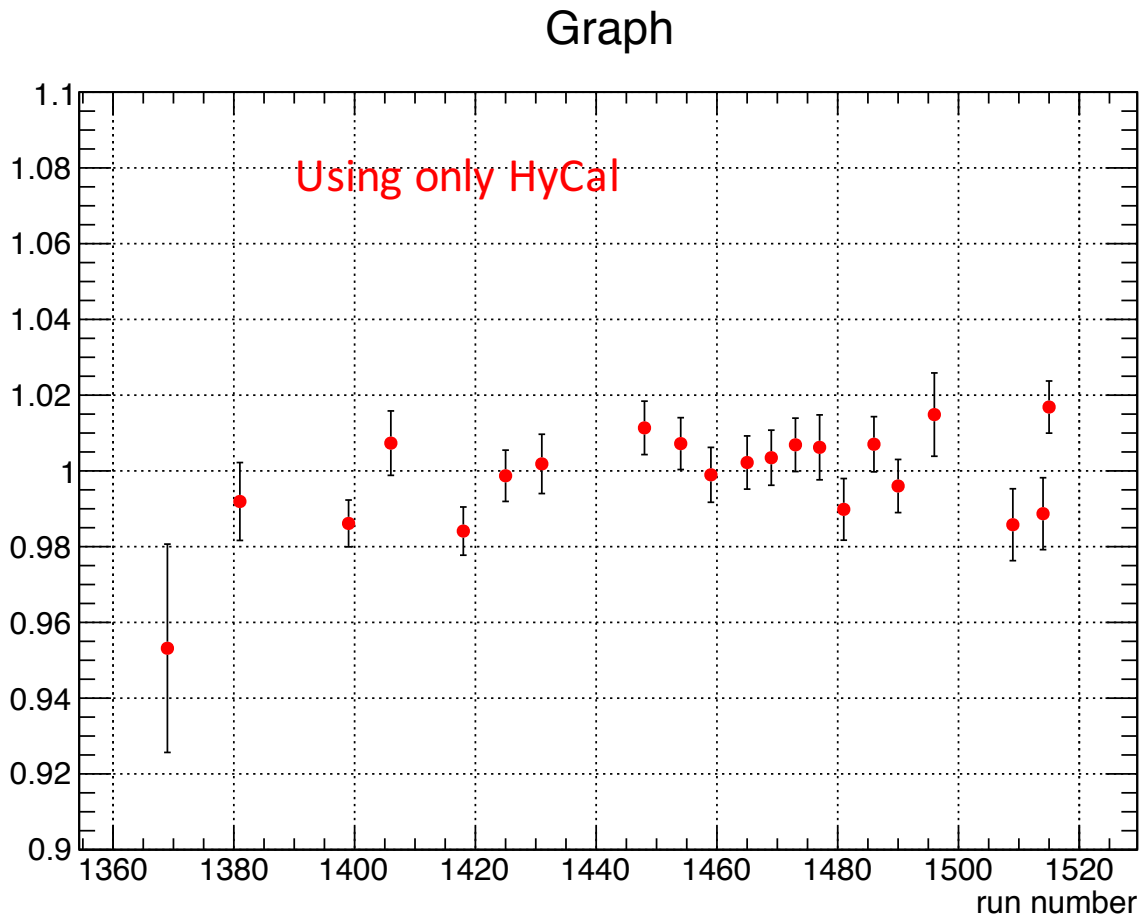
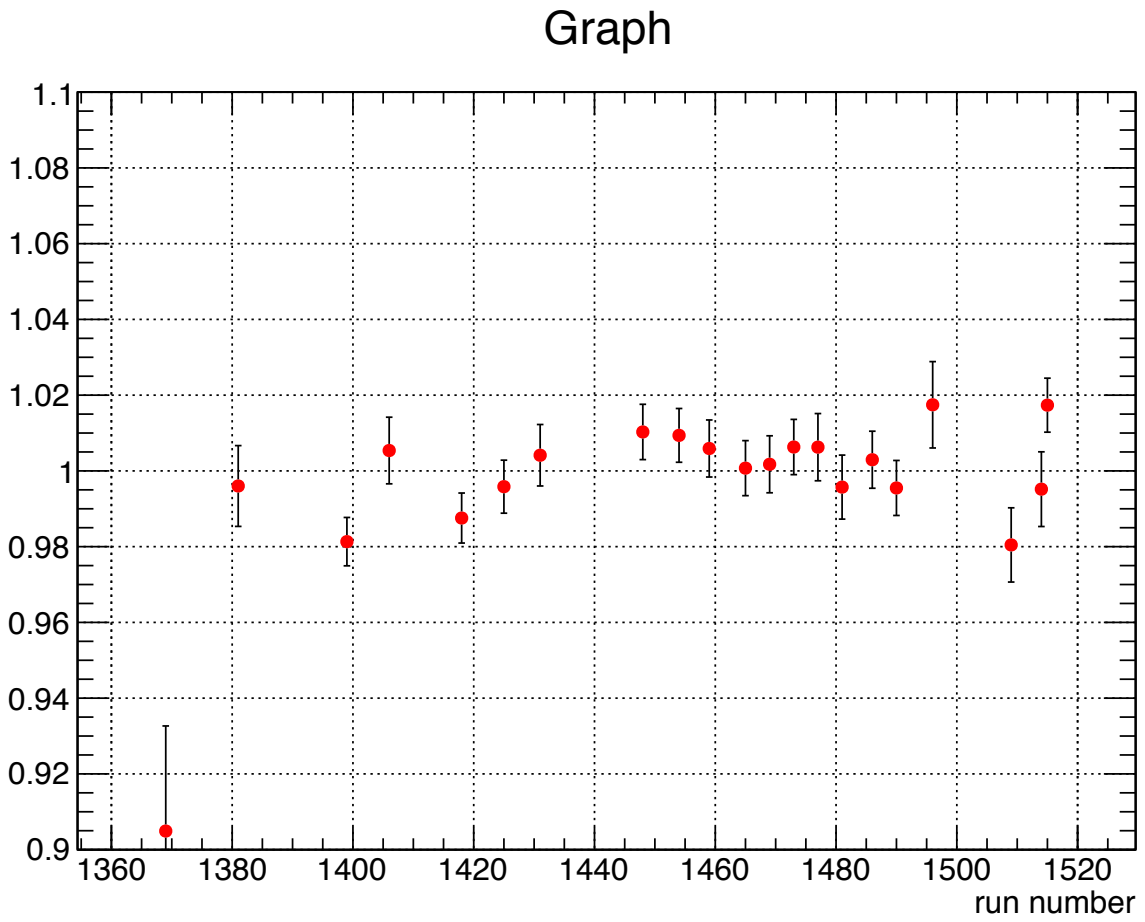
Live charge weighted ep yield from all the 2GeV empty target runs

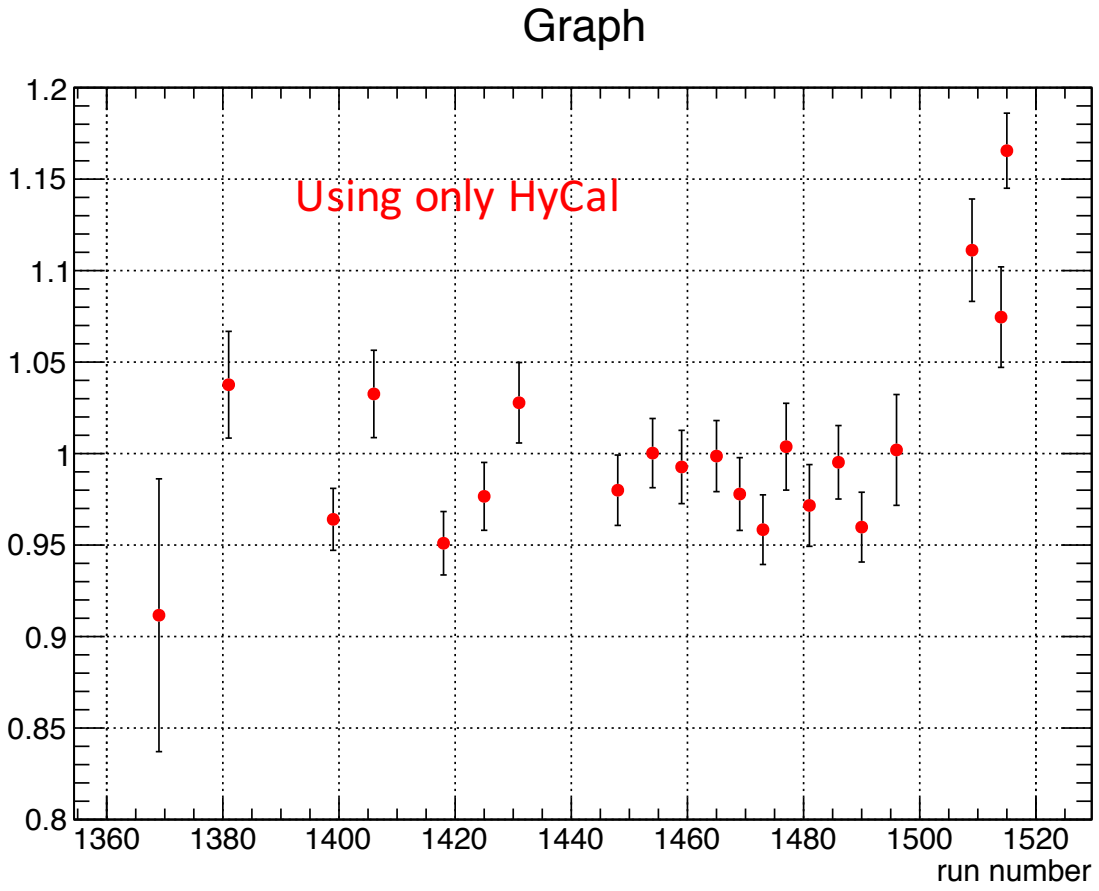
- Scattering angle from 0.7 to 0.9 deg, background dominated by upstream collimator (80%)
- Notice that here uncertainty from the live charge measurement is convoluted with the background fluctuation

