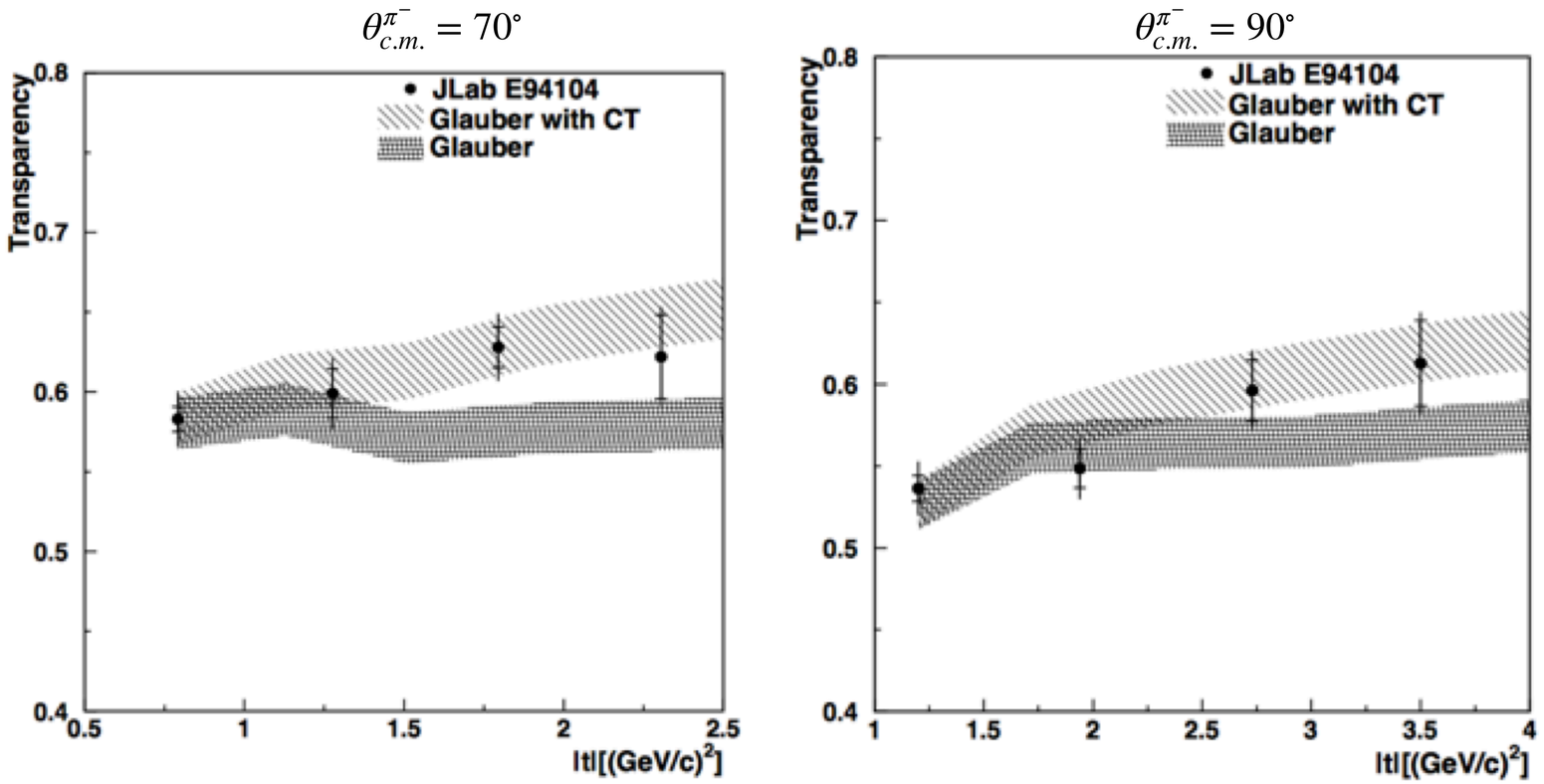
Nuclear transparency with $\gamma n \rightarrow \pi^- p$ channel

- Definition: $T = \frac{\sigma_N}{\sigma_0}$ (N: bound nucleon, 0: free nucleon)
- $T_{^4He} = \frac{\sigma_{^4He}}{\sigma_{^2H}} T_{^2H}$, due to the lack of free neutron target
- Color transparency: transparency close to 1 at high momentum transfer
- Exclusive processes prefer color singlet with small transverse size

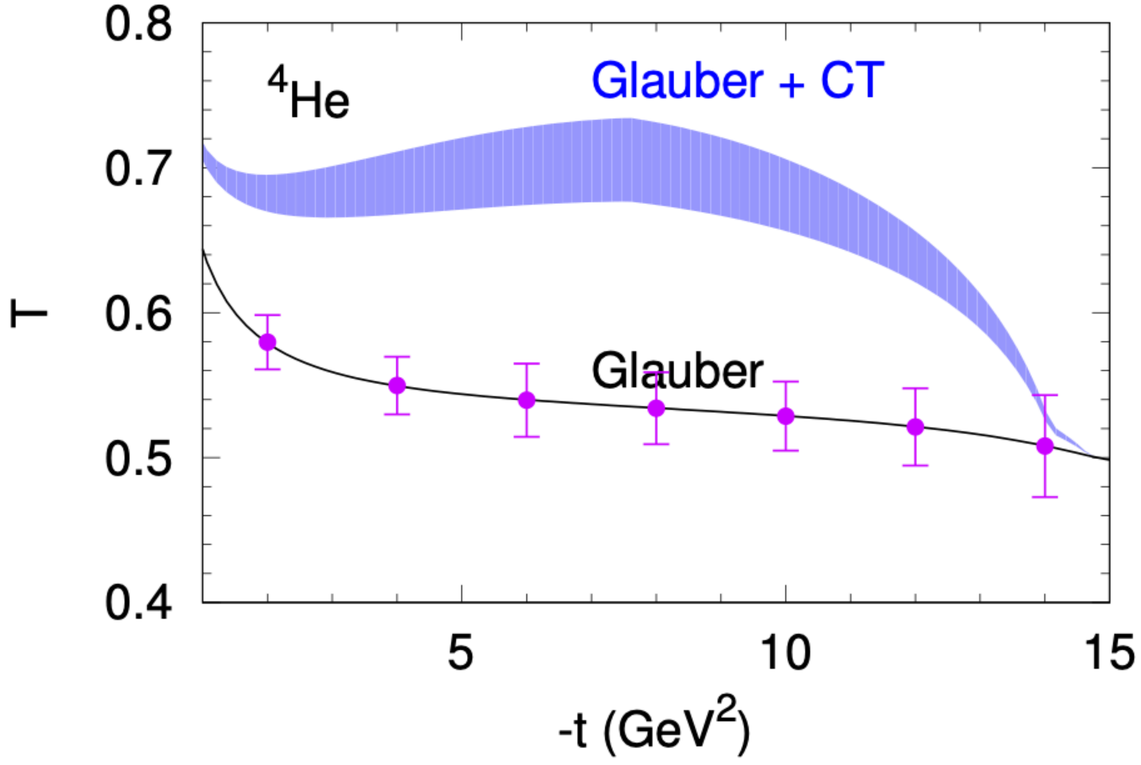
Nuclear transparency with $\gamma n \rightarrow \pi^- p$ channel

