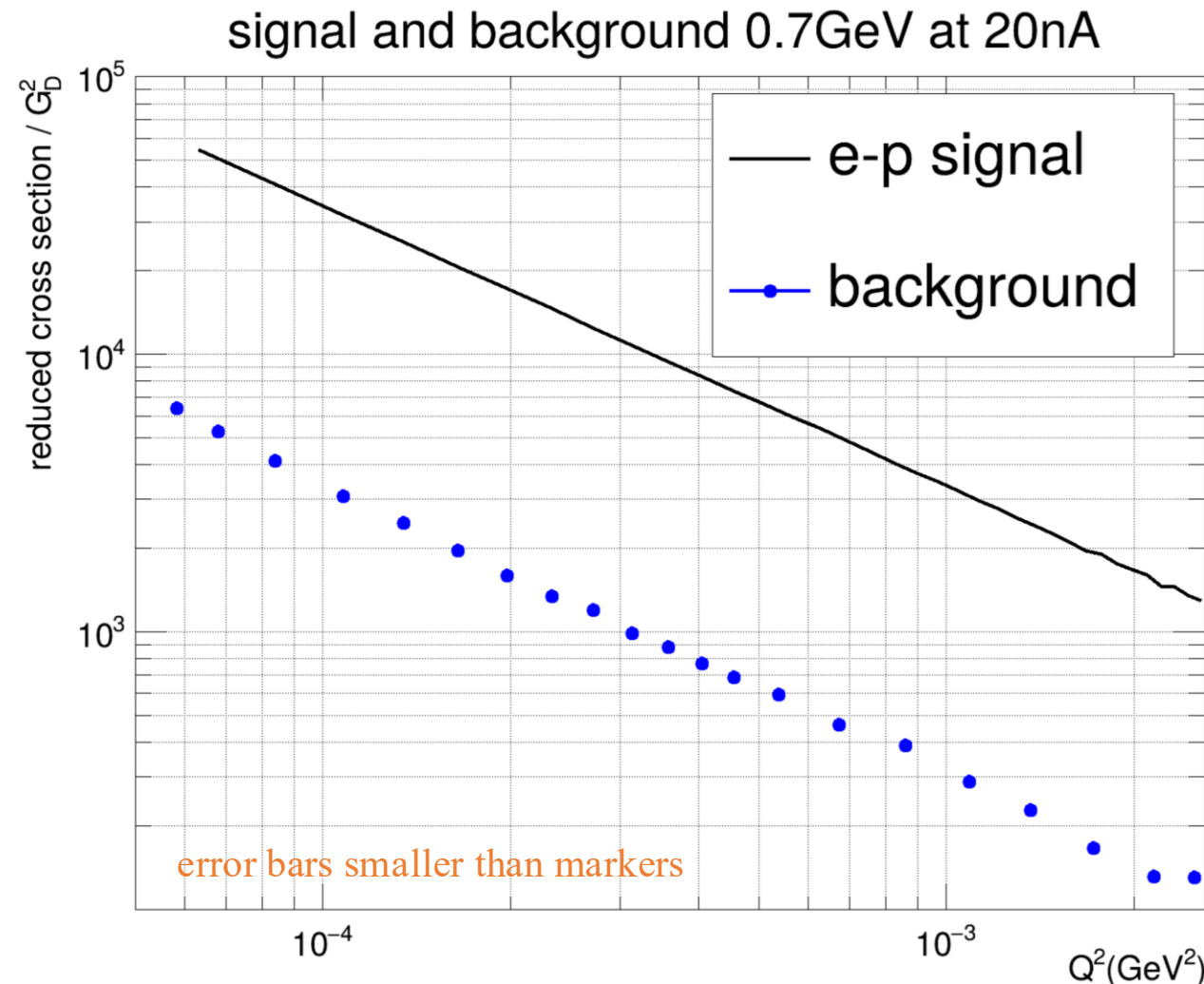# ERR – PRad-II Recommendation #2

Recommendation:

A plot of reduced cross section vs Q^2 showing signal events and expected background events would help everyone see the potential for the background correction to introduce systematic errors into the radius determination.