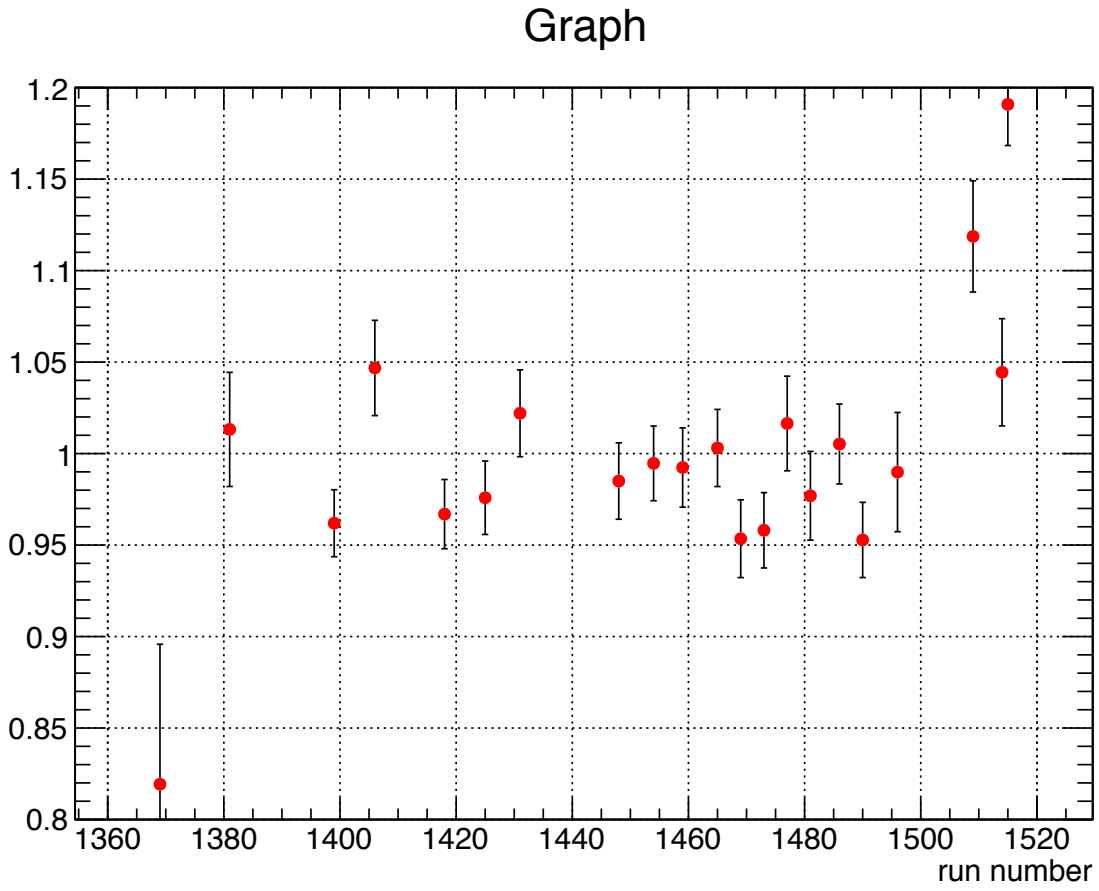




Live charge weighted ep yield from all the 2GeV empty target runs

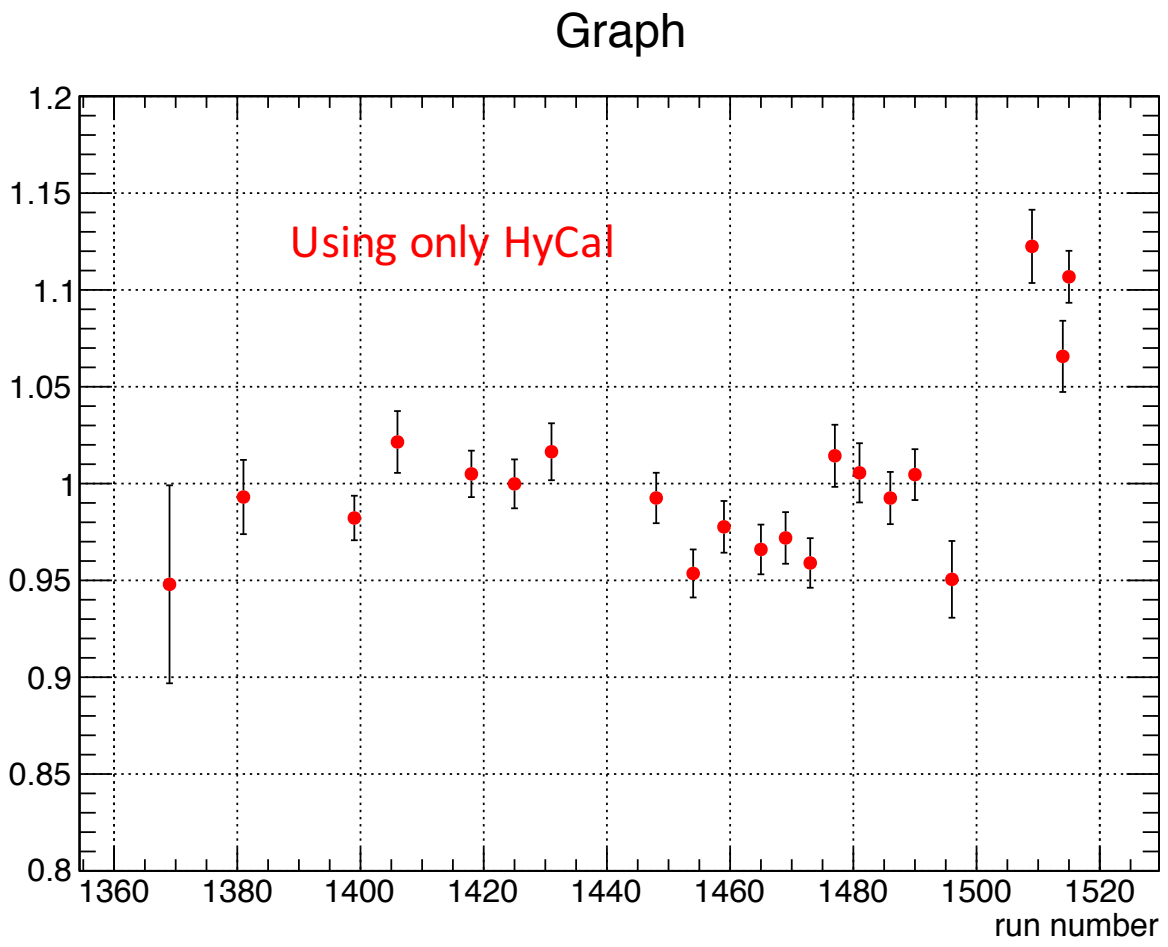
- Scattering angle from 1.3 to 5.2 deg, background dominated by residual gas and target cell

