BigBite Analysis

5.89 GeV Cut Acceptances, Preliminary Asymmetries and Preliminary d2 Statistical Precision

Matthew Posik

[1] Temple University
Philadelphia, PA 19122

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Outline

Cut Acceptance Procedure

- Track cut acceptance over entire 5.89 GeV data set
- Cut acceptance is defined as:
- $\frac{n_{\text{passed}}}{n_{\text{total}}}$, where
- n_{total}: number of tracks
- n_{passed}: number of total tracks that passed a selected cut

5.89 GeV Cut Acceptance (1)

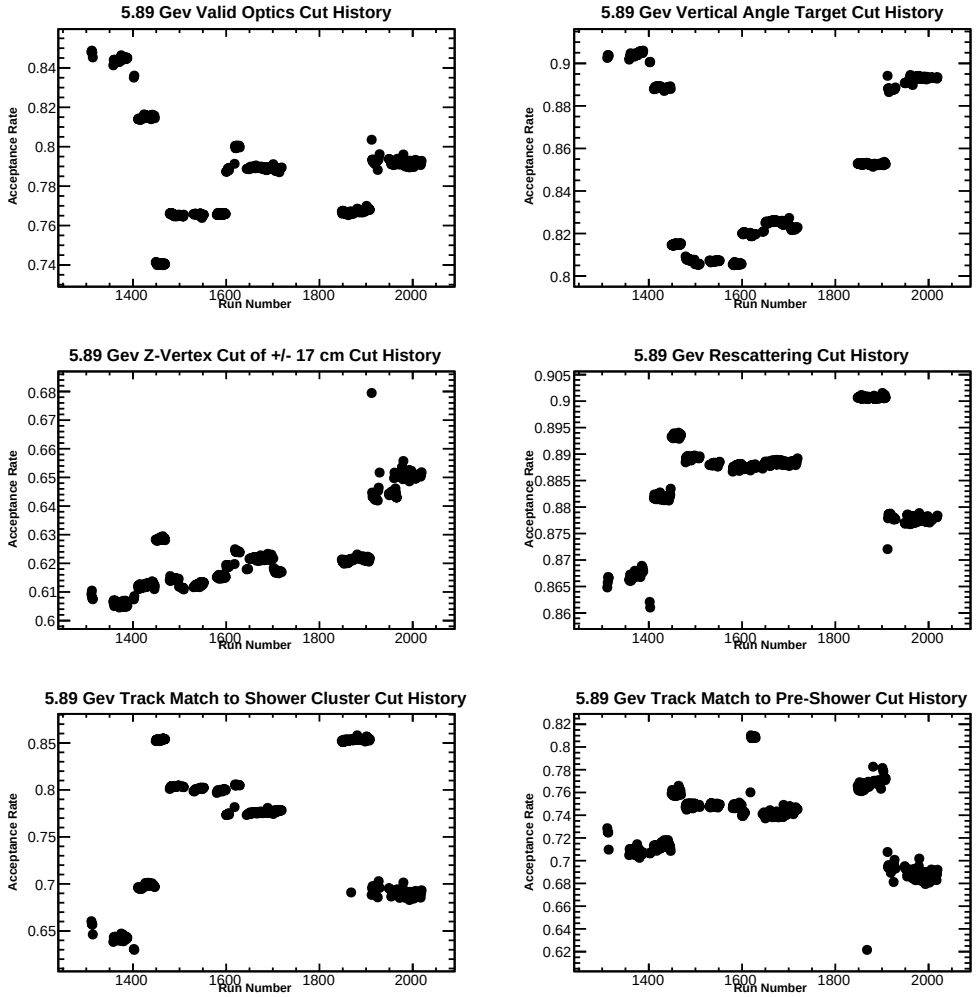


Figure: Shows cut acceptance for selected cuts over 5.89 GeV data set.

5.89 GeV Cut Acceptance (2)

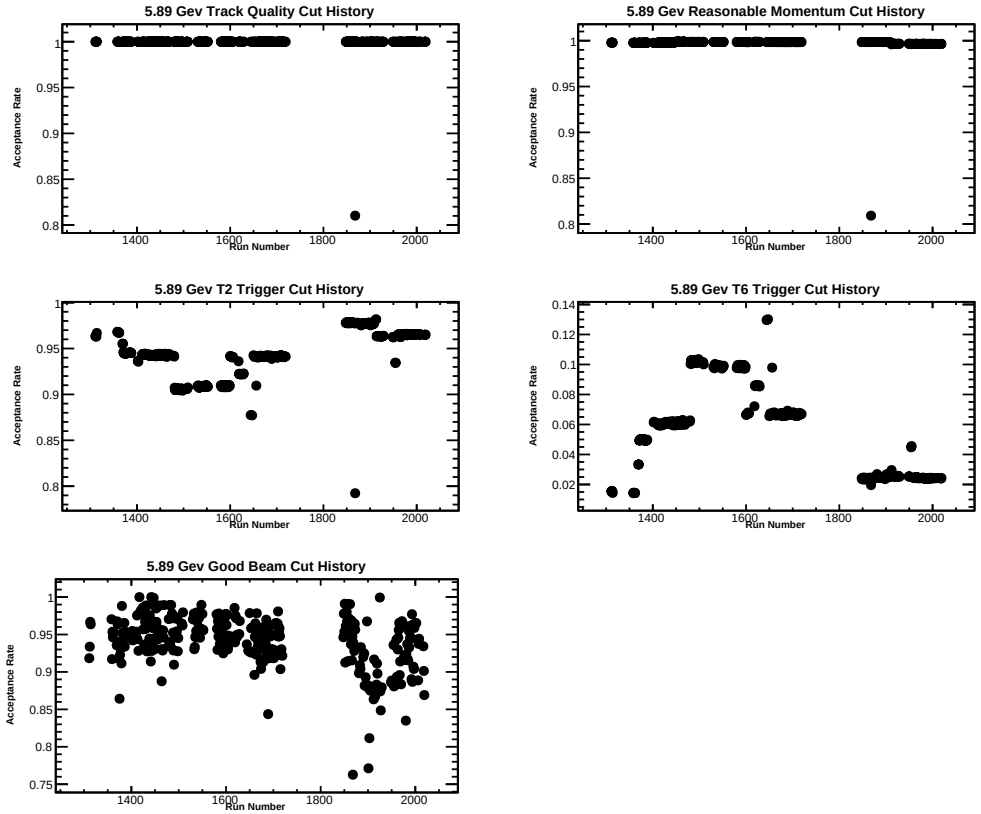


Figure: Shows cut acceptance for selected cuts over 5.89 GeV data set.

5.89 GeV Cut Acceptance (3)

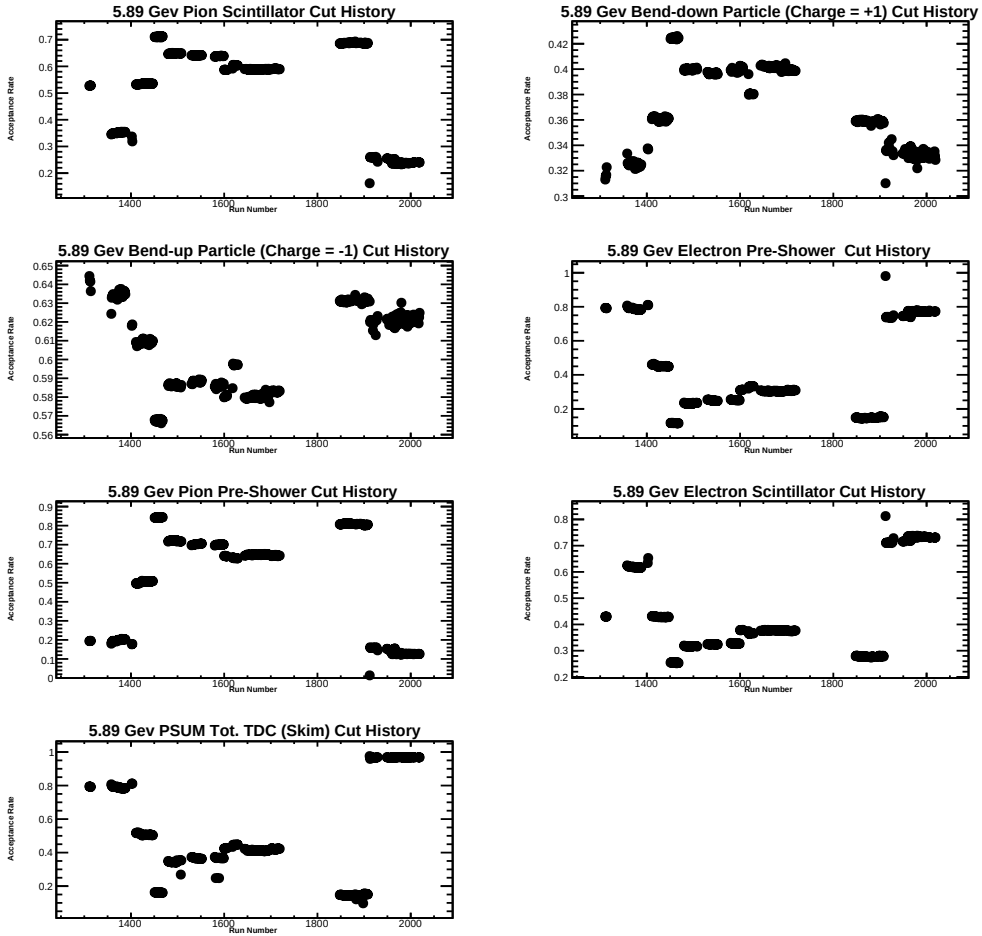


Figure: Shows cut acceptance for selected cuts over 5.89 GeV data set.

5.89 GeV Cut Acceptance (4)

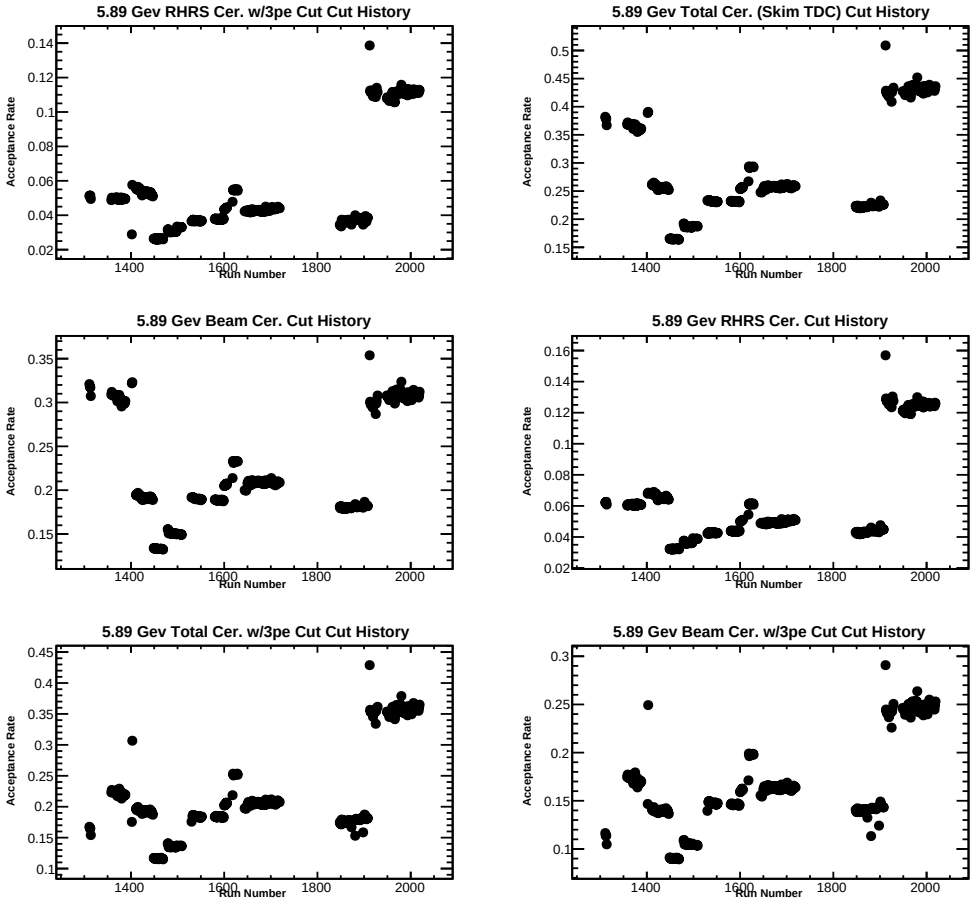


Figure: Shows cut acceptance for selected cuts over 5.89 GeV data set.

5.89 GeV Cut Acceptance (5)

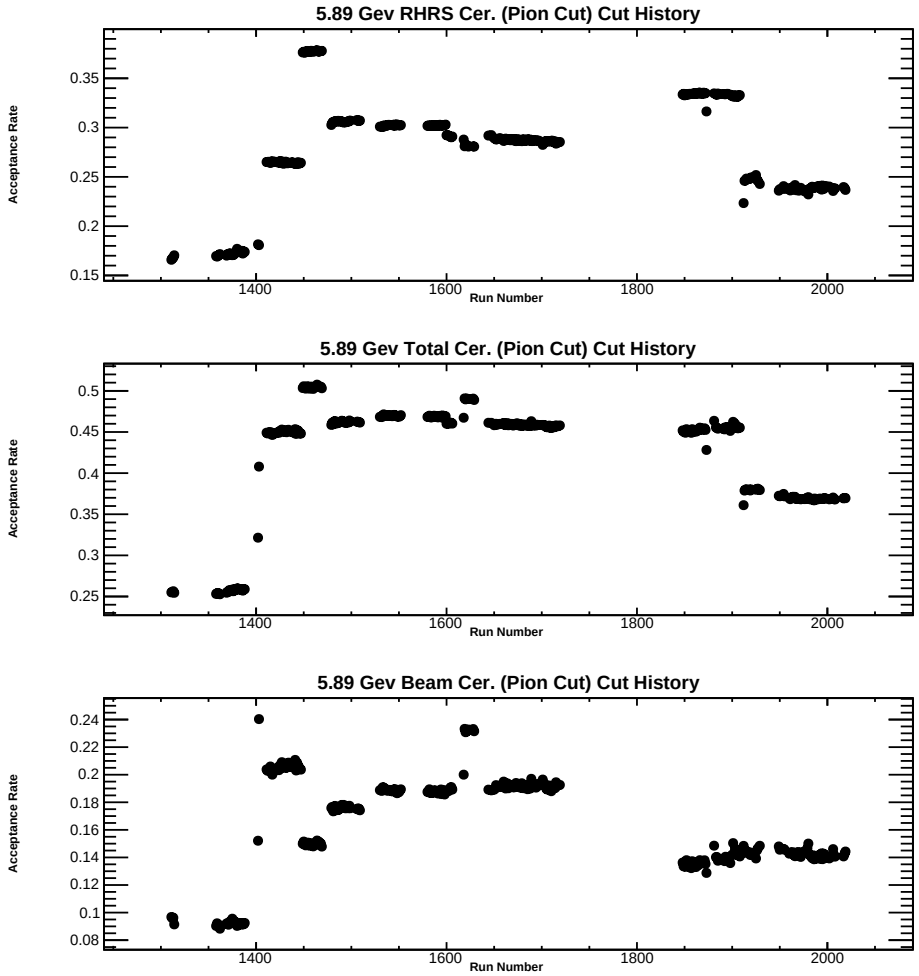


Figure: Shows cut acceptance for selected cuts over 5.89 GeV data set.

