

Radius extraction

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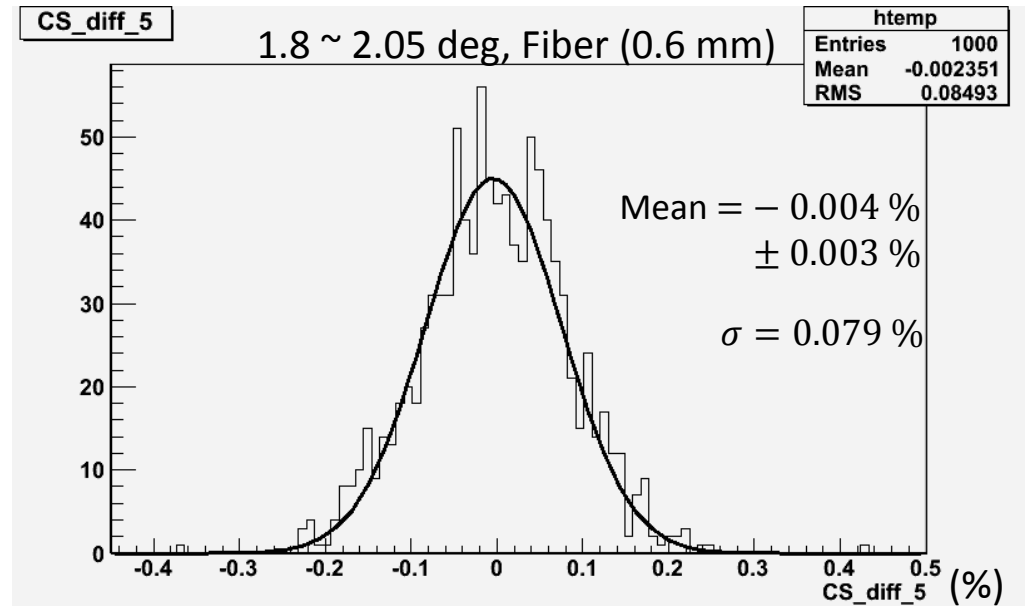
