Estimates for SSA Measuring Experiment at JLab

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Assumed Conditions

- Total Luminosity: 5.5×10^{34} /cm²/s
  - 3/17 of that luminosity is on polarized hydrogen
  - Total Lumi. on Hydrogen = 9.7×10^{33} /cm²/s
- Rosenbluth cross section with dipole proton form factors, i.e.
  - $d\sigma/d\Omega = d\sigma/d\Omega_{Mott}\ (\tau/\varepsilon(1+\tau))\ [\varepsilon/\tau\ G_E^2 + G_M^2]$
- Particle trajectories are bent by the vertical holding field for the target.
  - Assuming 2 Tm entering and leaving the target region
    - Holding field: 5 T
    - Field radius: 0.2 m

Shift due to holding field

The holding field will shift the horizontal angle $\theta = \tan^{-1}(x/z)$ by:

- $\Delta\theta = 2 \sin^{-1} [1.5 \text{ GeV} / p]$

For the simulation the spherical coordinates are converted to cylindrical about the y axis (vertical axis), the shift is applied, then the resulting vector is re-calculated.

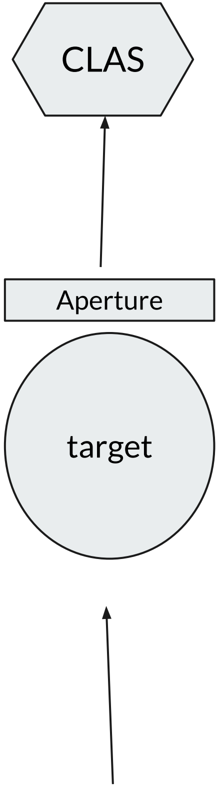
There are two shifts

- The incoming beam is shifted as it reaches the target; at the target, the beam is shifted off the hall axis.
- After scattering, the outgoing electrons are shifted in the opposite direction.

Aperture Modeling

In order to reach the detectors, outgoing electrons (after shift) must meet two conditions:

- Exit within the target chamber window aperture
  - Assumed to be a region ± 25° out of plane from the beamline (in the y direction) and ± 65° in plane (xy plane), forming a section of a cylinder.
- Enter one of the six sectors of the CLAS forward detector.
  - Each sector has an azimuthal acceptance of ±25° for Θ in the range of 16˚-35˚.
  - In the forward region (Θ: 8˚–16°), the phi acceptance pinches to ±(25˚/8˚)(Θ-8˚)
  - Sectors are centered at φ=0˚, 60˚, 120˚, 180˚, 240˚ and 300˚



Monte Carlo

- The Monte Carlo generates random theta and phi, accounts for the holding field shift, and checks for if electrons scatter through magnet support aperture and into the CLAS acceptance range

- Binning done per degree in Θ with N = 1000 for rate estimates(N=1000 total in figure 1)

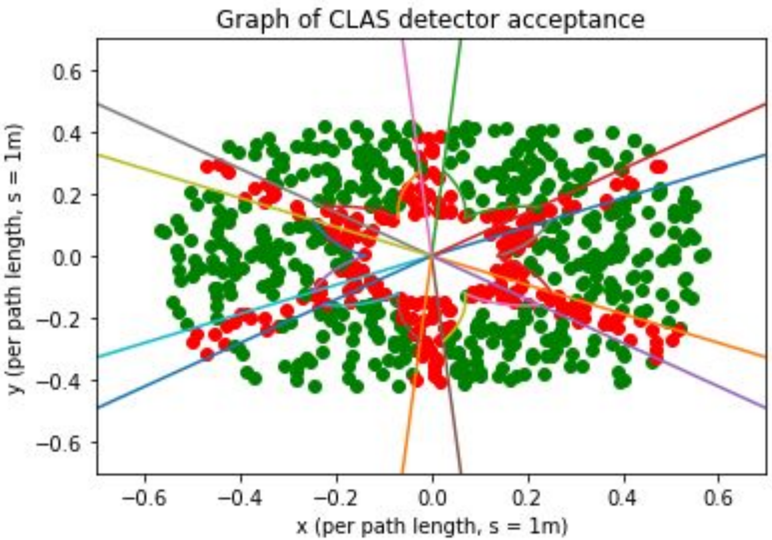
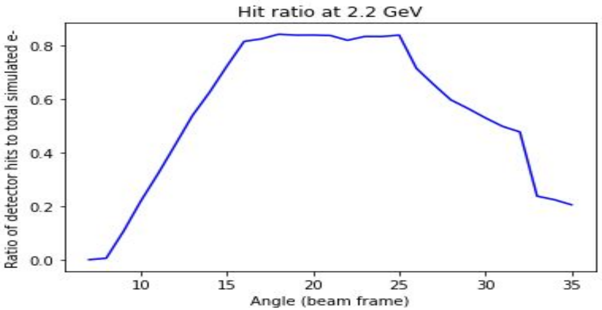
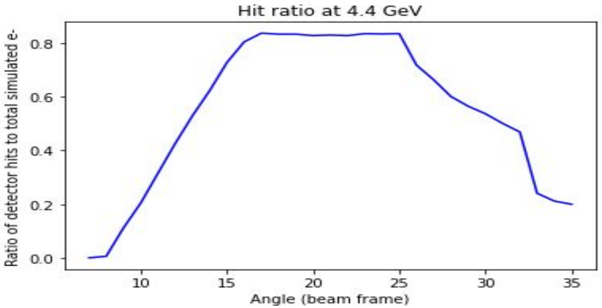
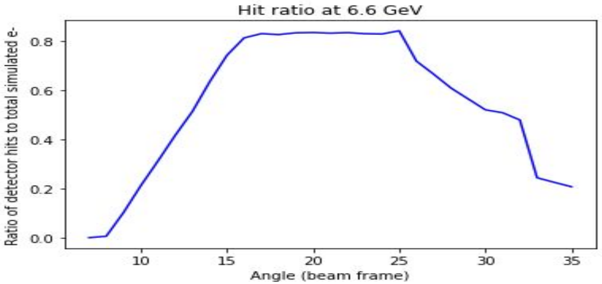


Fig. 1 CLAS Detector Monte Carlo Plot. Colored straight lines are acceptance ranges of each segment of the detector and the curved lines are the low angle pinch. Green dots represent particles that hit the detector in the acceptance range and are ones that fall outside the range.