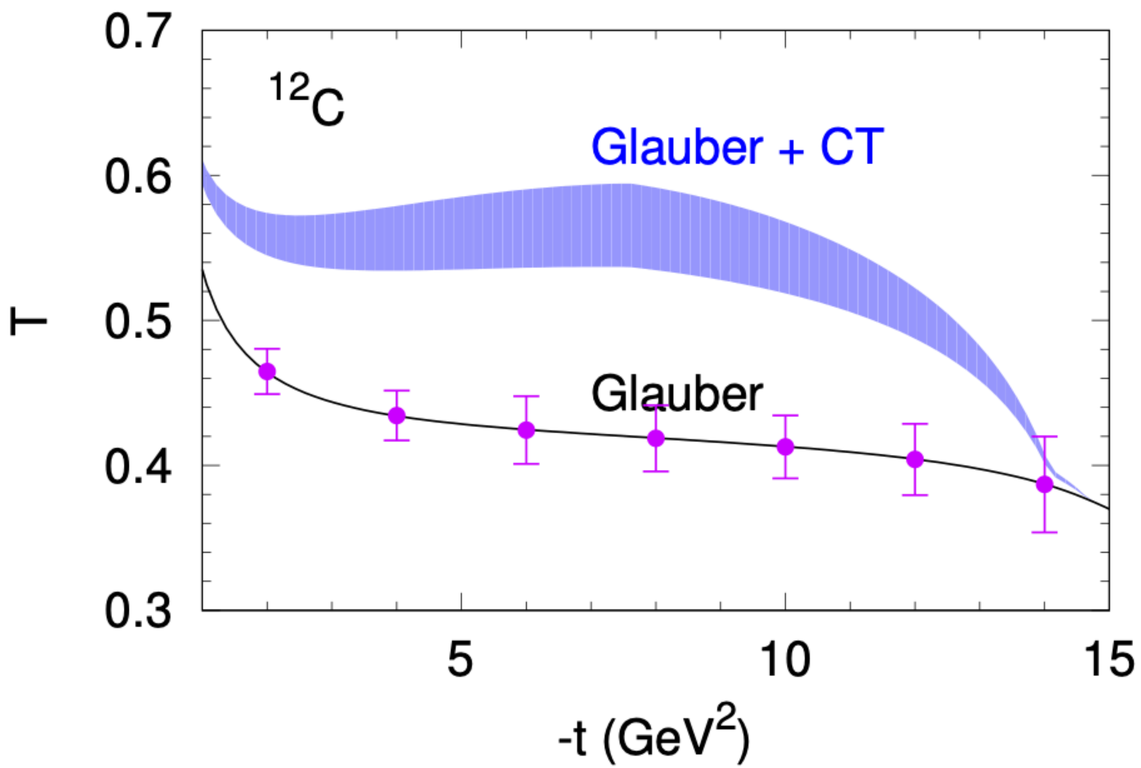
- Previous Hall A measurements from 1.6-4.5 GeV
- Not precise enough to distinguish between theory models



