Analysis Progress

for the d_2^n analysis meeting

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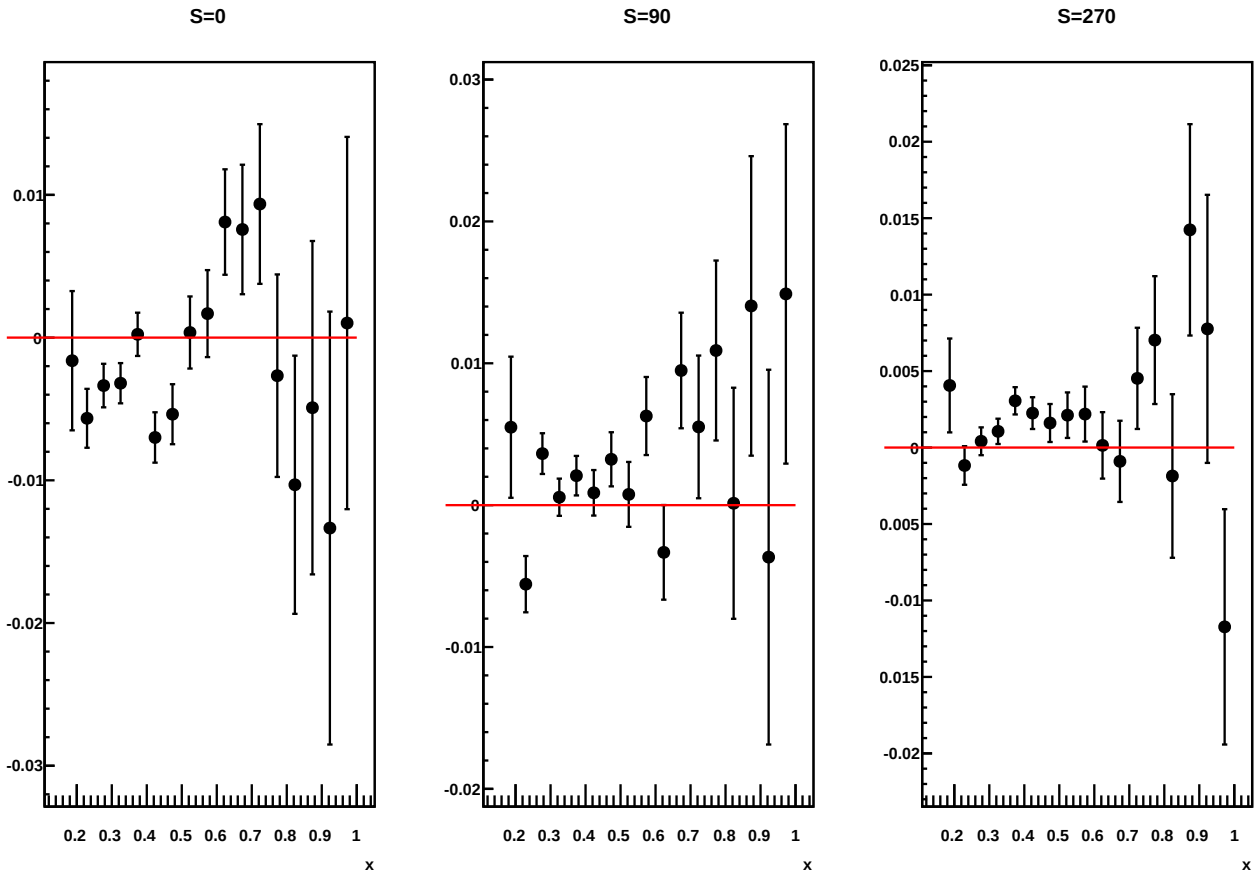
1. Asymmetries
   - Cut Definitions
   - From Raw Asymmetries to Physics Asymmetries
   - Kinematic Variables
   - A_1 and A_2
2. What's Next?
3. Longer-Term Issues

Cuts

- Optics validity: `BB.optics.vzflag[]==1 && BB.tr.tg_th[]<0.2 && skim.p[]>0 && skim.p<10`
- Negative charge
- T2 trigger fired
- No beam trip
- Vertex z within 0.17 m of origin
- Shower and preshower clusters align with track projections
- Track quality: `BB.tr.chi2[]/BB.tr.ndof[]<5`
- No particles passing through rescattering centers
- Preshower energy > 200 MeV
- 2σ E/p cut: $0.833 < E/p < 1.158$
- Čerenkov cut (TDC, PMT acceptance, no ADC)

Raw Asymmetries

- There was an error in the asymmetries last time – Čerenkov cut was not executing
- Here are raw counting asymmetries, IHWP in+out, for full cuts



Physics Asymmetries (i): Dilution

- We need to correct the raw asymmetry for various effects:
  - Imperfect beam polarization P_e
  - Imperfect target polarization P_t
  - Nitrogen dilution factor D_{N_2}