signal and background 0.7GeV at 20nA

error bars smaller than markers

- Results based on beam halo level of $\mathbf{10^{-5}}$, dominated by target cell windows
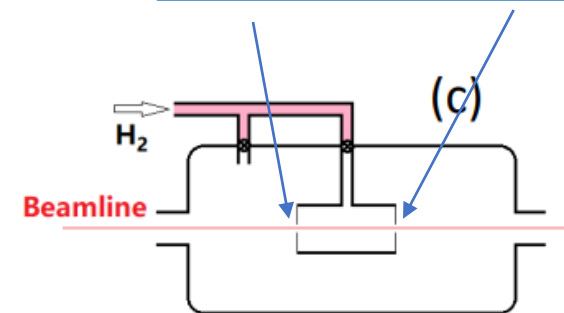
- **~9%** total background to signal ratio at 0.7GeV, no obvious angular dependence.
- For other energies, the backgrounds are lower.
- Systematic uncertainty associated with background subtraction is expected to be 0.1% (see slides 4-6 for details)

ERR – PRad-II Recommendation #4

Recommendation:

The beam background contributions and associated uncertainties presented at the review were based on the beam halo level of 10^{-7}, consistent with the original PAC proposal. On the other hand, the beam halo requirements were modified to 10^{-5} during the review. The beam background contributions and the corresponding uncertainties should be evaluated for beam halo levels of 10^{-5}. Alternatively, the capability to measure the beam halo down to the level of 10^{-7} should be demonstrated.
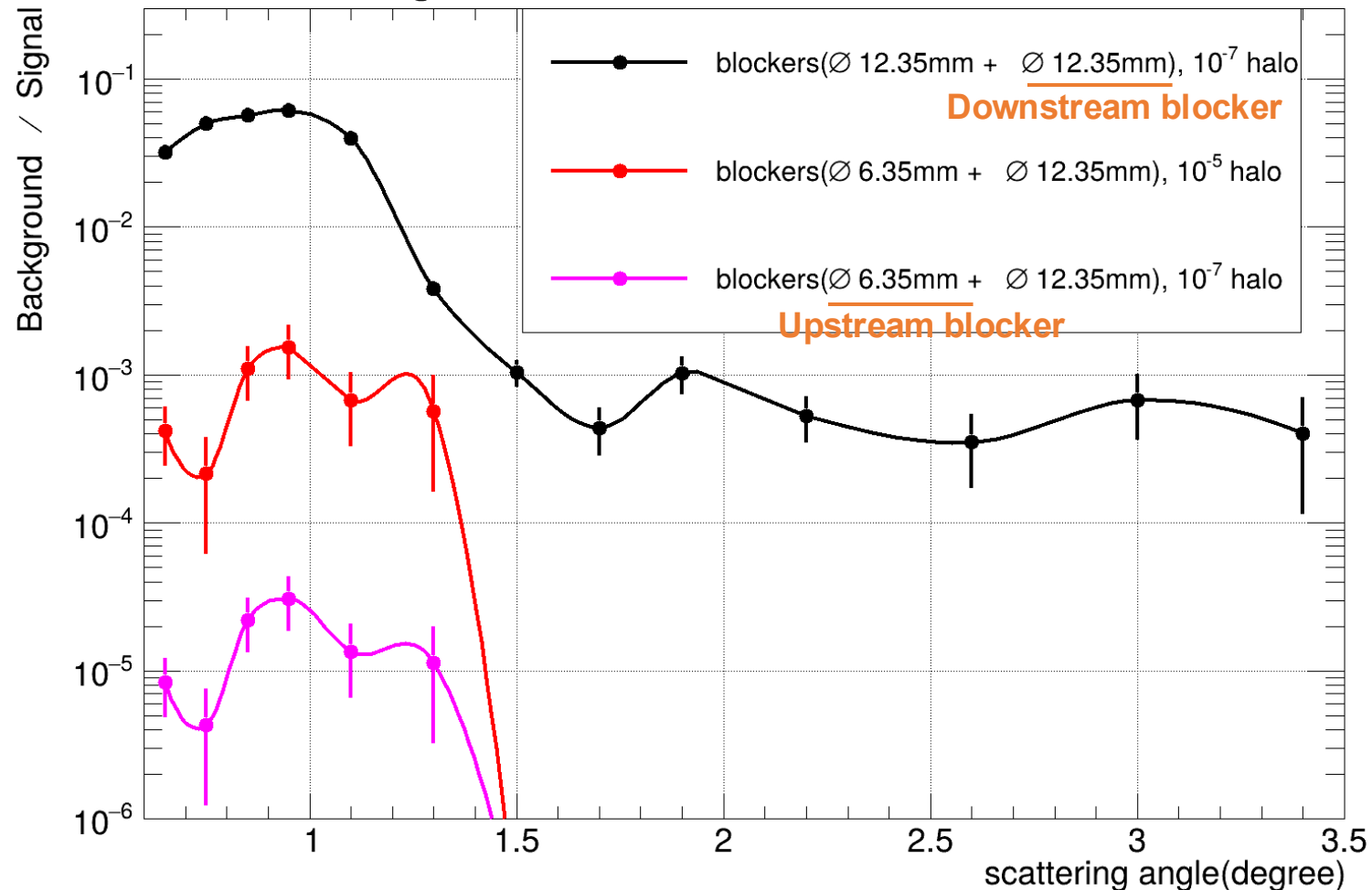
Black curve:
- $\varnothing 12.35mm$ upstream halo blocker
- 10^{-7} halo level
- Background to signal (B/S) ratio ~**4%** at small angles

