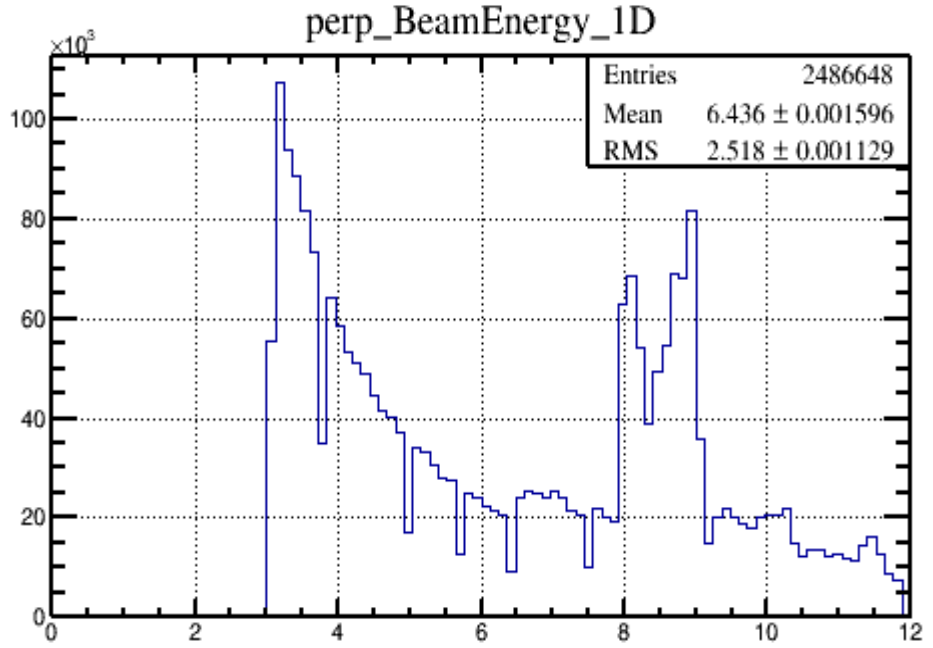
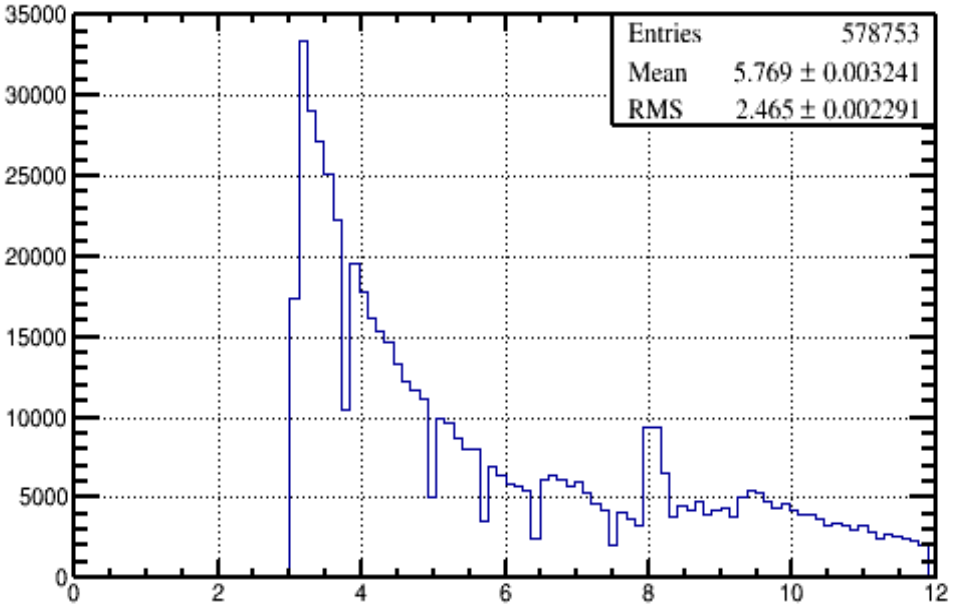
Phi Meson Physics Analysis

- Purpose: Investigate the properties of the Phi meson at GlueX, specifically Beam asymmetries
- Total: 9,000 files (~9B events)
    - After Loose cuts: ~4.5M events = 0.05 %
- 80 Runs Total (35 perp, 34 para, 11 amor)
- Runs 11366 - 11663
- Files from Run Block 1 & 2

Beam Asymmetry / Spin Density Matrix Elements

- In order to study beam asymmetry or the spin density matrix elements of the phi, certain cuts on the data must be done:
    - Cut on Beam Energy ~ [8.5-9.0] GeV
        - Enforces beam polarization
    - Cut on Phi Mass ~[1.01 – 1.03] GeV/c^2
        - Enforces the polarization is transferred to Phi and not BG
    - 1 Issue Right Now:
        - ~~Beam does not show a good coherent peak~~
        - There is sufficient beam background at 8 GeV

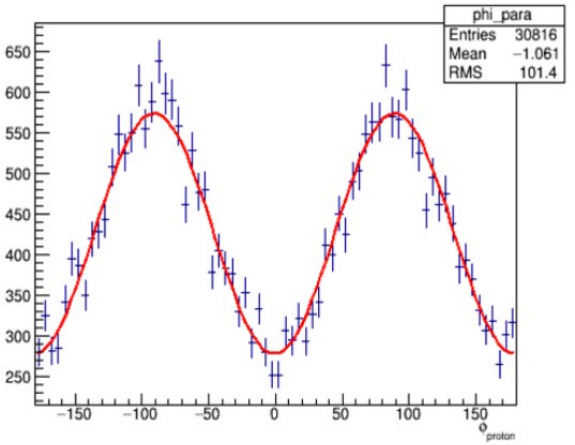




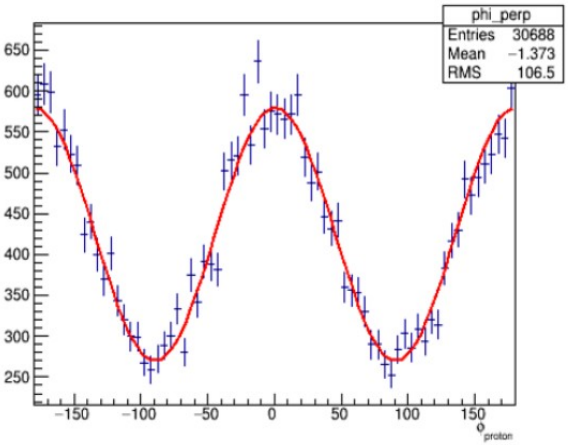
Beam Asymmetry Study

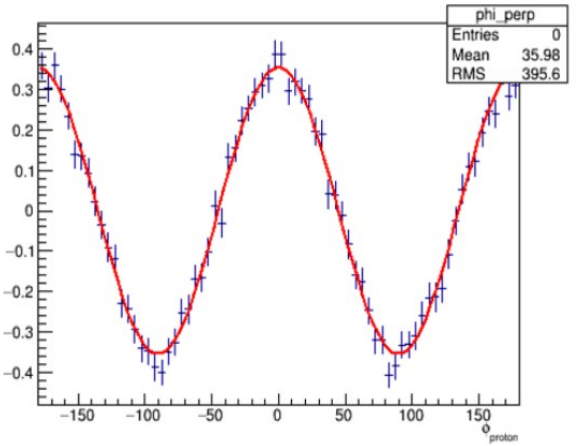
- Lets see what we get, again...
- Procedure: Show 3 different steps of data
  - Data with no cuts
  - Data with a beam cut
  - Data with beam and phi mass cut
  - Compare to Justin Stevens' work from Analysis Workshop
  - Also study amorphous radiator for consistency