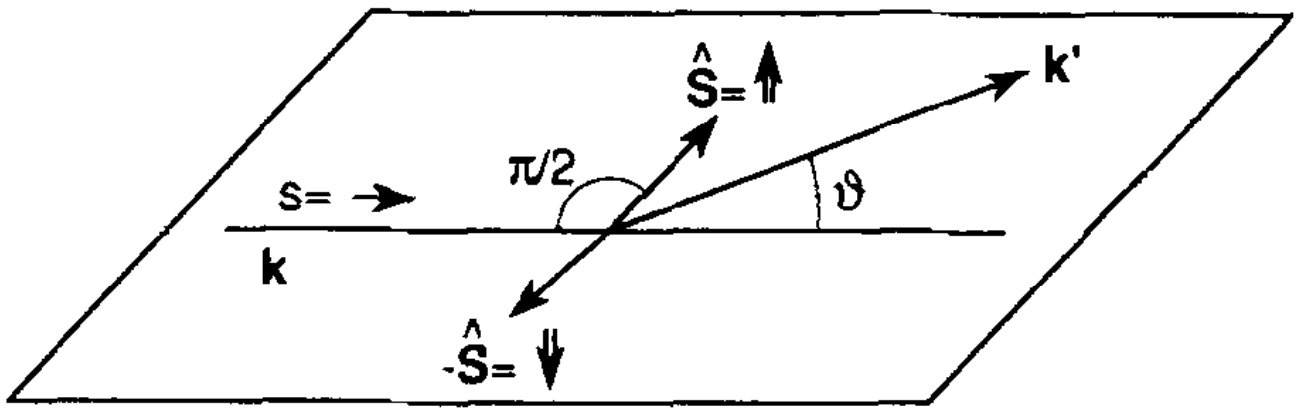
$$A_{phys} = \frac{A_{raw}}{P_e P_t D_{N_2}} \tag{1}$$

- Our asymmetry is small, so we assume no helicity-correlated deadtime/livetime effects
- I have presented values for P_e, P_t, and D_{N_2} in previous meetings

Physics Asymmetries (ii): Sign

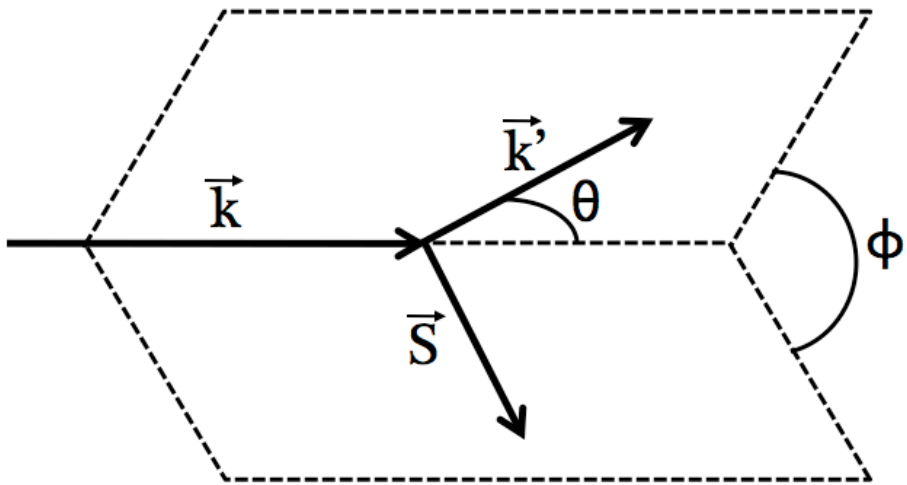
- **Electron Spin**
  - Positive sense of electron spin is *negative helicity*
  - $A = \frac{N_- - N_+}{N_- + N_+}$
- **Target Spin**
  - *Longitudinal*: Only available direction is toward beam dump (0°)
  - *Transverse*: Since we're measuring scattered electrons with BigBite, positive sense is target spin pointing to beam right, *i.e.* 270°