Nuclear transparency with $\gamma n \rightarrow \pi^- p$ channel

- Estimation of the SRC-CT experiment

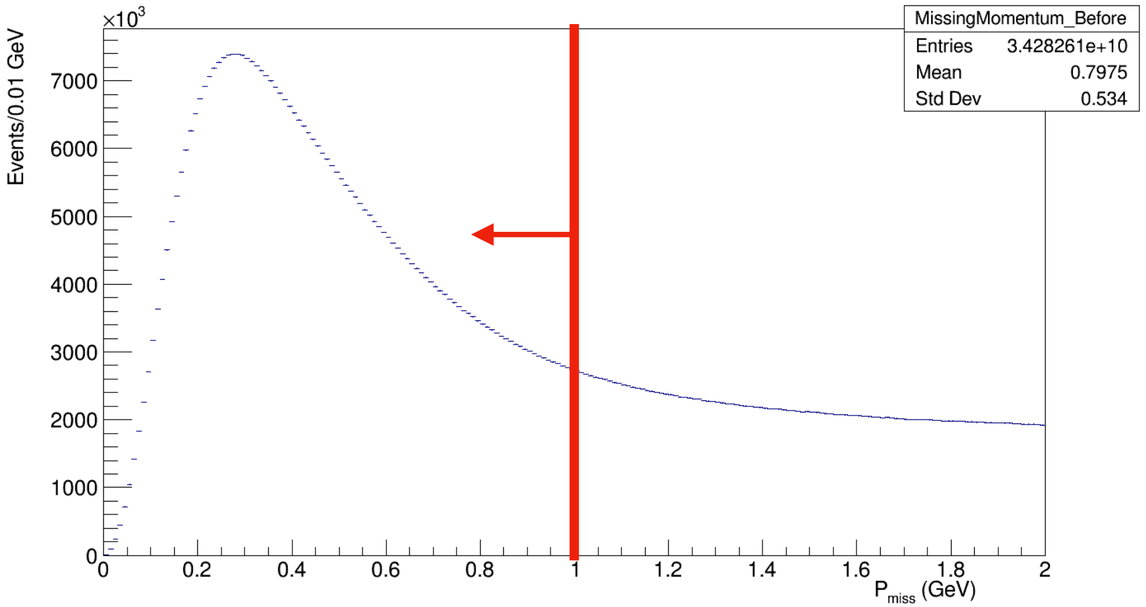




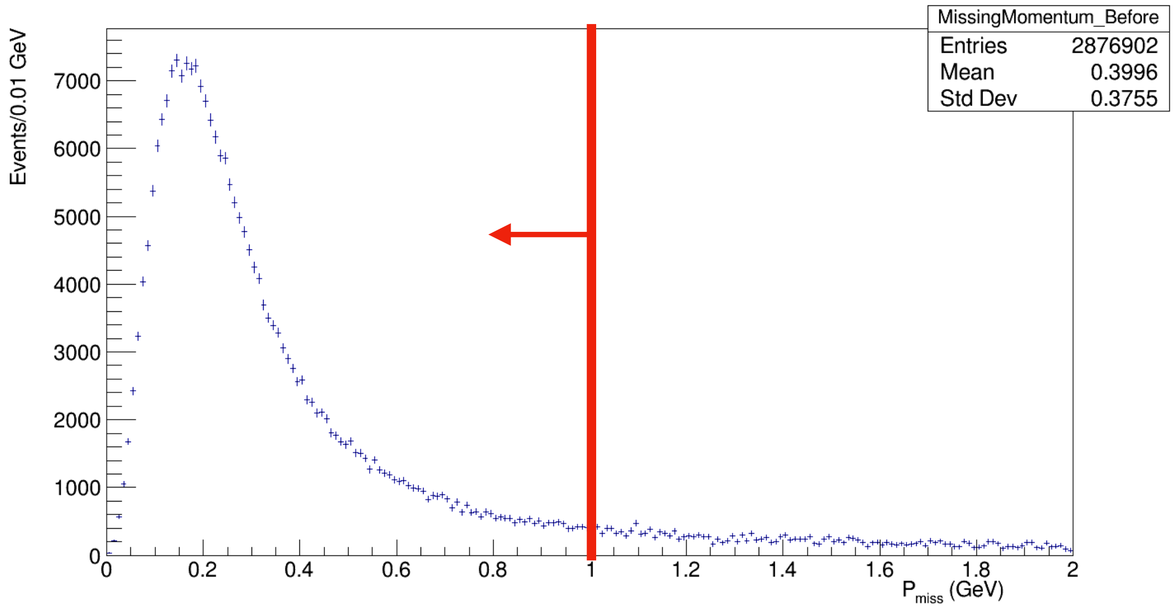
Nuclear transparency with $\gamma n \rightarrow \pi^- p$ channel

- Event selection on helium data
- Similar to deuterium data, except
- $P_{miss} < 1.0$ GeV

Data



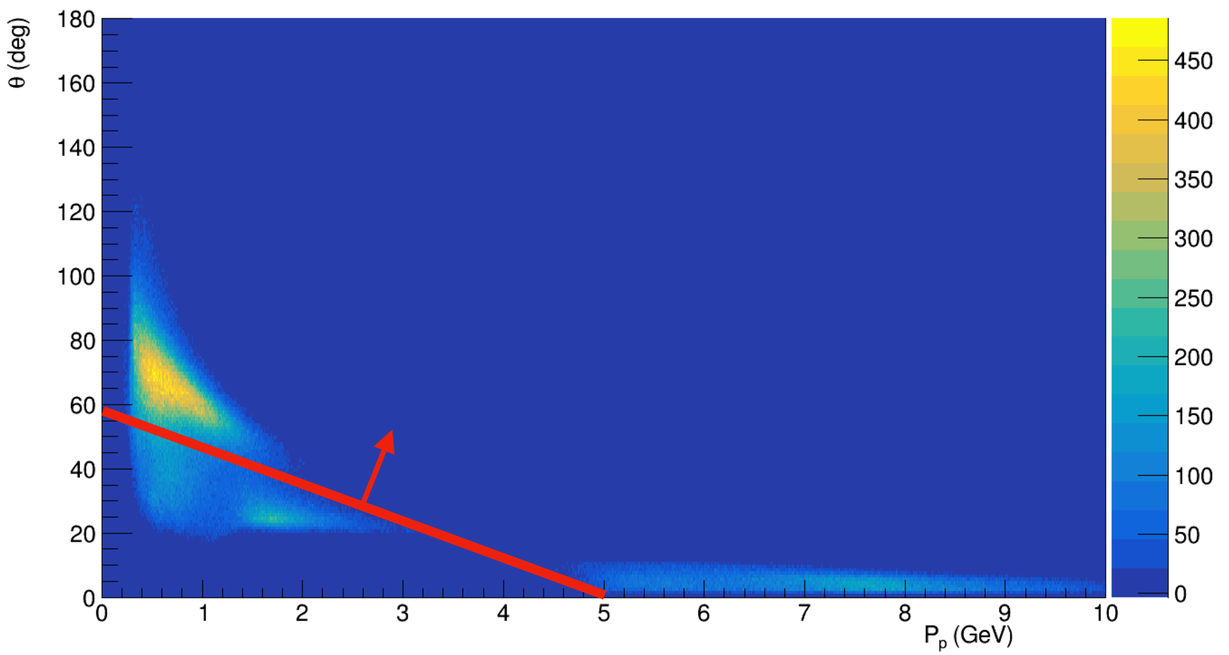
Sim



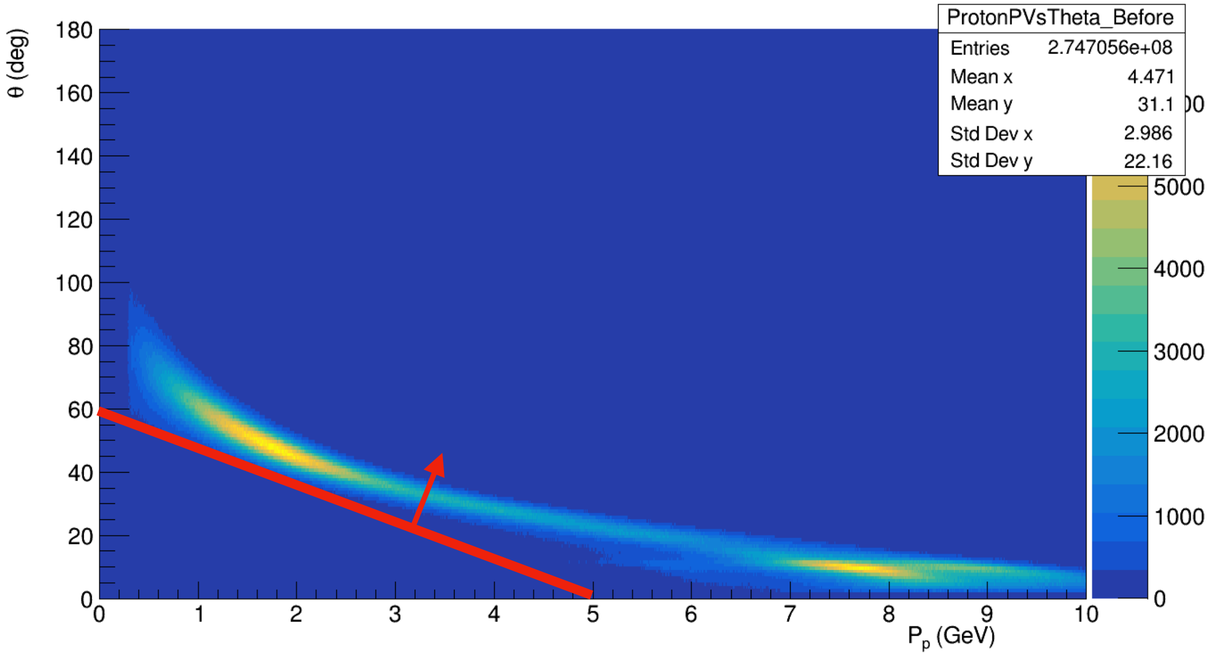
Nuclear transparency with $\gamma n \rightarrow \pi^- p$ channel

- Proton kinematics cut
- $\rho^0 \rightarrow \pi^-\pi^+$ with π^+ misidentified (small angle and momentum)