$d\sigma_{\parallel} \sim 1 - P_{\parallel}\Sigma cos2\phi$

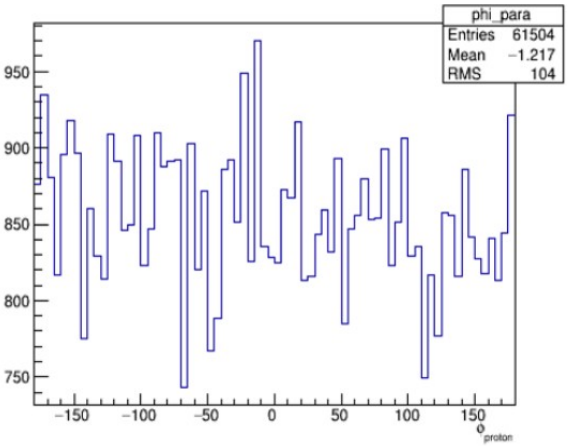


$d\sigma_{\perp} \sim 1 + P_{\perp}\Sigma cos2\phi$





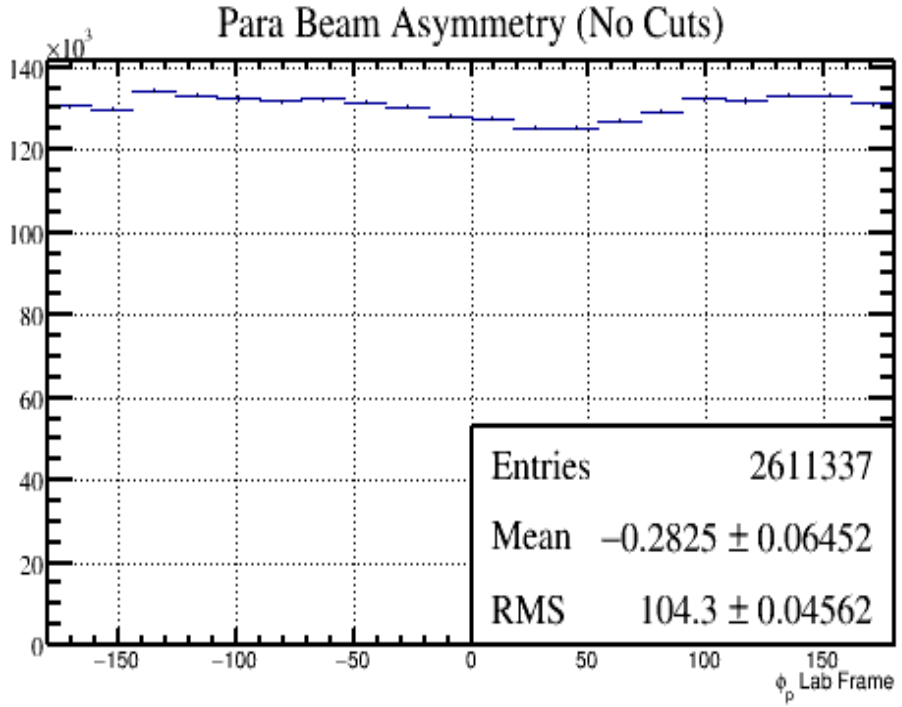
$$\frac{Y_{\perp} - Y_{\parallel}}{Y_{\perp} + Y_{\parallel}} = P\Sigma cos(2\phi)$$