M. Anselmino et al./Physics Reports 261 (1995) 1–124



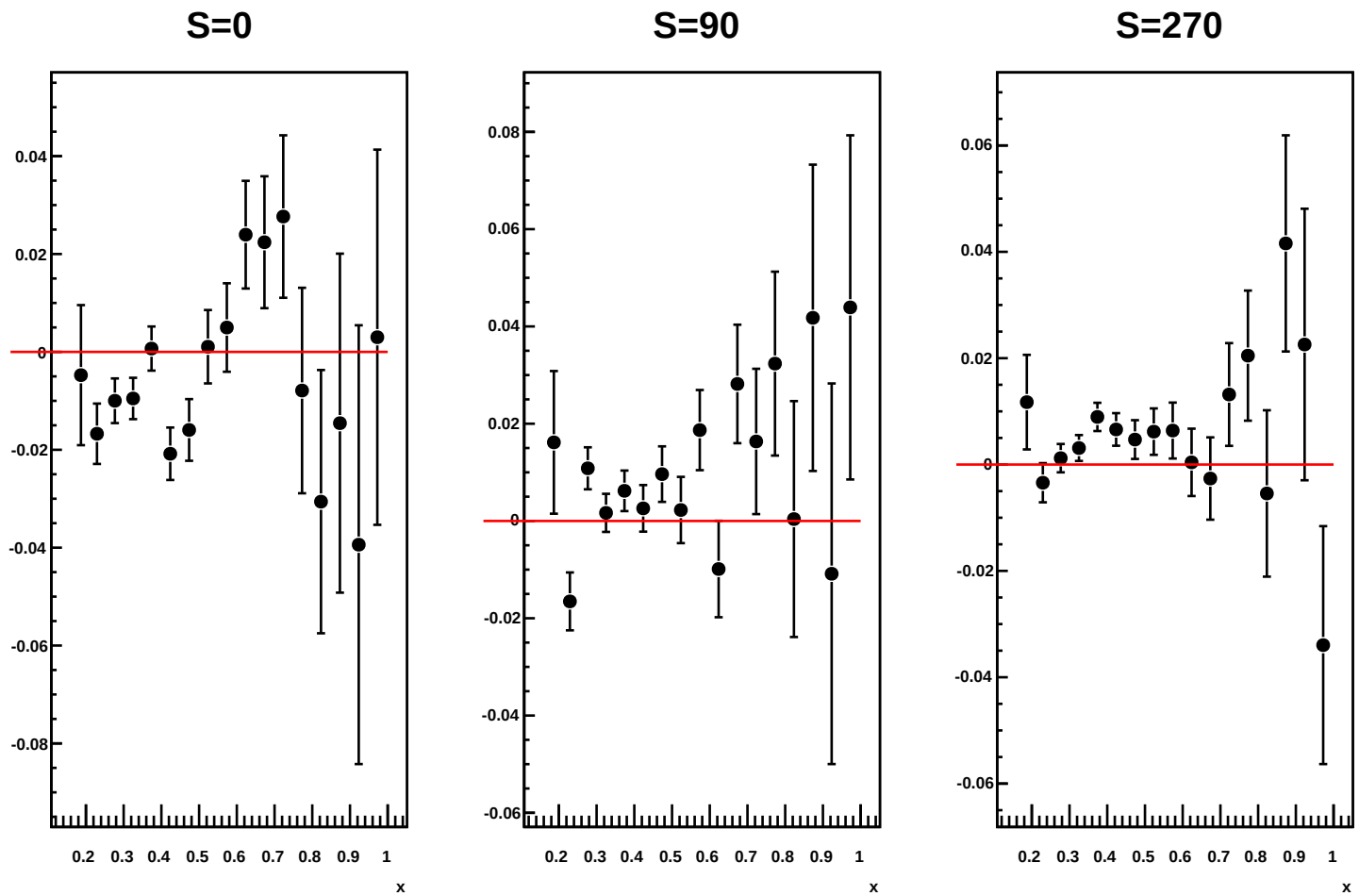
Physics Asymmetries (iii): Azimuthal Angle Correction

- A_T depends on $\cos\phi$ where ϕ is the angle between the target polarization plane and the scattering plane
- This azimuthal angle, confusingly enough, corresponds to `BB.tr.tg_th`
- BigBite has a large enough acceptance that this angle is *not* constant
- To compare with values from other experiments, we will divide out the average $\cos\phi$ for each x bin



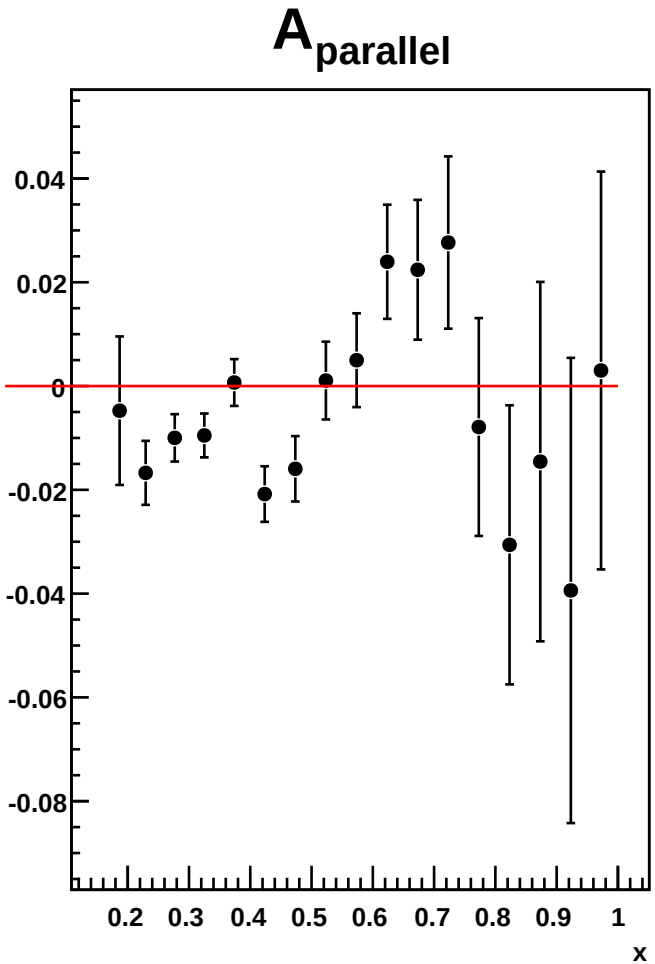
Physics Asymmetries (iv): Three Target Configurations