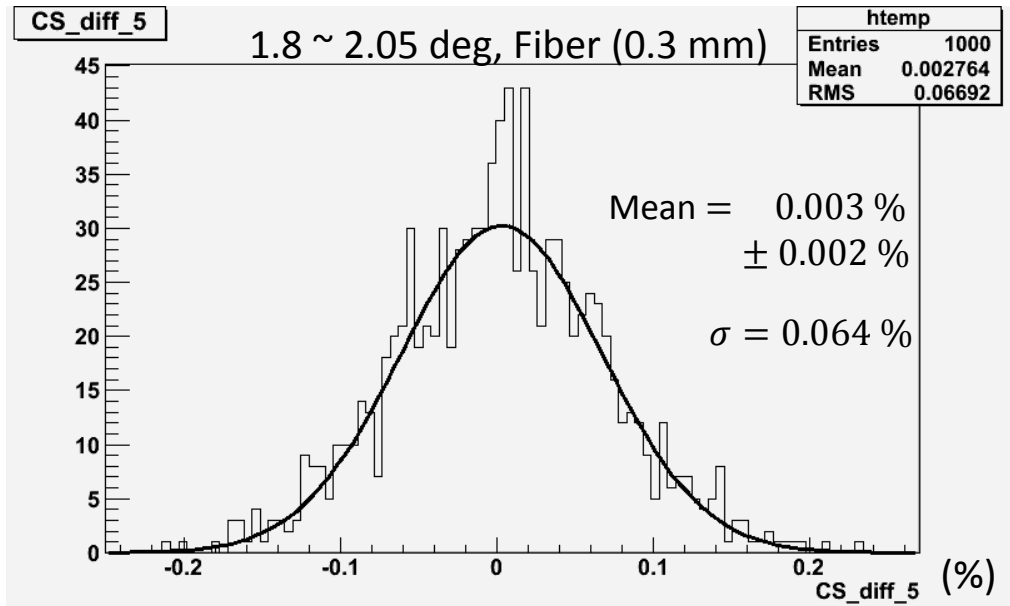
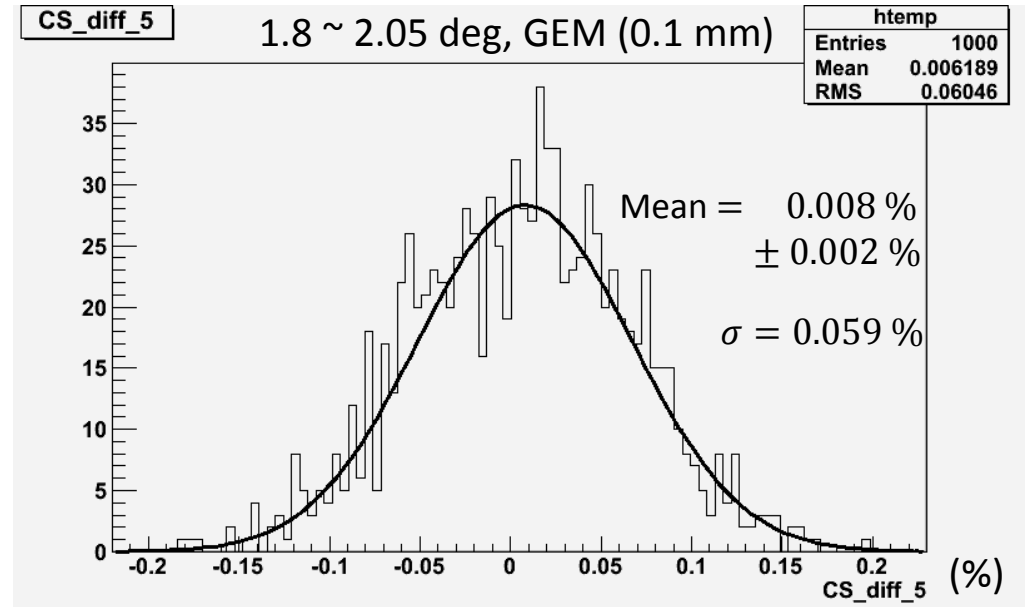
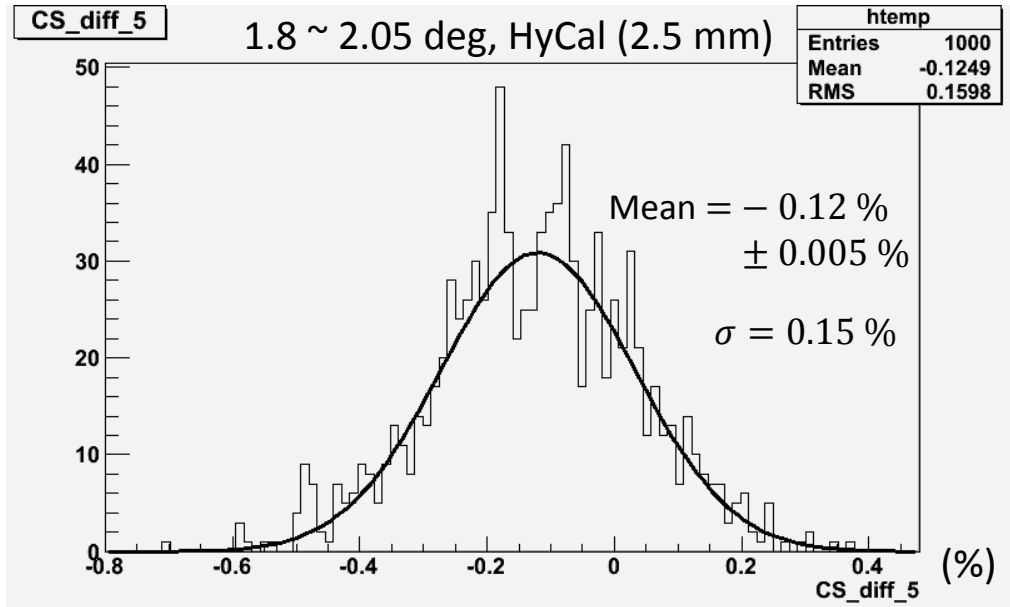
Simulation