Unweighted Monte Carlo Results

- Acceptance is independent of beam energy, as expected.
- Initial linear trend is from the beam pinch at low angles
- Plateau around θ = [16˚, 25˚], where the azimuthal acceptance is constant
- Decrease at $\theta > 25^{\circ}$ from the holding field shift

Preliminary Uncertainties

The first set of projection figures will use a simplified uncertainty estimate:

Since $A = (N_L - N_R)/(N_L + N_R)$, and assuming that $N_L \approx N_R \approx N/2$,

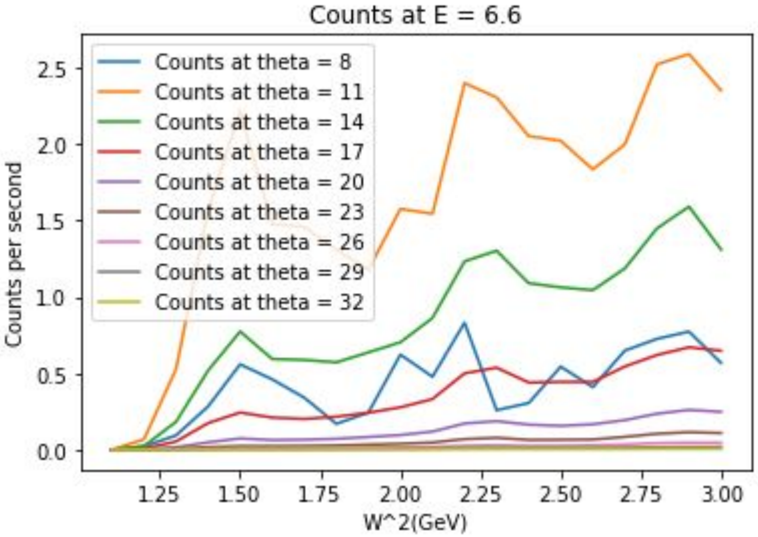
$$\delta A = 1/\sqrt{N}$$

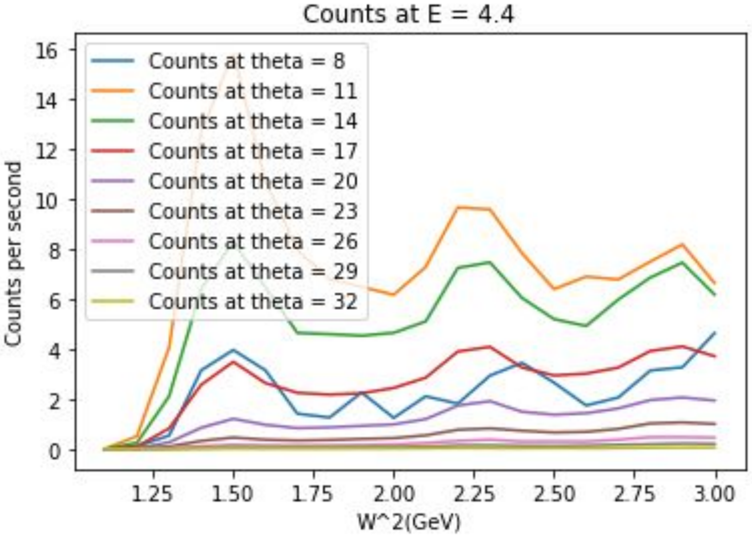
This neglects the effects of

- Target polarization < 100%
- Quasi-elastic background from scattering on N, He nuclei
- Azimuthal dependence of asymmetry

Finding Uncertainties

- Uncertainties without background are calculated from $A = N_L - N_R / N_L + N_R$, $\delta A = 1/\sqrt{N}$
- With background uncertainties are $\delta A = (1/0.6)\sqrt{((3/14)*0.04*E_p(\Theta)/0.5)+1/N}$
- Considering 3/14 Nitrogen dilution factor, 4% detector resolution,60% average target polarization factor, and 500 MeV background smearing
- For systematic uncertainty we use a preliminary estimate of $\delta S = 0.1$ added in quadrature with δA
- Using these equations and the counts per time generated from the Monte Carlo simulation error bars for our scattering data can be generated
- In the following slides scattering rates for different beam energies are shown alongside $\delta A(\Theta)$ superimposed on plots of theoretical predictions for A_n provided by Peter Blunden
  - Binning for counts are for per 1°
- At higher theta the holding field shift on makes it impossible to get asymmetry data above $\Theta = 32°$


Counts at E = 6.6
Counts at theta = 8
Counts at theta = 11
Counts at theta = 14
Counts at theta = 17
Counts at theta = 20
Counts at theta = 23
Counts at theta = 26
Counts at theta = 29
Counts at theta = 32
Counts per second
W^2(GeV)


Counts at E = 4.4
Counts at theta = 8
Counts at theta = 11
Counts at theta = 14
Counts at theta = 17
Counts at theta = 20
Counts at theta = 23
Counts at theta = 26
Counts at theta = 29
Counts at theta = 32
Counts per second
W^2(GeV)