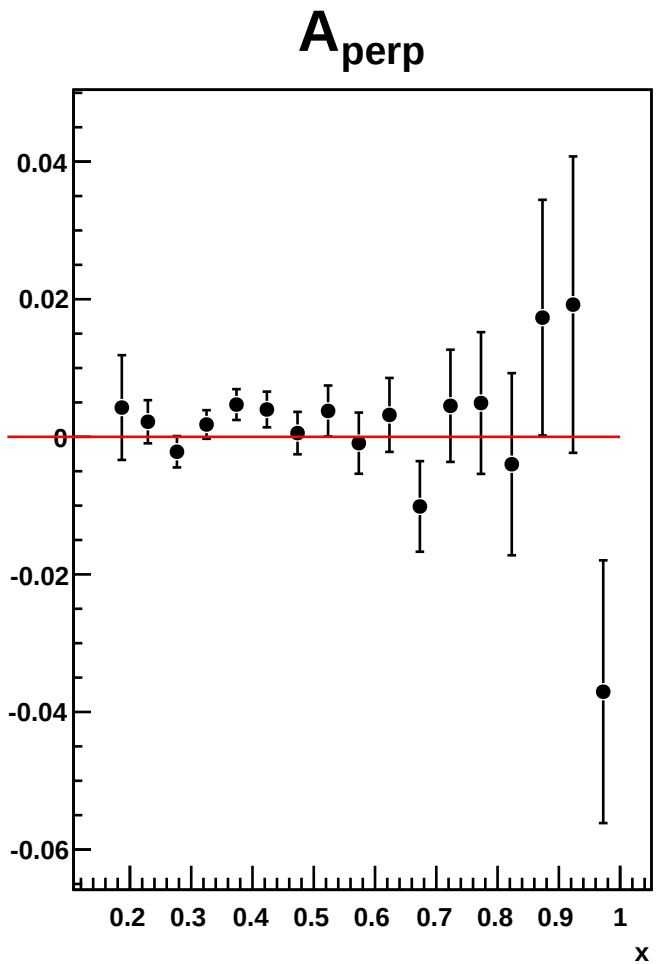
- Here are physics asymmetries after dilution has been corrected



Physics Asymmetries (v): $A_{\parallel}$ and $A_{\perp}$

- Here we have combined the two transverse cases and corrected for $\cos\phi$



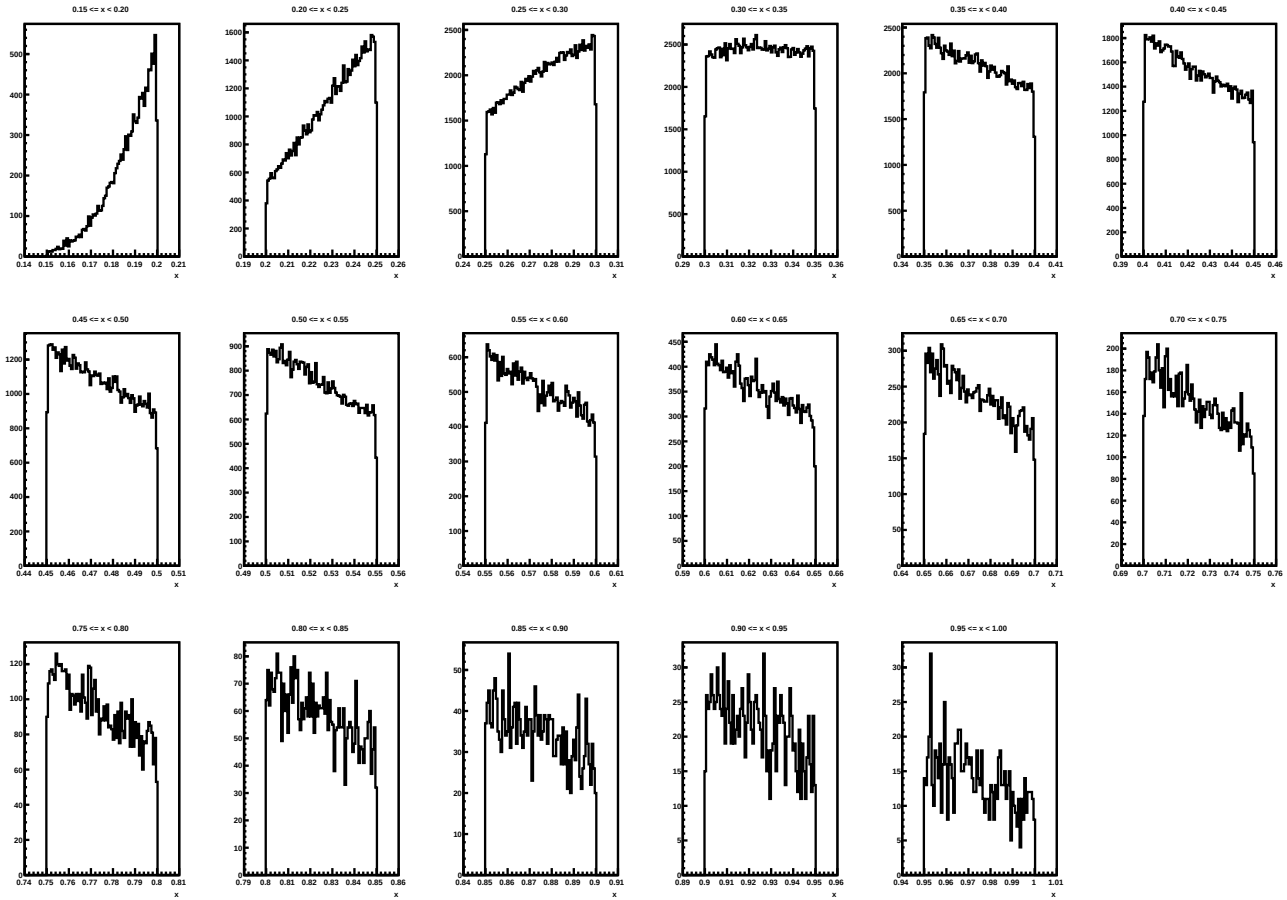


What Do We Need To Compute A_1?