- Monte-Carlo simulation, ep and Möller events at Born level are generated (3 days for 1.1 GeV, 12 days for 2.2 GeV)
- Target position uncertainty is included (Gaussian distribution, 1 cm sigma)
- Position and energy recorded on the detectors are smeared with the detectors' resolutions
 - HyCal, 2.5 mm for central part, 5.5 mm for lead glass part
 - GEM, 0.1 mm
 - Fiber, 0.3 mm and 0.6 mm
- Cross-sections are calculated according to the single-arm selection method

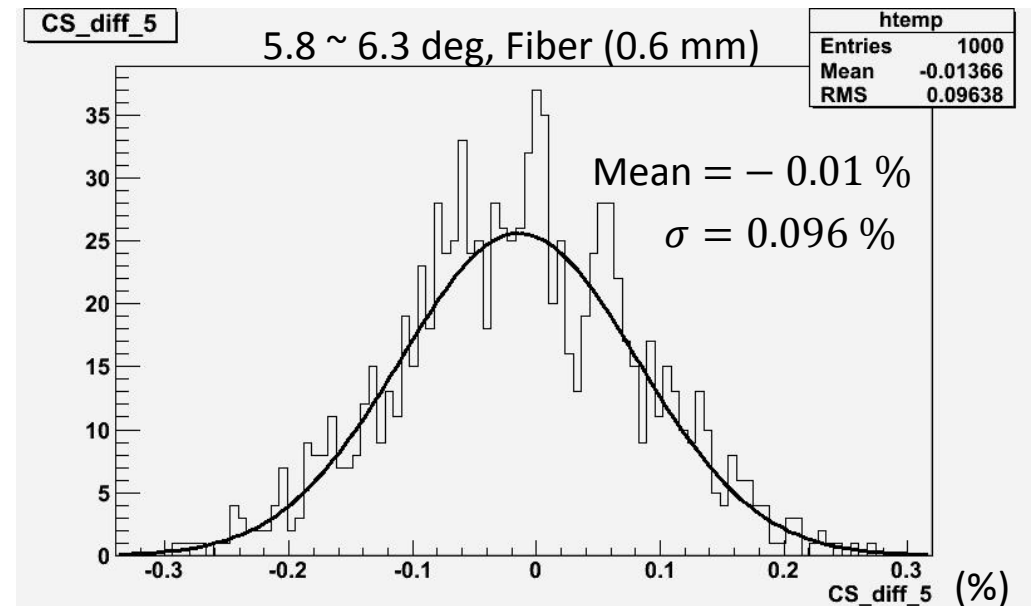
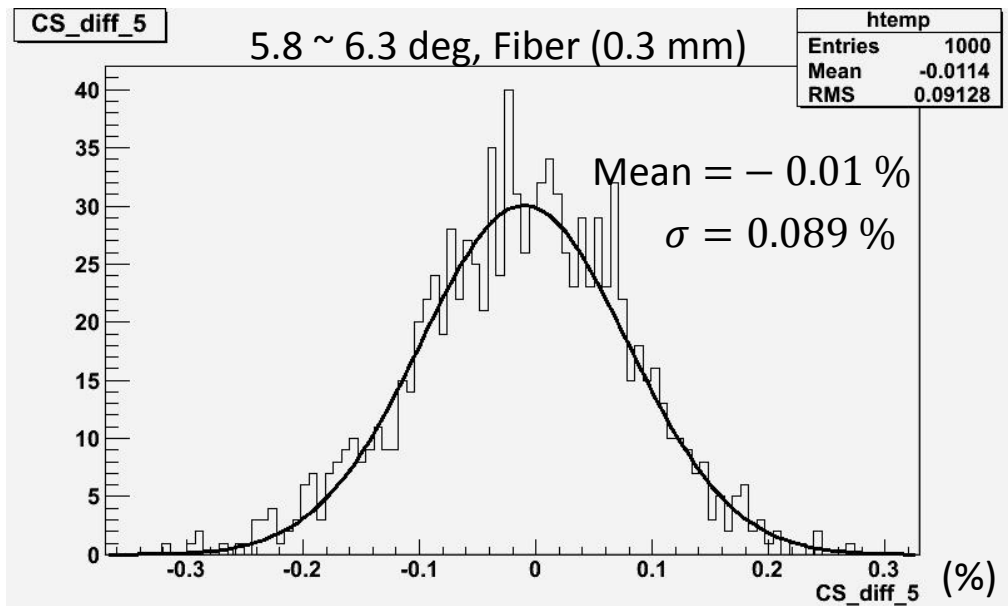
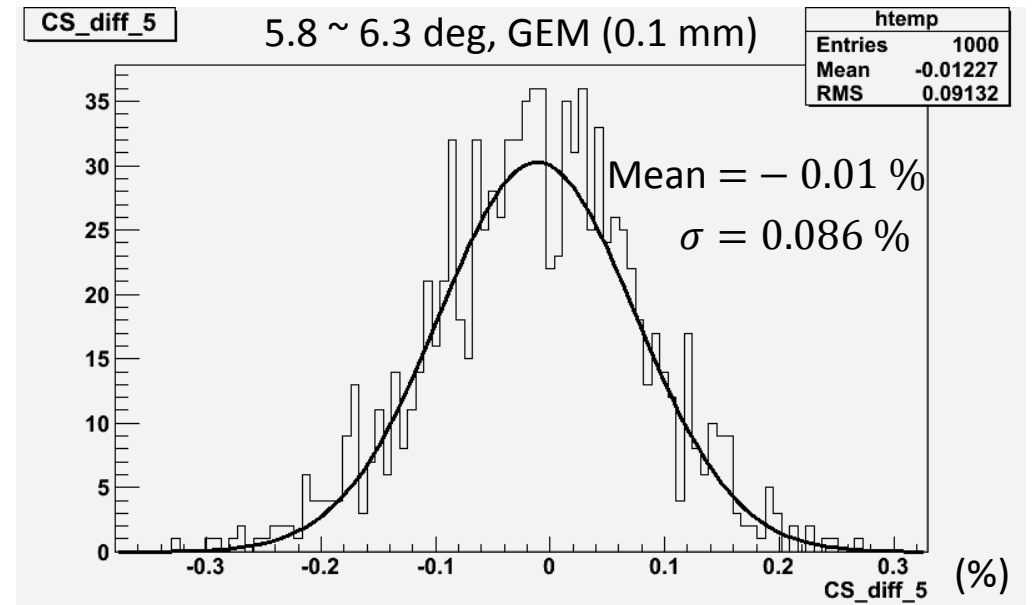
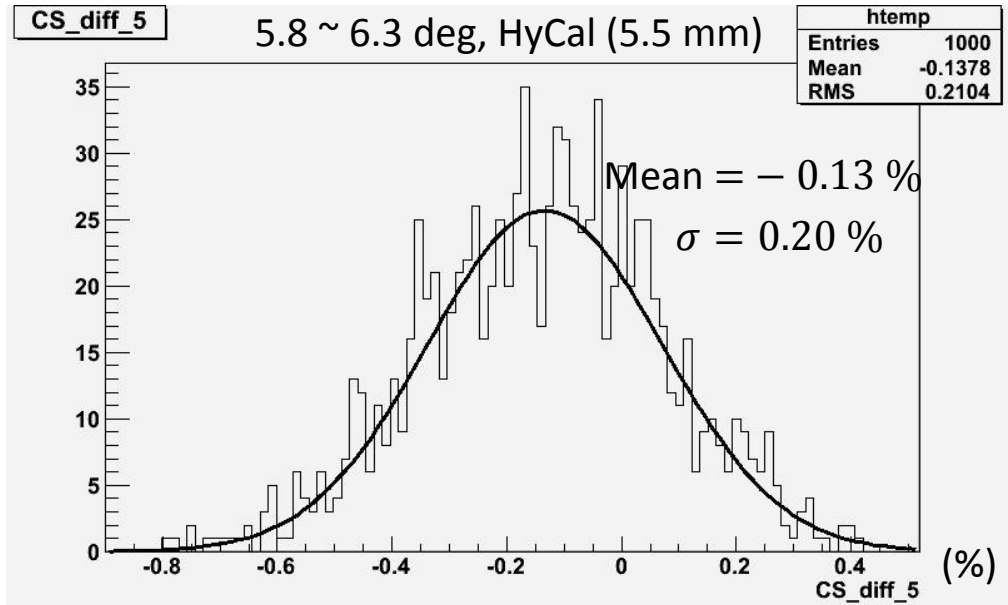
$$\left(\frac{d\sigma}{d\Omega}\right)_{ep}(Q_i^2) = \left[\frac{N_{\text{exp}}^{\text{yield}}(ep \rightarrow ep \text{ in } \theta_i \pm \Delta\theta)}{N_{\text{exp}}^{\text{yield}}(e^-e^- \rightarrow e^-e^-)}\right] \left(\frac{d\sigma}{d\Omega}\right)_{e^-e^-}$$

