LHRS Analysis for d_2^n

Multi-Scattering Effects on the Acceptance

D. Flay

6/28/12

Outline

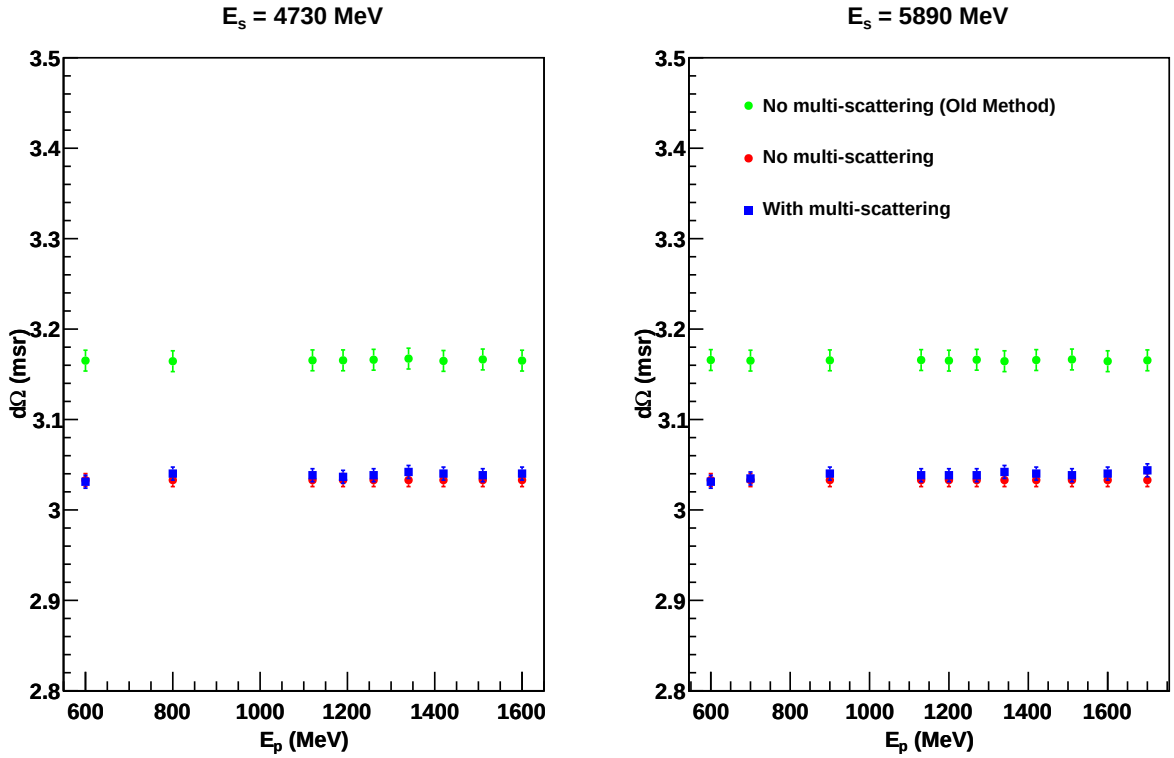
Multi-Scattering Effects (1)

Two Methods to Determine the Angular Acceptance

- Old method
  1. Throw a flat distribution in $\theta_{\rm tg}$, $\phi_{\rm tg}$, $y_{\rm tg}$ and $\delta p/p$ within analysis cuts ($N_{\rm trial}$)
  2. Determine how many of those events pass to the focal plane ($N_{\rm pass}$)
  3. $w = \frac{N_{\rm pass}}{N_{\rm trial}}$
  4. $d\Omega_{\rm eff} = w\Delta\theta\Delta\phi$, where $\Delta\theta\Delta\phi$ is determined from the widths chosen in the cuts
- New method (more correct)
  1. Throw a flat distribution in $\theta_{\rm tg}$ and $\phi_{\rm tg}$ larger than the LHRS acceptance. $y_{\rm tg}$ and $\delta p/p$ are thrown within analysis cuts ($N_{\rm trial}$)
  2. Determine how many of those events pass to the focal plane and pass analysis cuts ($N_{\rm pass}$)
  3. $w = \frac{N_{\rm pass}}{N_{\rm trial}}$
  4. $d\Omega_{\rm eff} = w\Delta\theta\Delta\phi$, where $\Delta\theta\Delta\phi$ is determined from the illuminated widths in $\theta_{\rm tg}$ and $\phi_{\rm tg}$