- $R = \sigma_L/\sigma_T$
  parameterization from Whitlow *et al.* Phys. Lett B **250**, 193, (1990)
- $\frac{1}{\epsilon} = 1 + 2\left(1+\gamma^2\right)\tan^2\frac{\theta}{2}$
- $D = \frac{E-\epsilon E'}{E(1+\epsilon R)}$
- $d = D\sqrt{\frac{2\epsilon}{1+\epsilon}}$
- $\eta = \frac{\epsilon\sqrt{Q^2}}{E-\epsilon E'}$
- $\xi = \eta\frac{1+\epsilon}{2\epsilon}$

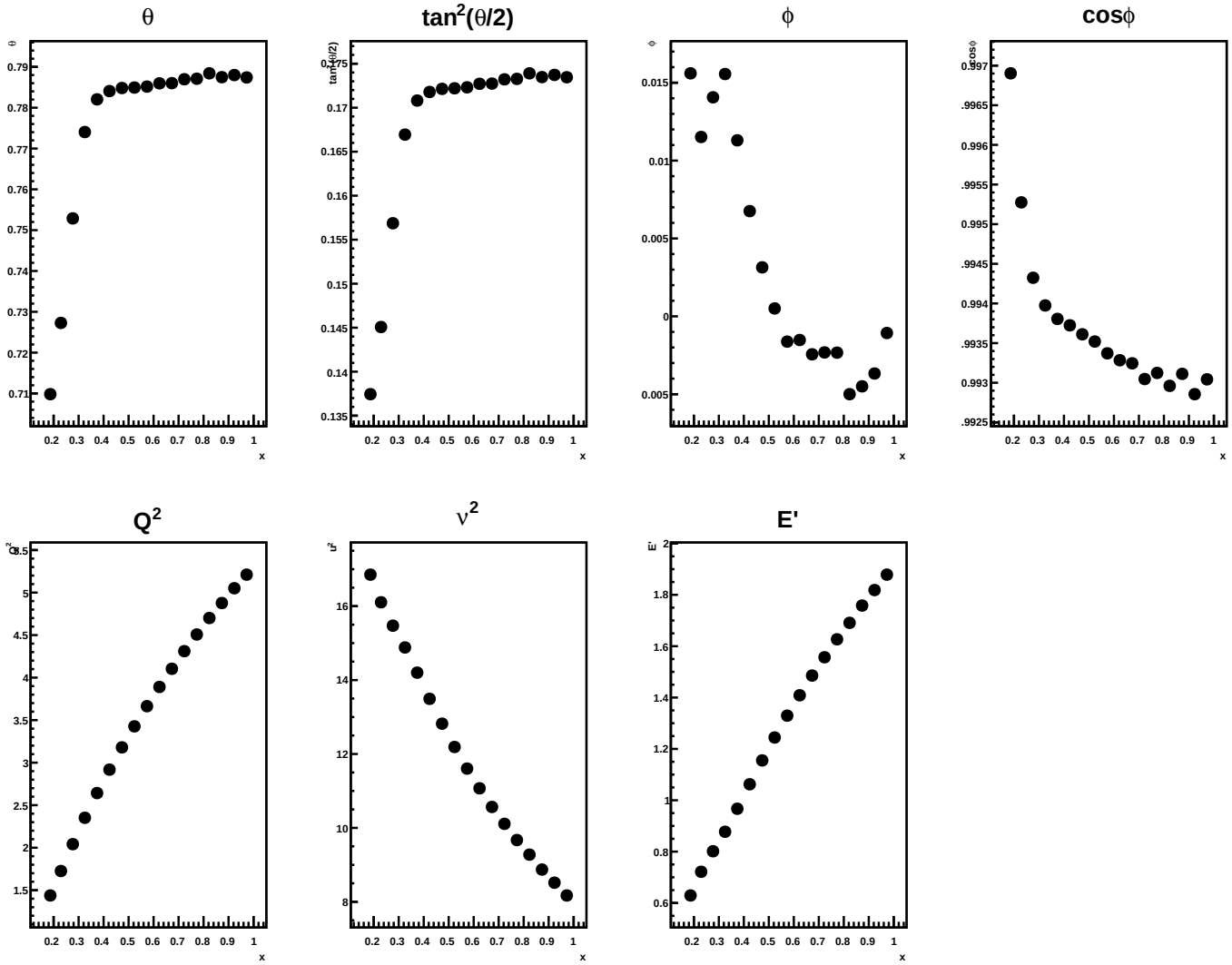
Kinematics Binned in x (i): x

- We want to compute various kinematic variables that depend on, say, θ or ϕ or x
- First step: What is the average value of θ or ϕ or x in each of the 17 x bins, once all cuts have been applied?