- Q^2 is determined by angle and incident beam energy, resolution on determining Q_i^2 is considered in the fitting

Uncertainty of the measured cross sections



Uncertainty of the measured cross sections

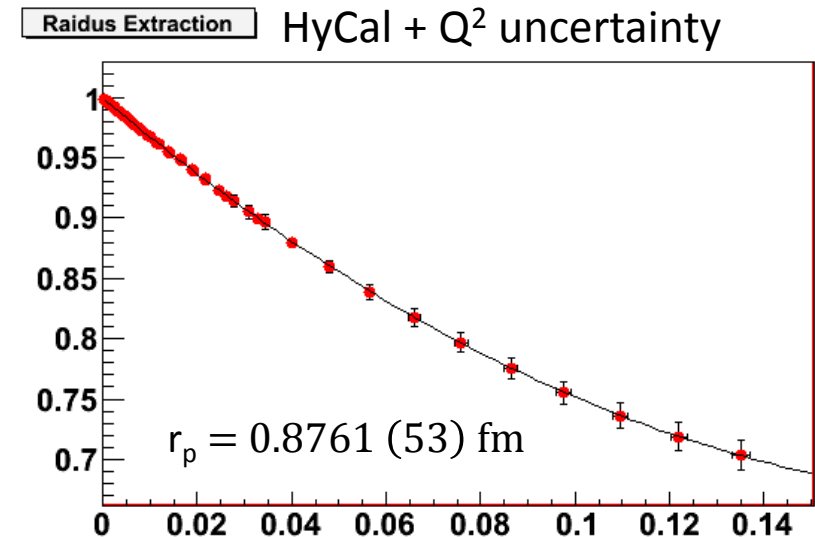
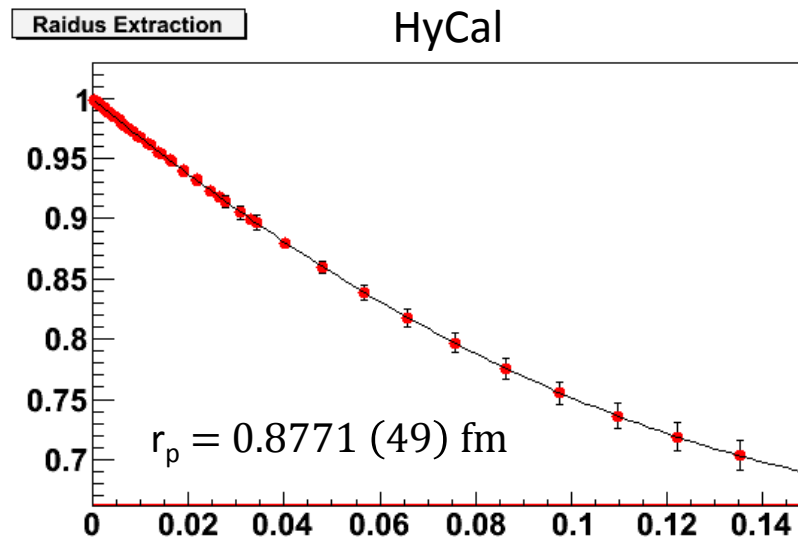