Data



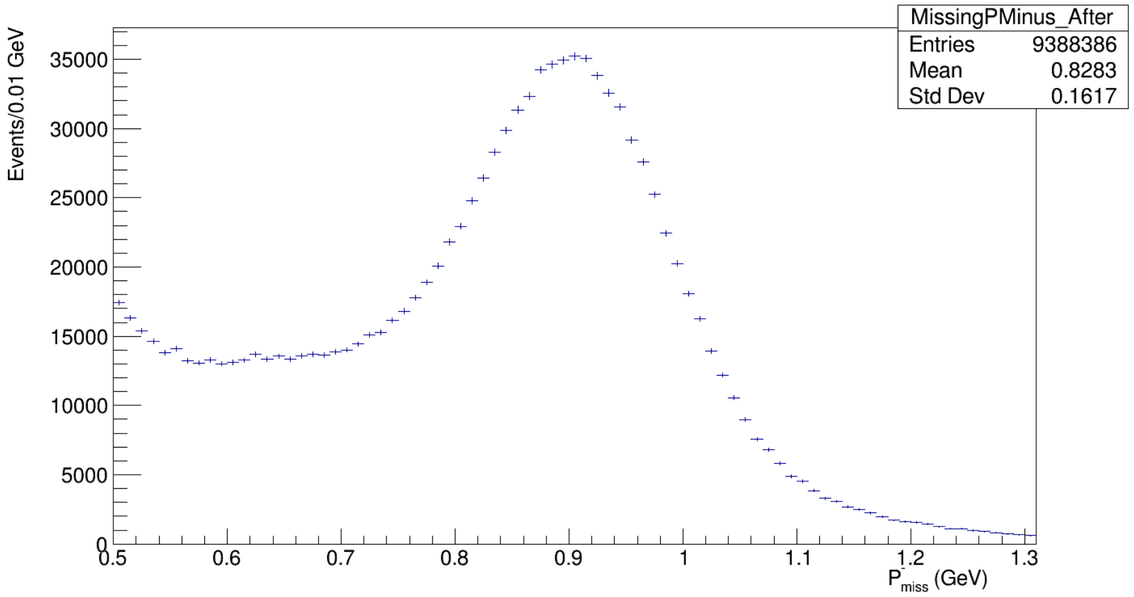
Sim



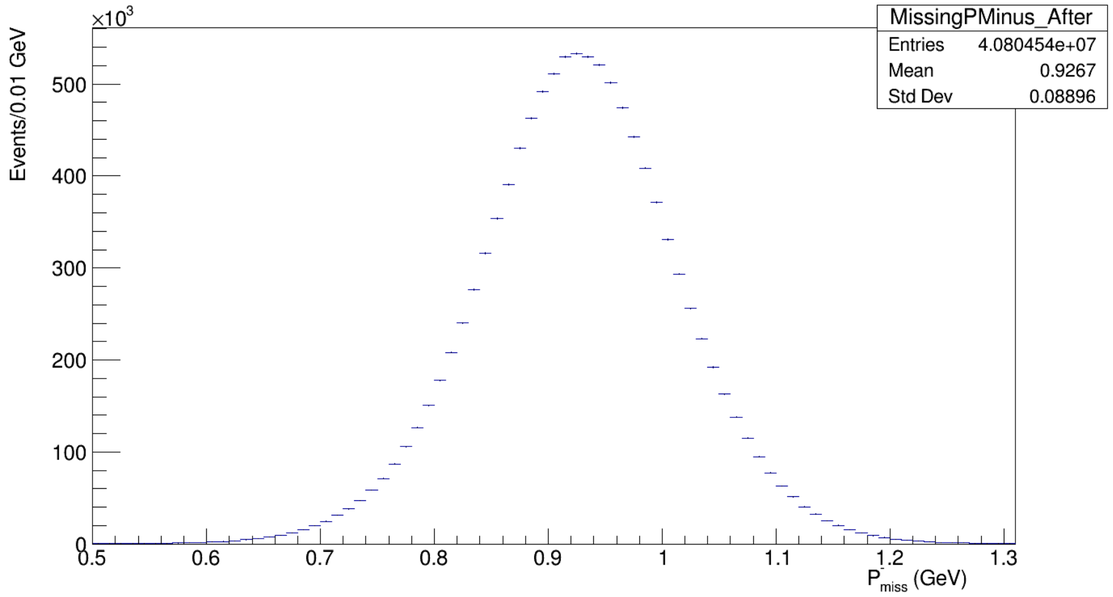
Nuclear transparency with $\gamma n \rightarrow \pi^- p$ channel

- Selected events
- Bin-to-bin fit on both data/simulation from deuterium/helium target