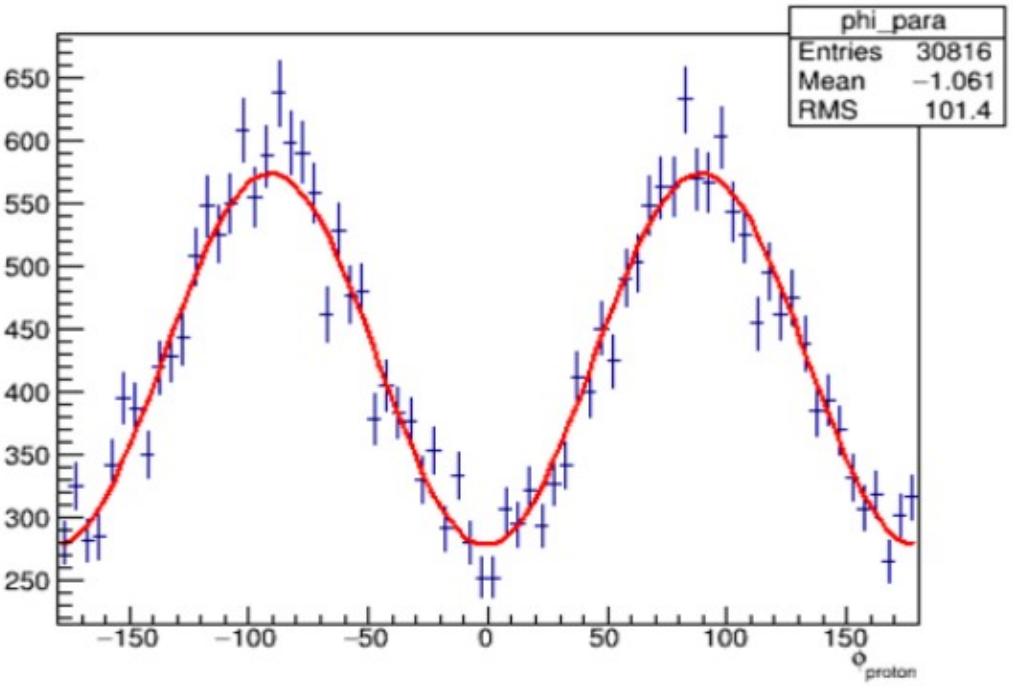


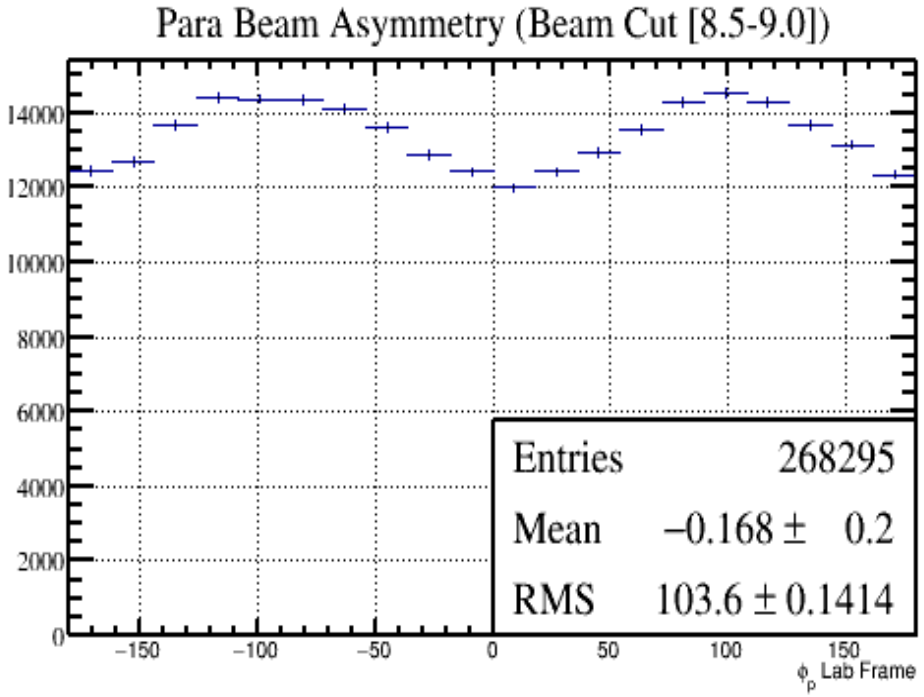
$Y_{\perp} + Y_{\parallel}$

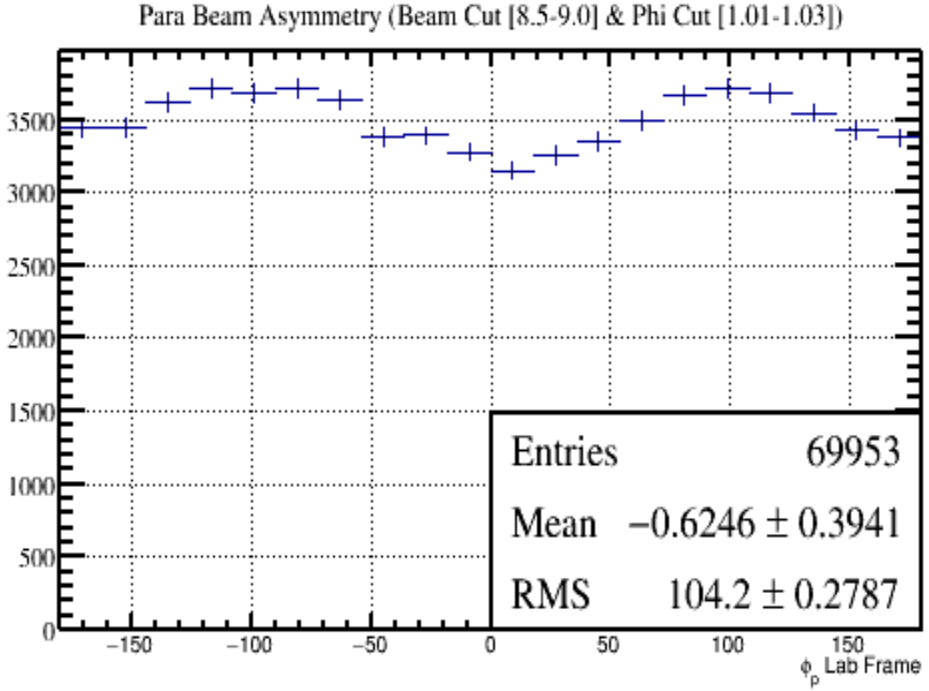
Para Beam Results

$$d\sigma_{||} \sim 1 - P_{||}\Sigma cos2\phi$$