Cross-sections uncertainty

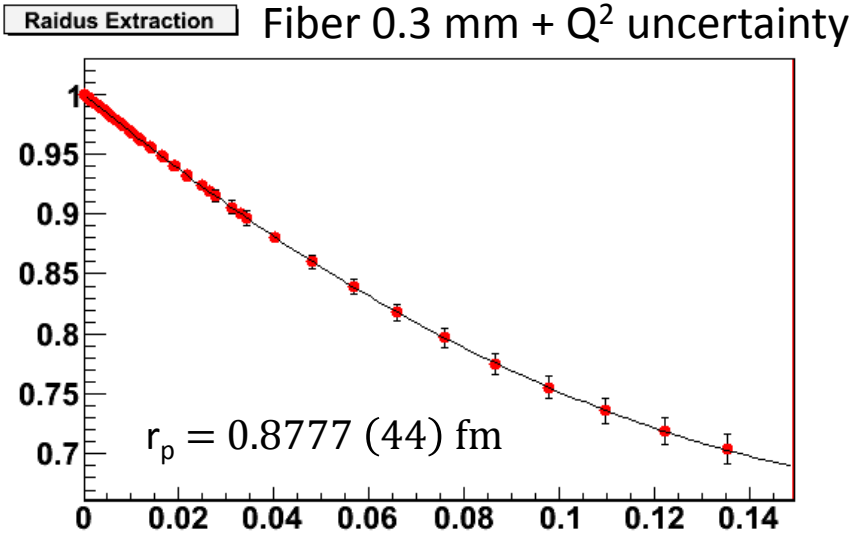
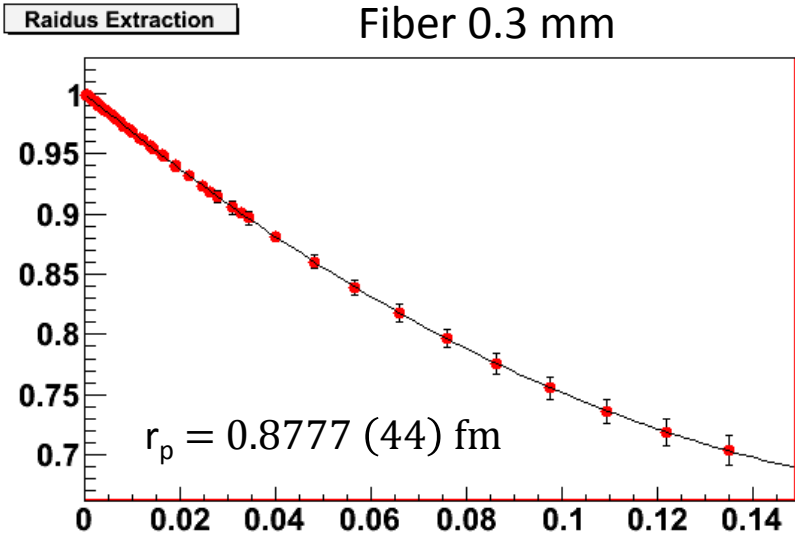
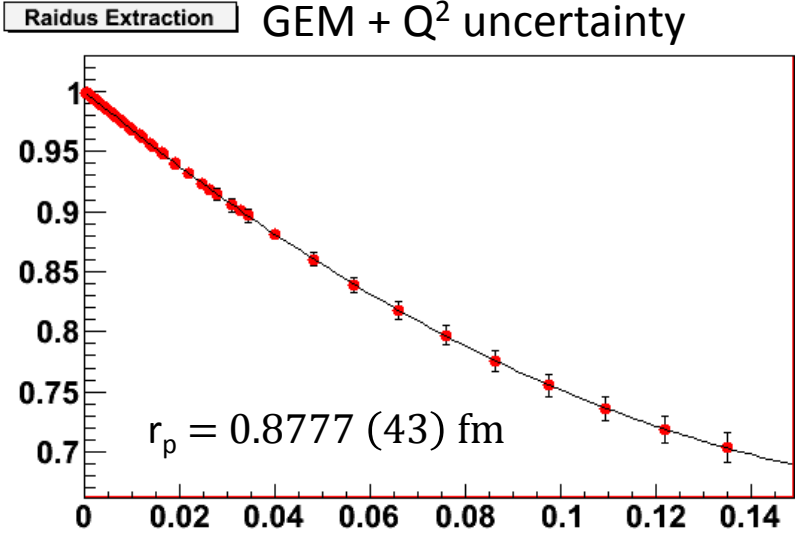
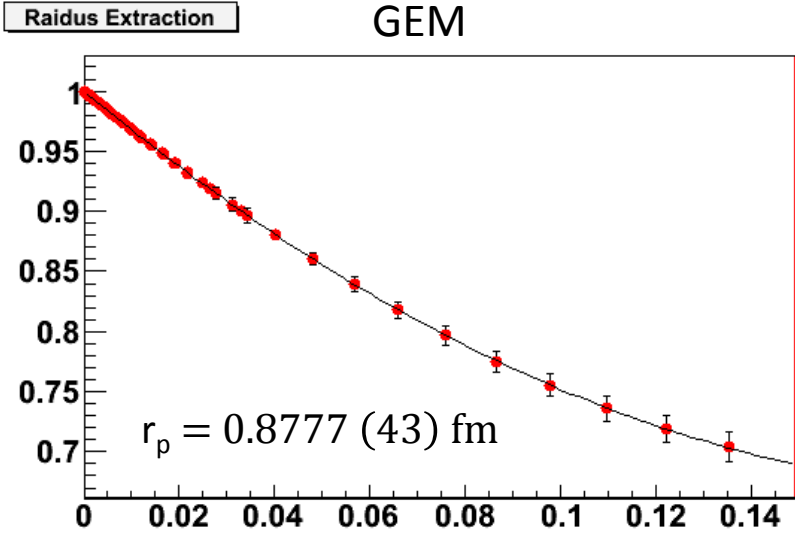
- For some bins, the mean difference with the true values is not 0, this is due to the different distributions of ep and Möller events and the smearing effects
 - It can be reduced by improving the angular resolution
 - This is set to be the systematical error in the fitting
- The sigma of the different fittings is also related to the angular resolution, it will be added to the statistical uncertainty in the radius fitting

