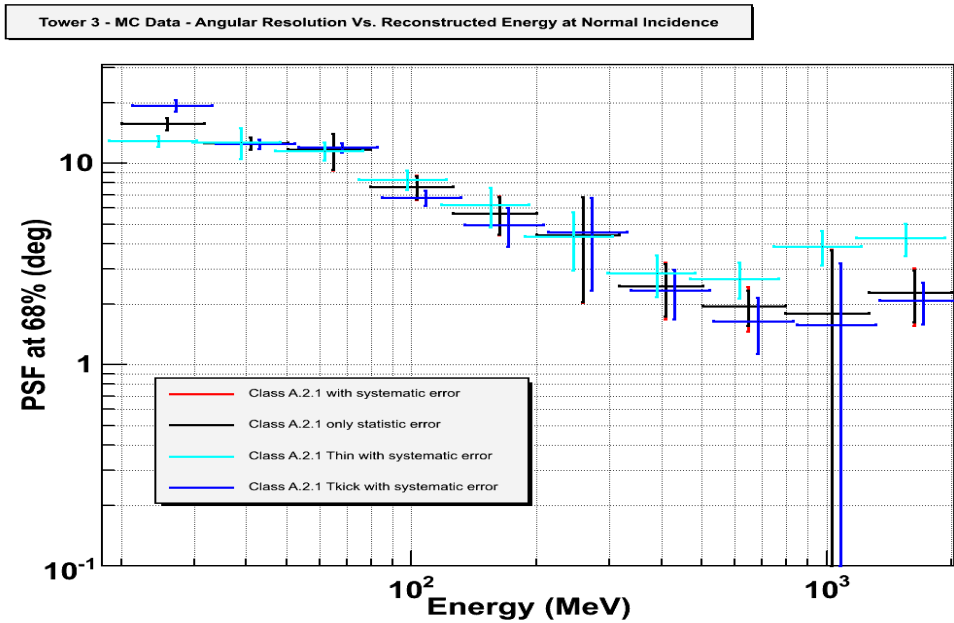


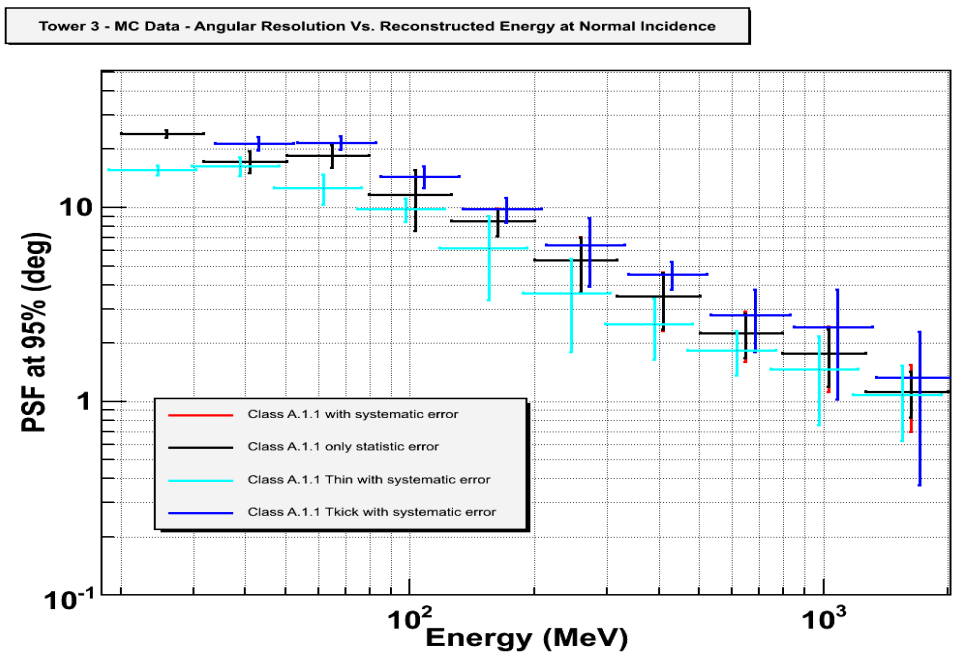


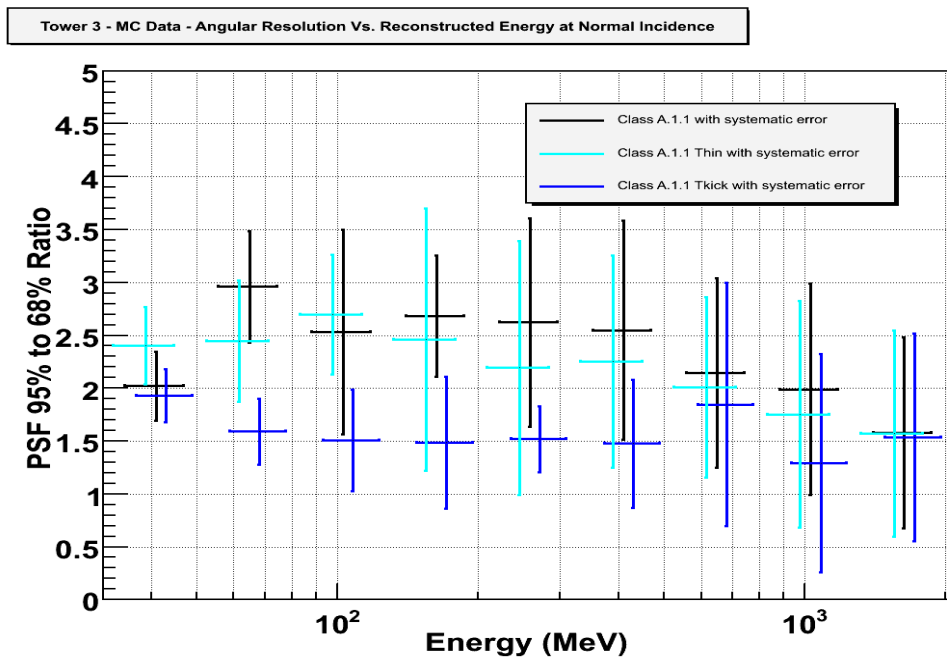