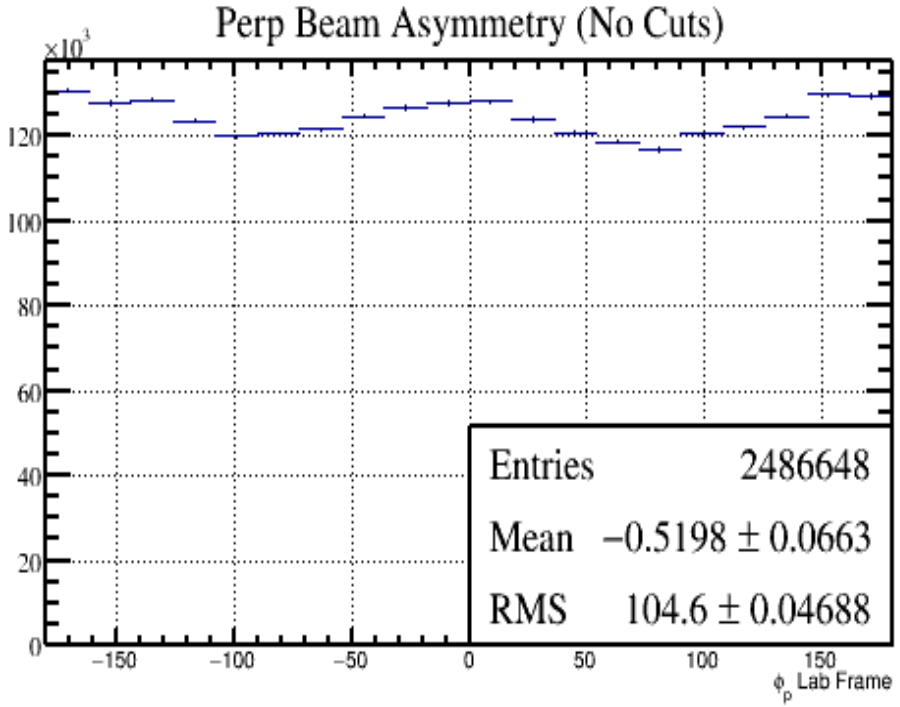


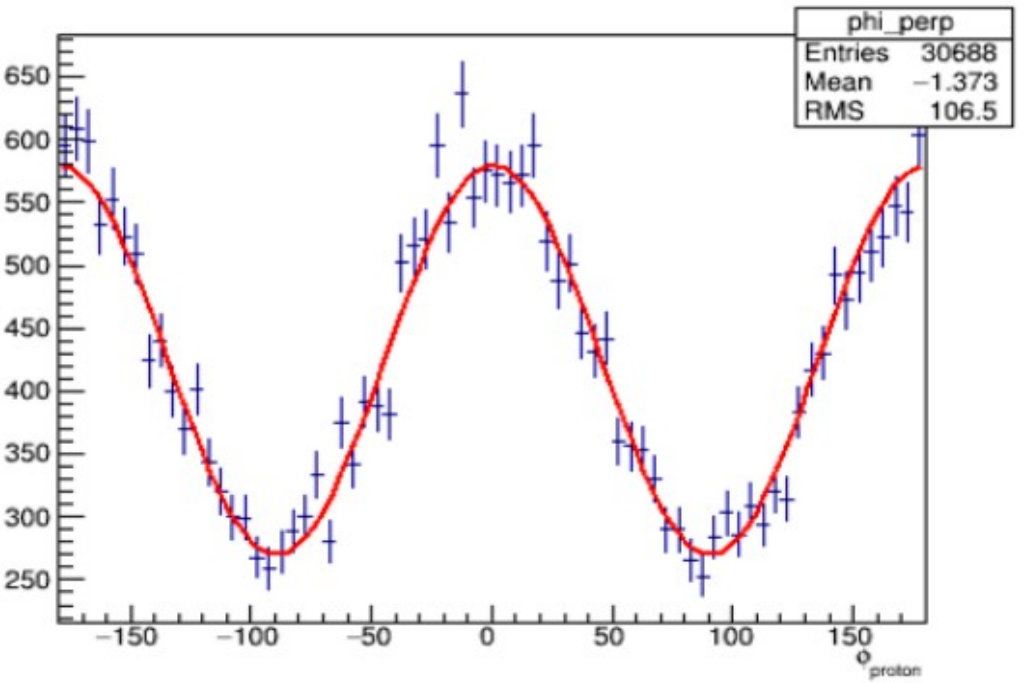


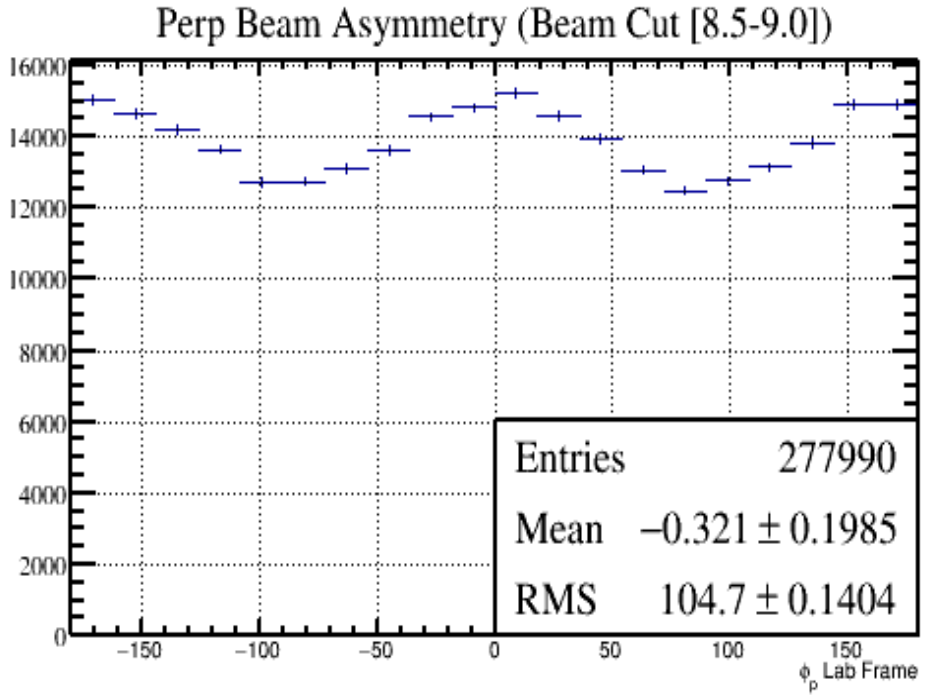


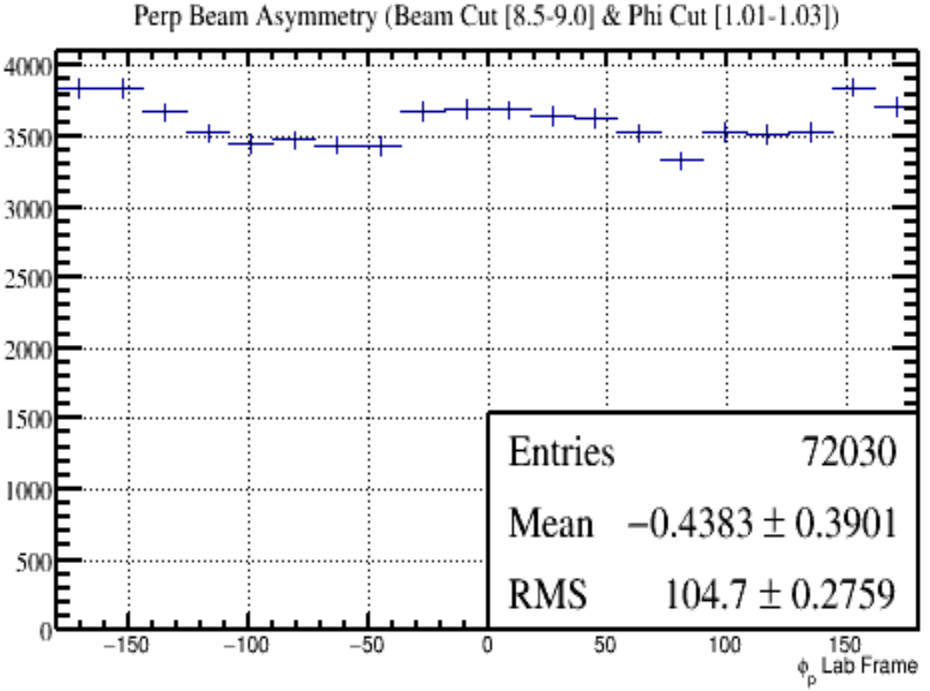
Perp Beam Results