Cut Acceptance Summary

- Track cut acceptance over 5.89 GeV data set jumps around a lot
- Maybe due to:
  - Trigger Threshold changes
  - Pre-scale changes
- Need to see if there is a correlation in the cut acceptance jumps with trigger changes(pre-scale and thresholds)

N2 Dilution Factor Definition

$$D_{N_2} = 1 - \frac{Y_{N_2}\rho_{^3He}}{Y_{^3He}\rho_{N_2}}$$

- $Y = \frac{Nps}{Qt_{LT}}$
  - N: Number of electrons
  - ps: T2 pre-scale value
  - t_{LT}: T2 live time
  - Q: charge on target
- $\rho_{^3He}$: N_2 density in ^{3}He cell 0.113 amg
- ρ_{N_2}: N_2 density in ref. cell 7.71 amg
- Take weighted average over all runs for each x-bin
- Used a live time of 1 for the 5.89 GeV analysis (still need to compute)

4.74 GeV Run Settings

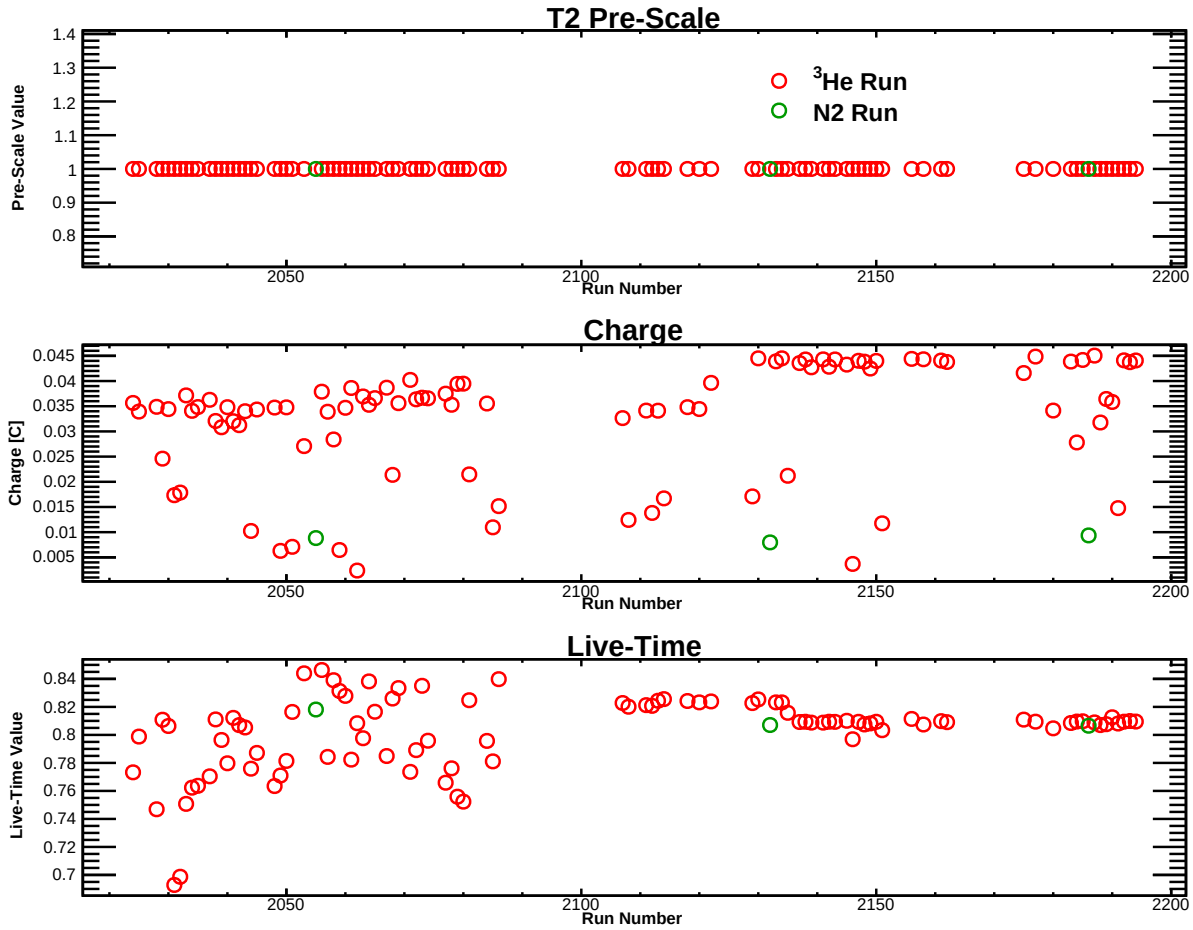


Figure: Shows, from top to bottom, 4.74 GeV T2 trigger pre-scales, total charge on target and T2 trigger live time.

4.74 GeV Yields

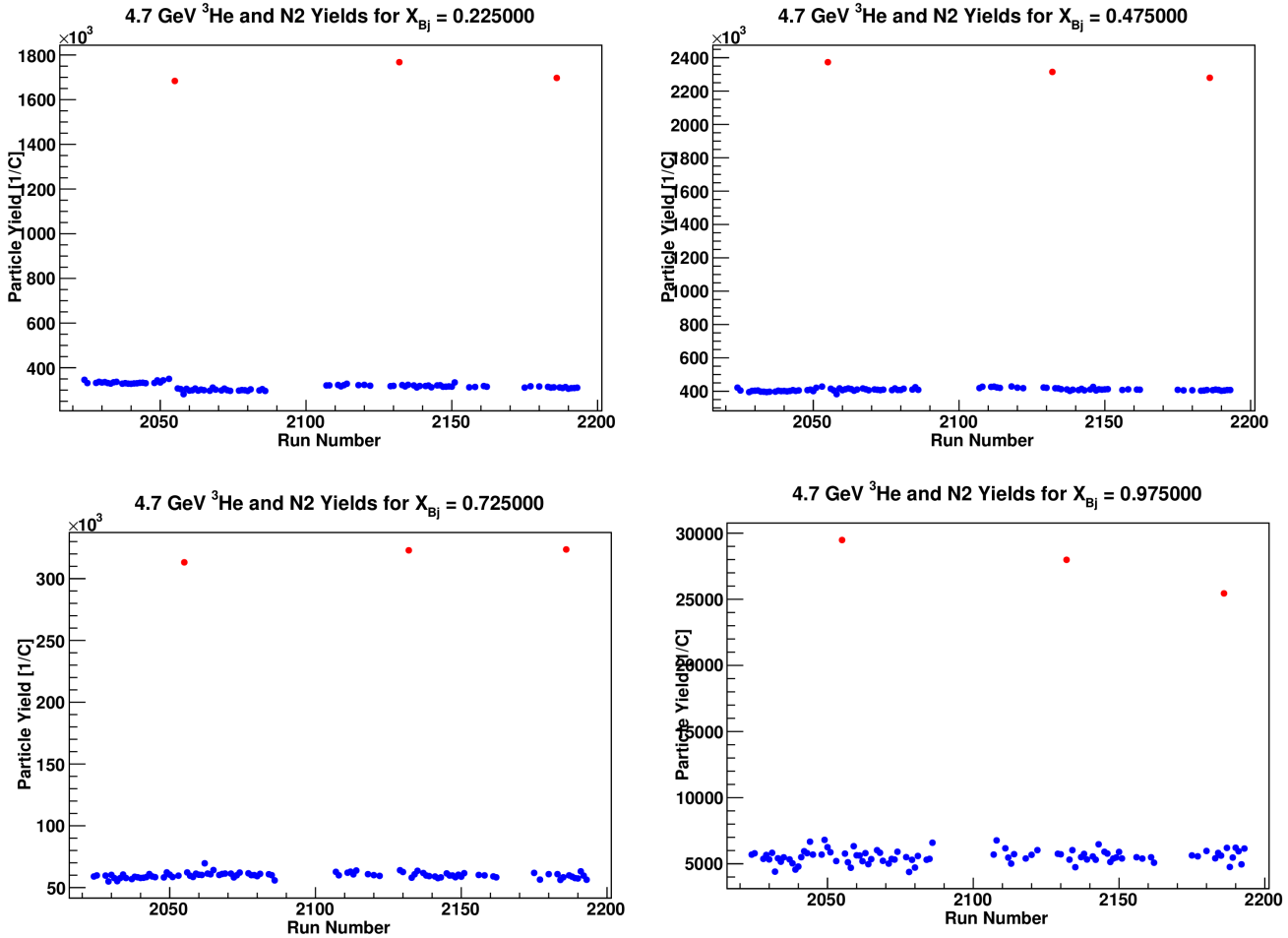


Figure: Shows, the run by run ^{3}He (blue markers) and N_2 (red markers) yields for several bins.

4.74 GeV N2 Dilution Factor

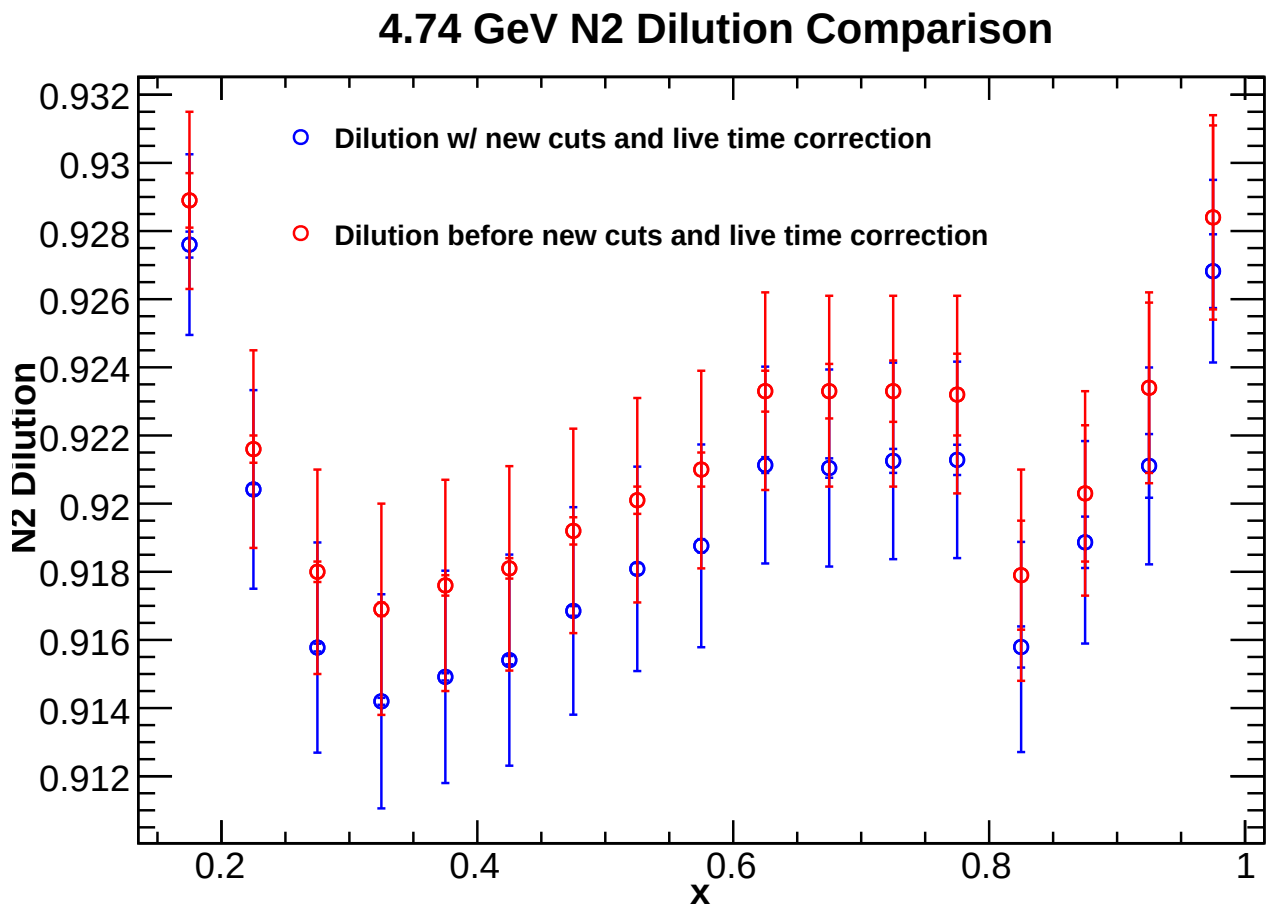


Figure: Shows comparison of old N2 dilution factor (red markers) with no live time correction and new N2 dilution factor (blue markers) with live time correction. There is also a modified track match to shower cluster as well as a scintillator cut applied to the new value.