Data

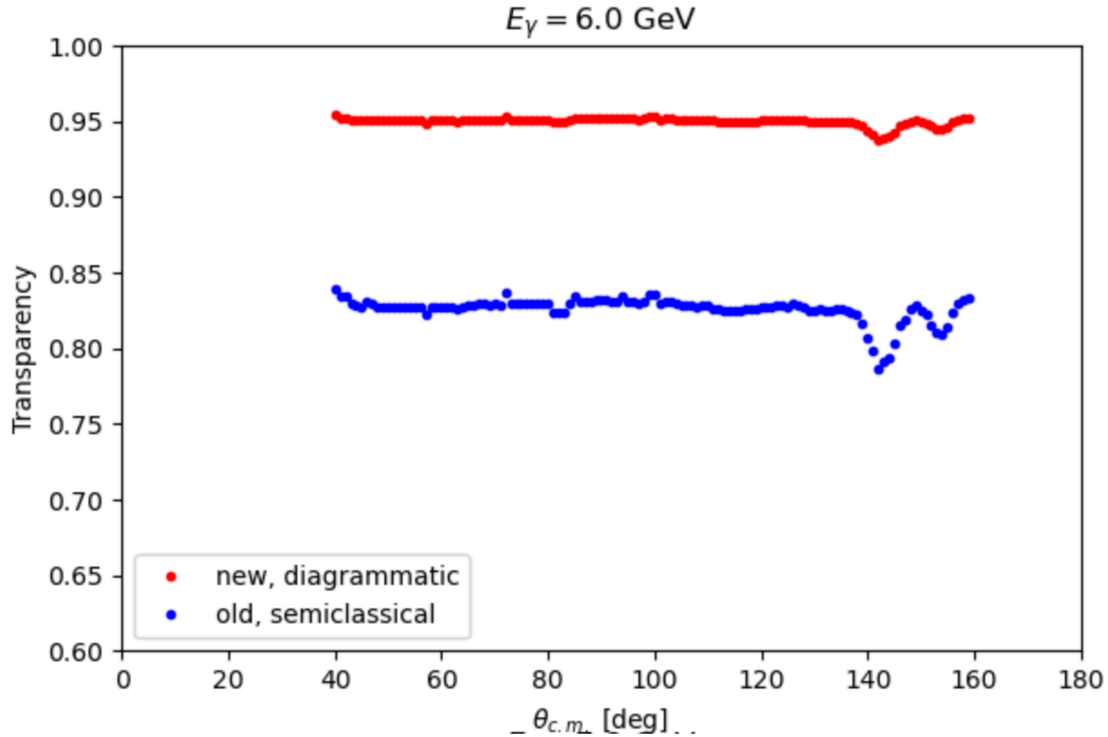


Sim



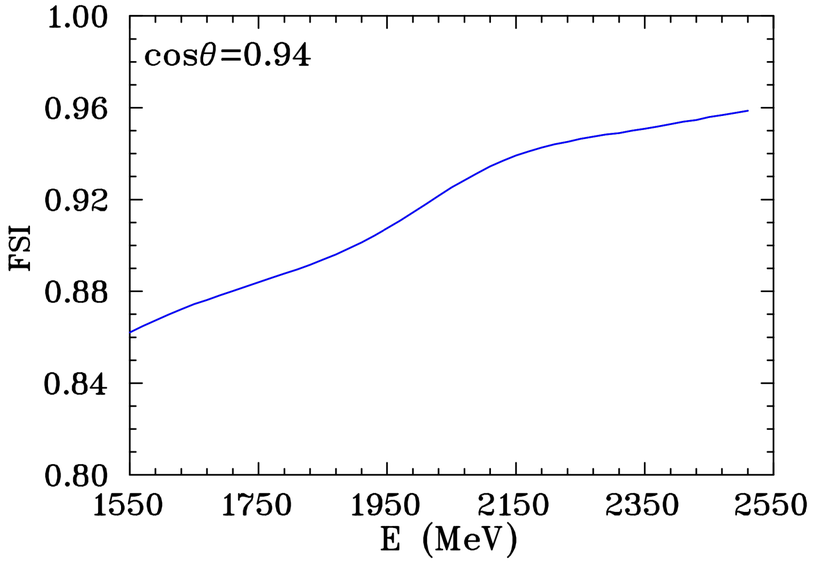
Nuclear transparency with $\gamma n \rightarrow \pi^- p$ channel

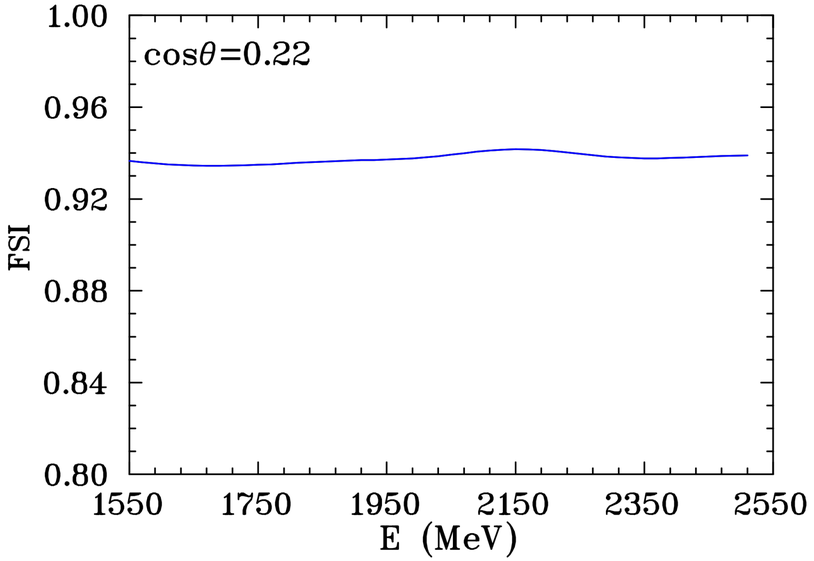
- Nuclear transparency on deuterium
- Previous estimate based on $\sigma_{pp}, \sigma_{\pi^- p}$ (red curve). T~0.95
- It suffers distortion from the $pp, \pi^- p$ resonance



Nuclear transparency with $\gamma n \rightarrow \pi^- p$ channel

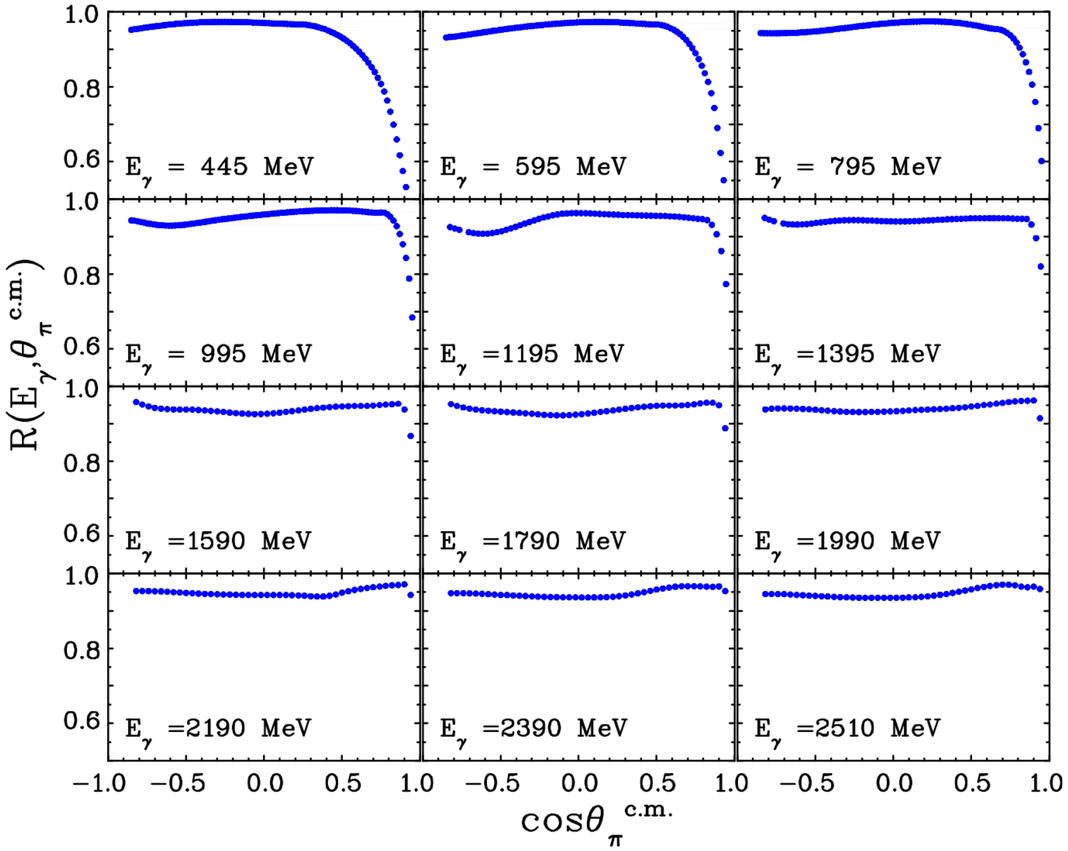
- Discussion with Prof. Igor Strakovsky of GWU
- Energy dependence up to 2.5 GeV