Magenta curve:
- $\varnothing 6.35mm$ upstream halo blocker
- 10^{-7} halo level
- B/S ratio ~**0.002%** at small angles

Red curve:
- $\varnothing 6.35mm$ upstream halo blocker
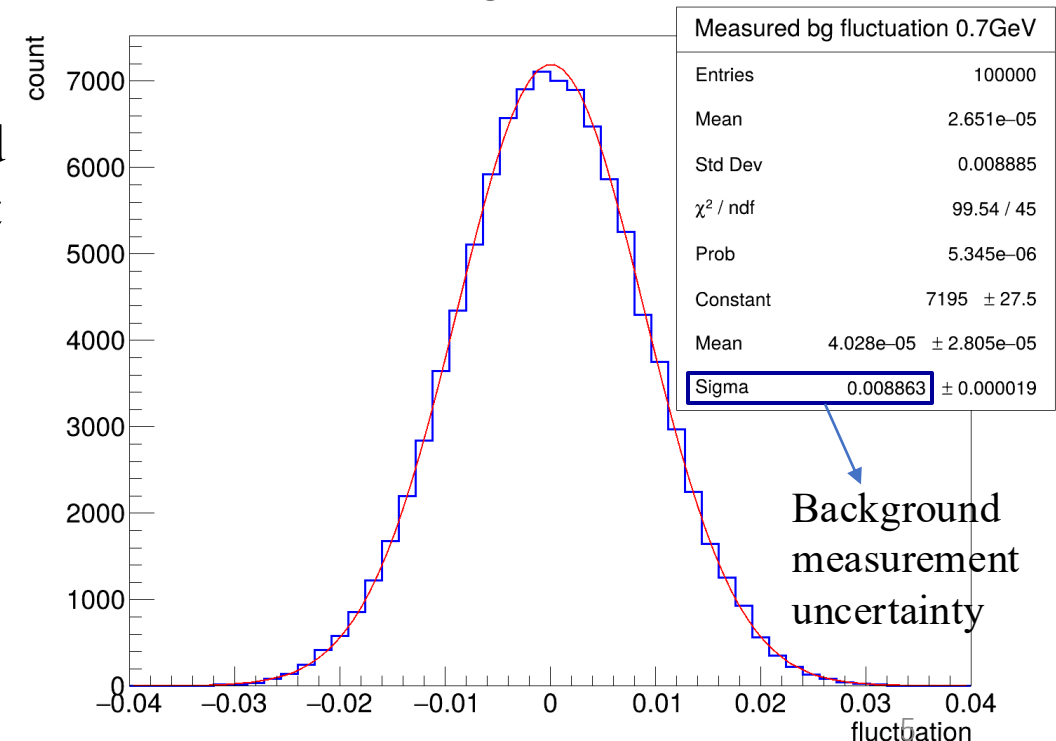- 10^{-5} **halo level**
- B/S ratio ~ **0.1%** at small angles.
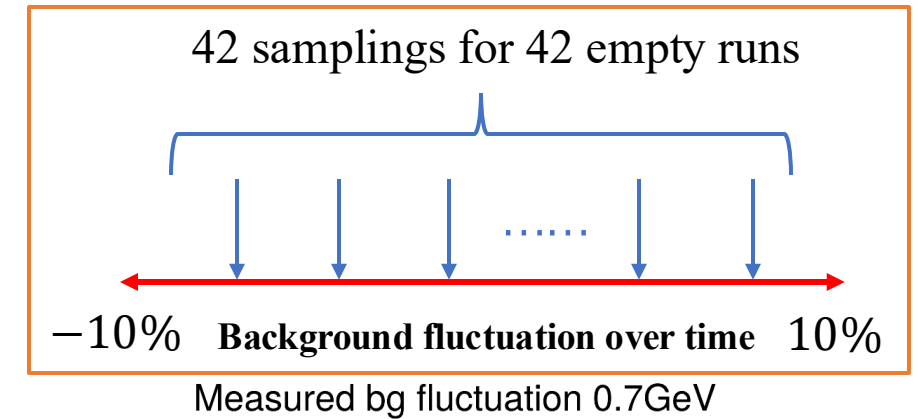
Additional information