MC normal incidence Tower 3

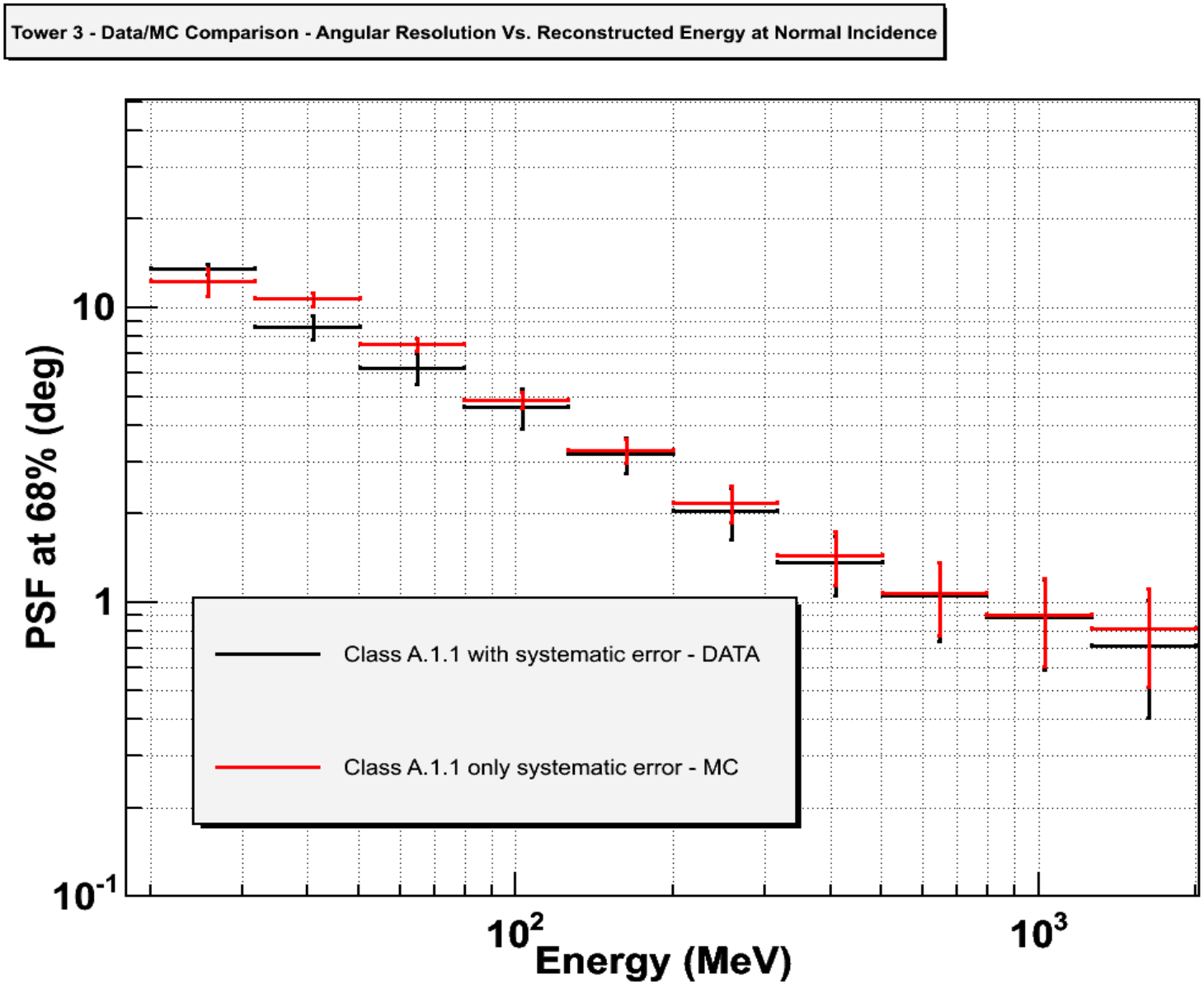




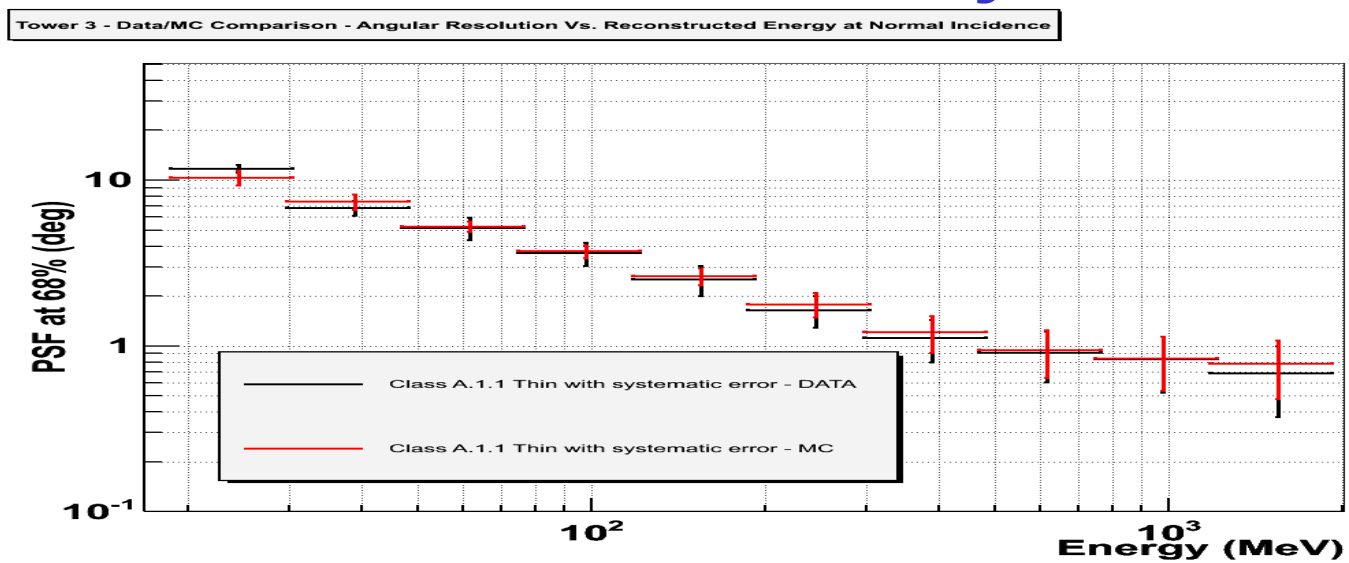


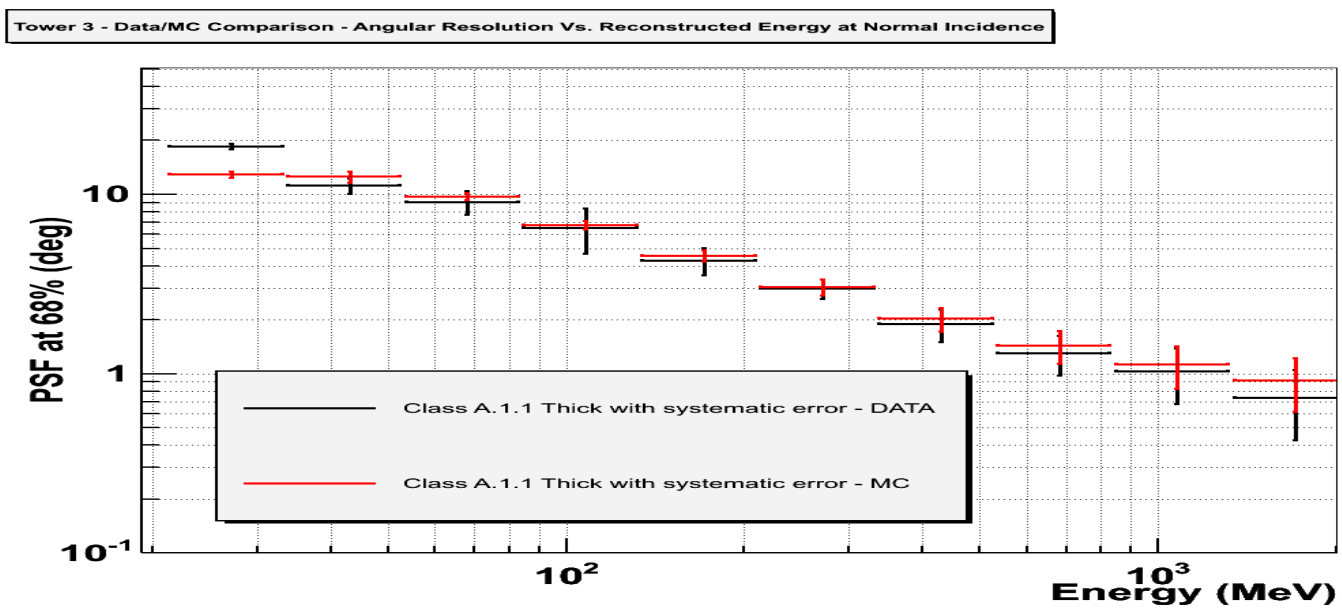