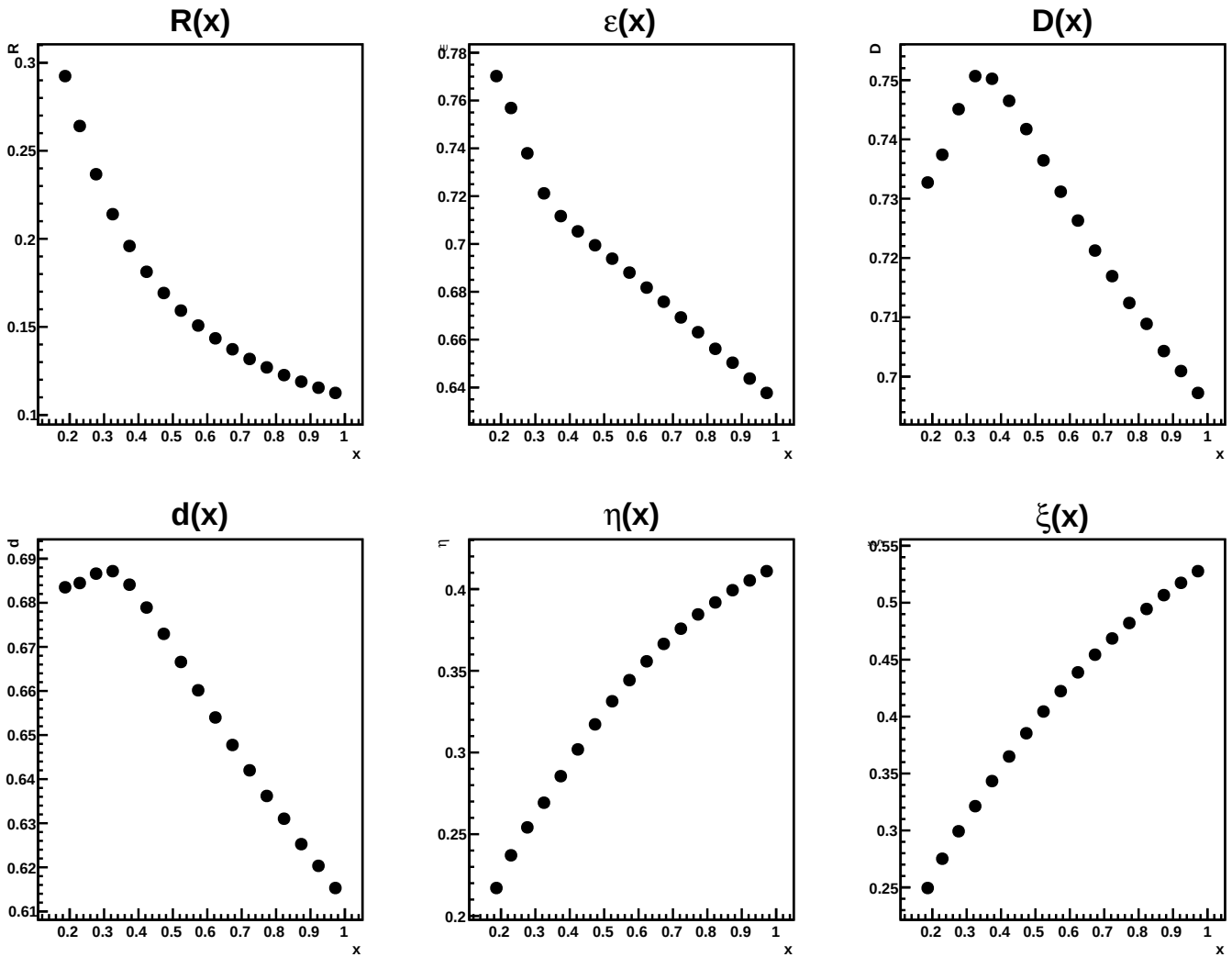
Kinematics Binned in x (ii)

- Now let's measure the average value of each other kinematic parameter



Kinematics Binned in x (iii)

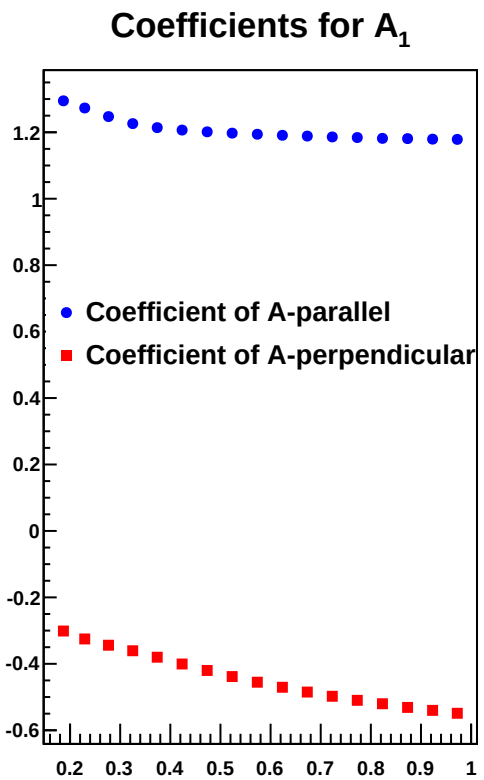
- Final step: Compute kinematic variables from bin-averaged parameters