5.89 GeV Run Settings

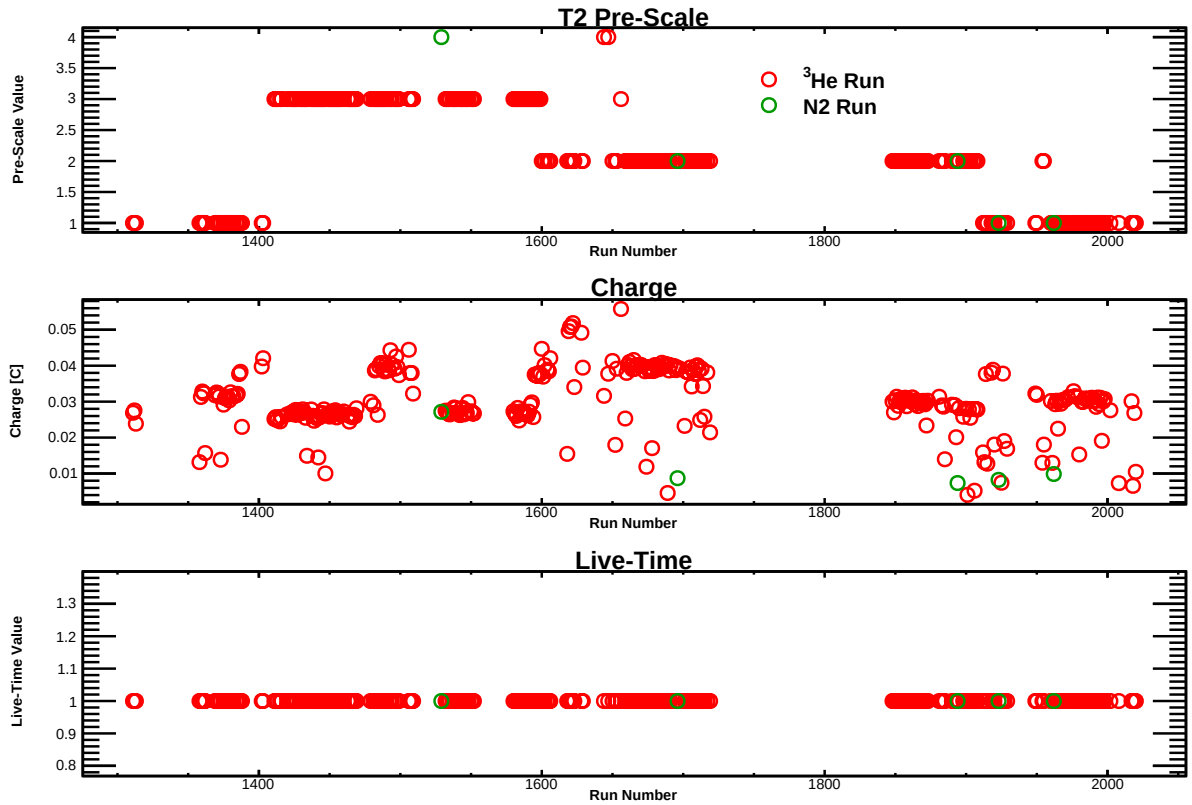


Figure: Shows, from top to bottom, 5.89 GeV T2 trigger pre-scales, total charge on target and T2 trigger live time(not computed yet).

5.89 GeV Yields

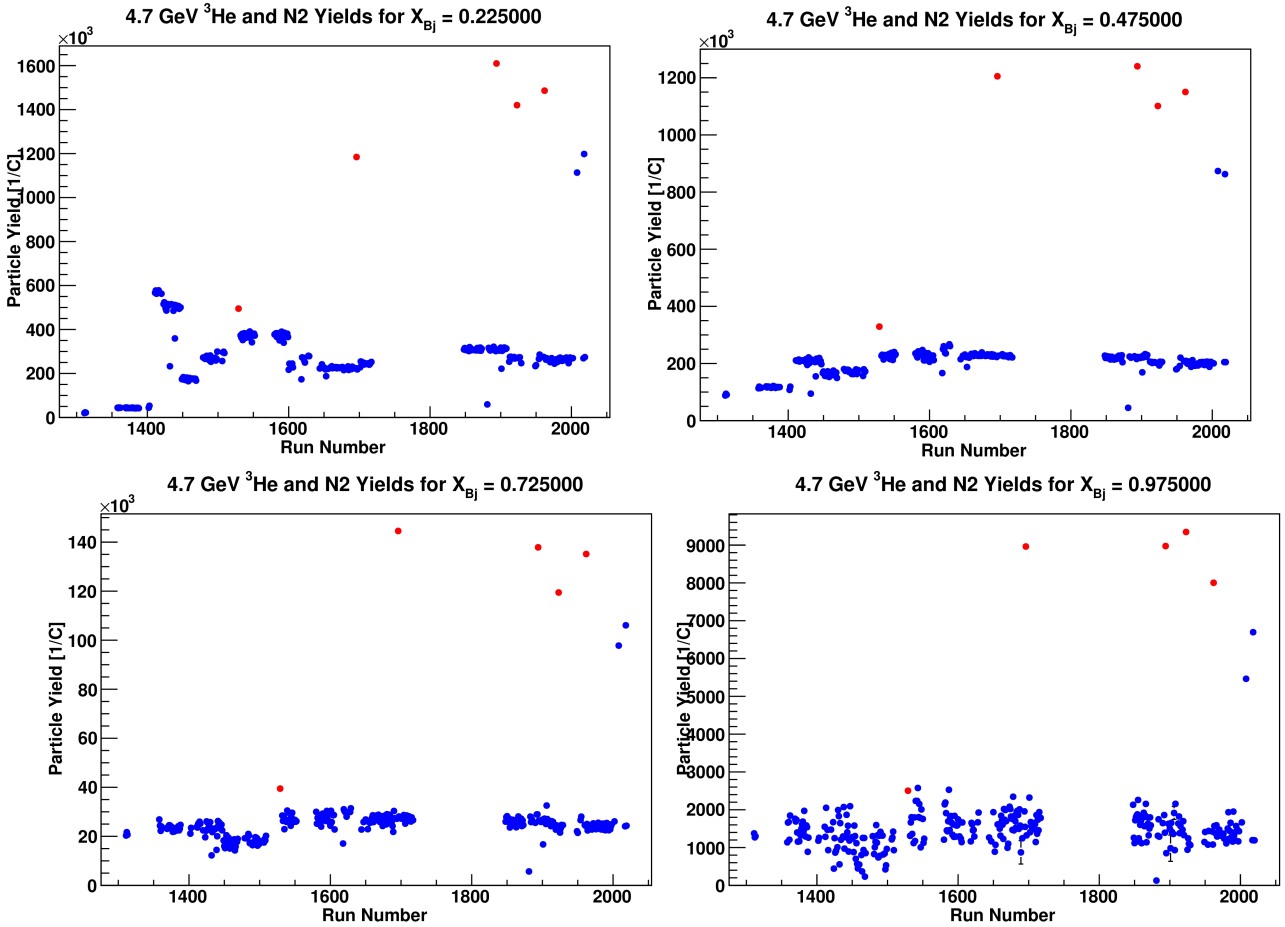


Figure: Shows, the run by run ^{3}He (blue markers) and N_2 (red markers) yields for several bins (mis-labeled titles).

5.89 GeV N2 Dilution Factor

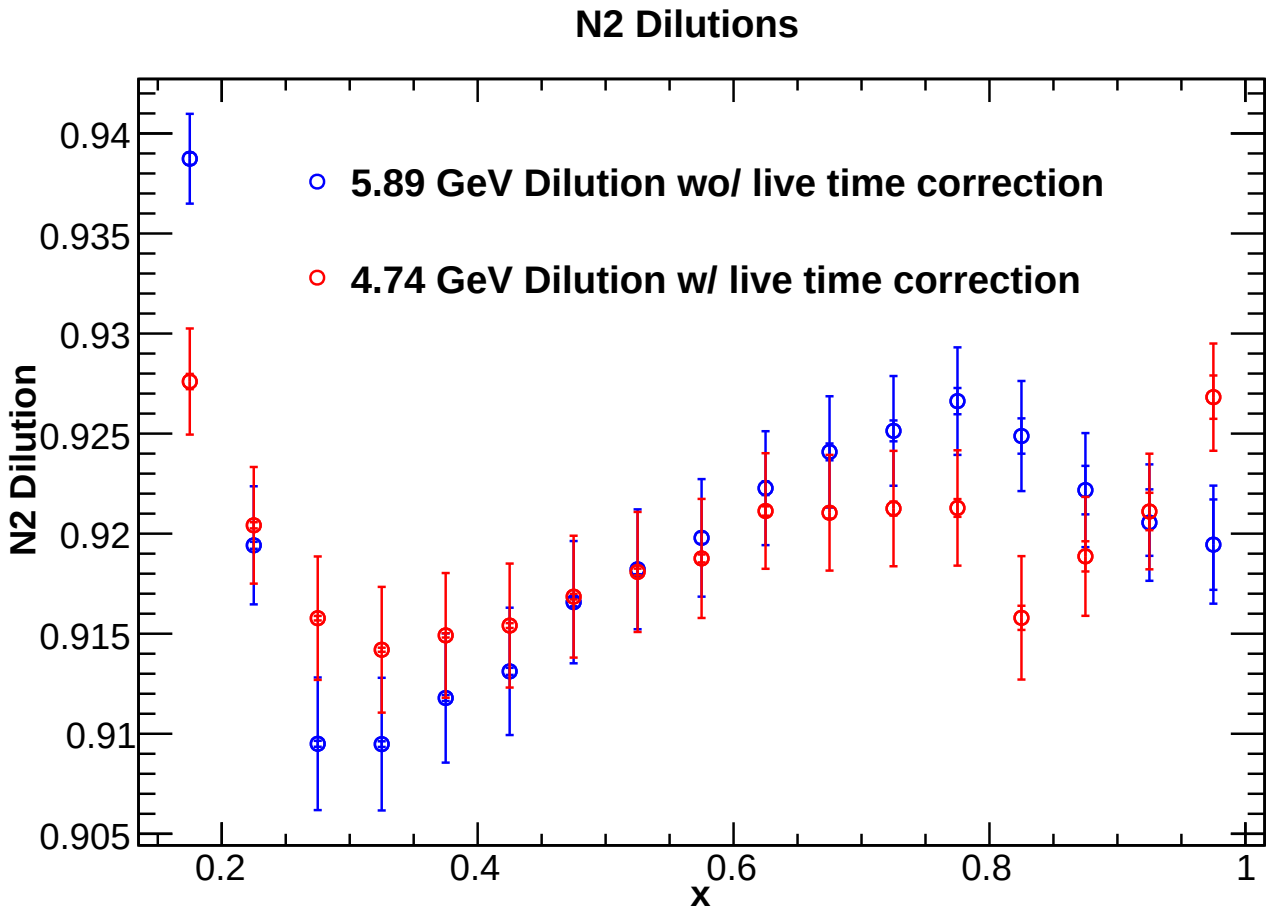


Figure: Shows comparison of new 4.74 GeV N2 dilution factor (red markers) with live time correction and 5.89 GeV N2 dilution factor (blue markers) with no live time correction.

Preliminary Raw Asymmetries

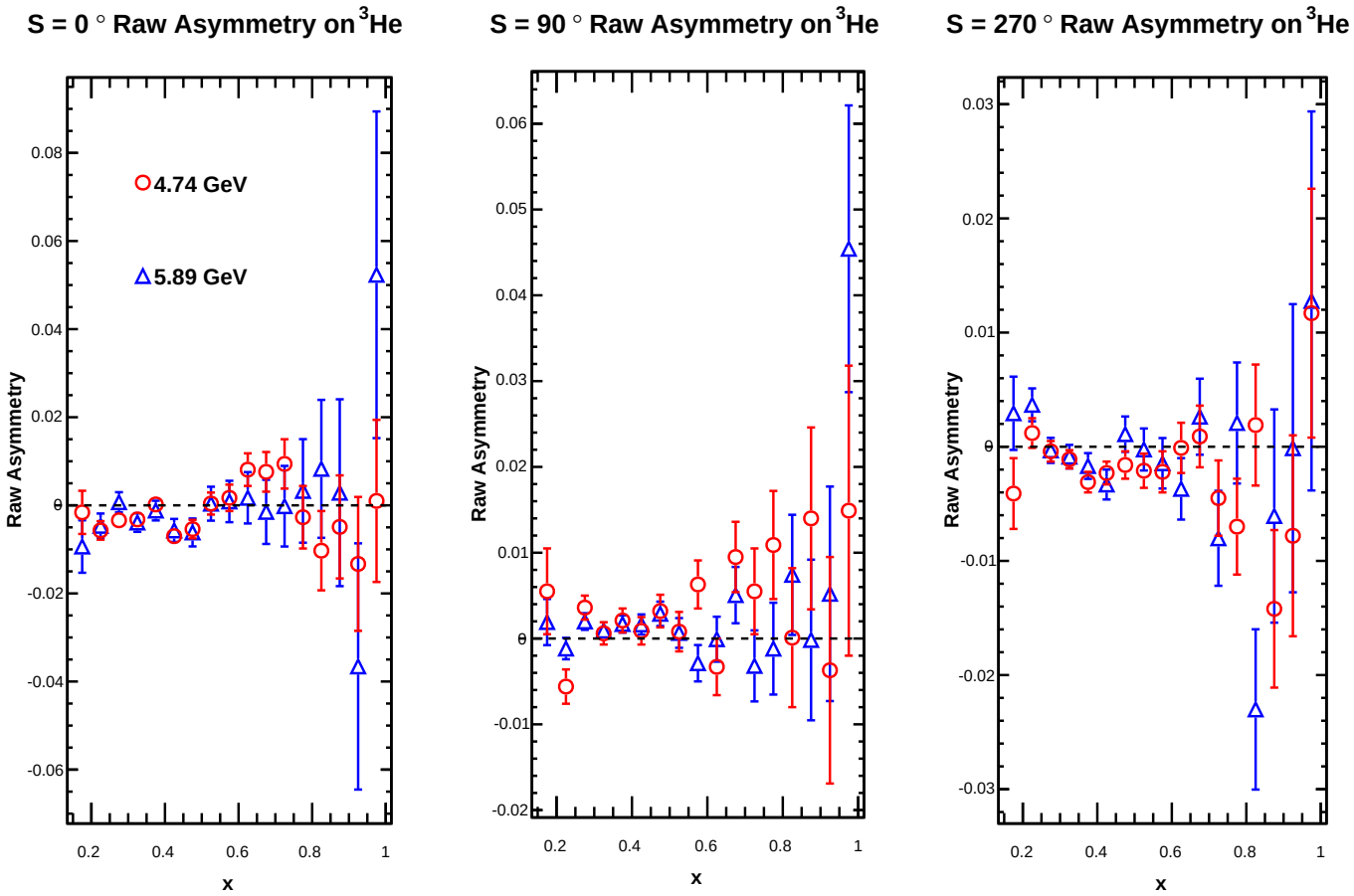


Figure: Preliminary 4.74 and 5.89 GeV raw asymmetries.