Data-MC comparison: PSF 68%

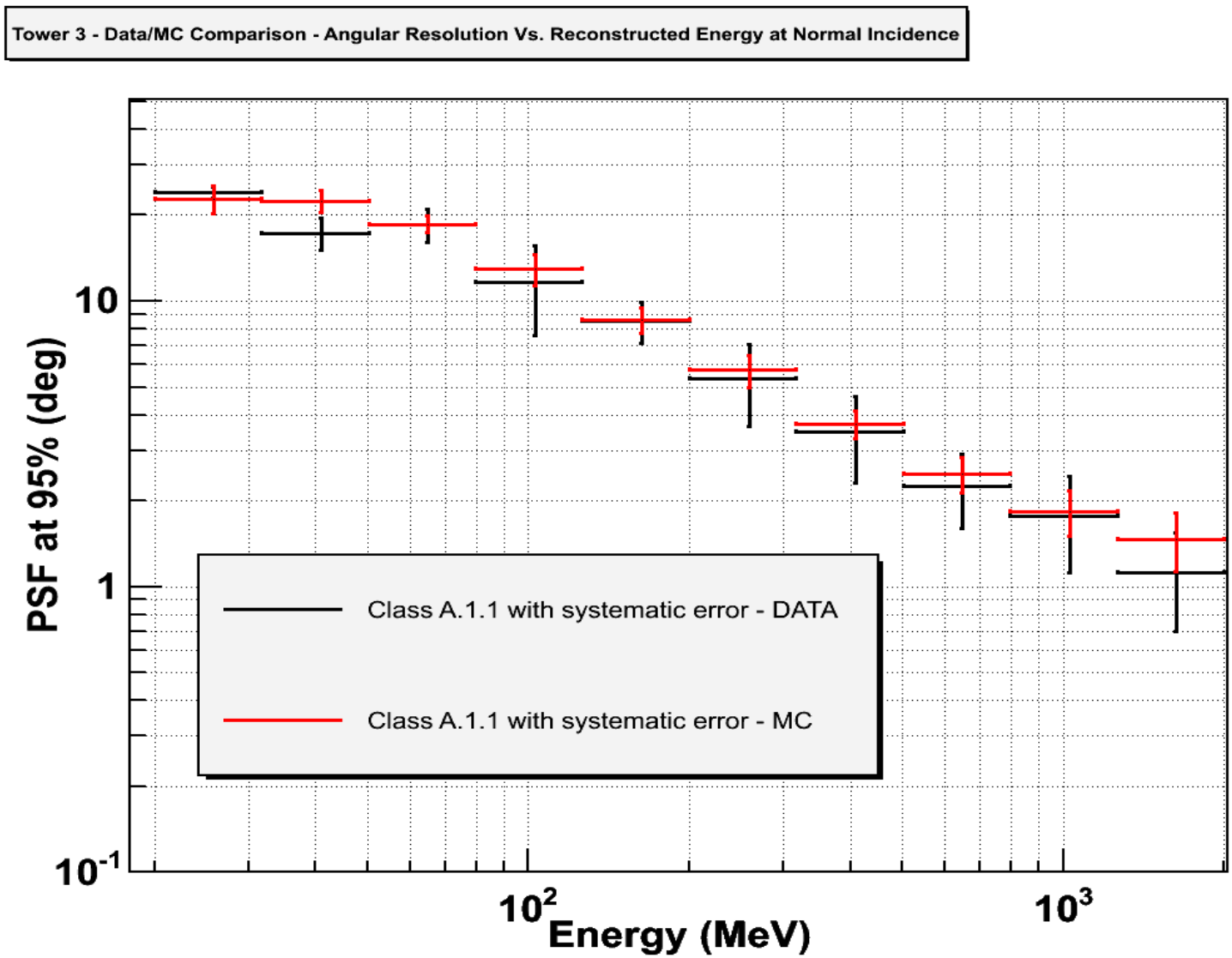


Data-MC comparison: PSF 68% in Thick and Thin layers