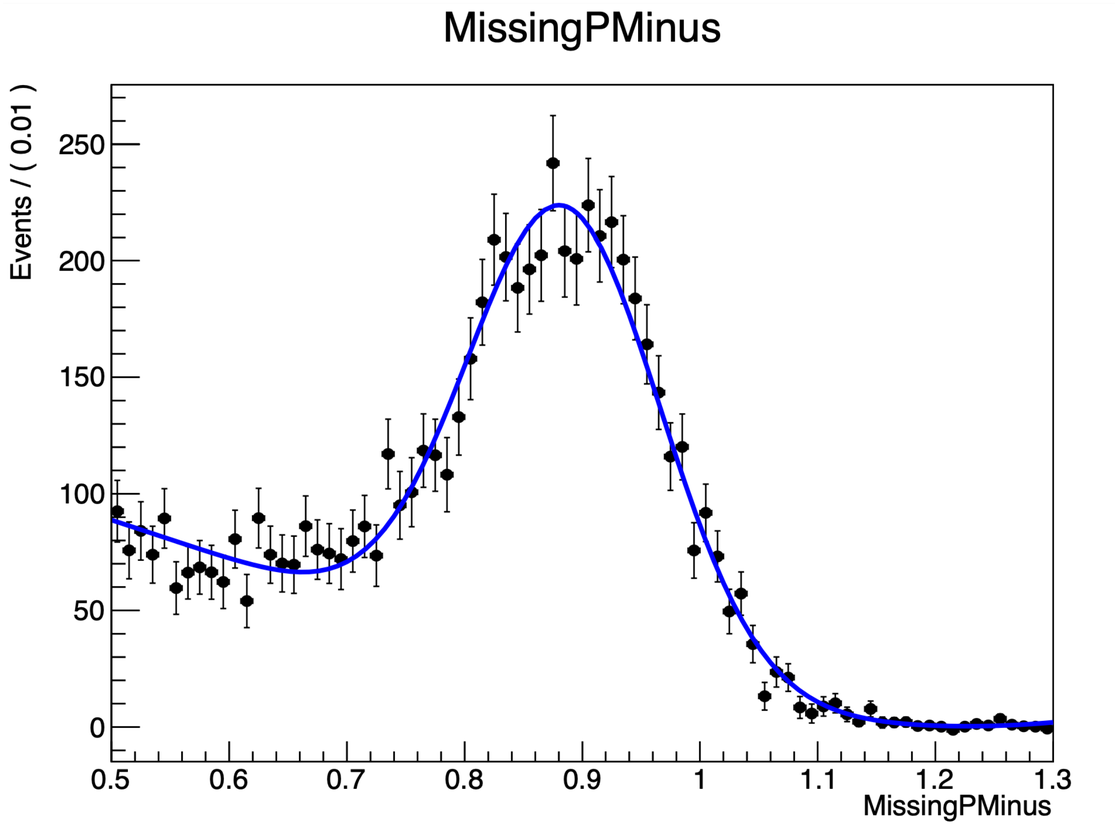
Nuclear transparency with $\gamma n \rightarrow \pi^- p$ channel

- Angular dependence up to 2.5 GeV
- FSI factor is smooth and stable around 0.95
- Systematic error about 2-3%
- Agrees with my previous estimate



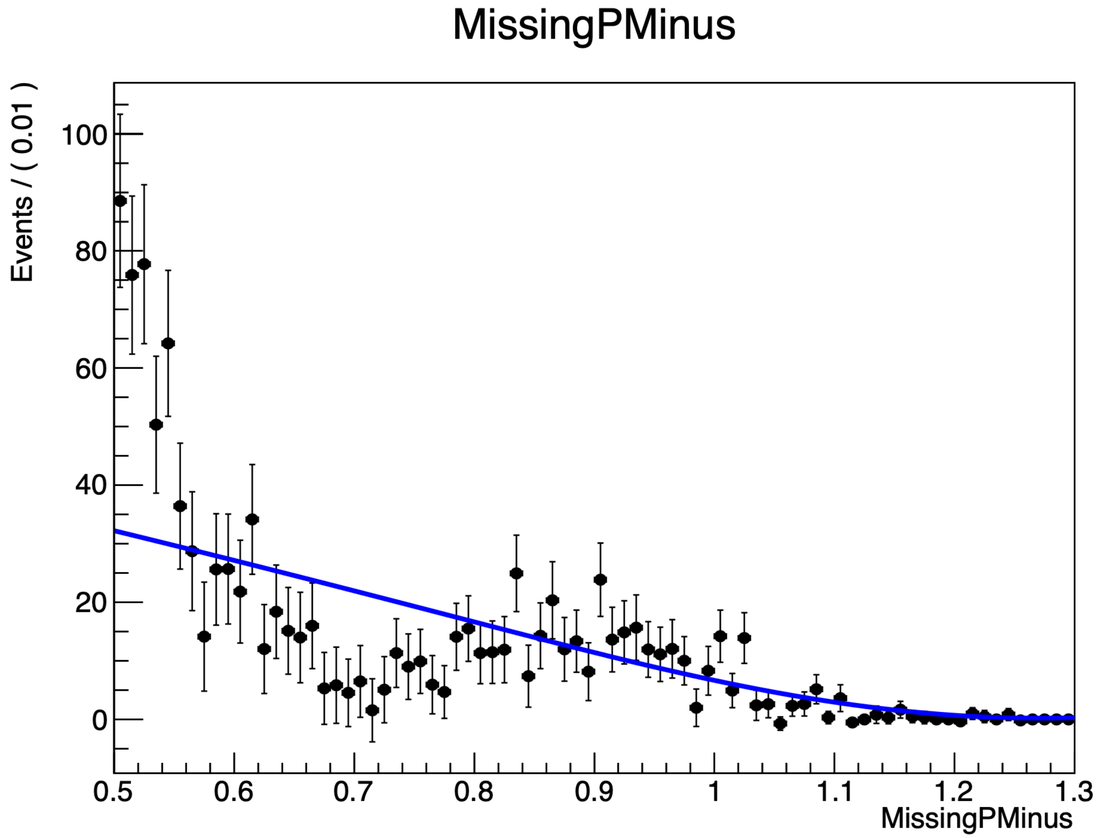
Nuclear transparency with $\gamma n \rightarrow \pi^{-} p$ channel

- Bin to bin fit to extract the yield of the Helium data
- Fit is acceptable at small pion production angle, $\theta_{c.m.} = 20^{\circ} - 30^{\circ}$