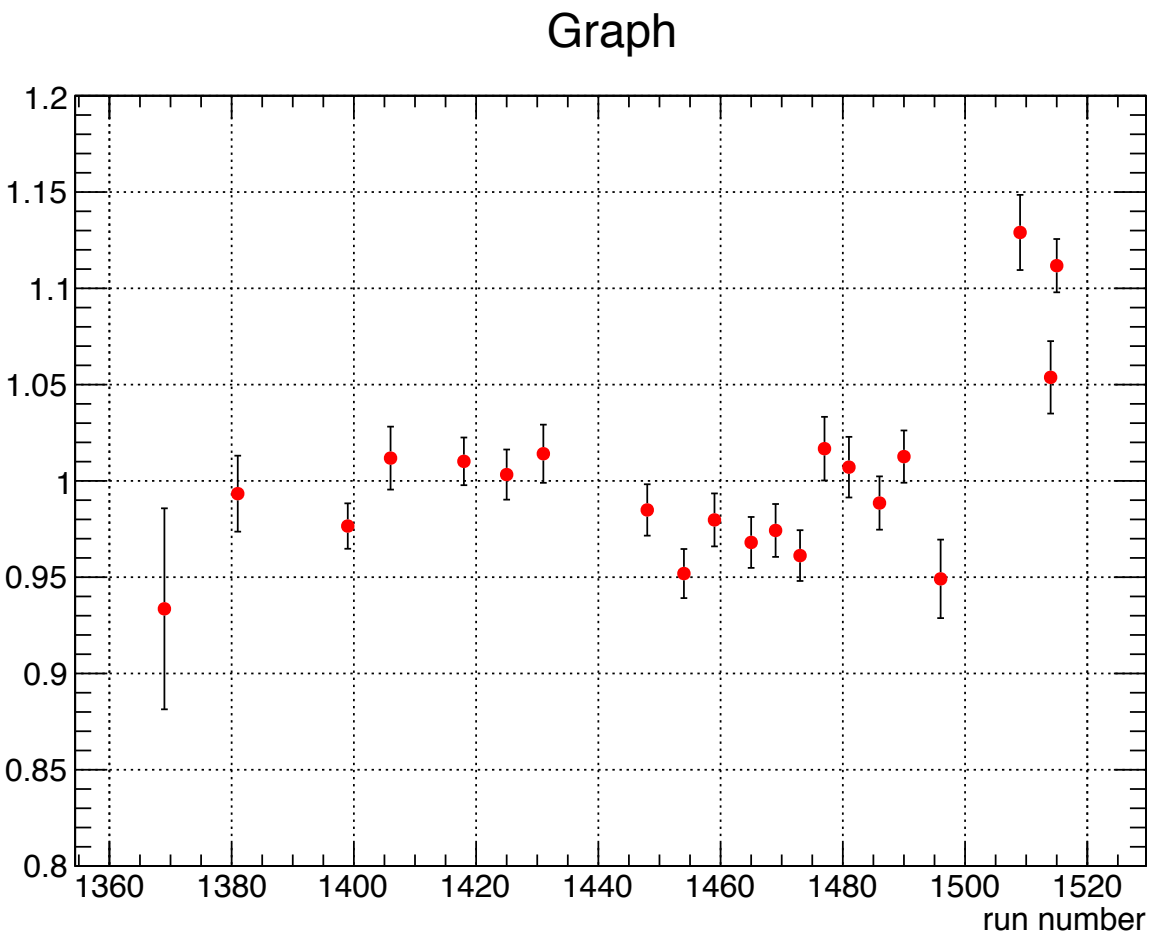




Live charge weighted ee yield from all the 2GeV empty target runs

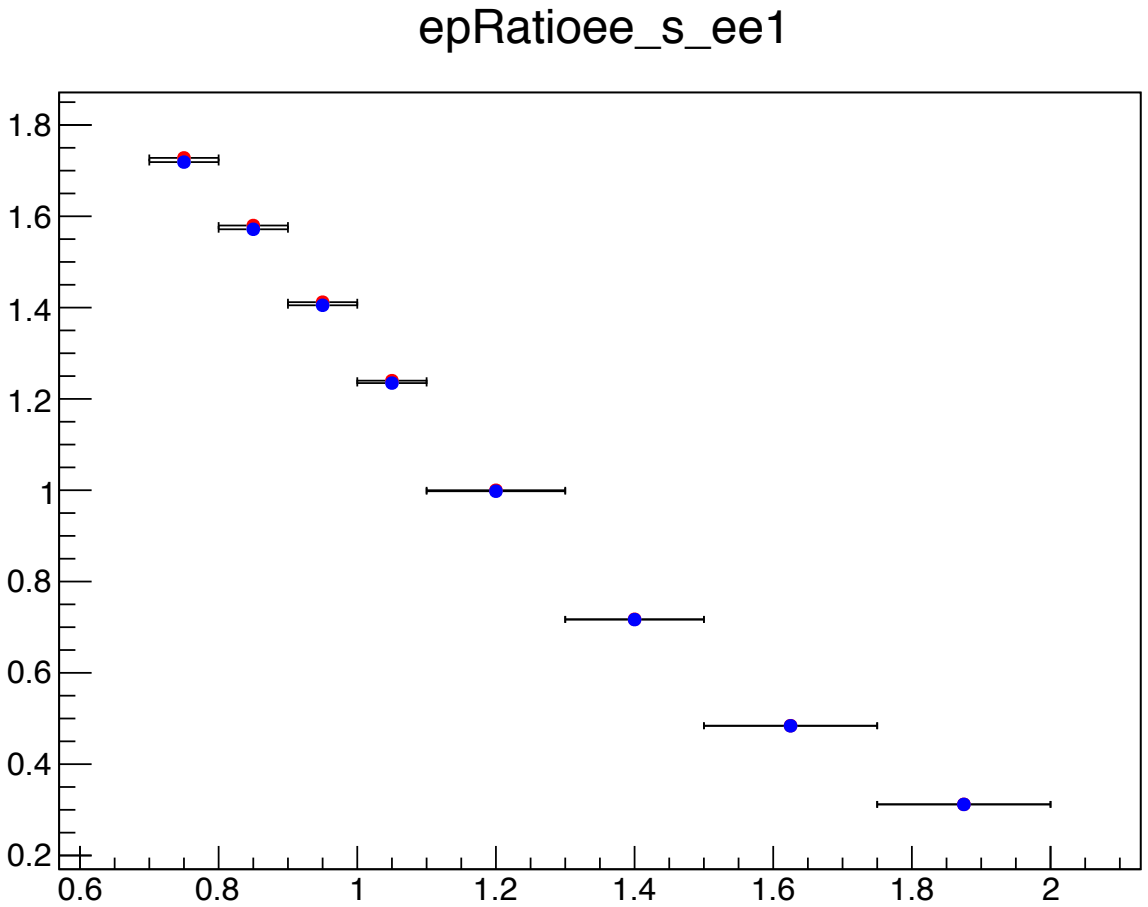
- Scattering angle from 0.7 to 2.0 deg, background dominated by residual gas and target cell

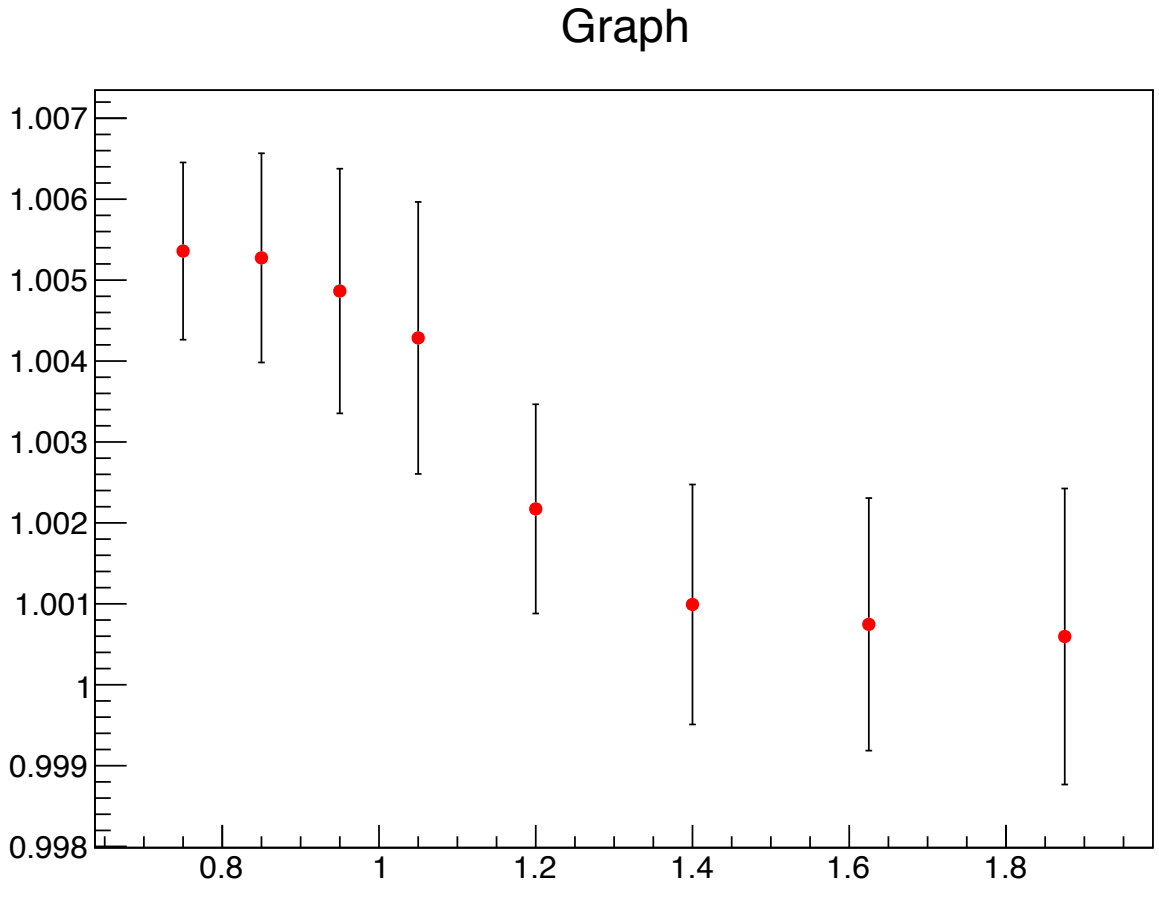




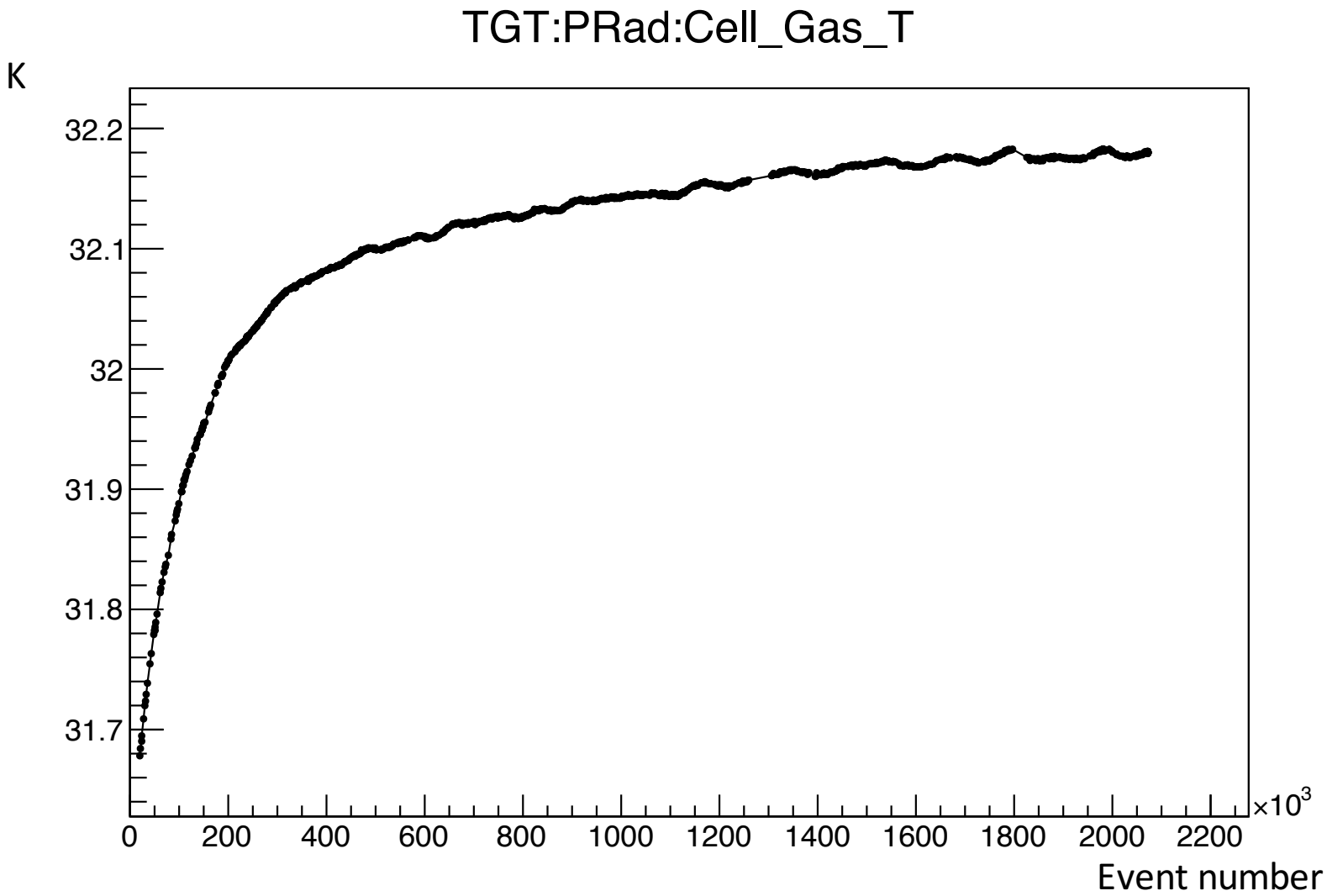
Error from live charge normalization on the ratio

- Assume there is a 5% error from the measurement of live charge, it will lead to a 0.5% difference for the ep/ee ratio at small angle





- From some EPICS values, it seems there is a relatively unstable period at the beginning of the run, check the live charge weighted yields for different time period of a run