$$d\sigma_{\perp} \sim 1 + P_{\perp}\Sigma cos2\phi$$

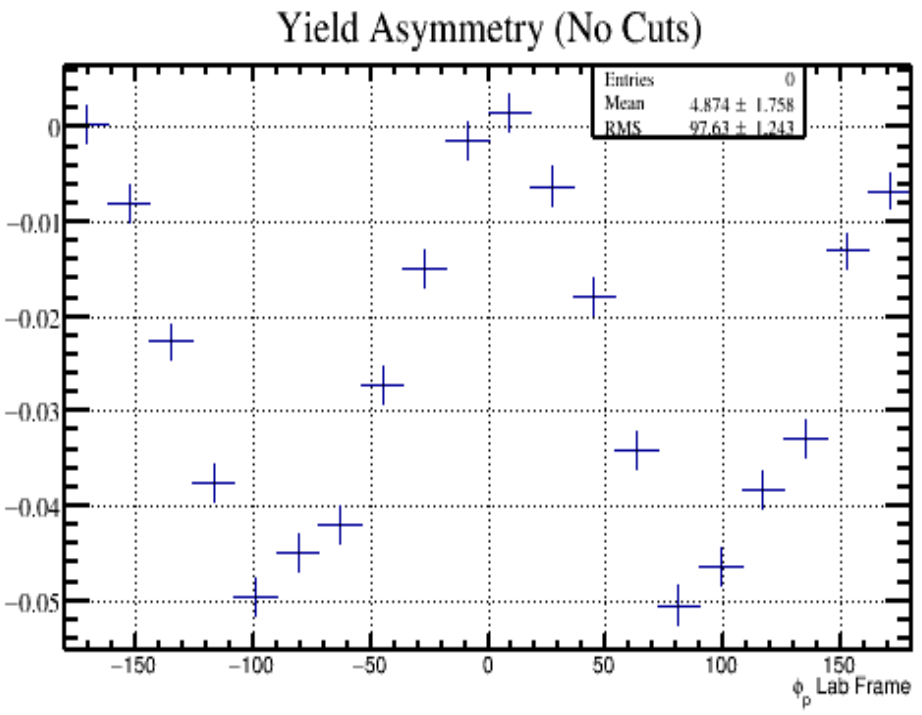


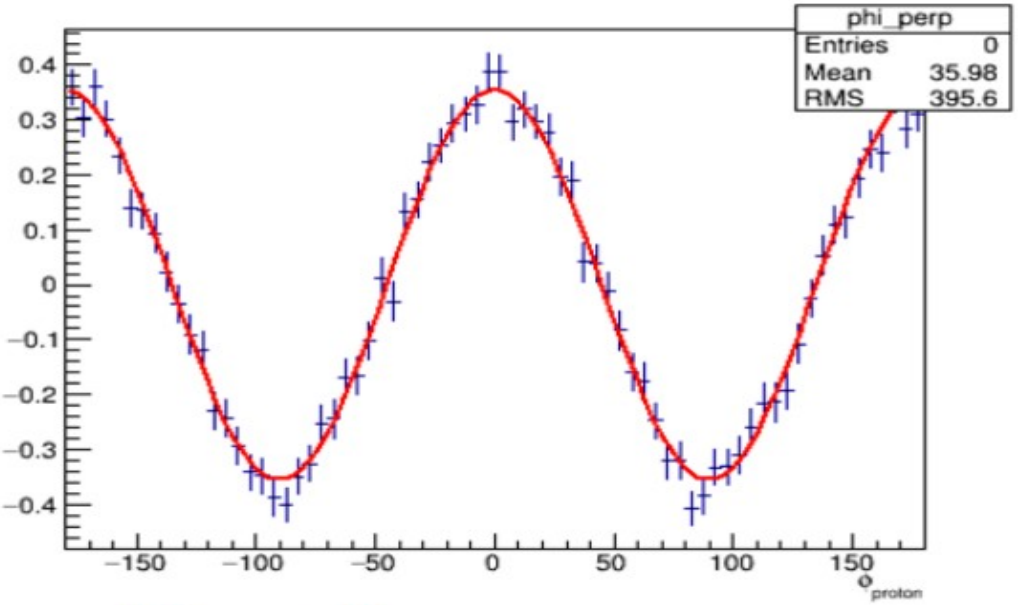




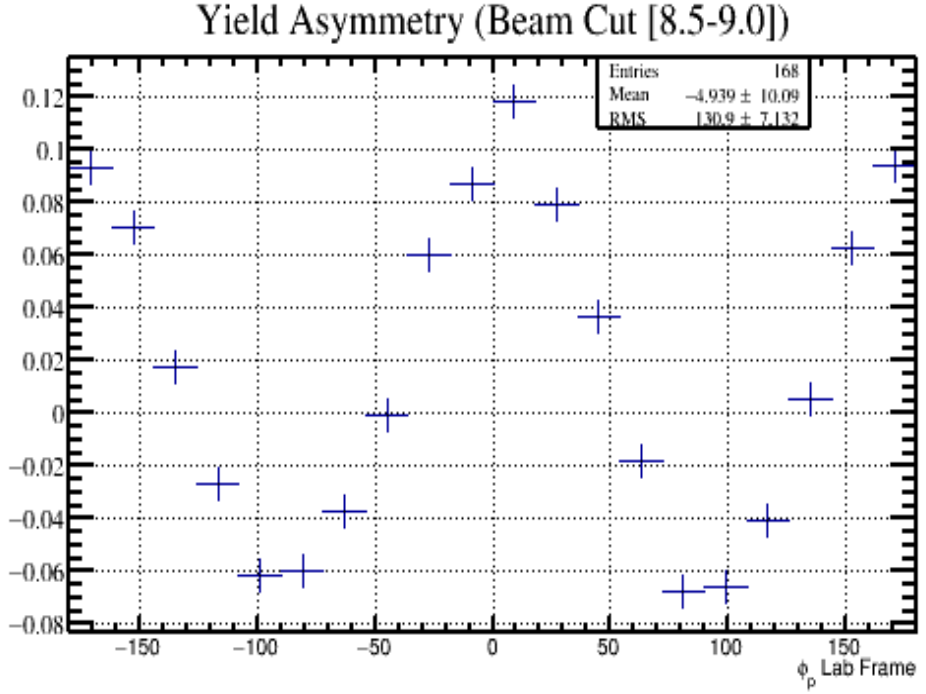


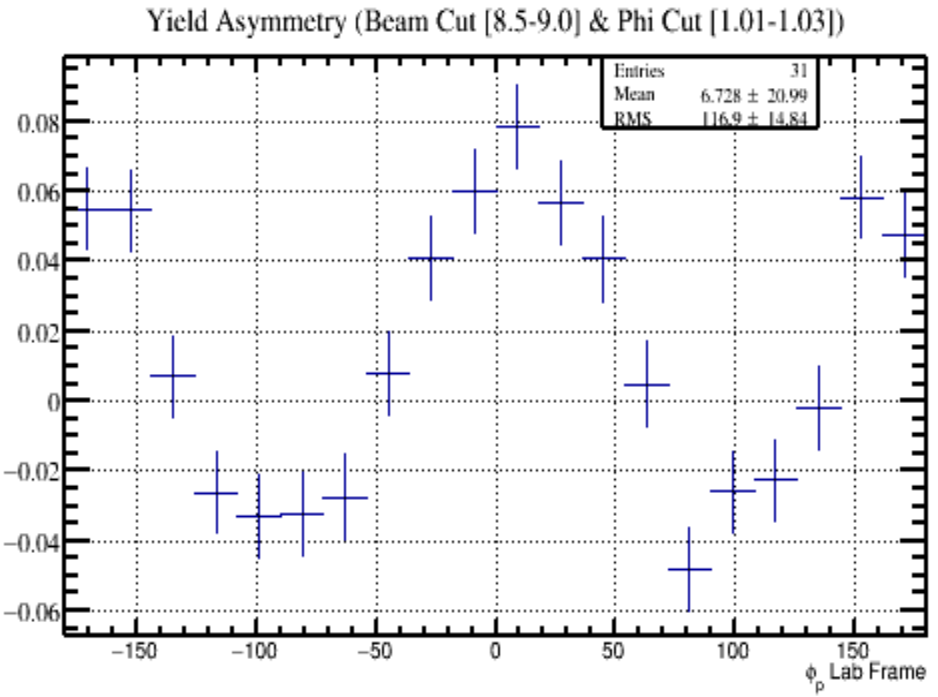