Multi-Scattering Effects (2)

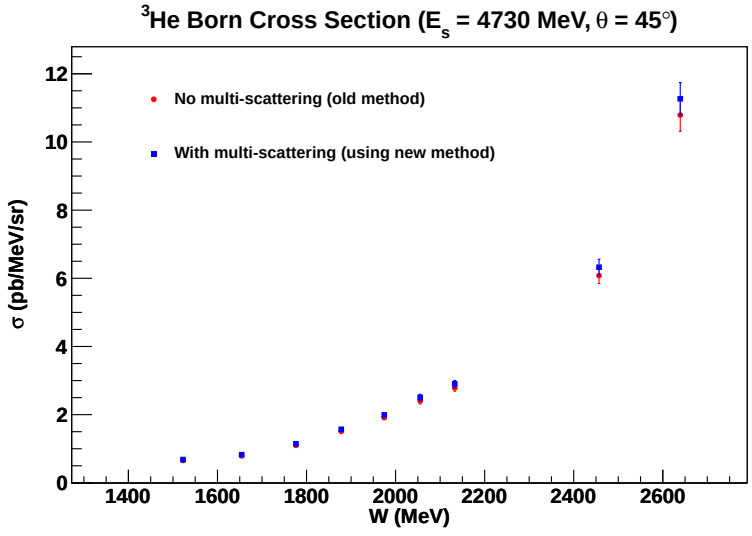
Results

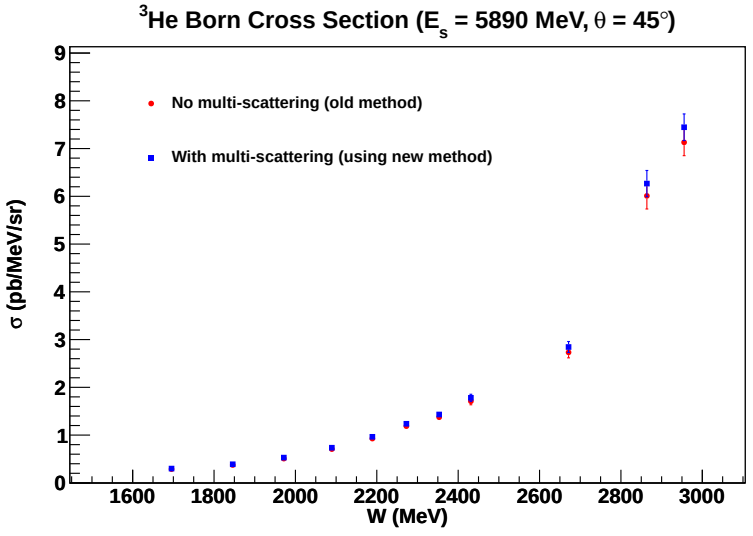


- Adding multi-scattering into SAMC causes a change in the acceptance by $\lesssim$1%

Multi-Scattering Effects (3)

The Born Cross Section





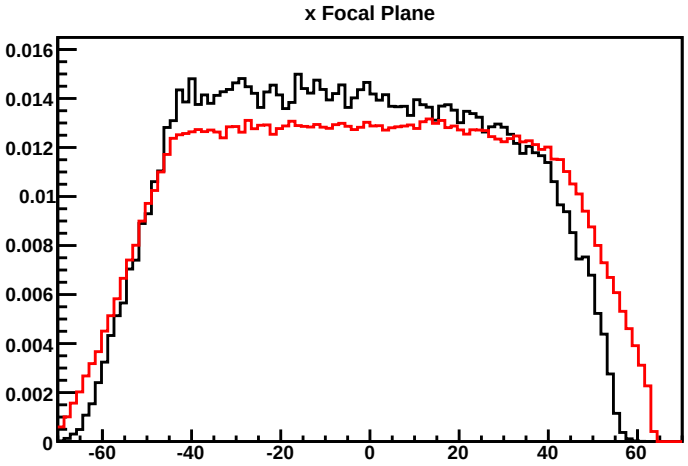
Fortran Version of SAMC (1)