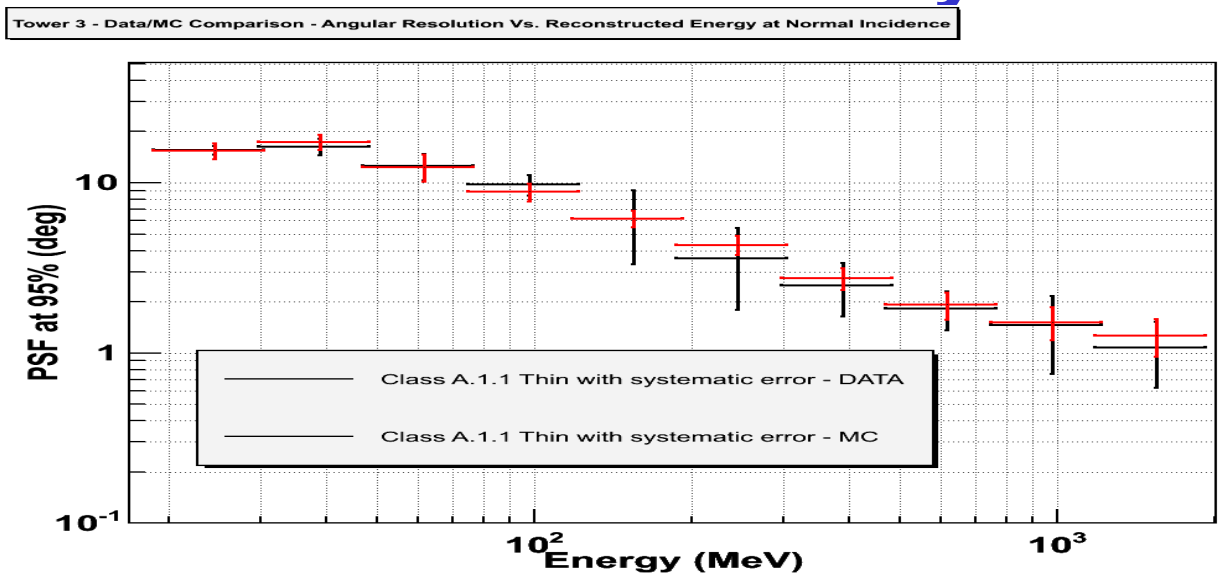


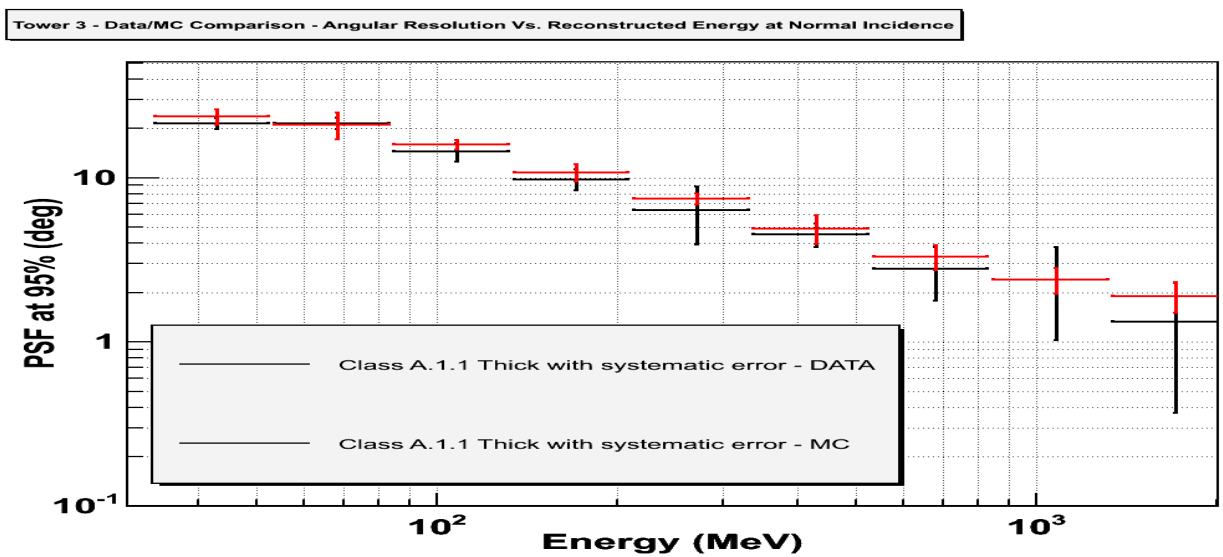


Data-MC comparison: PSF 95%