Calculating Kinematic Quantities

- The kinematic quantities W,p,ν,θ,ϕ,Q^2 and x were calculated.
- Used 3 runs: 1311(S=270),1479(S=90) and 1547(S=0)
- Extracted the mean value for each x-bin
- Used the rms value as the statistical uncertainty on the quantity

Preliminary 5.89 GeV Kinematic Quantities

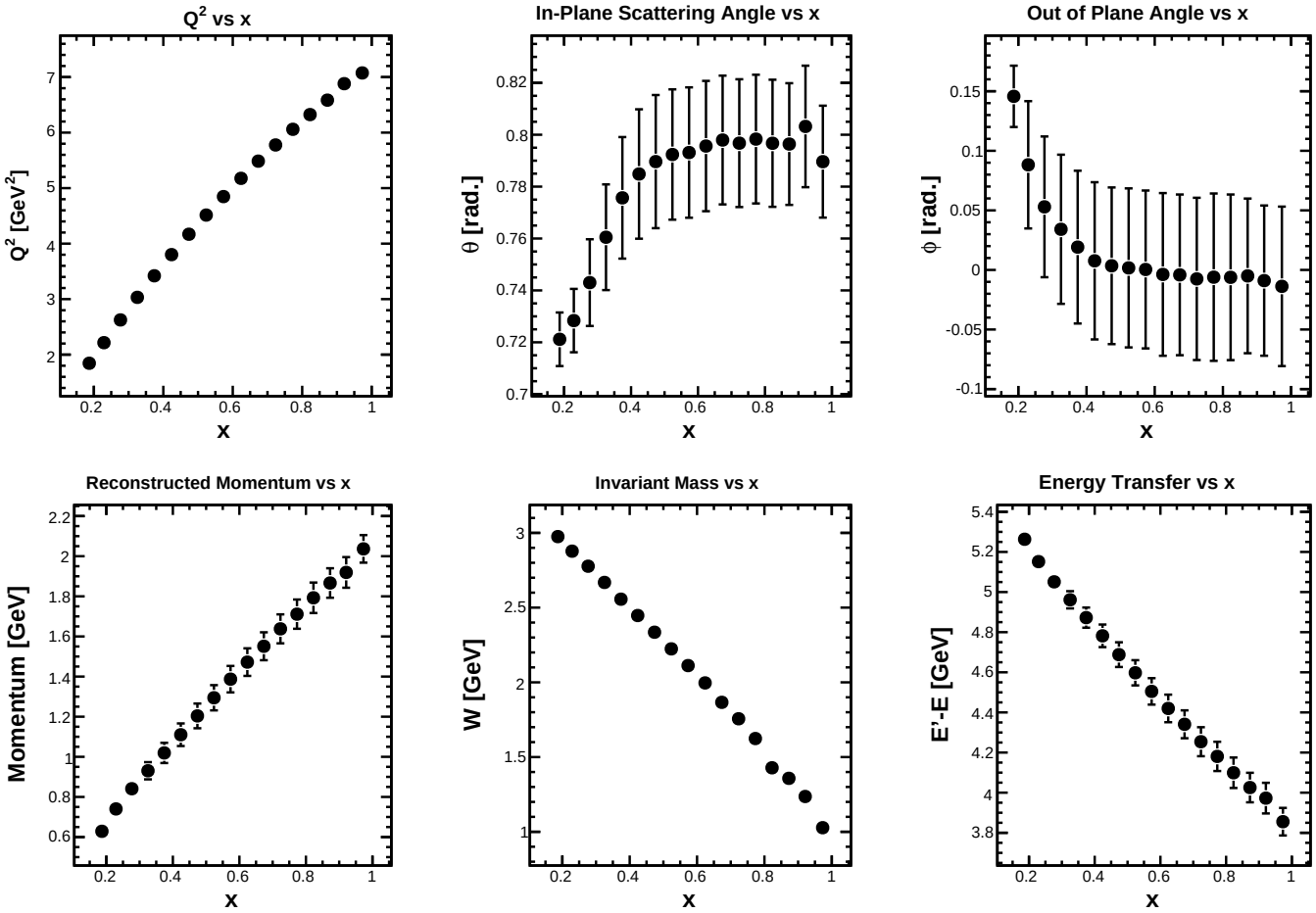


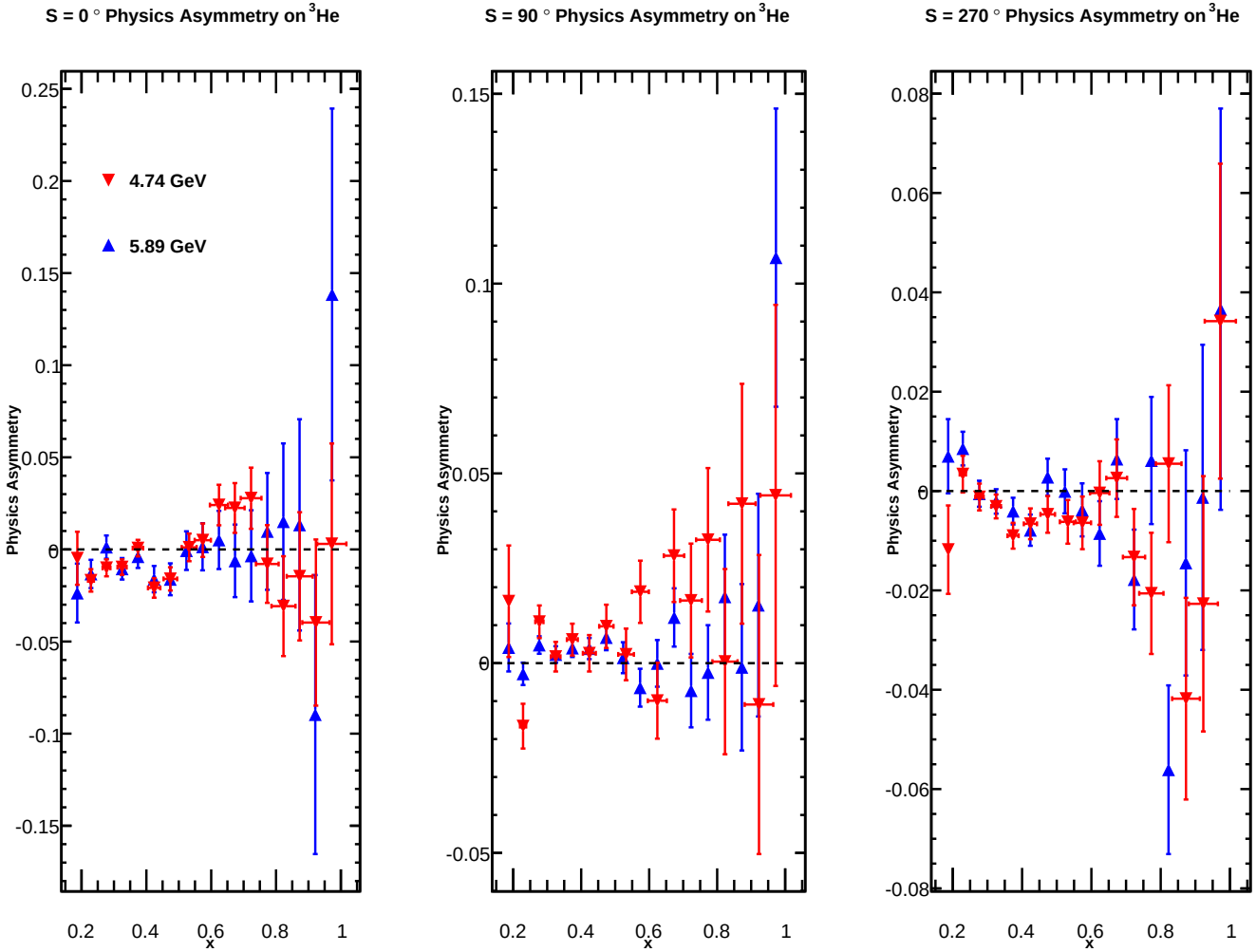
Figure: Preliminary 5.89 GeV kinematic quantities.

Forming Physics Asymmetry

Note: From this point on, all error bars shown include raw asymmetry and N_2 dilution statistical errors only

- $A_{\parallel} = \frac{A_{\parallel}^{raw}}{P_t P_b D_{N2}}$, $A_{\perp} = \frac{A_{\perp}^{raw}}{P_t P_b D_{N2} cos(\phi)}$
- P_t: target polarization (uses Yawei's values, pumping chamber polarizations)
- P_b: beam polarization
- D_{N2}: Nitrogen dilution factor
- $cos(\phi)$: cosine of the azimuthal angle (out of plane)

Preliminary Physics Asymmetries



Preliminary Longitudinal and Transverse Asymmetries

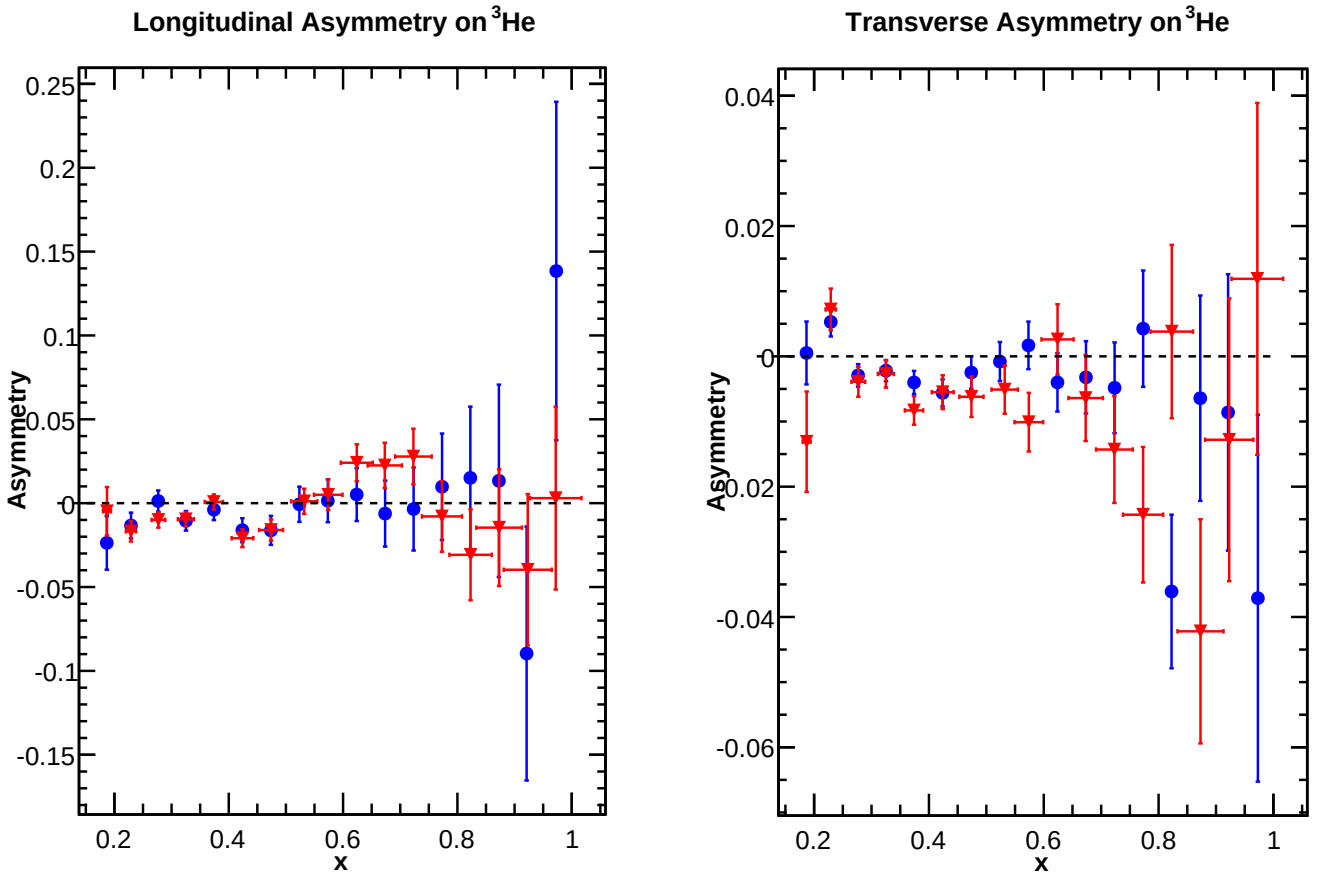


Figure: Preliminary 4.74 (red) and 5.89 (blue) GeV longitudinal and transverse asymmetries.

Defining A_1 and A_2

$$A_1 = c_1^{A_1} A_{\parallel} + c_2^{A_1} A_{\perp}$$

$$A_2 = c_1^{A_2} A_{\parallel} + c_2^{A_2} A_{\perp}$$

- $c_1^{A_1} = \frac{1}{D(1+\eta\xi)}$
- $c_2^{A_1} = \frac{-\eta}{d(1+\eta\xi)}$
- $c_1^{A_2} = \frac{\xi}{D(1+\eta\xi)}$
- $c_2^{A_2} = \frac{1}{d(1+\eta\xi)}$

Preliminary 5.89 GeV A_1 and A_2 Kinematics

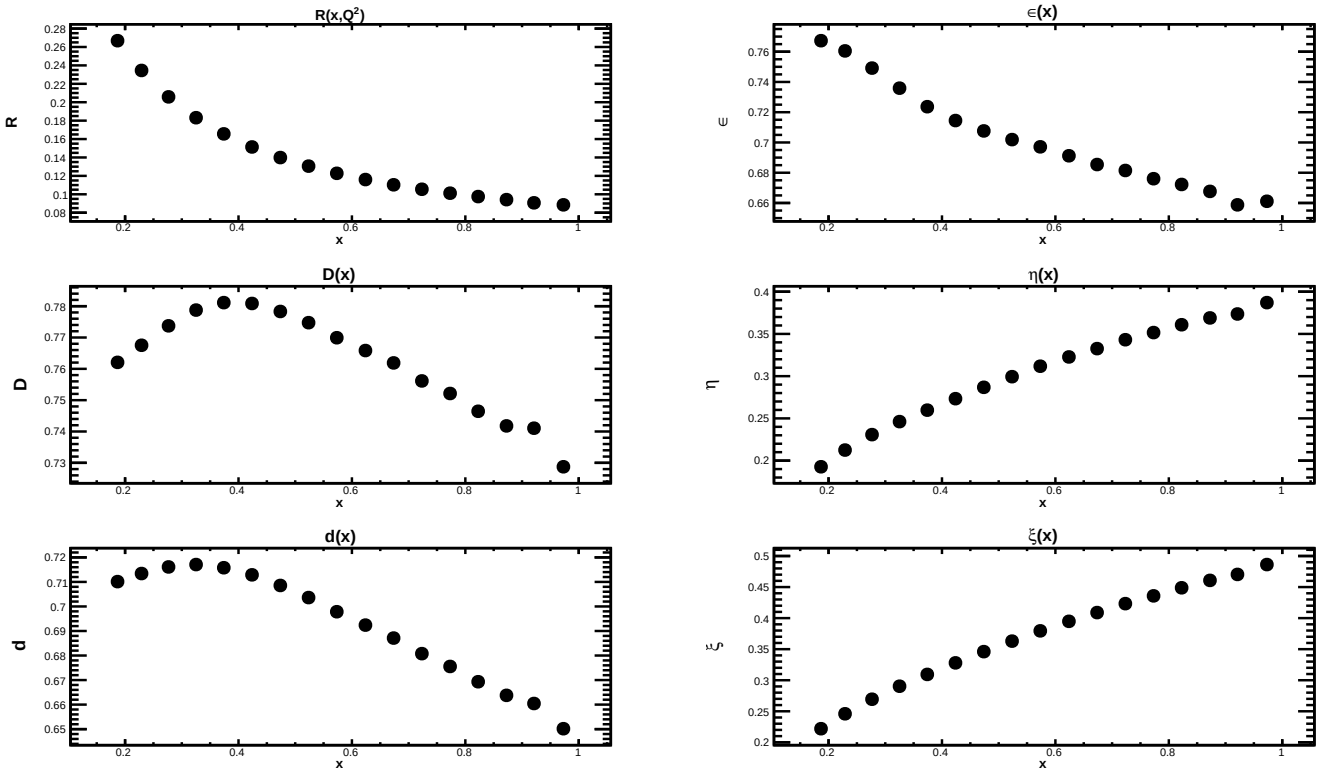


Figure: Preliminary 5.89 GeV A_1 and A_2 kinematics.