Radius extraction

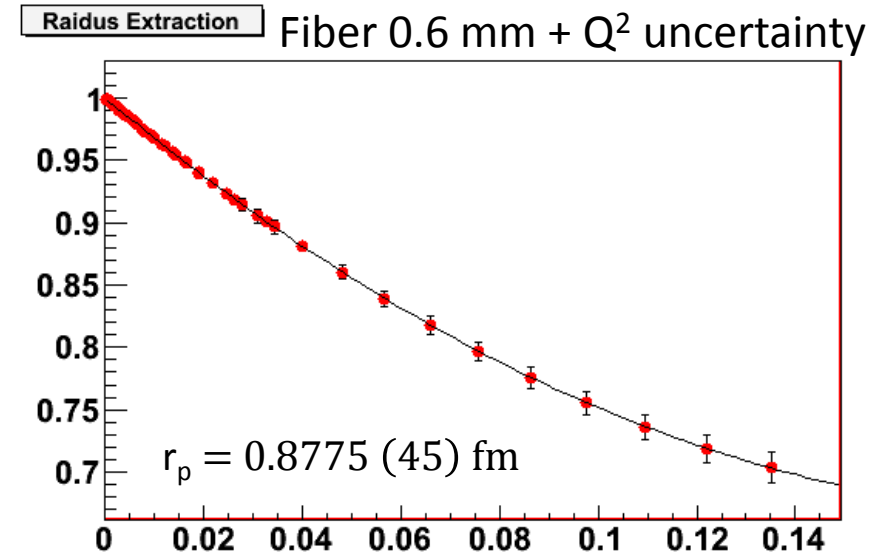
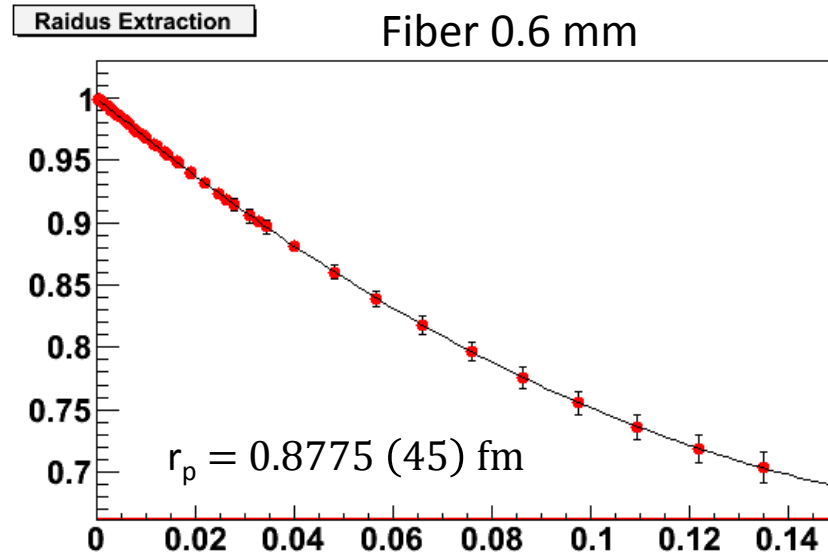
- $r_p = 0.8768$ fm in code
- Uncertainties on plot
 - Uncertainties from the simulation included
 - Statistical uncertainty $1/\sqrt{N}$ for each bin included
 - Q^2 resolution is directly added in the right plot



Radius extraction



Radius extraction



Summary

- Additional tracking device can improve the final extracted radius
 - Additional detector may reduce other systematics
 - The biased position reconstruction of HyCal is not considered in this study
- The effect of Q^2 resolution on the fitting is negligible
 - The binning can further reduce the Q^2 uncertainty, so the effect will be even smaller