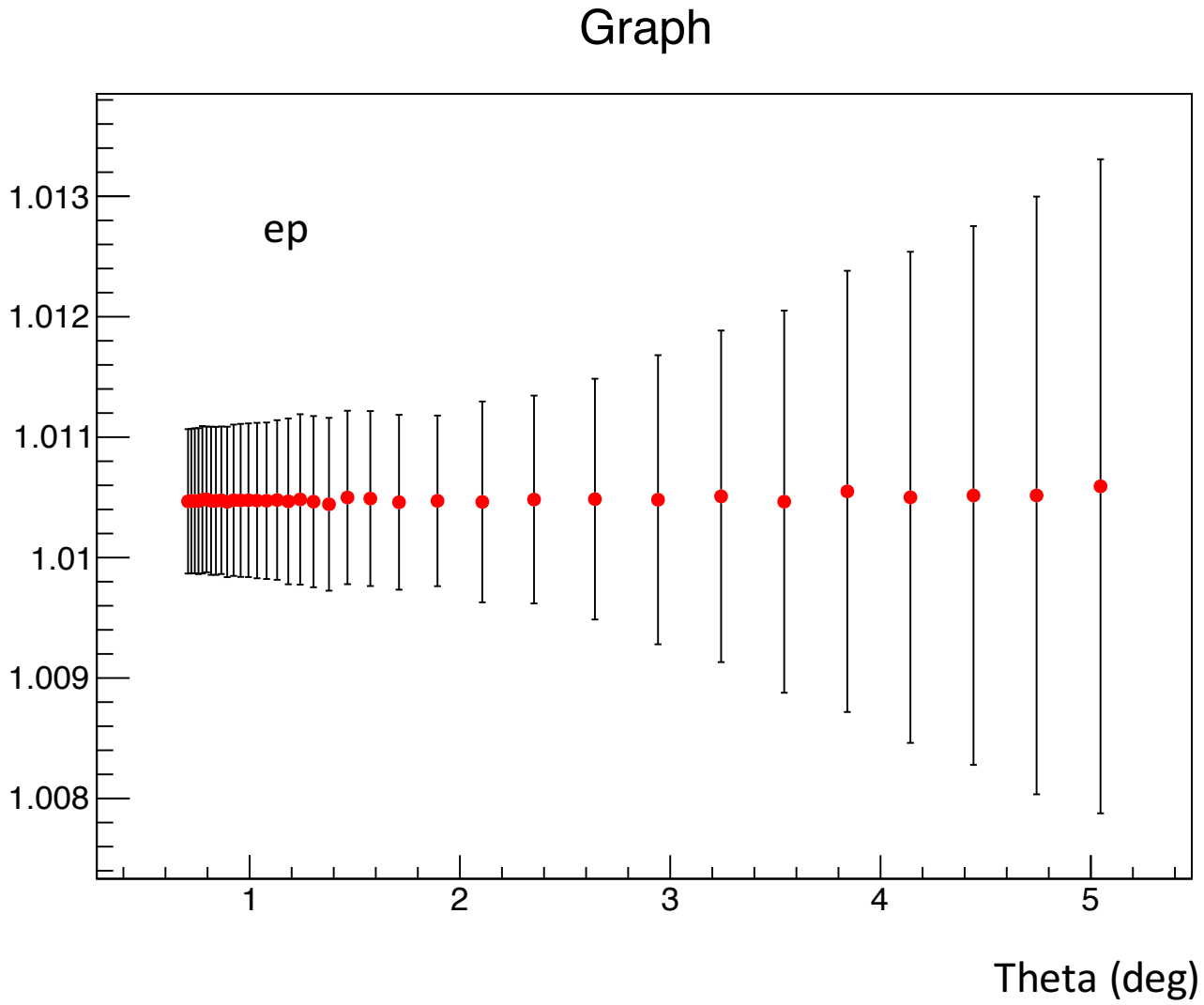


Other things that can be checked

- There are some scalar counters around the beam line during the experiment, we can check the readout (recorded in the EPCIS), which mean indicates something about the background level
    - scaler_cS3b
    - scaler_cS4b
    - scalerS8b
    - scalerS9b
    - scalerS10b
    - scalerS11b
    - scaler_cS5b
    - scaler_cS6b
    - scaler_cS7b
- Residual gas distribution around the target window, we can assume various gas distributions and assume that it is not subtracted cleanly, see if that affect the slope.

Possible residual gas effect

- Two simulation samples:
  - Sample A: z uniformly distributed in target cell, used to get the ep/ee ratio and compared with data (after bg subtraction)
  - Sample B: z uniformly distributed in a 20cm region, upstream of the target cell window
- Normalize the two samples by the total luminosity, and then scale down sample B by 100 times
- The plot shows the ratio of the yields: (sample A + scaled sample B)/(sample A)



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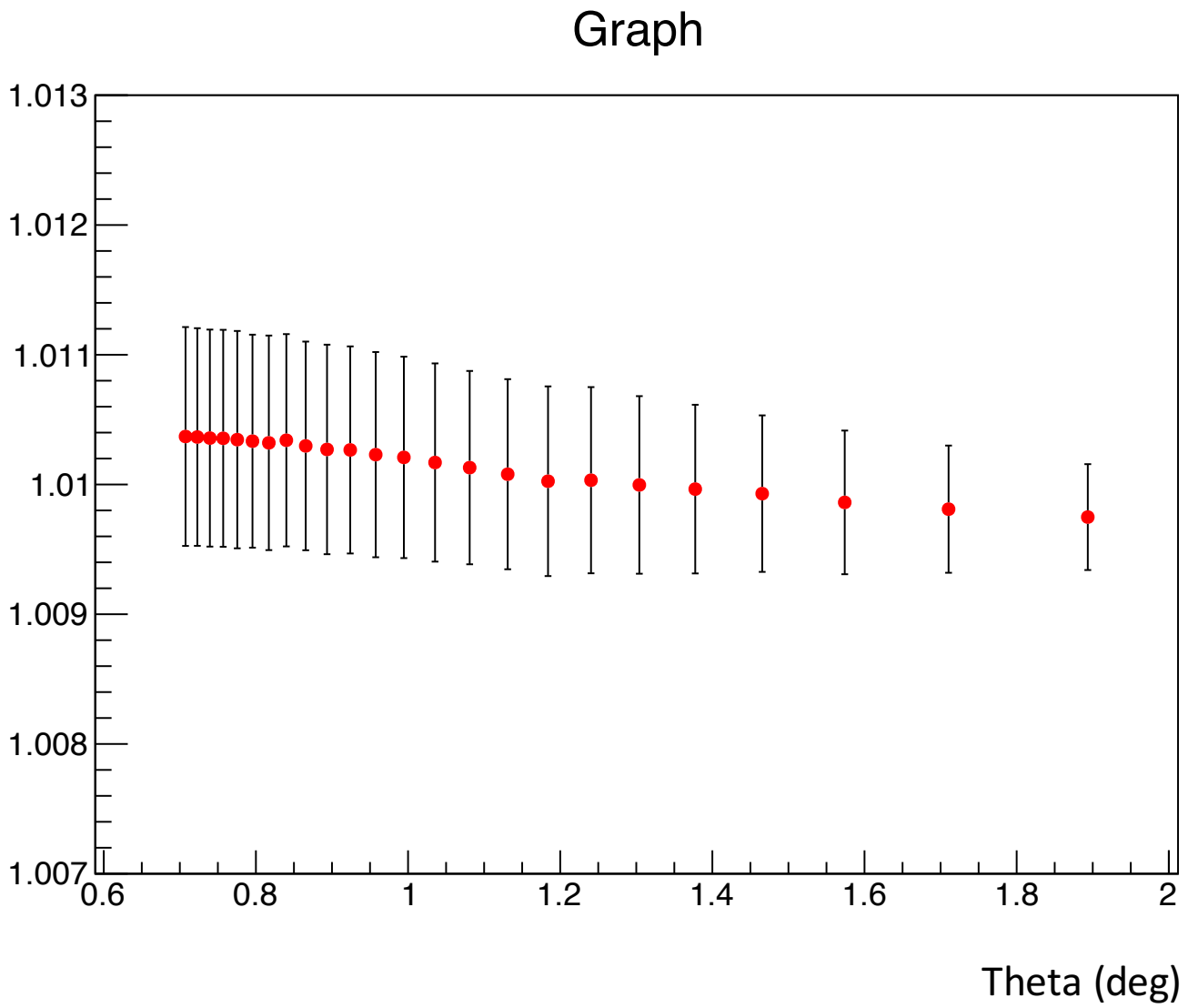
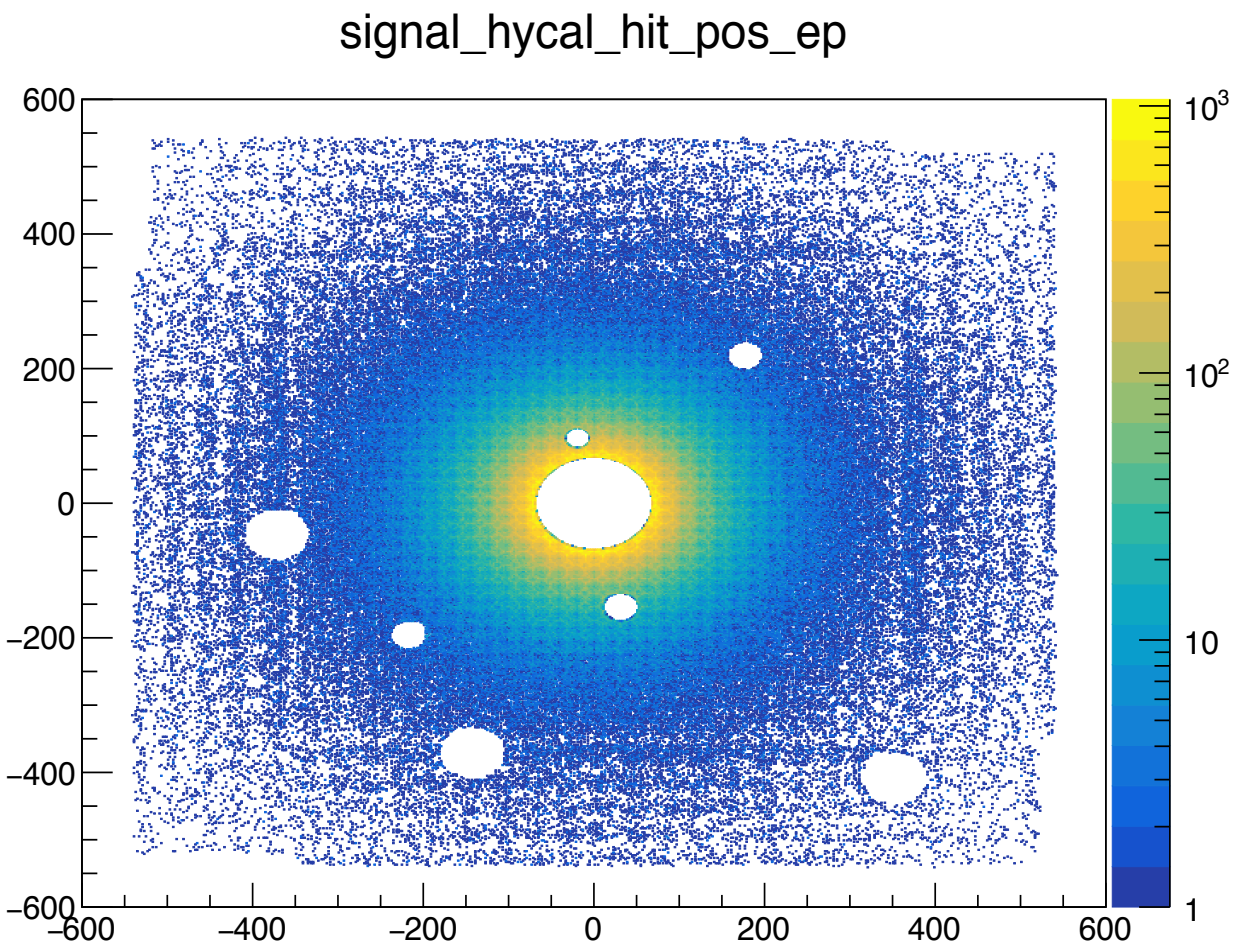