Preliminary 5.89 GeV A_1 and A_2 Constants

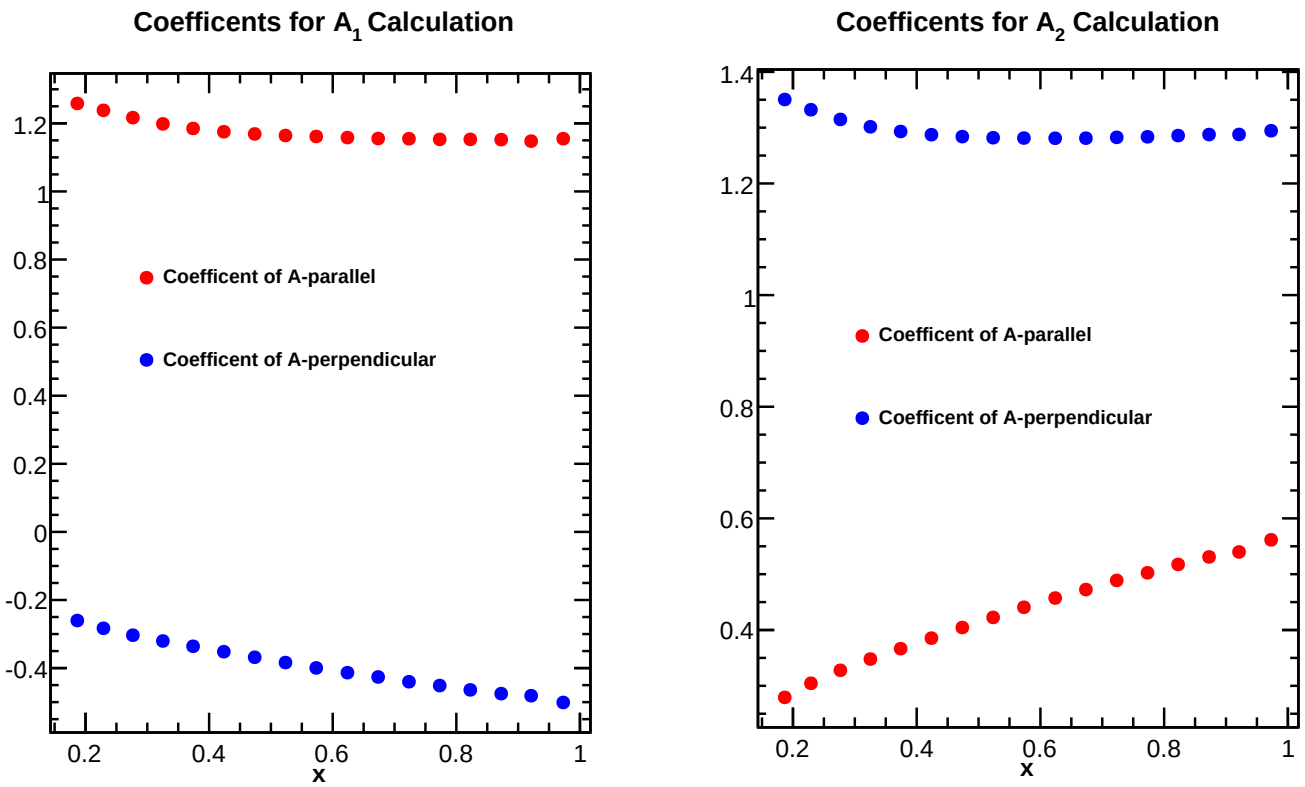


Figure: Preliminary 5.89 GeV A_1 and A_2 constants.

Preliminary A_1 and A_2

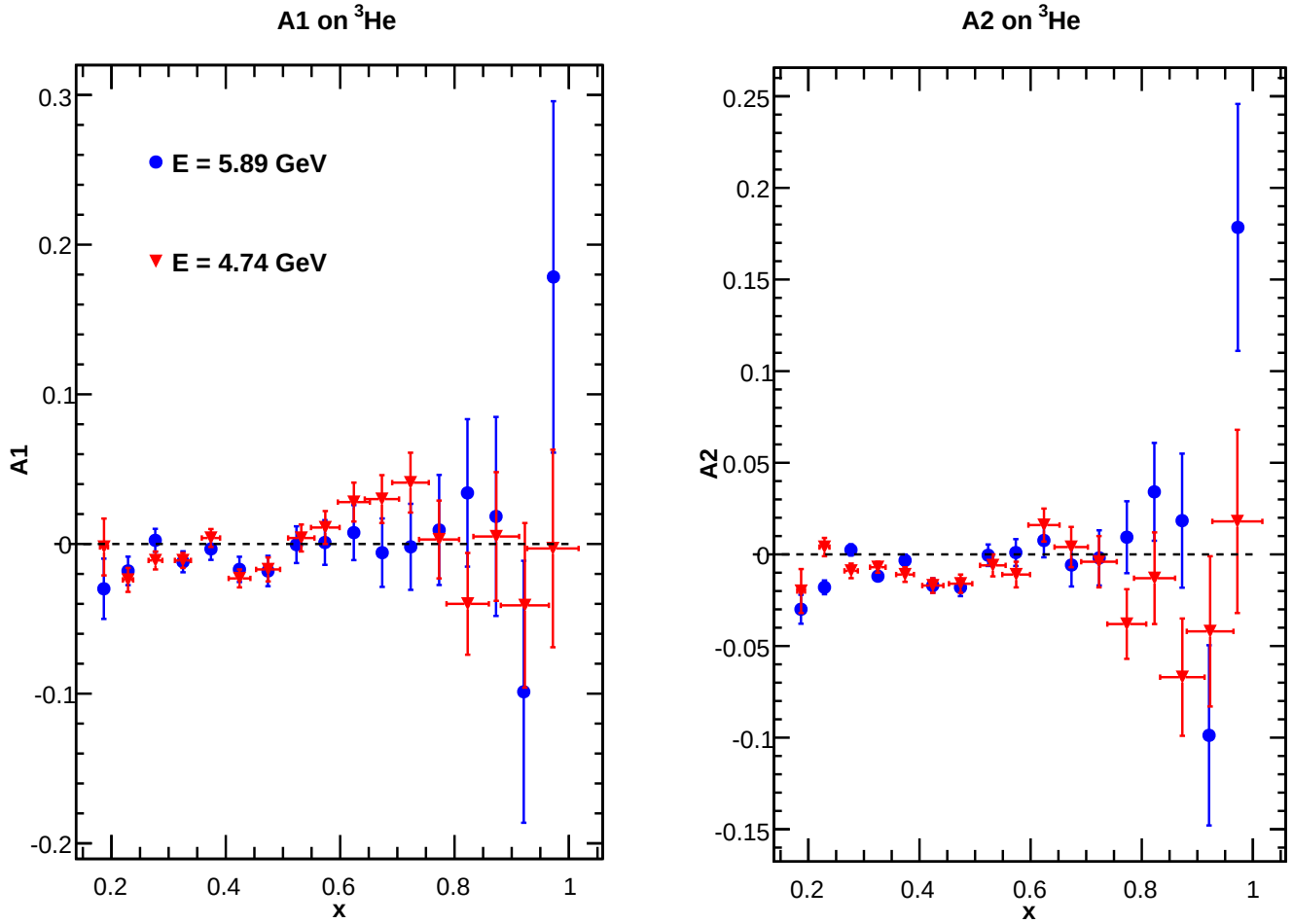


Figure: Preliminary 4.74 and 5.89 GeV A_1 and A_2.

Preliminary A_1 World Data

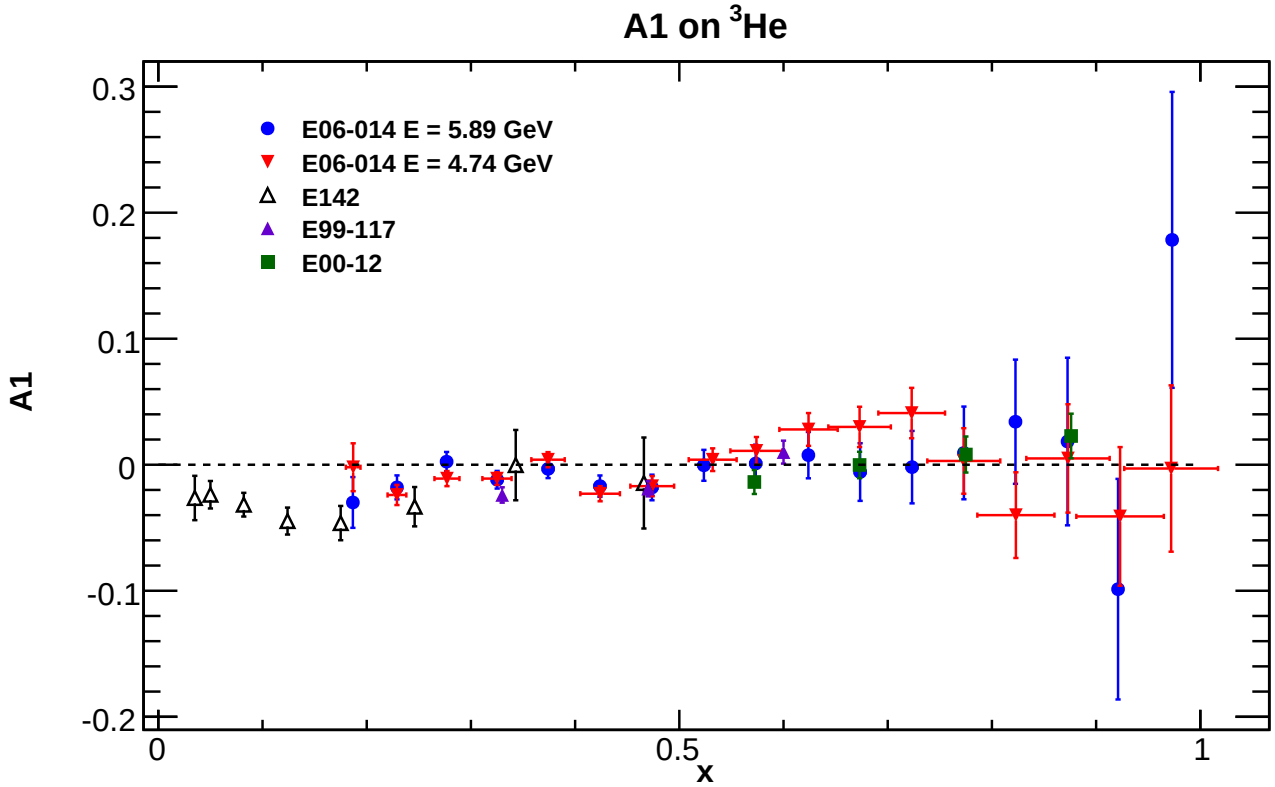


Figure: Preliminary 4.74 and 5.89 GeV A_1 compared to previous experiments.

Preliminary A_2 World Data

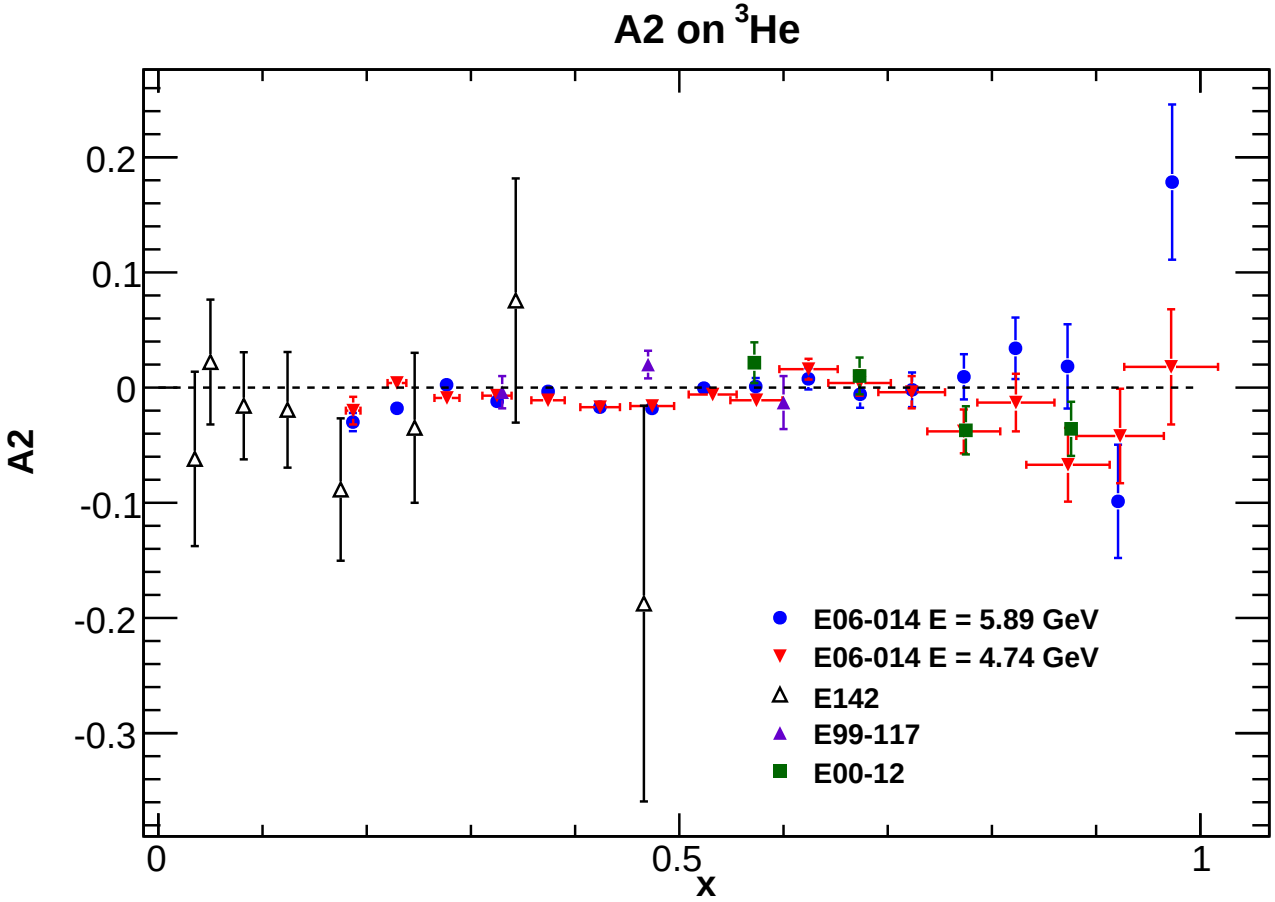


Figure: Preliminary 4.74 and 5.89 GeV A_2 compared to previous experiments.