Yield Beam Results



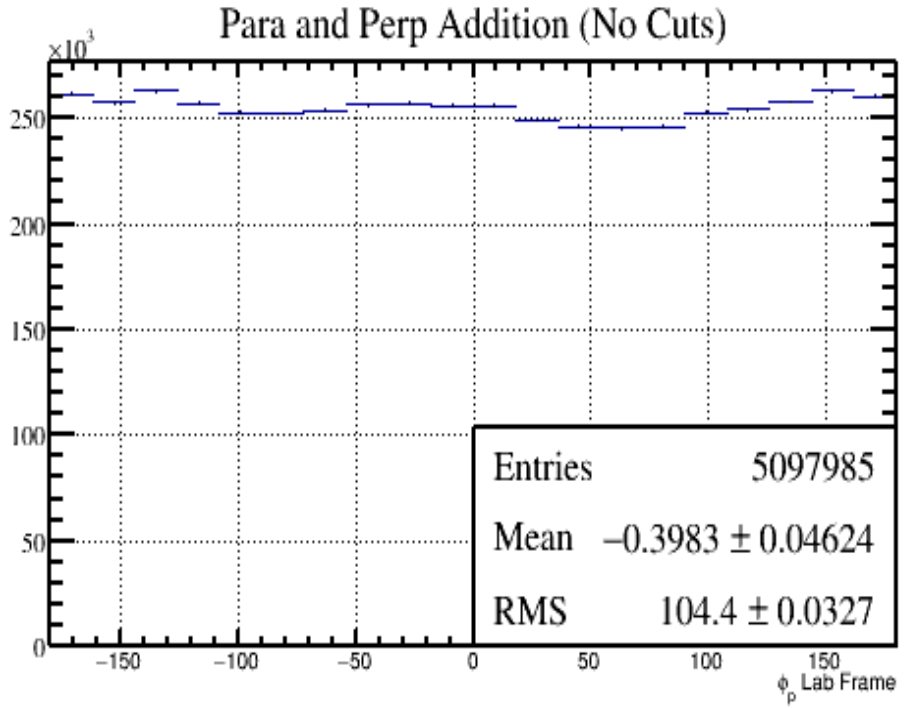


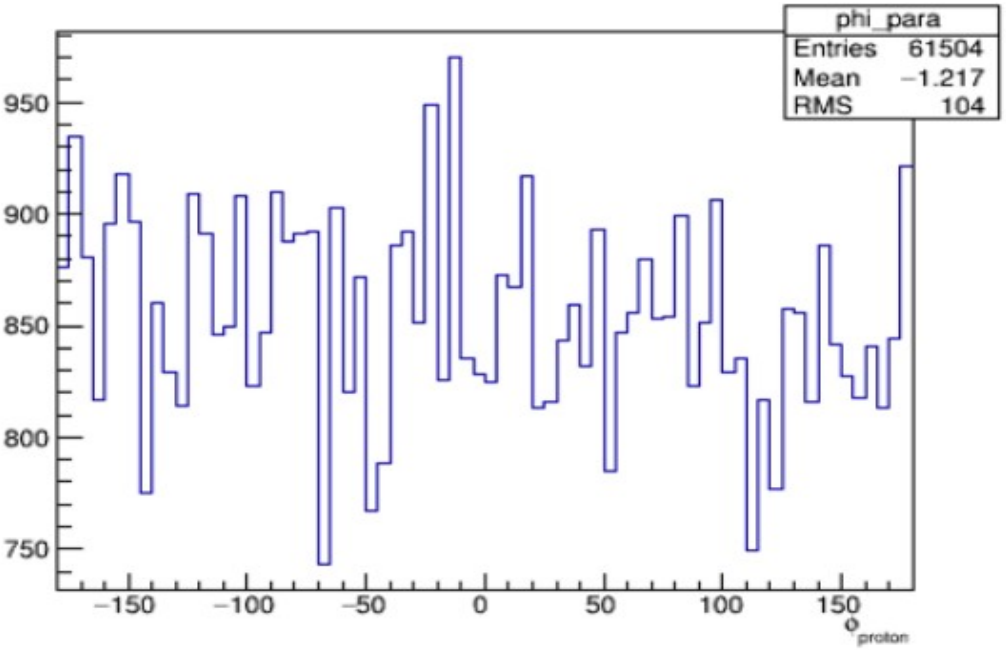
try: $\frac{Y_\perp - Y_\parallel}{Y_\perp + Y_\parallel} = P\Sigma cos(2\phi)$