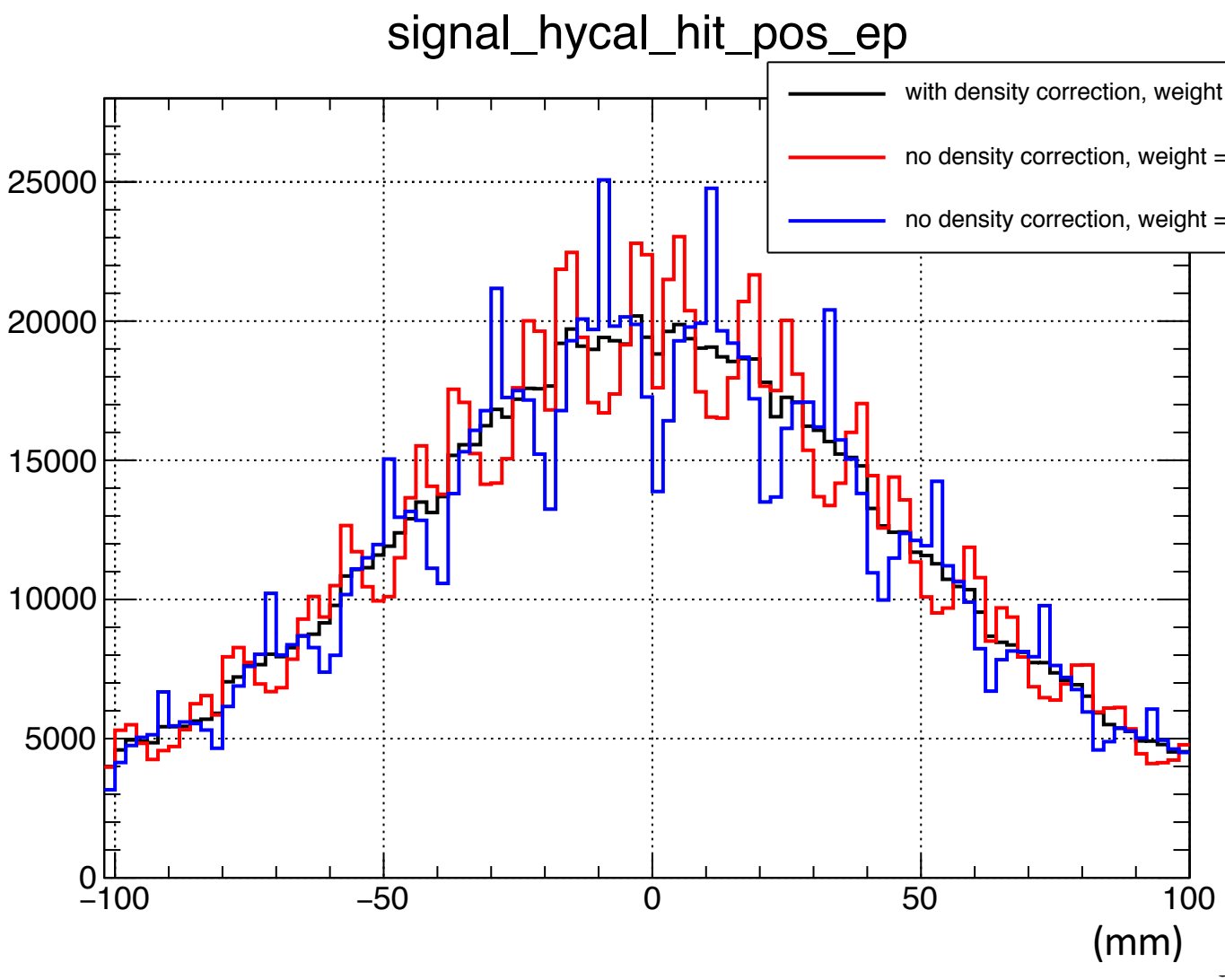
Testing the density correction

- The reconstructed hit position of a calorimeter is in general not smooth
- Density correction is to make it smooth
- The degree of concentration depends on the weights we assign to the modules during reconstruction
  - We are using the logarithmic weight: W=free parameter + $\log(E_i/E_{total})$, W = 0 if W < 0
  - If the free parameter is small, module with small E dep will not participate in the reconstruction, so hits near the center
- Previously the free parameter was 3.6 (give the best matching width)
- Current density correction uses 4.2

Reconstructed hit position for ep, with free parameter 3.6



Testing the density correction



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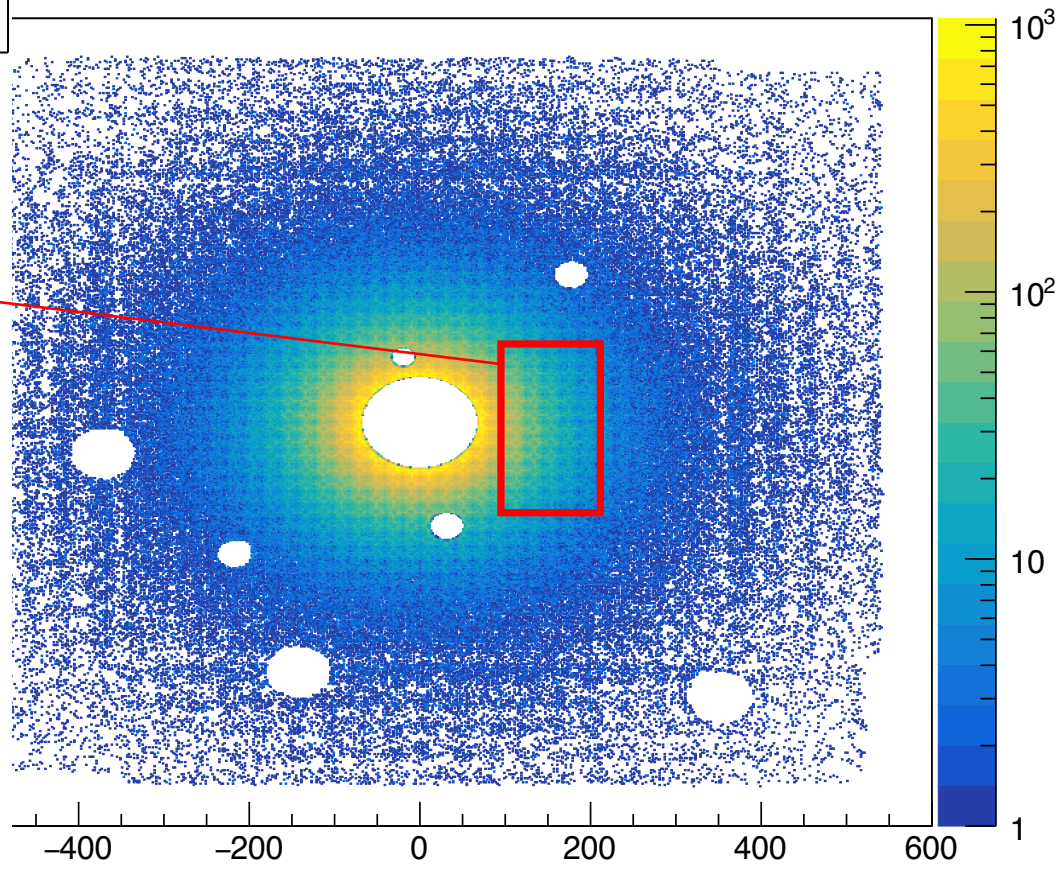
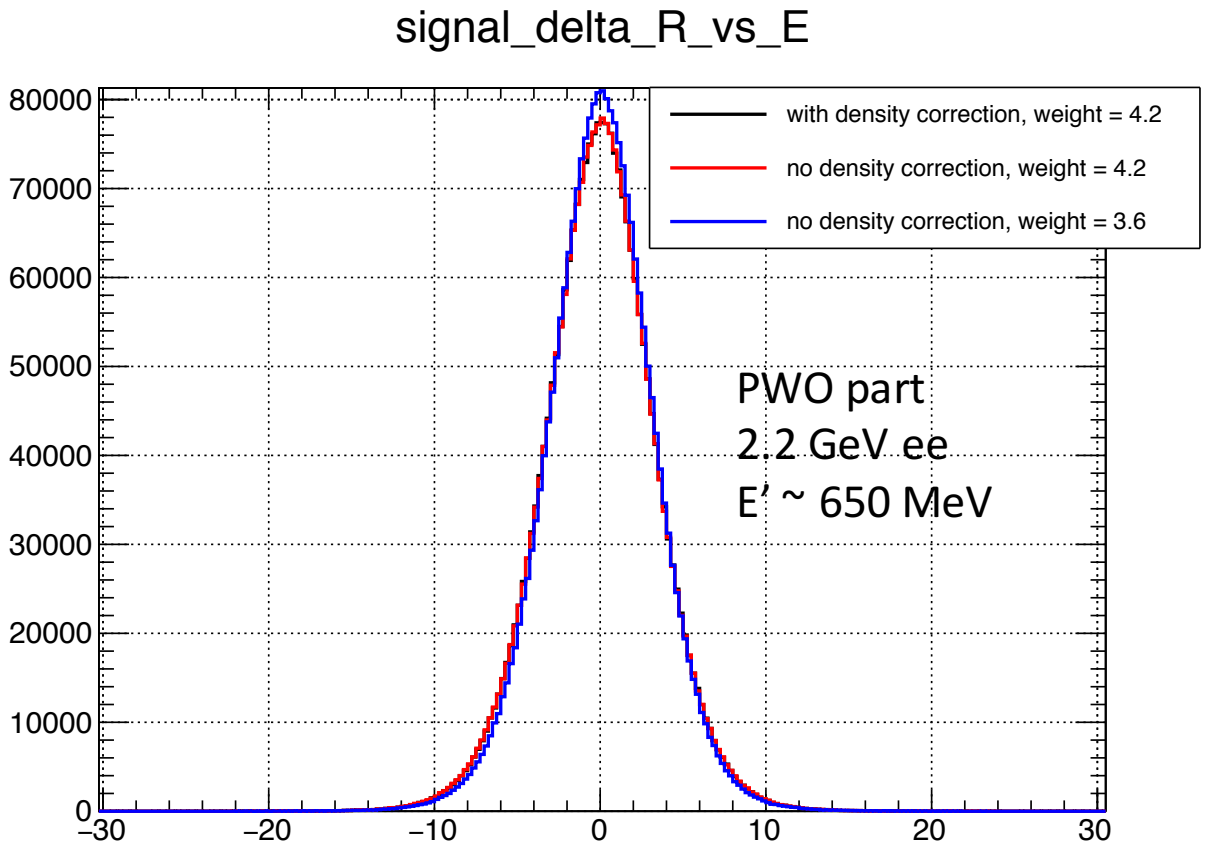
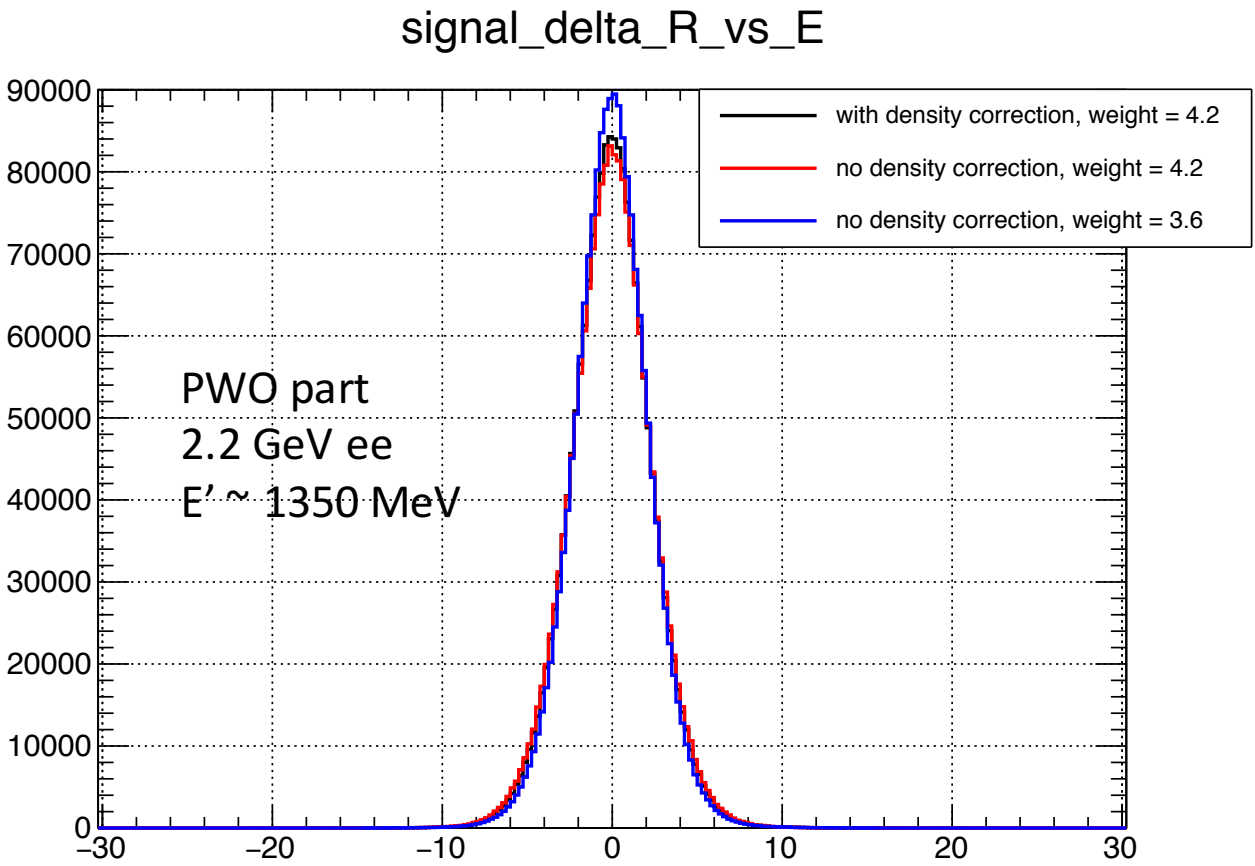