- PRad data: Moller background/signal ratio is ~1.7% (**c–d**, from beam halo incident on target cell window)

- Simulation assumptions: halo level 10^{-5}, Moller background/signal ratio 1.7%, as observed in the PRad data

- The simulation matches the PRad data very well, suggesting PRad data consistent with a halo level of 10^{-5}
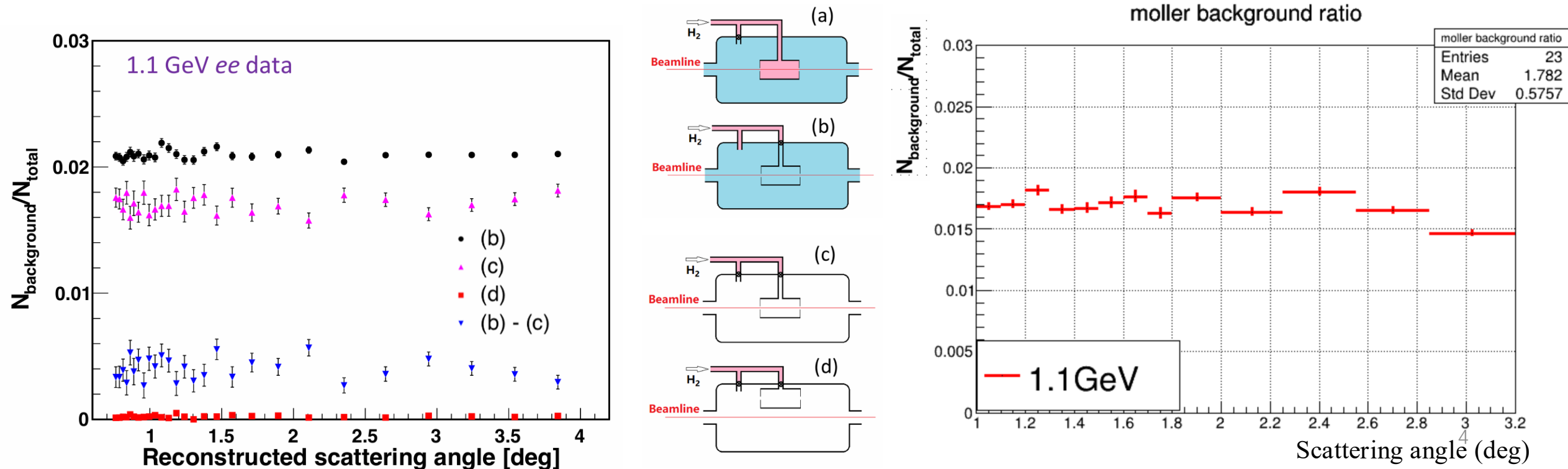
Halo Background Subtraction Uncertainty

- **Assume 1 empty target run after every 3 production runs (like PRad)**

- 7 PAC days for 0.7GeV, in total 126 production runs and 42 empty target runs.

- Assume halo with $\pm 10\%$ fluctuation over time based on PRad data, carry out 42 samplings through out the total period to get the average syst. uncertainty from time variation.

- The uncertainty of background measurement due to background fluctuation is 0.89%. For ~10% B/S ratio, systematic uncertainty due to background subtraction will be 0.1%

42 samplings for 42 empty runs

-10% **Background fluctuation over time** 10%

Measured bg fluctuation 0.7GeV

Measured bg fluctuation 0.7GeV	
Entries	100000
Mean	2.651e−05
Std Dev	0.008885
χ^2 / ndf	99.54 / 45
Prob	5.345e−06
Constant	7195 ± 27.5
Mean	4.028e−05 ± 2.805e−05
Sigma	0.008863 ± 0.000019

Background measurement uncertainty

Halo Background Subtraction Uncertainty

- **1 empty target run after every 3 production runs**

- Assume **10%** B/S ratio in each bin

- The projected systematic uncertainty of subtraction due to background statistics ~ **0.1%**

statistical uncertainty of signal and background