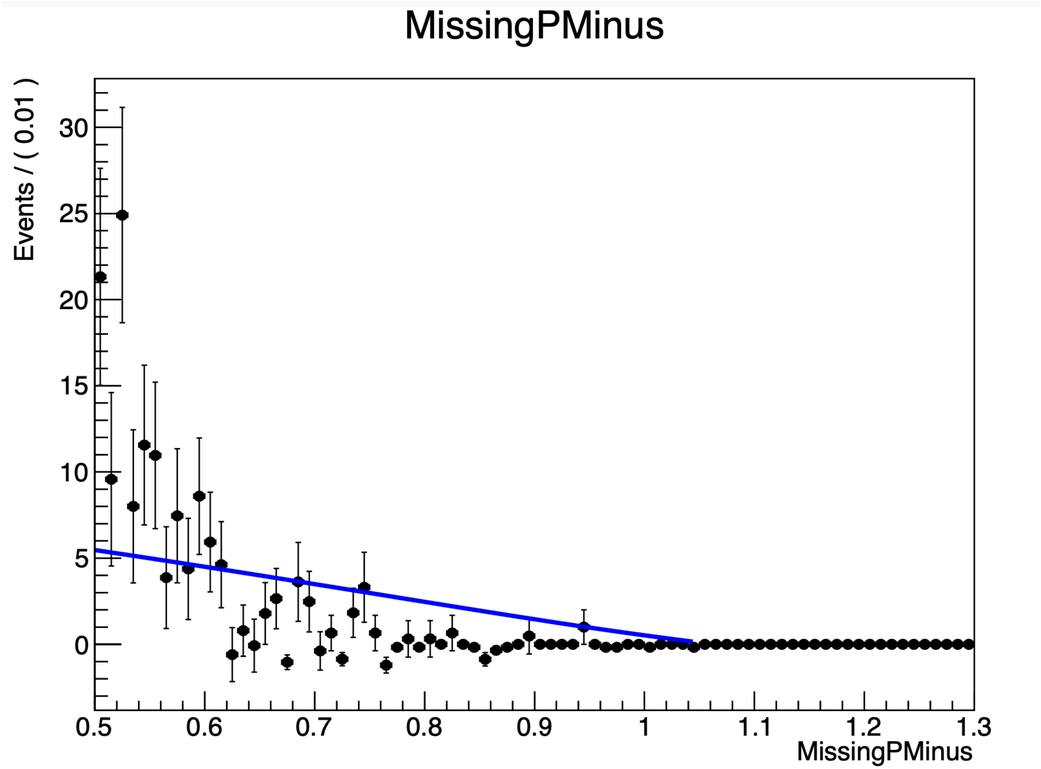
Nuclear transparency with $\gamma n \rightarrow \pi^- p$ channel

- Bin to bin fit to extract the yield of the Helium data
- Fit starts to fail when signal to bkg ratio is small, $\theta_{c.m.} = 30^\circ - 50^\circ$



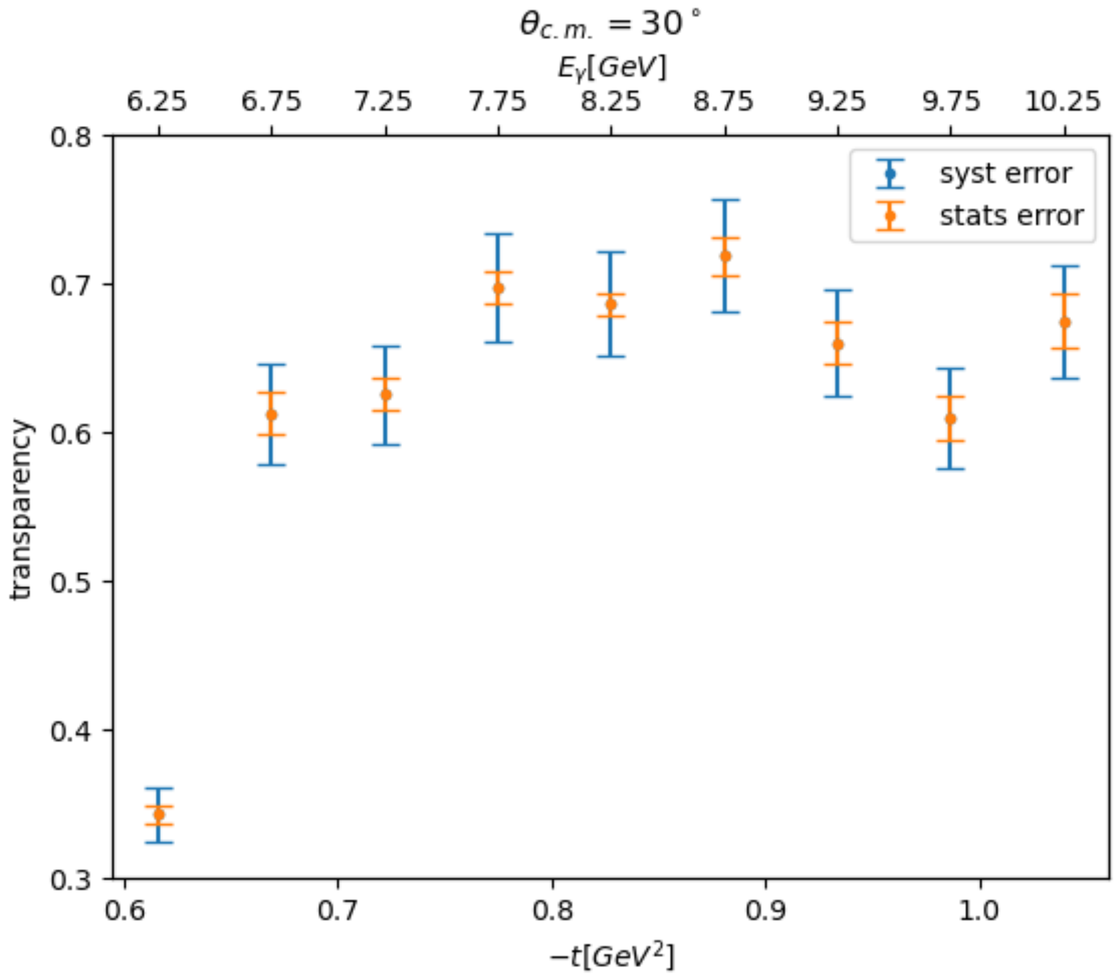
Nuclear transparency with $\gamma n \rightarrow \pi^- p$ channel

- Bin to bin fit to extract the yield of the Helium data
- Almost no events at large pion production angle, $\theta_{c.m.} = 50^\circ - 130^\circ$