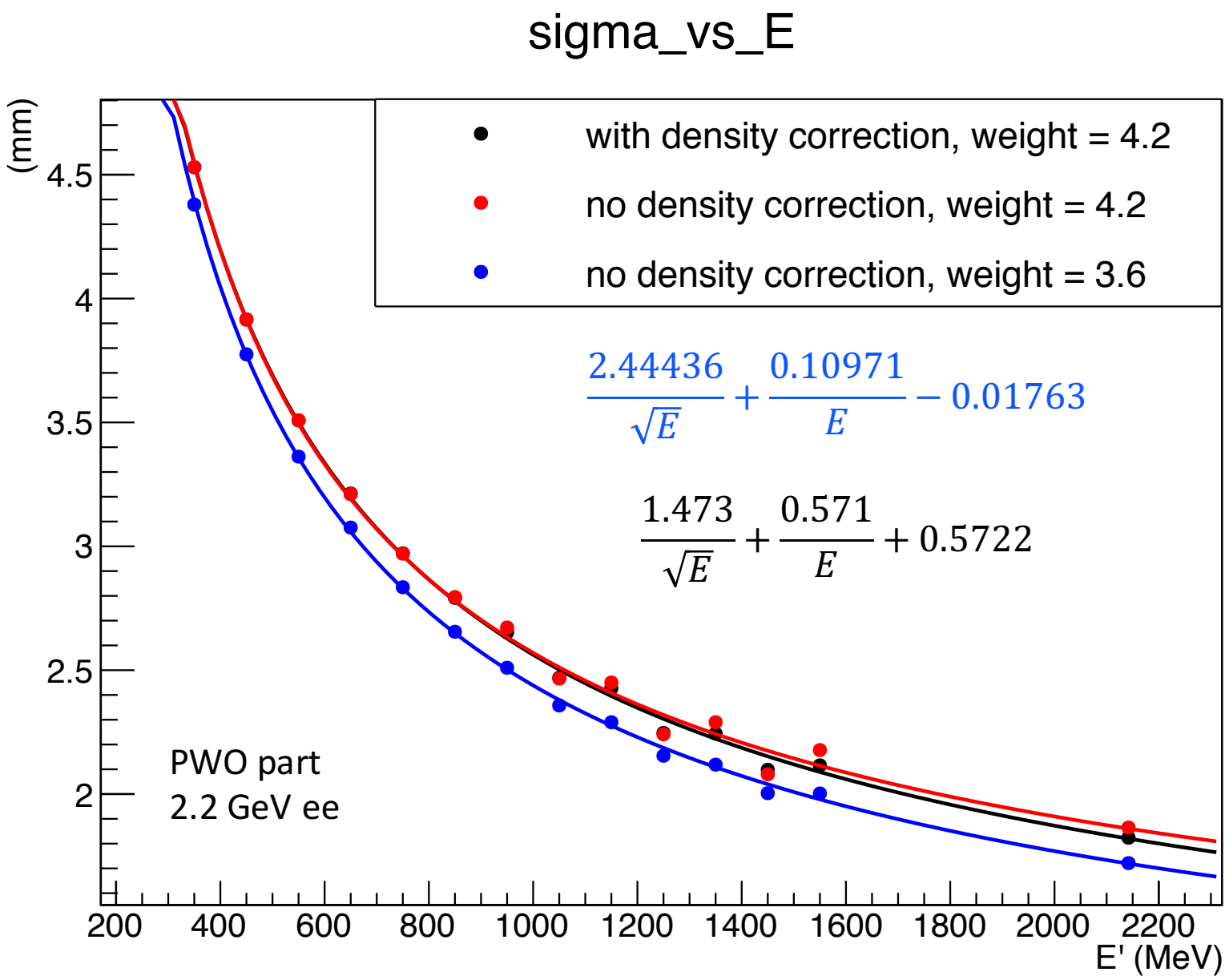
Testing the density correction

- **Δ**R is the difference between GEM measured R coordinate and HyCal measured R coordinate
- With free parameter as 3.6, the width is still slightly smaller