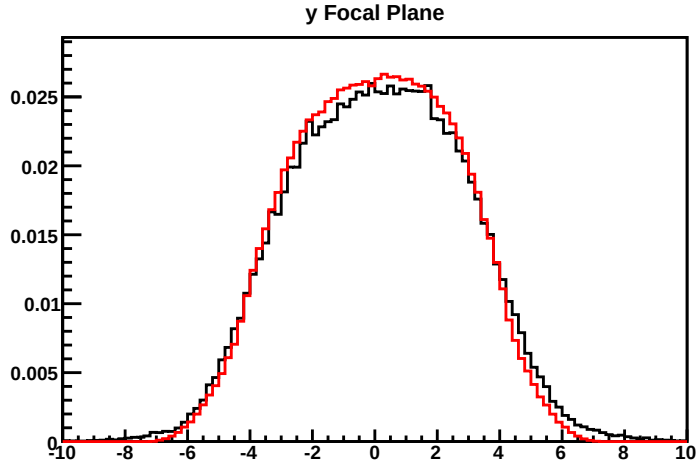
Focal Plane Variables: E_s = 4730 MeV, E_p = 600 MeV

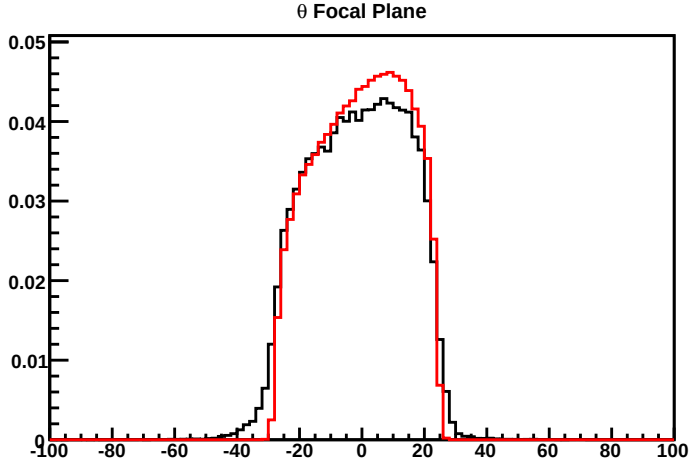
- Easier to understand compared previous C++ verison
- Uses F1F209 rather than QFS when calculating cross sections
- In the plots that follow:
  - Color code: simulation data
  - Good event count: Simulation: $\sim$900k good events; data: $\sim$100k
  - Includes multi-scattering only (including RC's takes a long time. . .)
  - Cross section weighted distributions
  - Histograms are normalized by their respective integrals

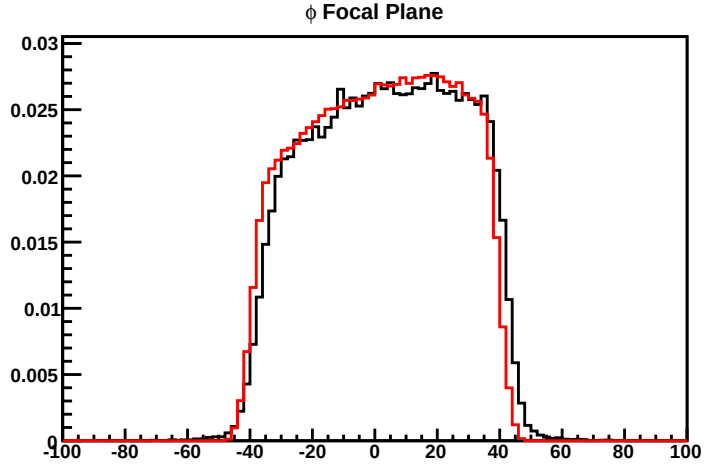
Fortran Version of SAMC (2)