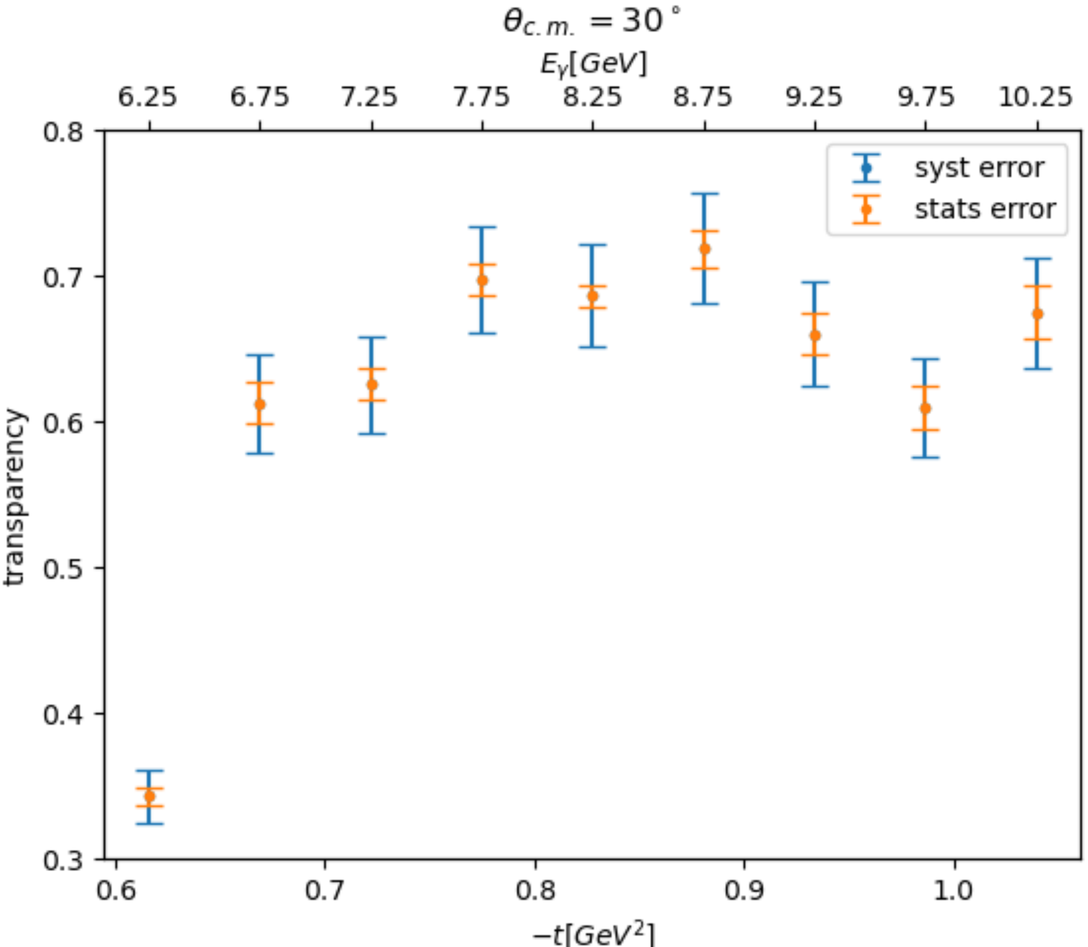
Nuclear transparency with $\gamma n \rightarrow \pi^- p$ channel

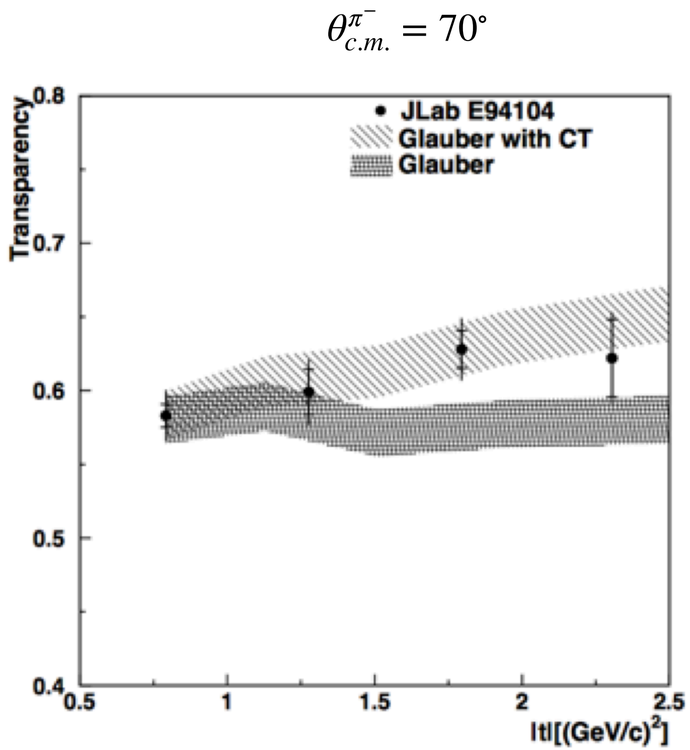
- Transparency at $\theta_{c.m.} = 30°$ (assume 5% syst error)

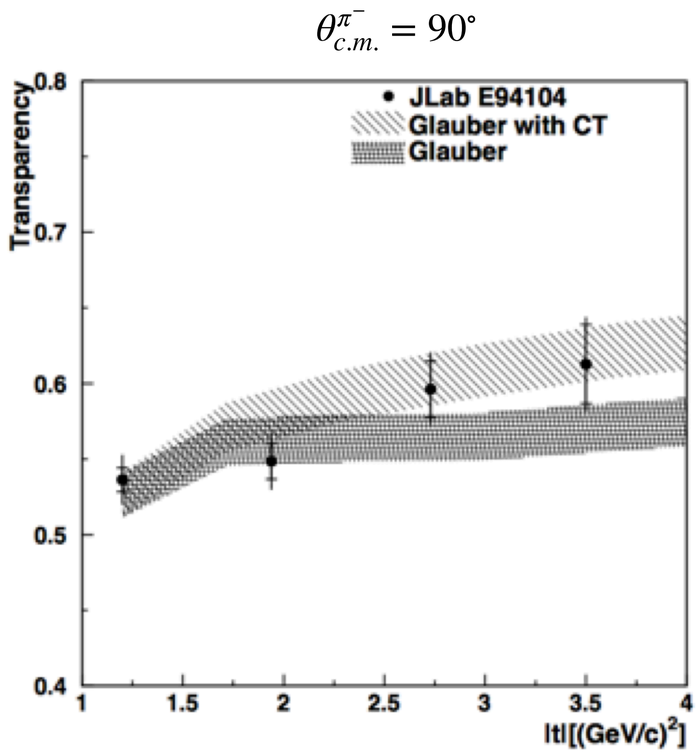


Nuclear transparency with $\gamma n \rightarrow \pi^- p$ channel

- Compare with previous Hall A data
- 30 deg is too small to reach large momentum transfer (CT region)







Nuclear transparency with $\gamma n \rightarrow \pi^- p$ channel

- Transparency at $\theta_{c.m.} = 25^\circ$