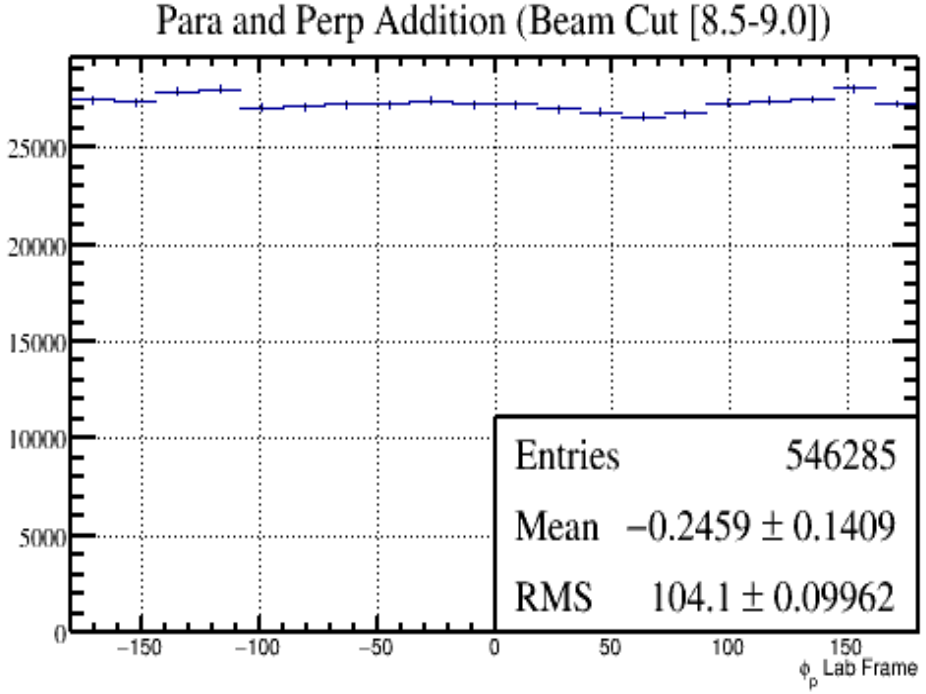


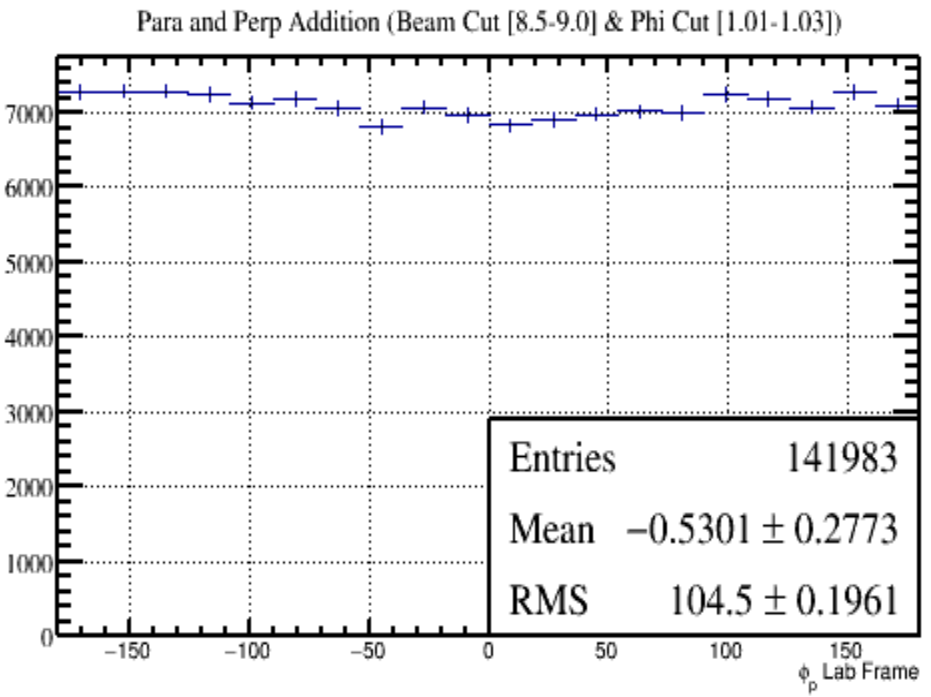
Add Beam Results



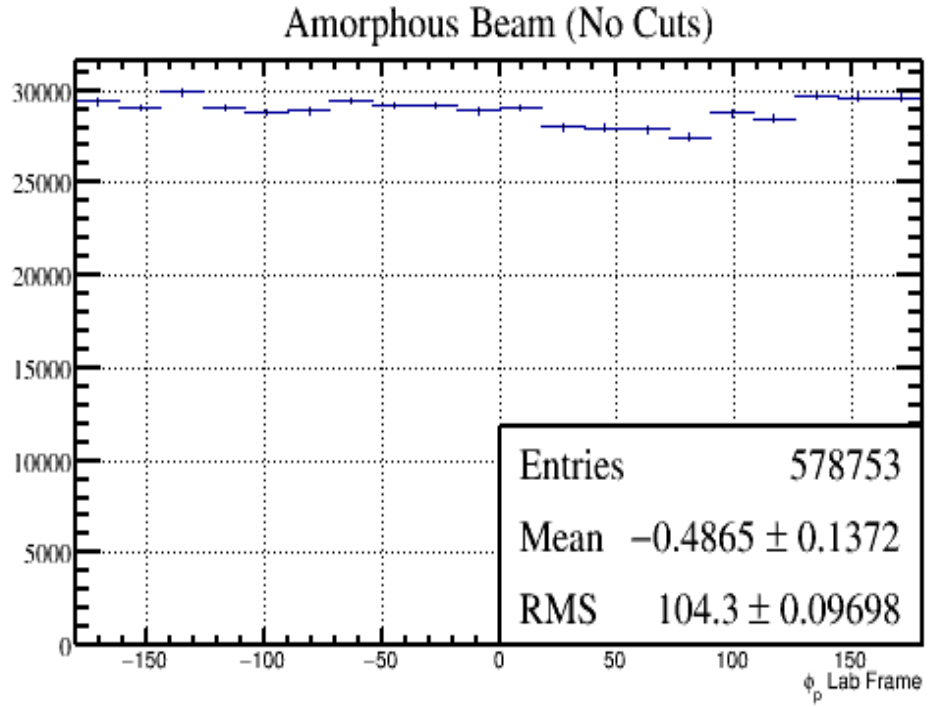


$$Y_{\perp} + Y_{||}$$

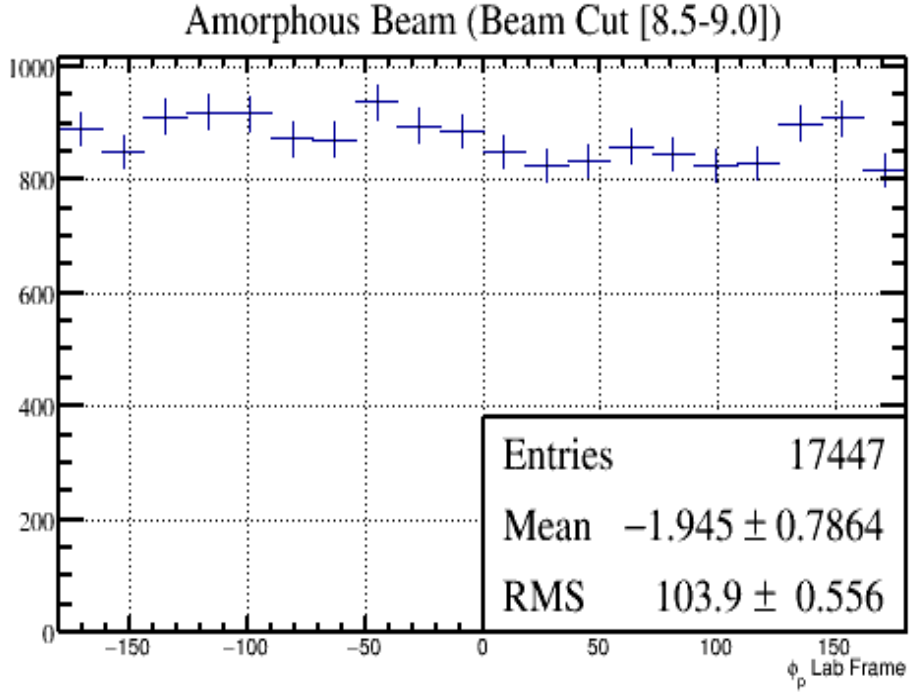


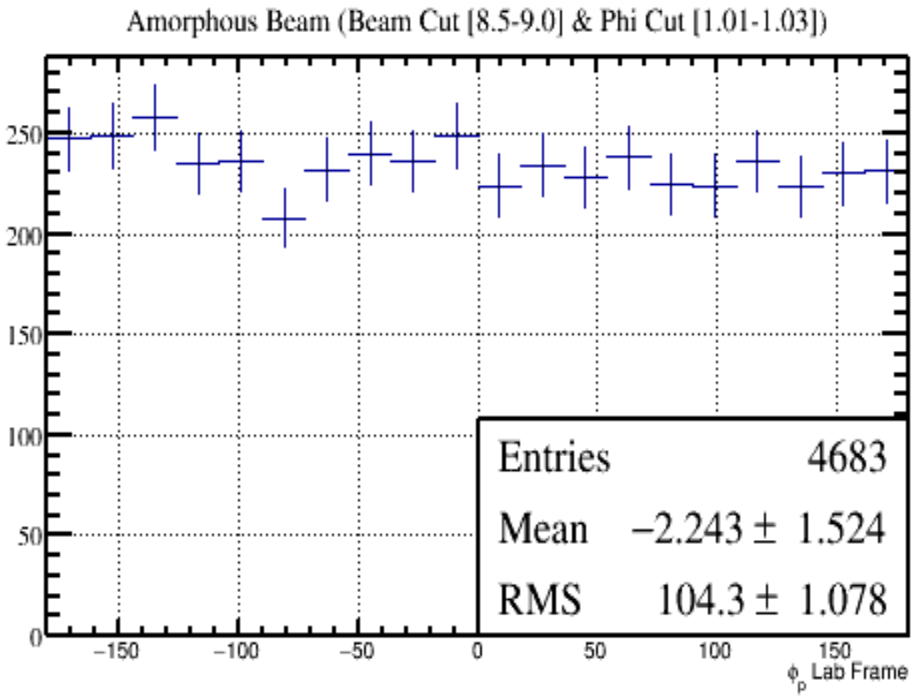


Amor Beam Results

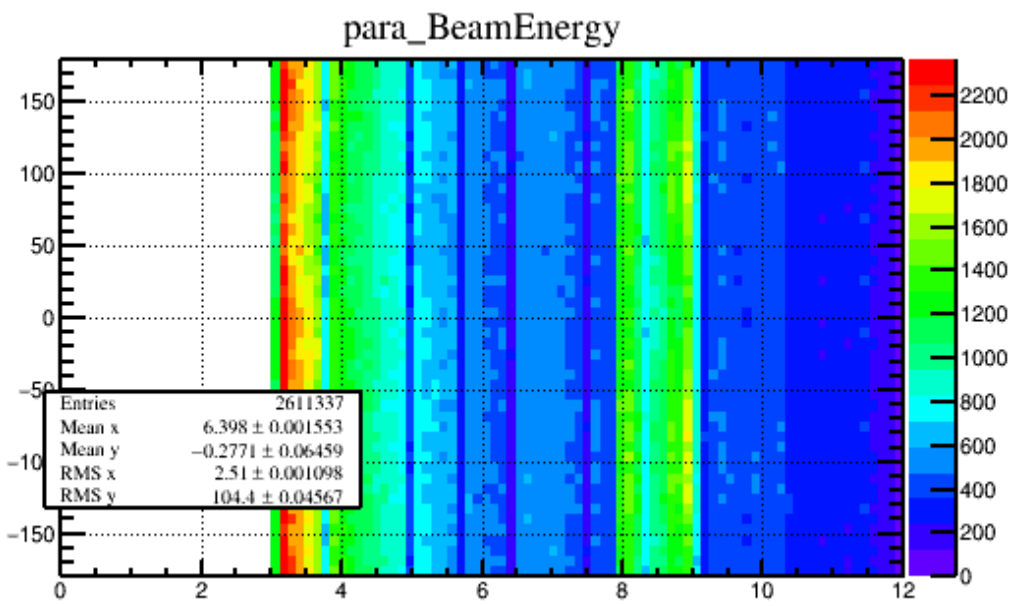