Focal Plane Variables: E_s = 4730 MeV, E_p = 600 MeV



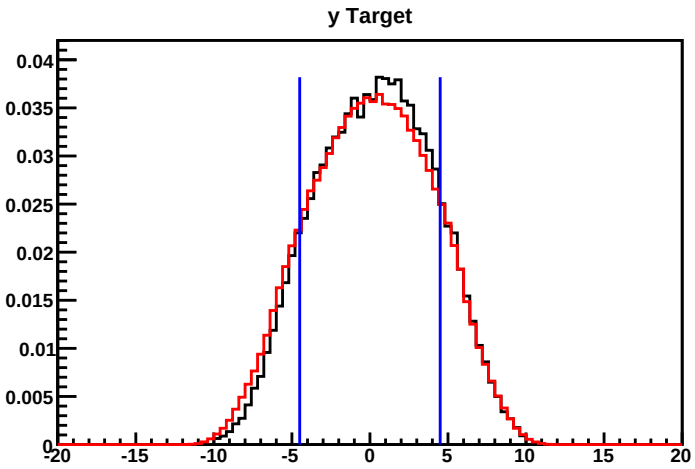


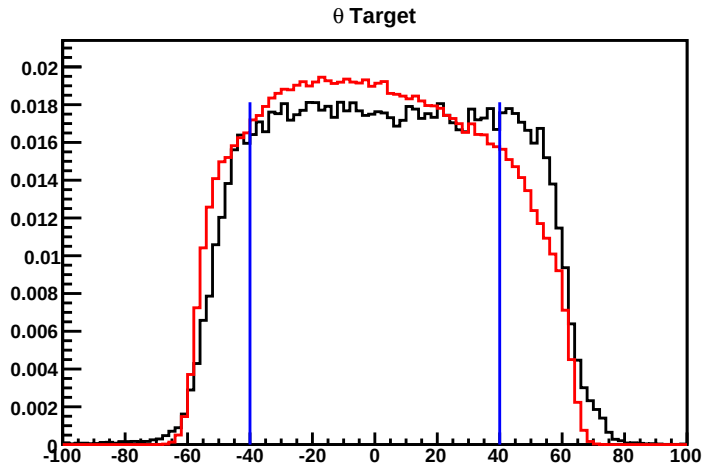


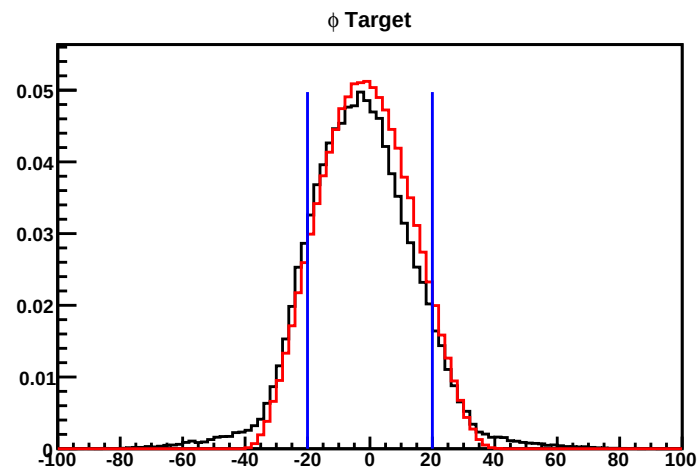


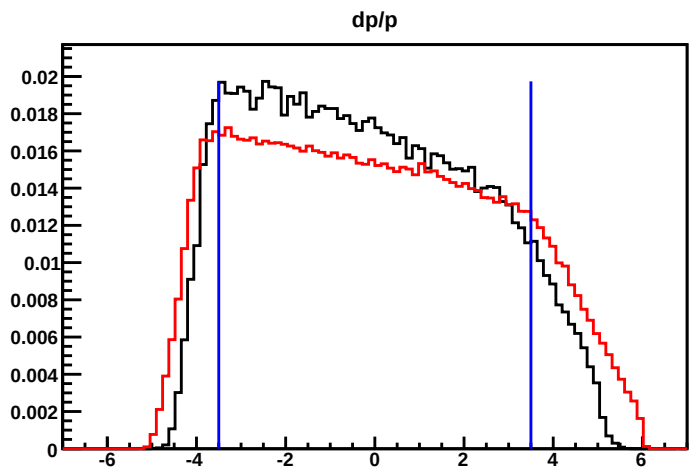
Fortran Version of SAMC (3)

Target Variables: E_s = 4730 MeV, E_p = 600 MeV









Summary

- Updated the method to obtain the effective angular acceptance
  - Updated the Born cross sections to reflect this change
- The effect of multi-scattering is small at best ($\lesssim$1%)
- Mismatch in x_{fp}, θ_{tg} and $\delta p/p$ needs to be looked at
  - The SAMC distributions are currently weighted with the Born cross sections – radiated spectra may change things a bit, but it won't be too large, given that the size of the RC's are not that big

What's Next?

- Acceptance
  - Insert cross-section weighting into acceptance weight
- Finite acceptance
  - Not sure if we want to do this: background signals are severely limited statistically speaking (nitrogen, positrons)
- $\pi^{+,-}$ cross sections compared to Wiser code
  - Are there protons or other garbage contaminating the π^{+} data?
  - Using our cross sections may be better for the Geant4 simulation of BigBite (?)