Defining g_1 and g_2

$$g_1 = \frac{\sigma_0}{(\hbar c)^2}\left(c_1^{g_1} A_{\parallel} + c_2^{g_1} A_{\perp}\right)$$

$$g_2 = \frac{\sigma_0}{(\hbar c)^2}\left(c_1^{g_2} A_{\parallel} + c_2^{g_2} A_{\perp}\right)$$

- $c_1^{g_1} = \left(\frac{MQ^2}{4\alpha^2}\right)\left(\frac{2y}{(1-y)(2-y)}\right)$
- $c_2^{g_1} = \left(\frac{MQ^2}{4\alpha^2}\right)\left(\frac{2y}{(1-y)(2-y)}\right) tan\left(\frac{\theta}{2}\right)$
- $c_1^{g_2} = -\left(\frac{MQ^2}{4\alpha^2}\right)\left(\frac{y^2}{(1-y)(2-y)}\right)$
- $c_2^{g_2} = \left(\frac{MQ^2}{4\alpha^2}\right)\left(\frac{y^2}{(1-y)(2-y)}\right)\left(\frac{1+(1-y)cos(\theta)}{(1-y)sin(\theta)}\right)$
- $(\hbar c)^2 = 389379$ nb GeV^2

Preliminary 5.89 GeV Total Cross-Section

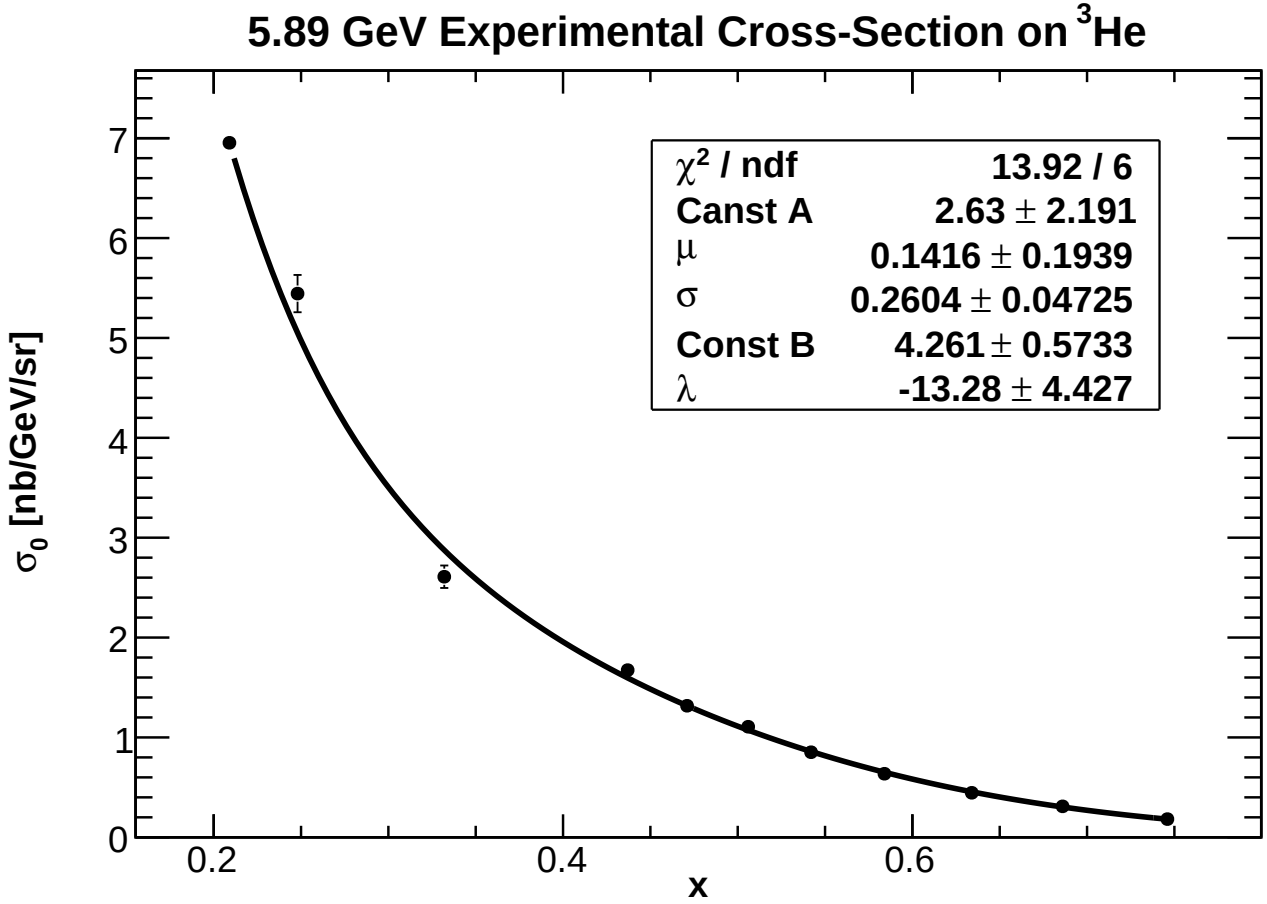


Figure: Preliminary 5.89 GeV Gauss + Exponential fit to LHRS cross-section

Preliminary 5.89 GeV g_1 and g_2 Coefficients

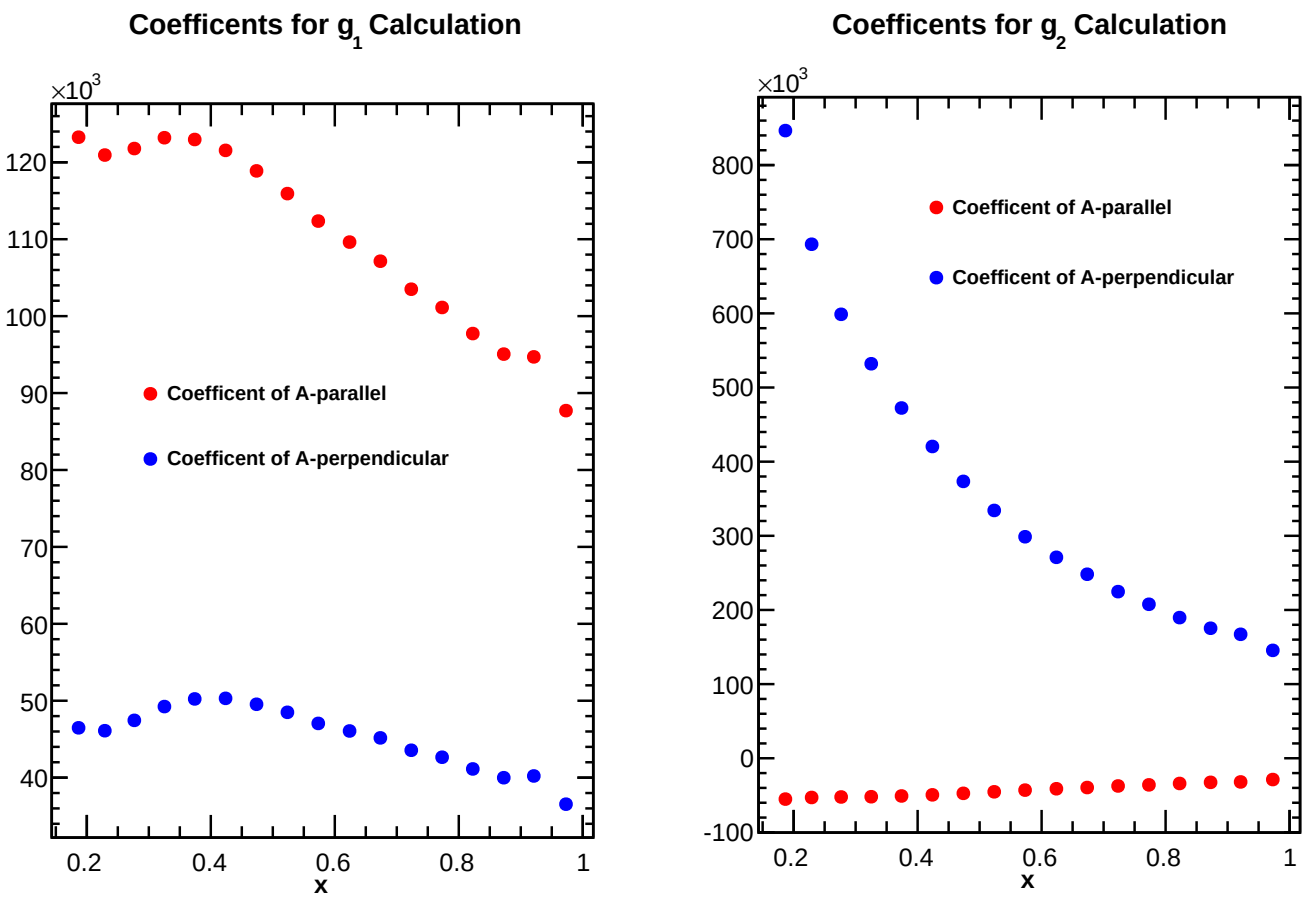


Figure: Preliminary 5.89 GeV g_1 and g_2 coefficients.

Preliminary 5.89 GeV g_1 and g_2

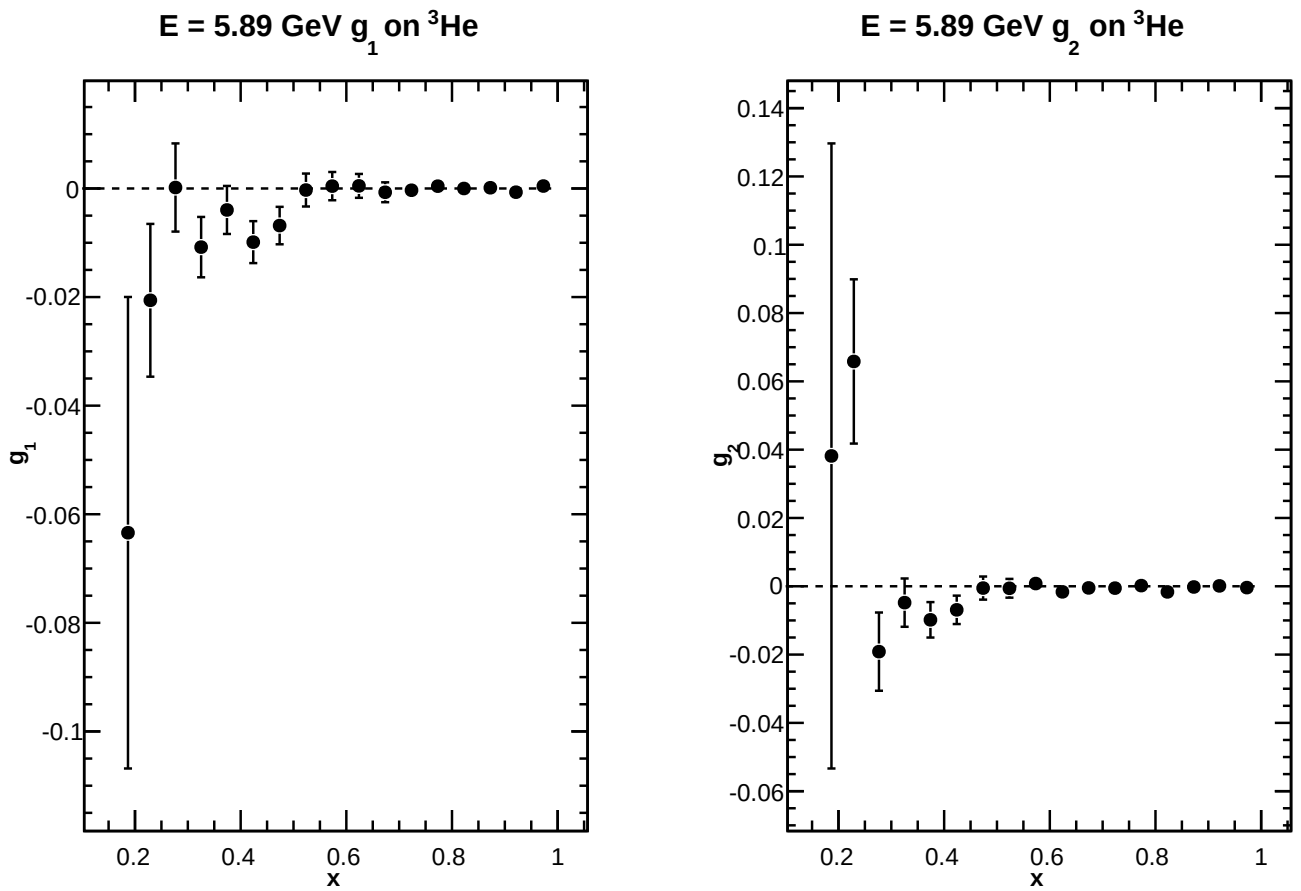


Figure: Preliminary 5.89 GeV g_1 and g_2.