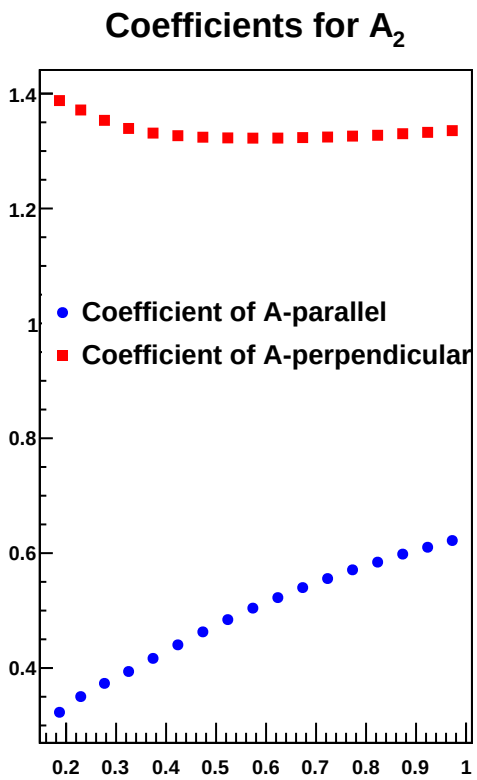


A_1 and A_2 (i): Coefficients

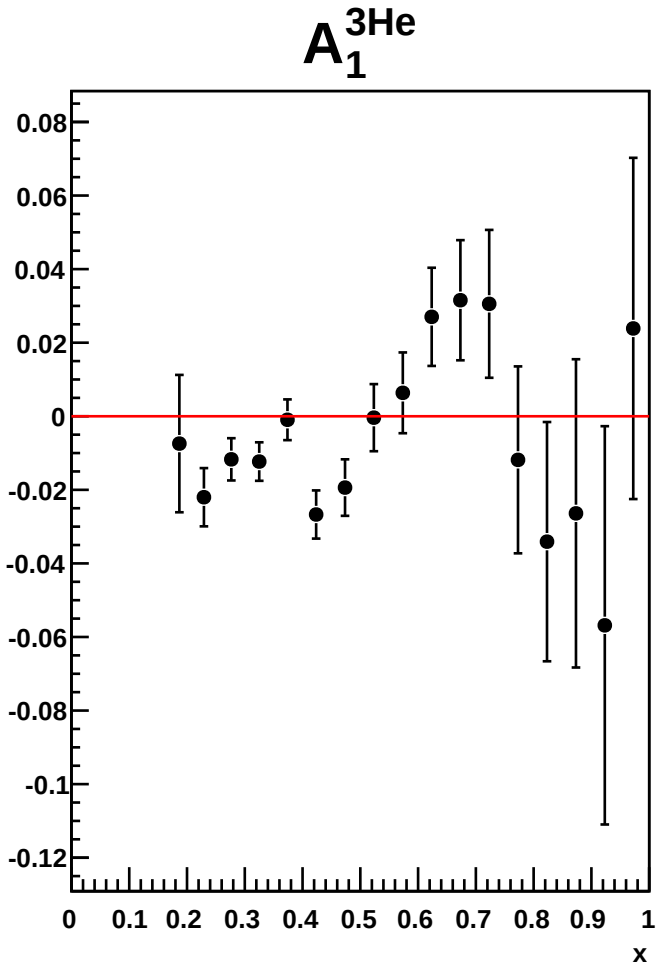
$$A_1 = \frac{1}{D\,(1+\eta\xi)} A_{\parallel} - \frac{\eta}{d\,(1+\eta\xi)} A_{\perp} \tag{2}$$

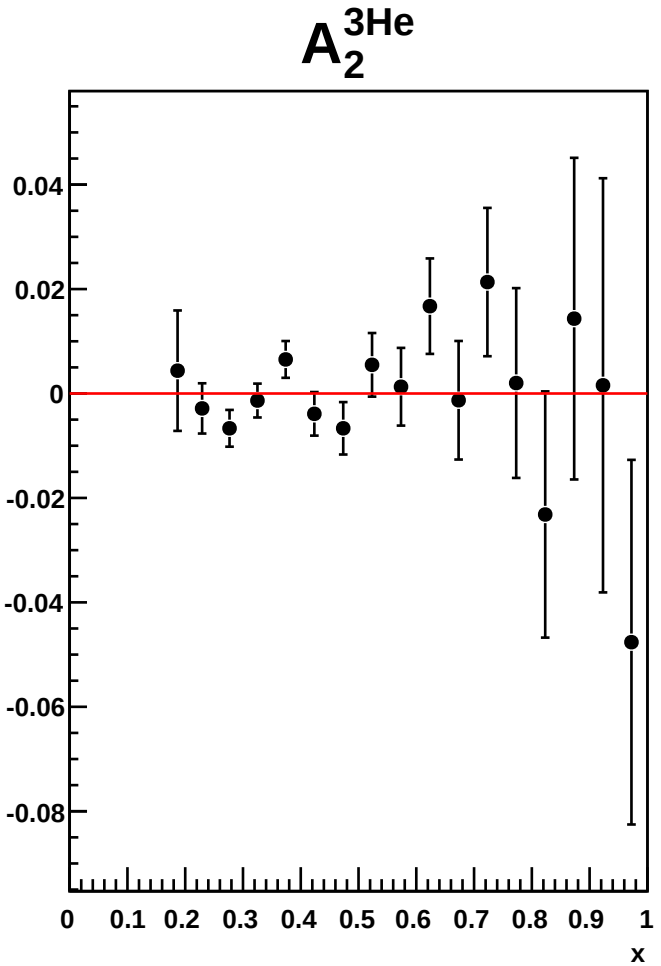
$$A_2 = \frac{\xi}{D\,(1+\eta\xi)} A_{\parallel} + \frac{1}{d\,(1+\eta\xi)} A_{\perp} \tag{3}$$