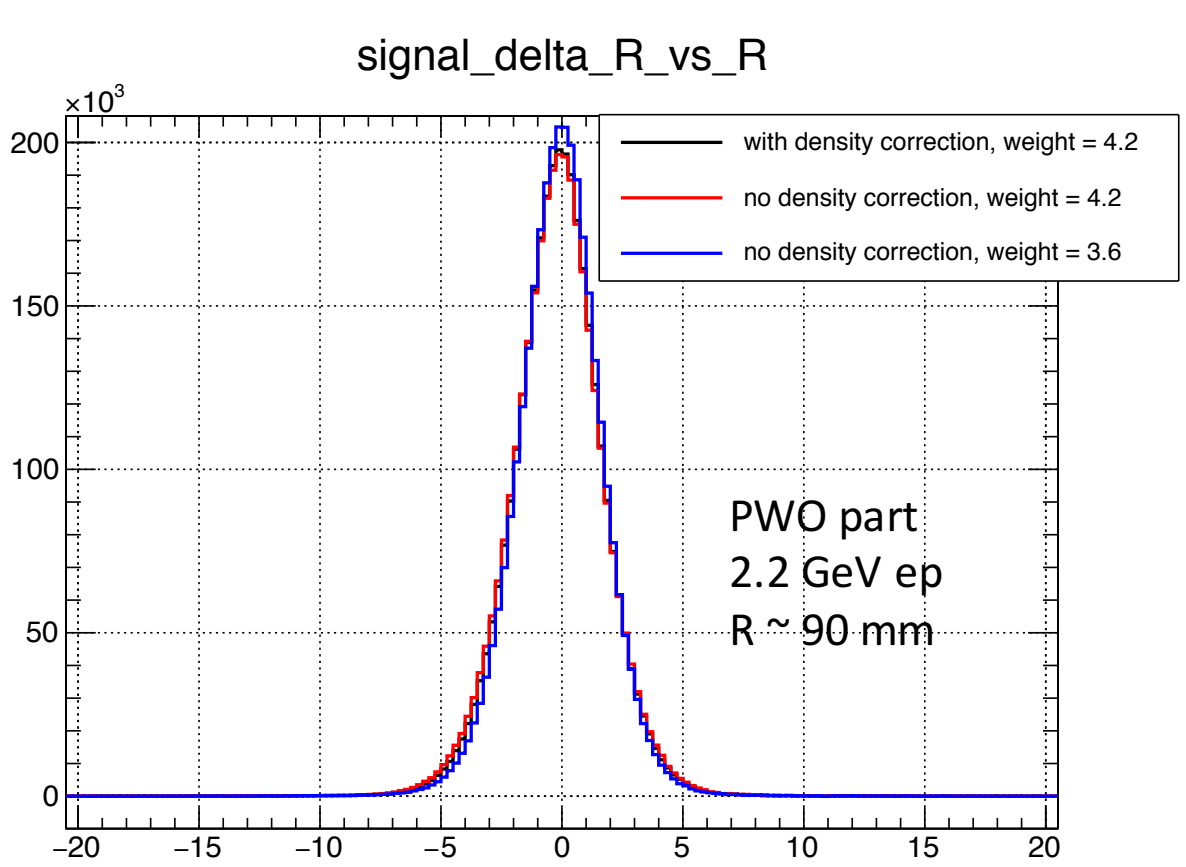


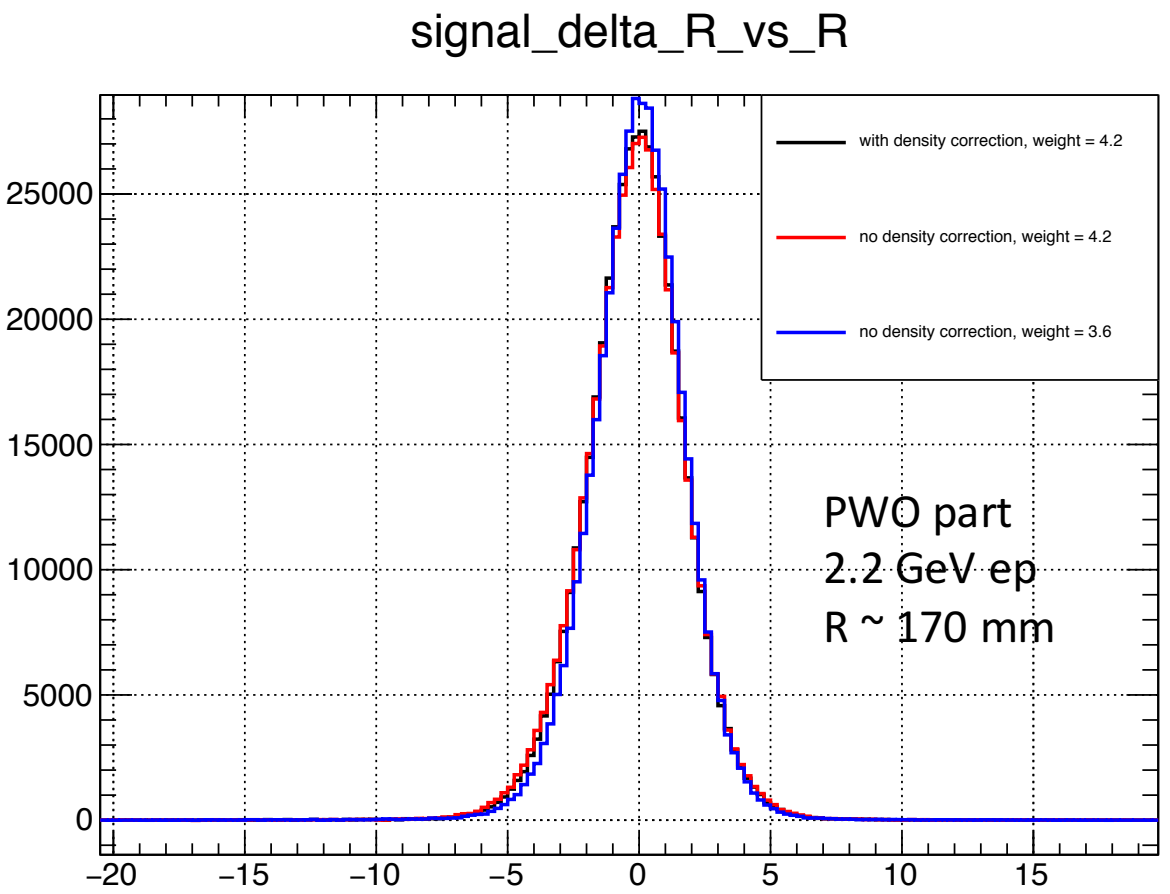


Testing the density correction



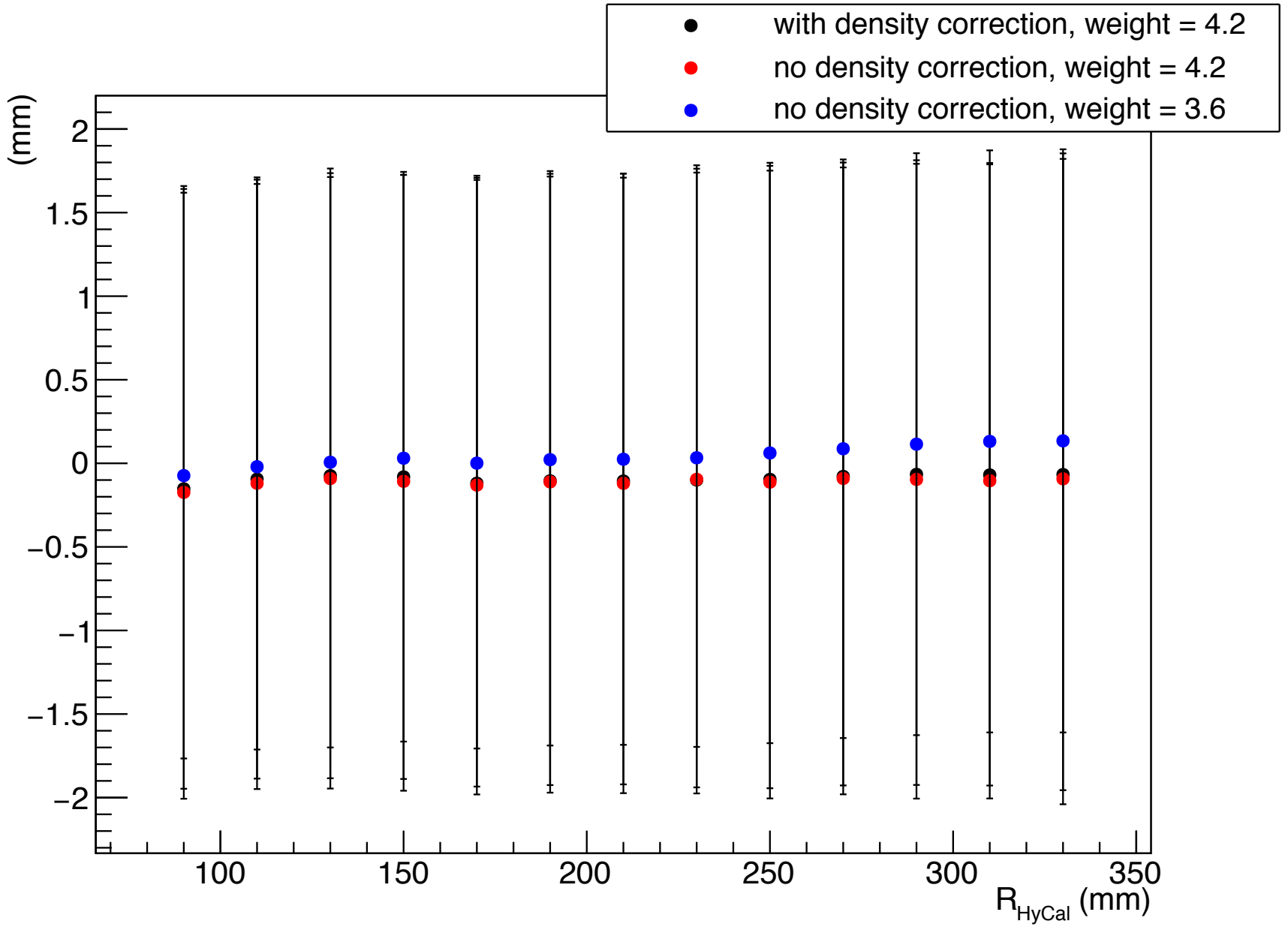
Testing the density correction





Testing the density correction

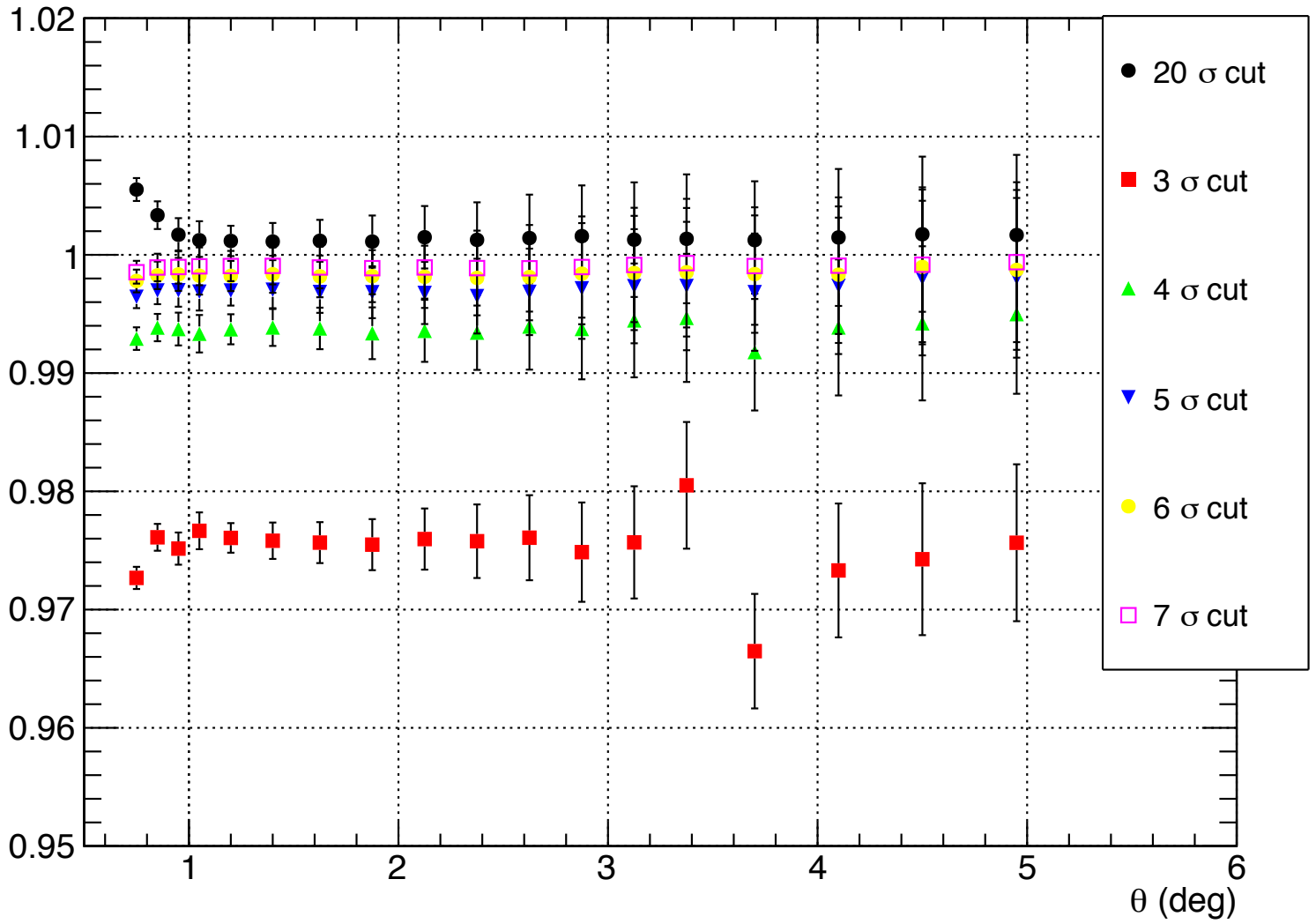
- Data points show the mean value of the **Δ**R distribution for ep
- Error bar is the width of the distribution
- Small shift from 3.6 to 4.2 but it is within 100~200 um