Preliminary 5.89 GeV g_1 World Data

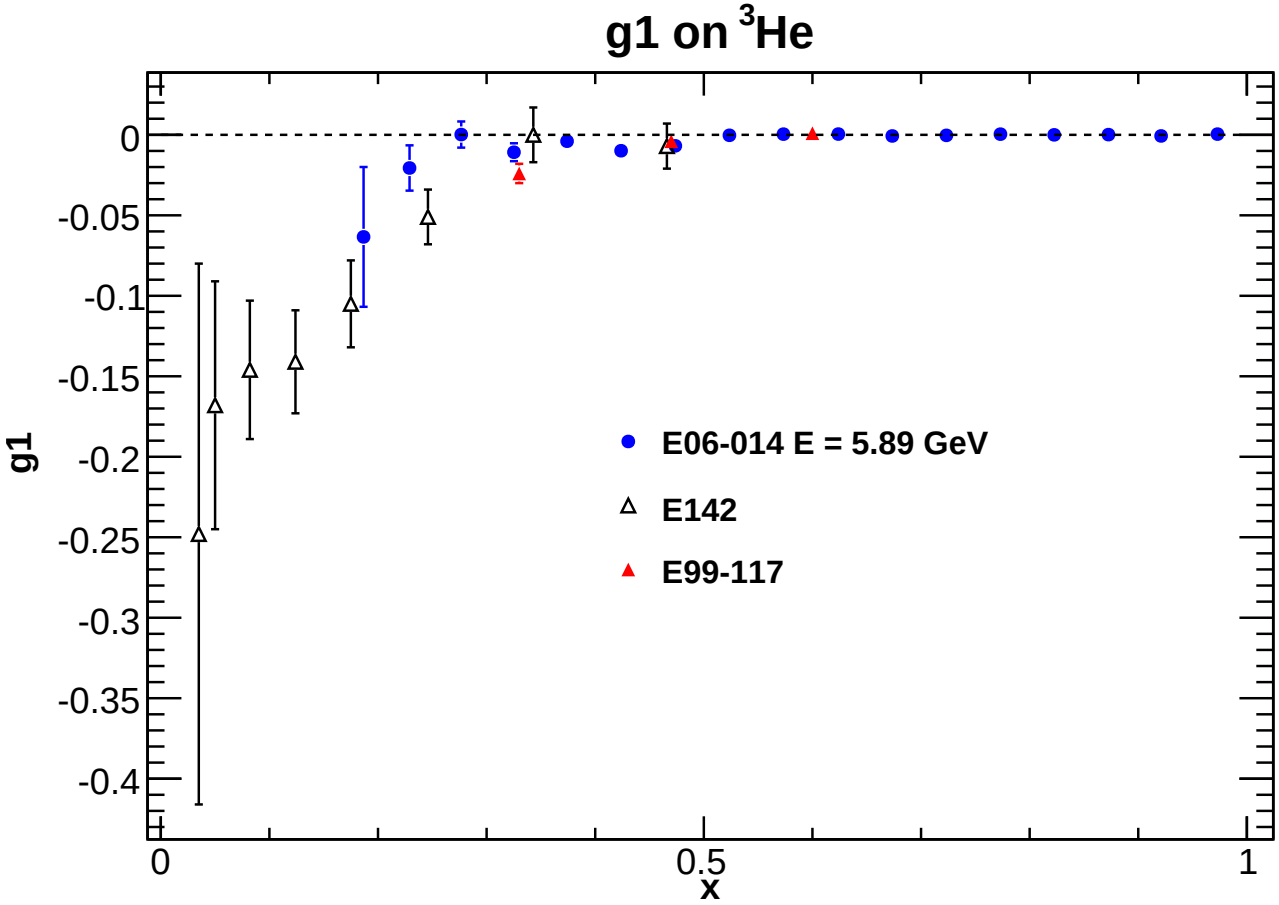


Figure: Preliminary 5.89 GeV g_1 compared to other experiments.

Preliminary 5.89 GeV g_2 World Data

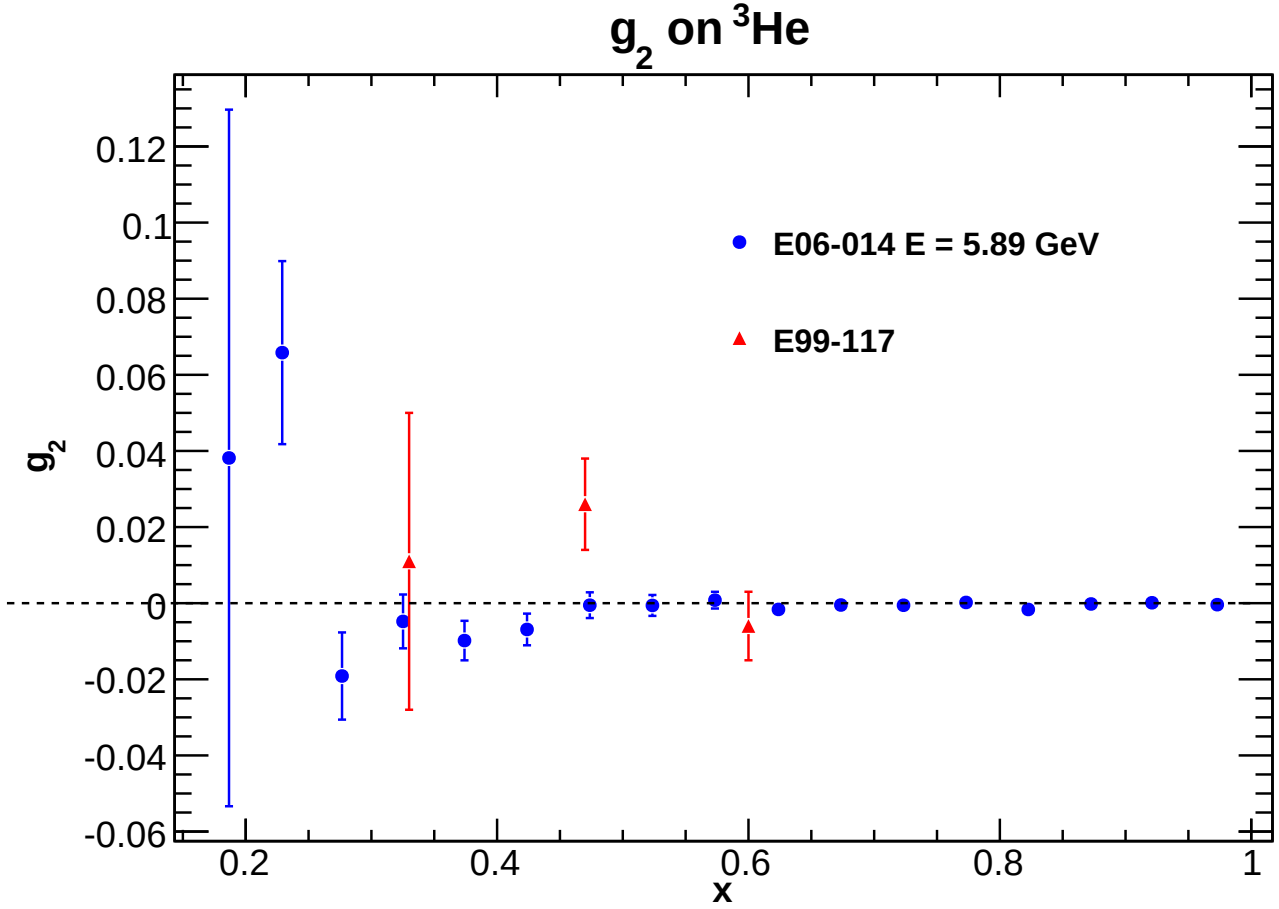


Figure: Preliminary 5.89 GeV g_2 compared to other experiments.

Computing 5.89 GeV d_2 Statistical Precision

- Compute $d_2(x, Q^2)$ for each x-bin
- Compute the weighted average and error of d_2 over all x-bins
- Weighted error is the statistical precision
- Two ways to compute d_2:
  - $d_2^{(1)}(x, Q^2) \propto g_1, g_2$
  - $d_2^{(2)}(x, Q^2) \propto A_{\parallel}, A_{\perp}$
- $\delta d_2^{(1)}(Q^2) = 4.79 \times 10^{-4}$
- $\delta d_2^{(2)}(Q^2) = 3.68 \times 10^{-4}$

Preliminary 5.89 GeV d_2 Statistical Precision

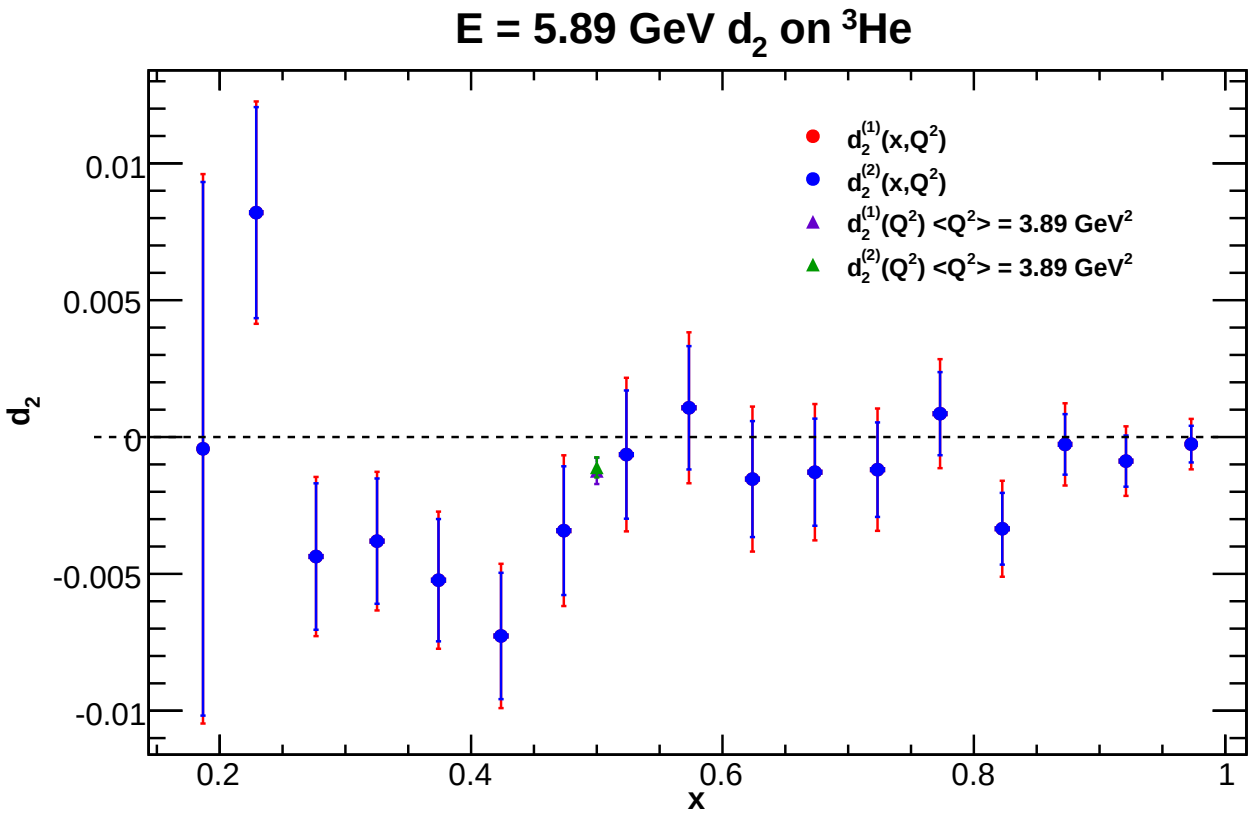


Figure: Sum of d_2 over all x-bins was done to estimate preliminary statistical error on d_2.

What's Next

- Look more into in-plane angle shift
- Compute 5-pass live times
- Look at raw pion asymmetries
- Apply diffuse equation to EPR polarizations

Preliminary A_1 World Data

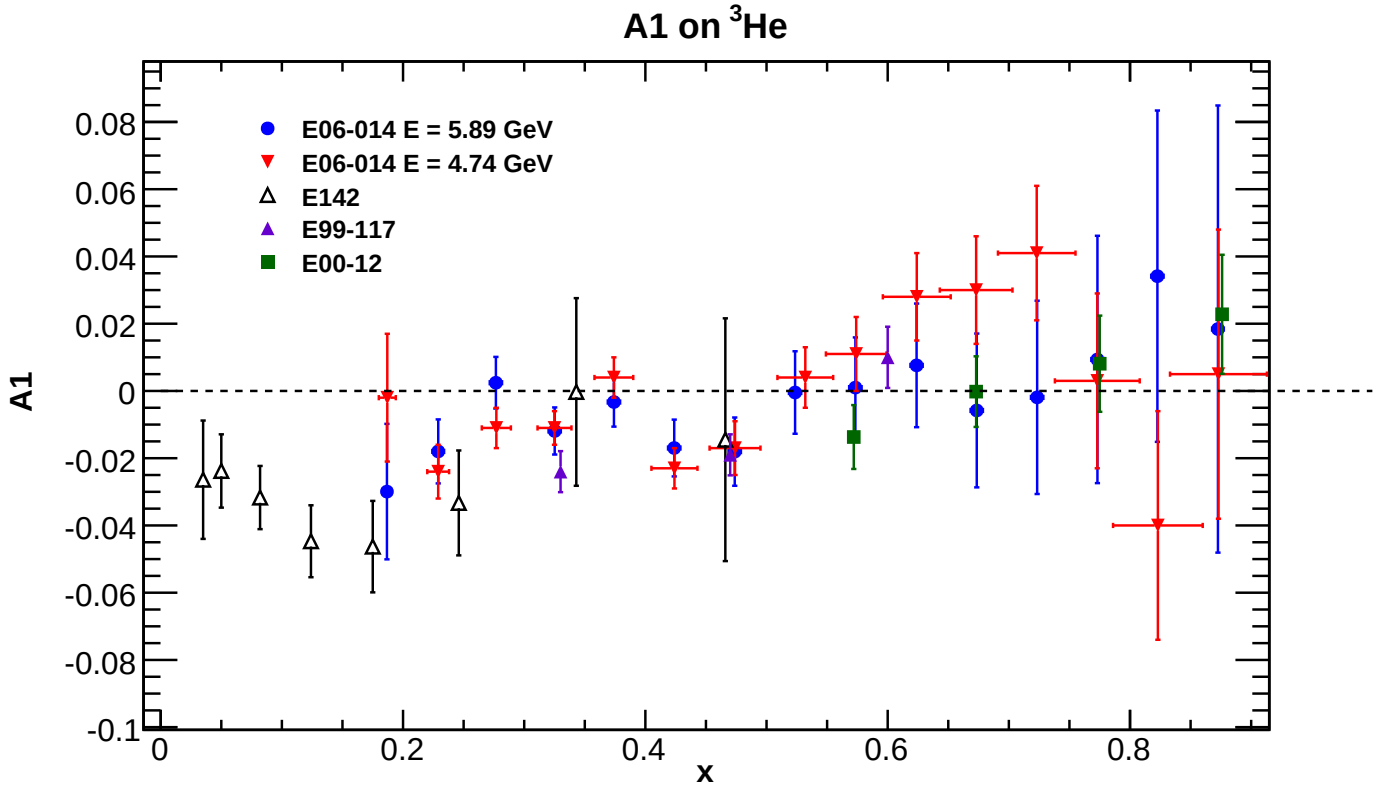


Figure: Preliminary 4.74 and 5.89 GeV A_1 compared to previous experiments.