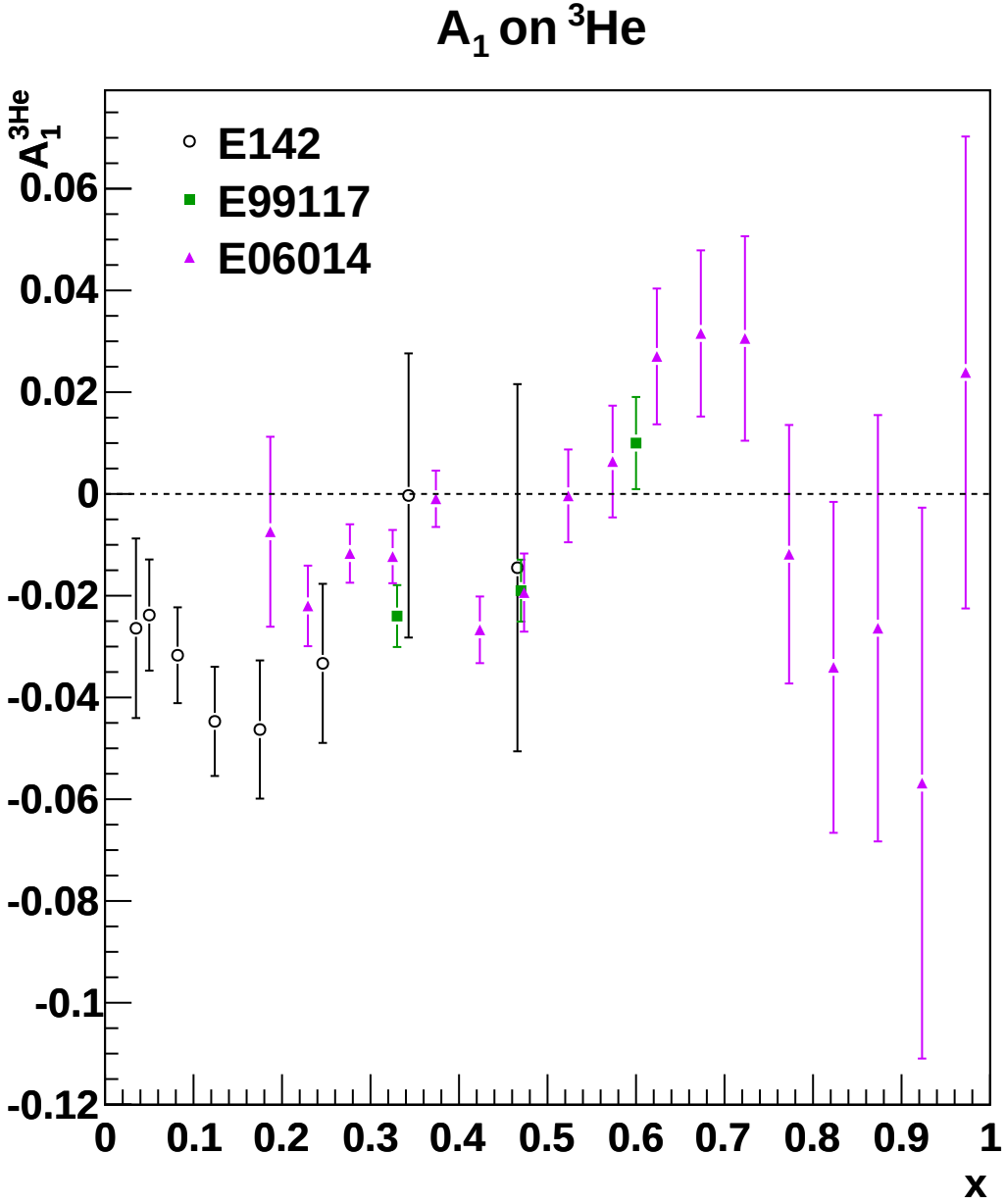


A_1 and A_2 (ii): Our Preliminary Four-Pass Results





A_1 and A_2 (iii): Our Preliminary Results in Context



What's Next?

- Asymmetries
  - Bound error due to mis-binning
  - Bound error due to finite detector resolution
- Doctoral defense scheduled for 25 March

Long-Term Issues

- Analyze and include five-pass data
- More careful cut/background studies
- Careful treatment of deadtime
- Careful treatment of systematic errors
- Better target polarization numbers forthcoming
- Five-pass data may reveal potential problems in four-pass dataset
- Nuclear corrections $\Rightarrow A_1^n, g_1^n$