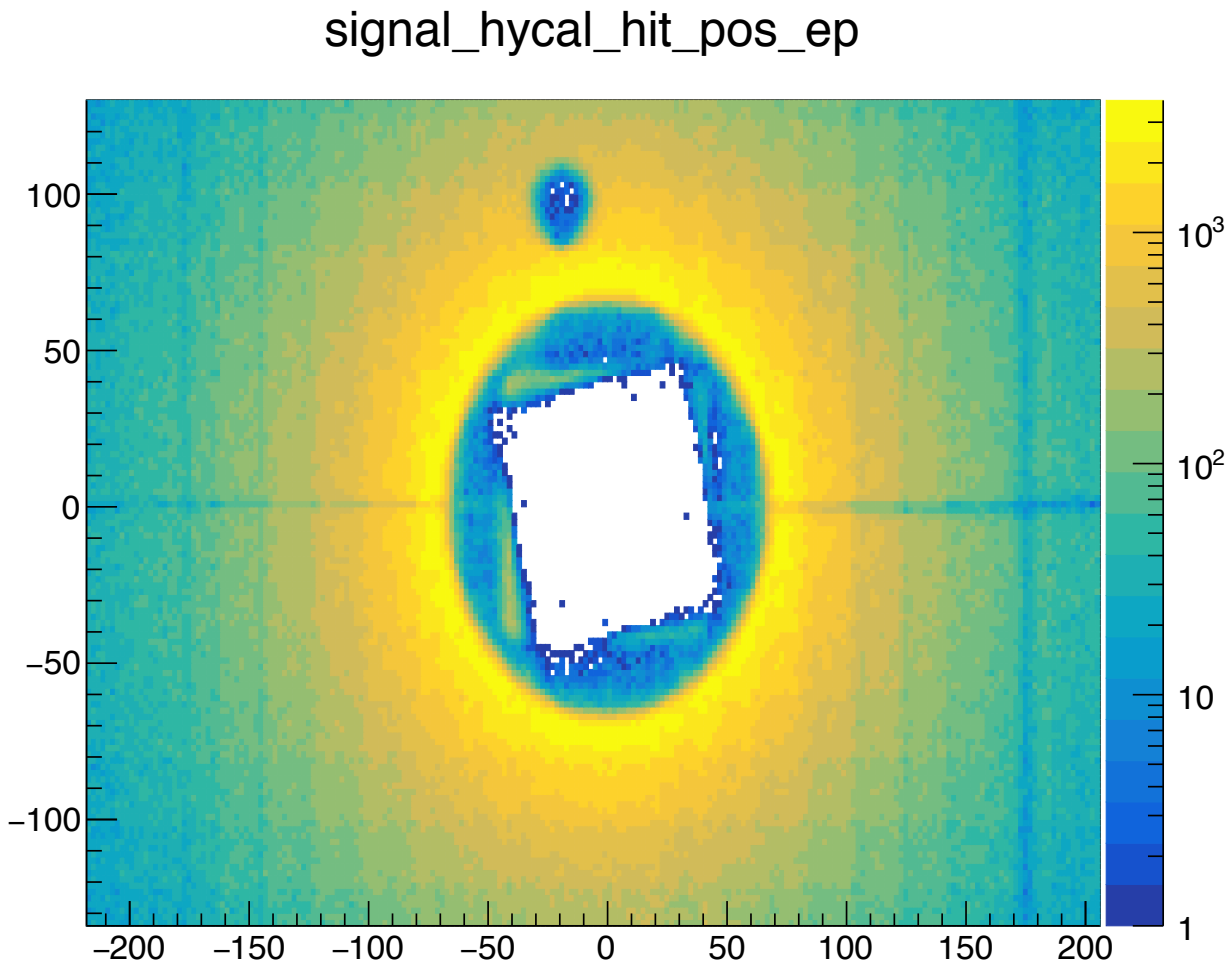
ep yields with different sigma matching cut

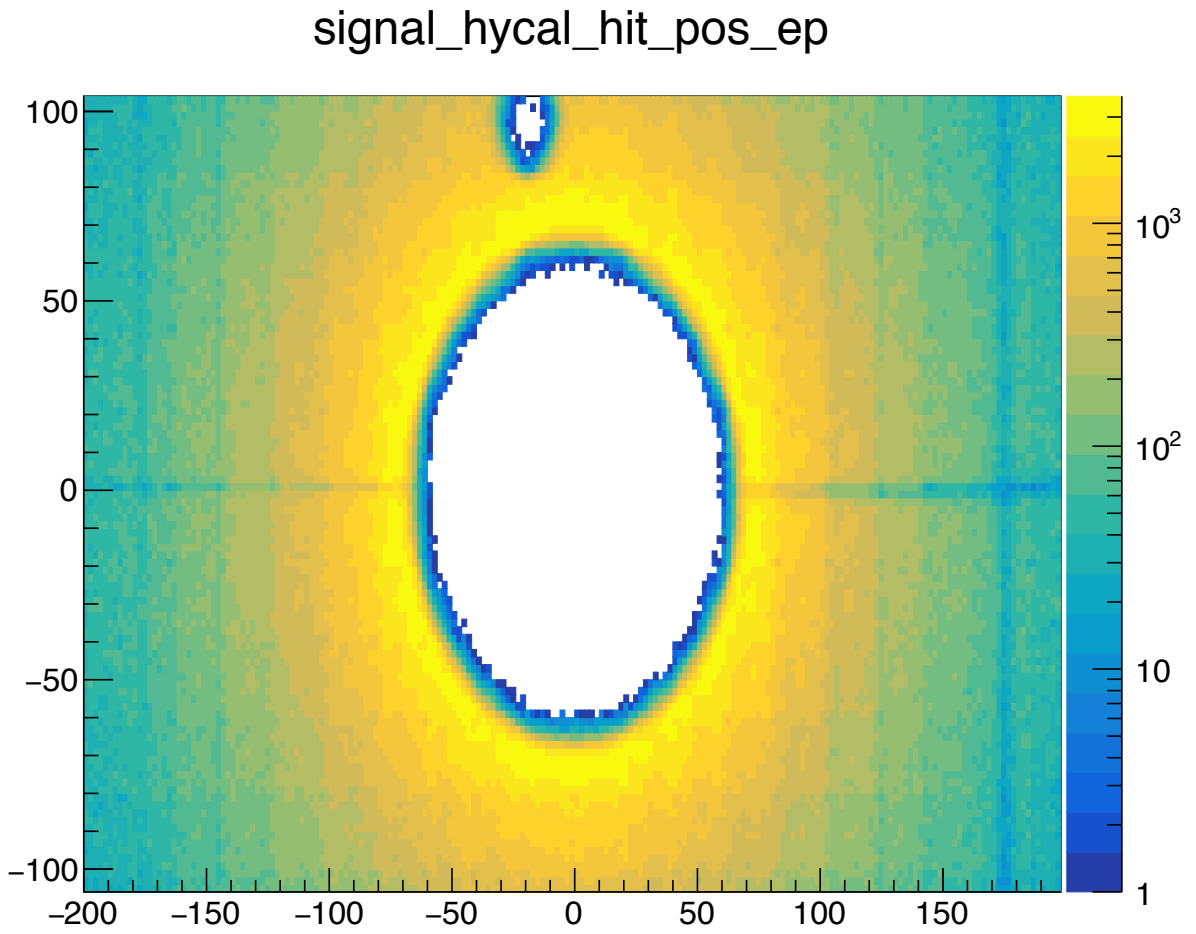
- Yields are normalized to the case with 10 sigma cut

Graph



- Plots shows the HyCal hit position after event selection (left with 20 sigma right with 6 sigma)
- Event selection: (1) matching (2) GEM hit > 0.7 deg

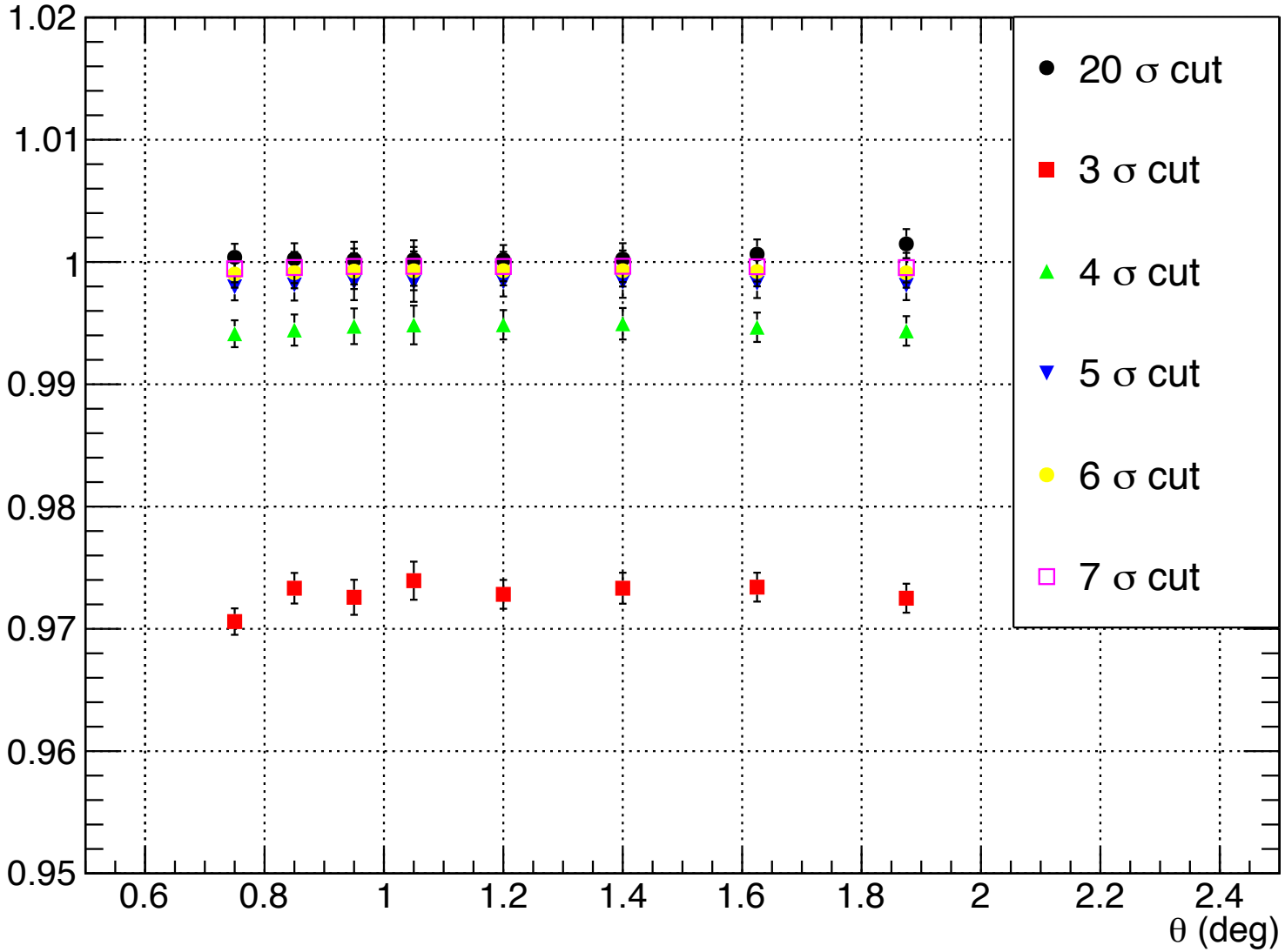




ee yields with different sigma matching cut

- Yields are normalized to the case with 10 sigma cut

Graph



Comparison of yields (GEM matched) with and without density correction

- Both case using free parameter = 4.2 and matching cut = 6 sigma
- Density correction doesn't has a strong effect on the yield that has GEM matching, which is expected