Preliminary A_2 World Data

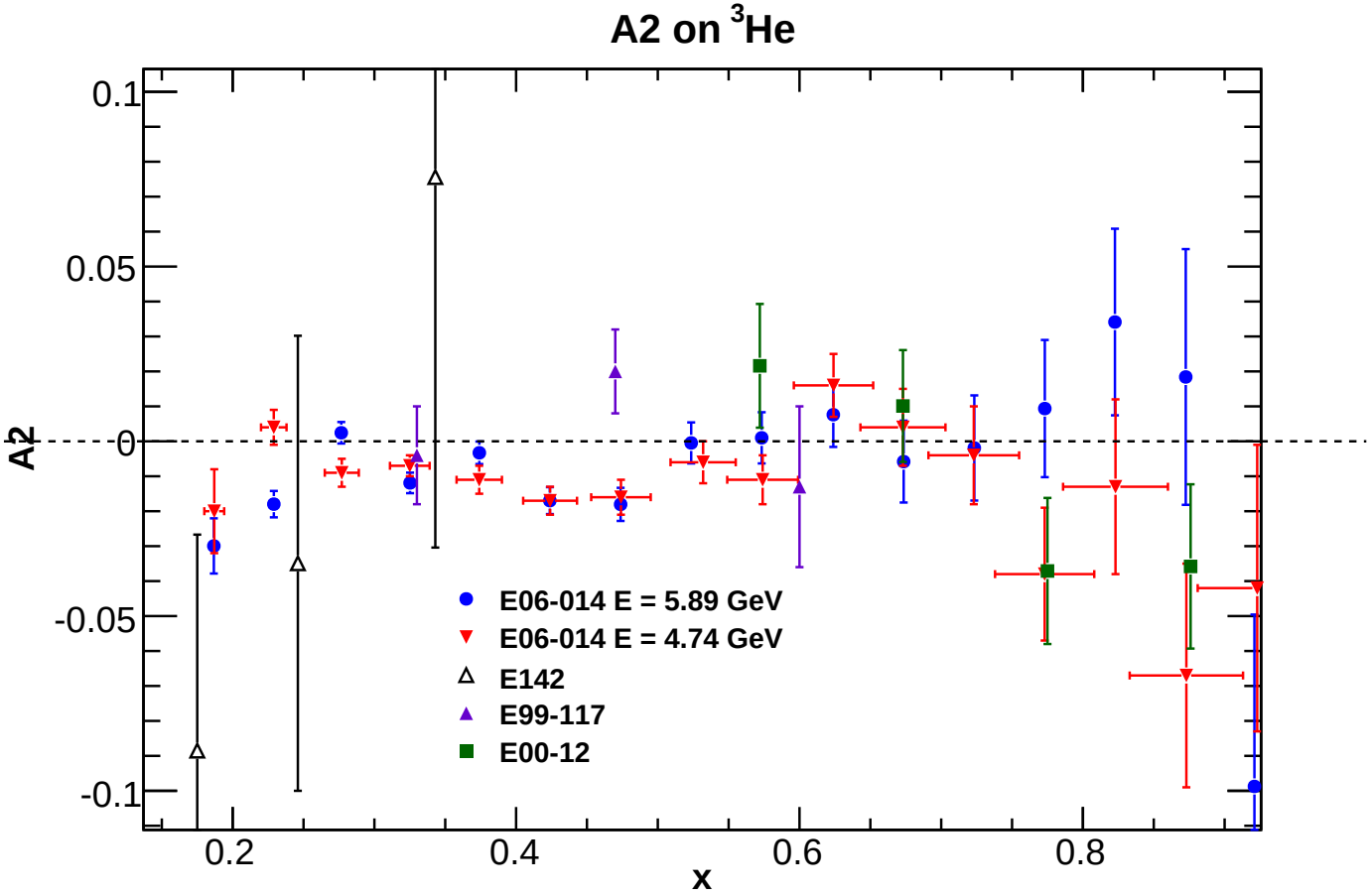


Figure: Preliminary 4.74 and 5.89 GeV A_2 compared to previous experiments.

Preliminary 5.89 GeV g_1 and g_2

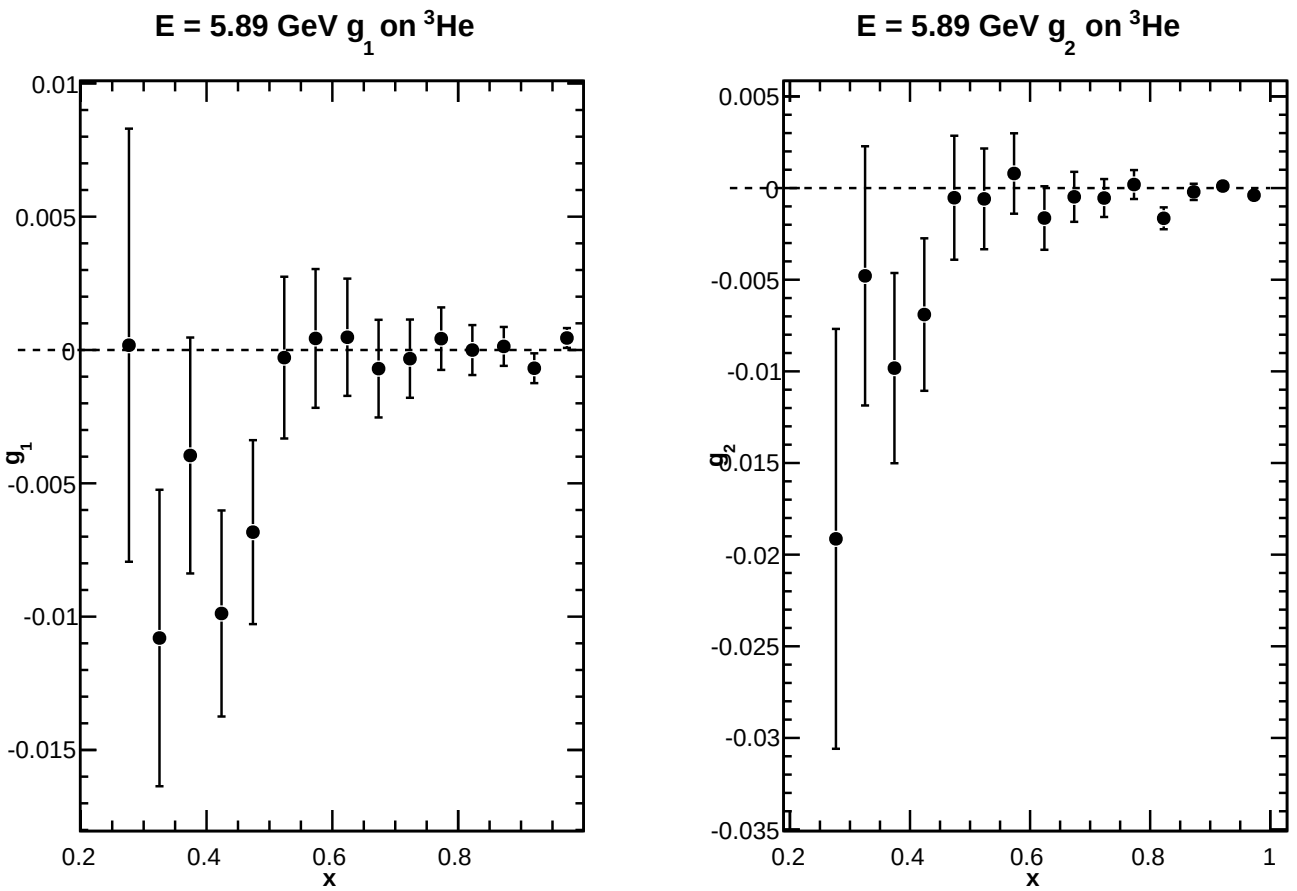


Figure: Preliminary 5.89 GeV g_1 and g_2.

Preliminary 5.89 GeV g_1 World Data

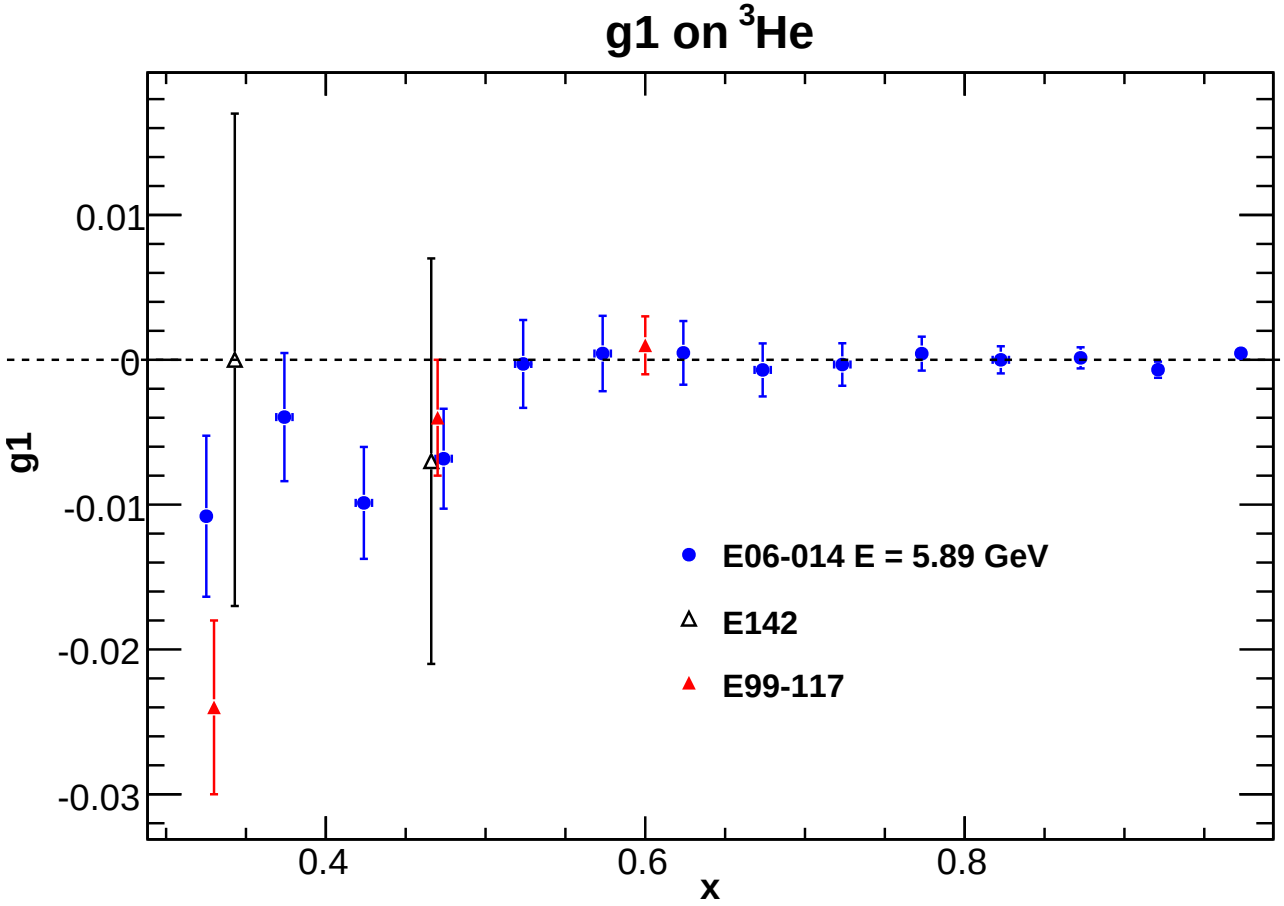


Figure: Preliminary 5.89 GeV g_1 compared to other experiments.

Preliminary 5.89 GeV g_2 World Data

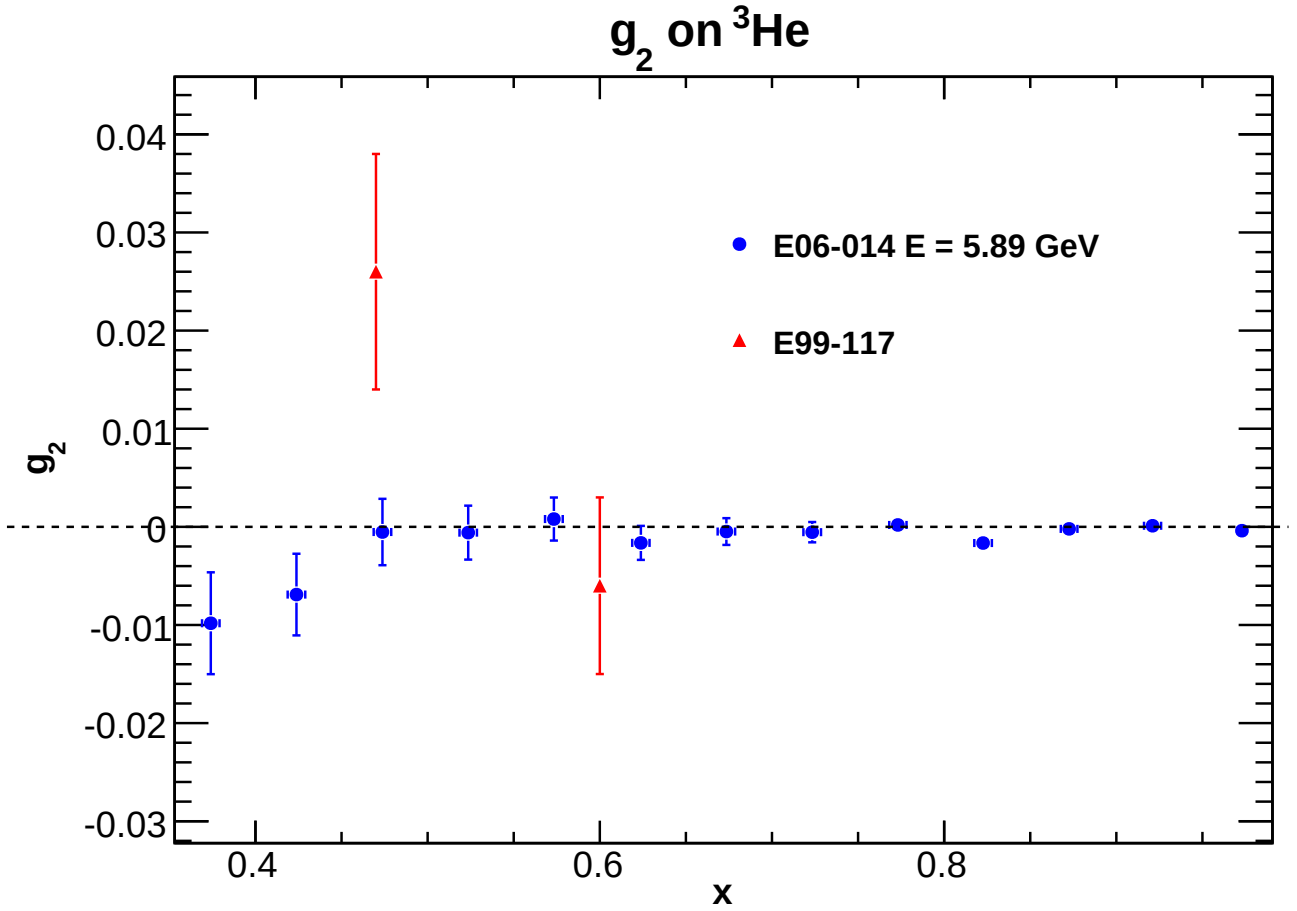


Figure: Preliminary 5.89 GeV g_2 compared to other experiments.