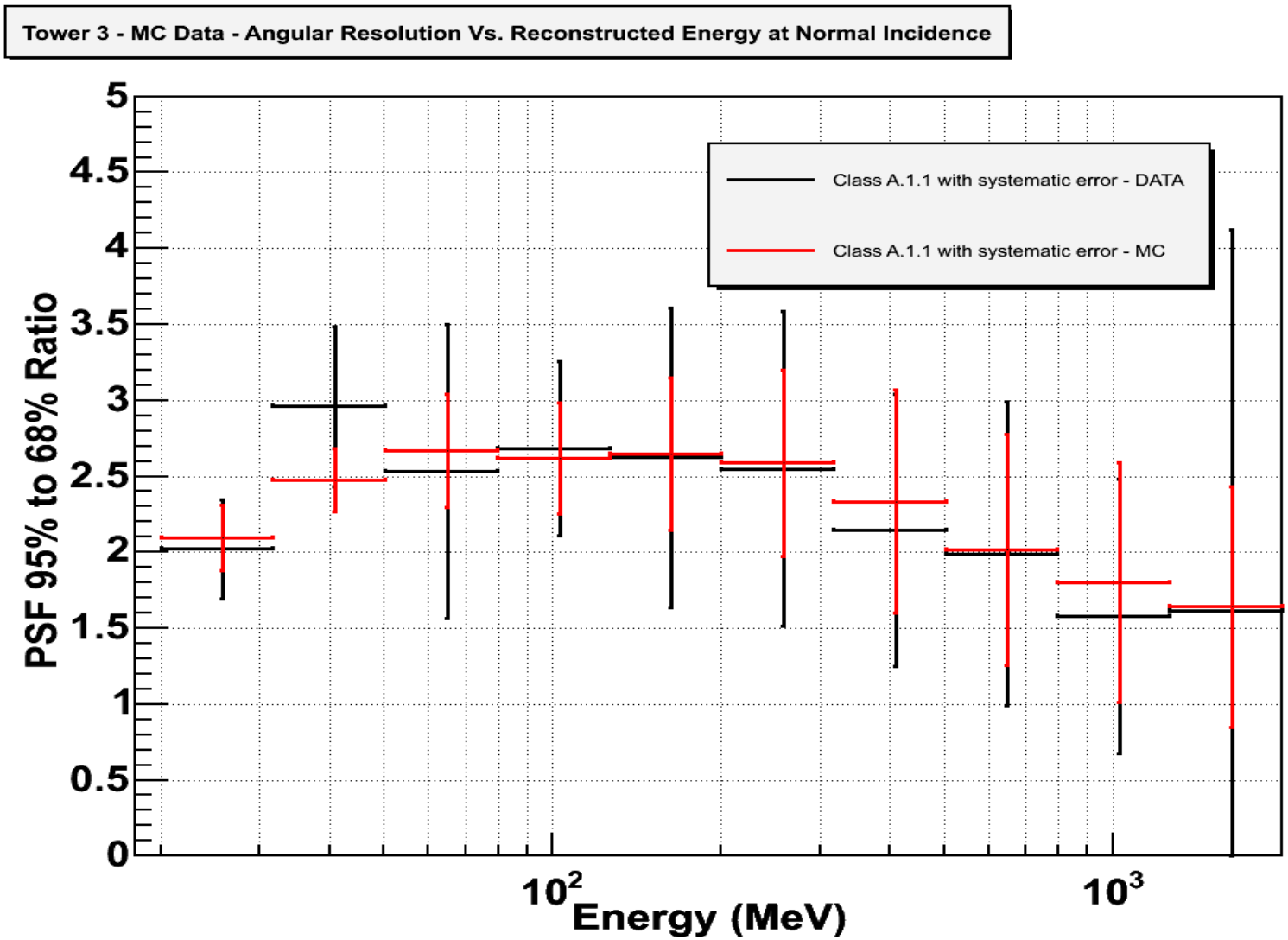


Data-MC comparison: PSF 95% in Thick and Thin layers





Data-MC comparison: PSF 95% to 68% Ratio



Conclusion

- The angular dispersion has been evaluated at normal incidence in Tower 2 and 3, at 30° and at 50°
  - All available photon runs (both full brems and tagged) have been merged
- The data are quite in agreement with the MC, at least at normal incidence