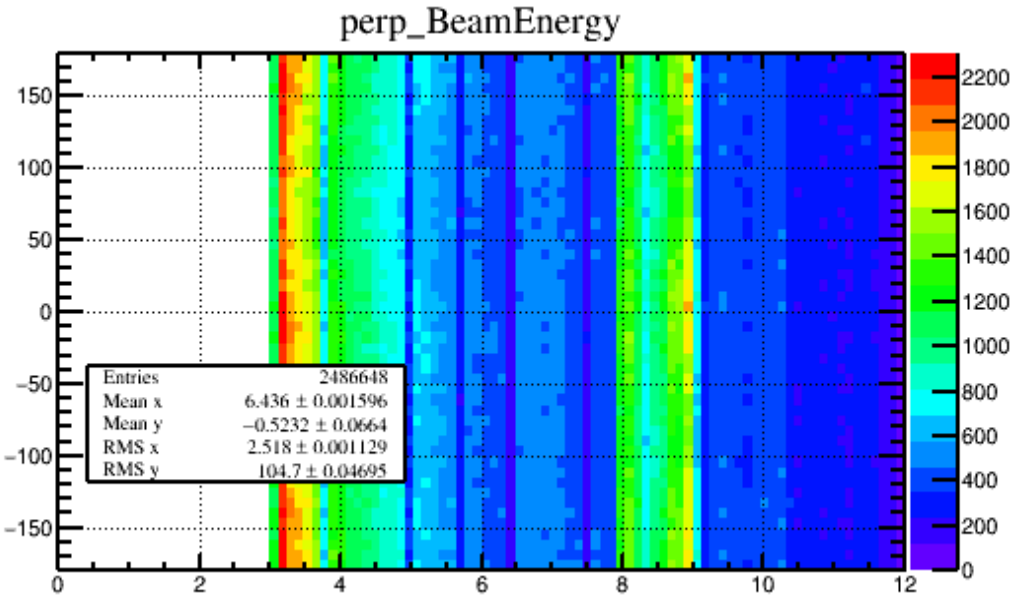
- Things look much better than before and make a lot more sense!
- But why did my Yield Asymmetry, Perp, and Para signal get worse after my Phi Mass cut?!
- Lets take a closer look at how I made my cut choices ...

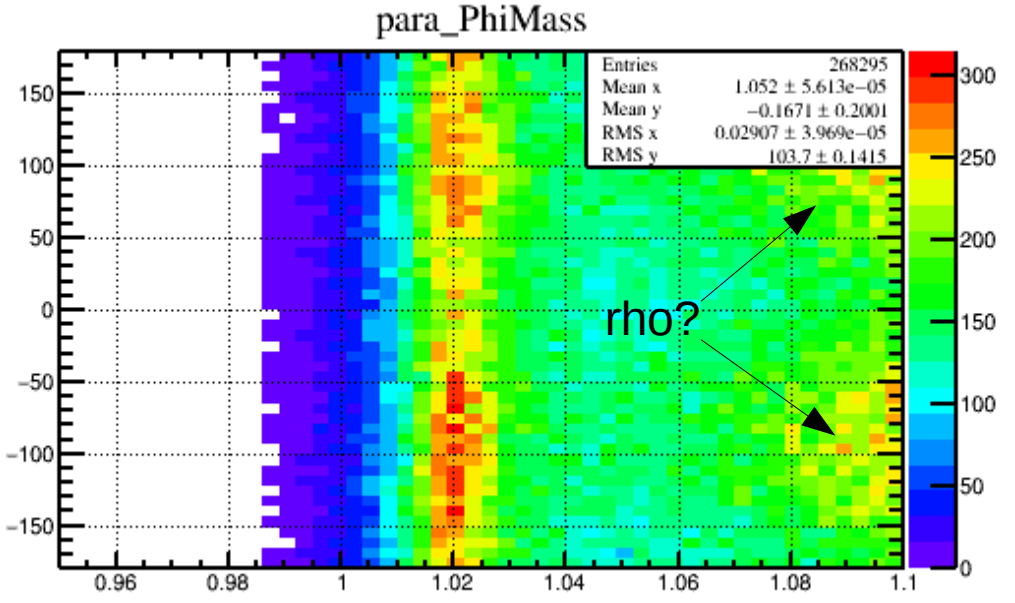


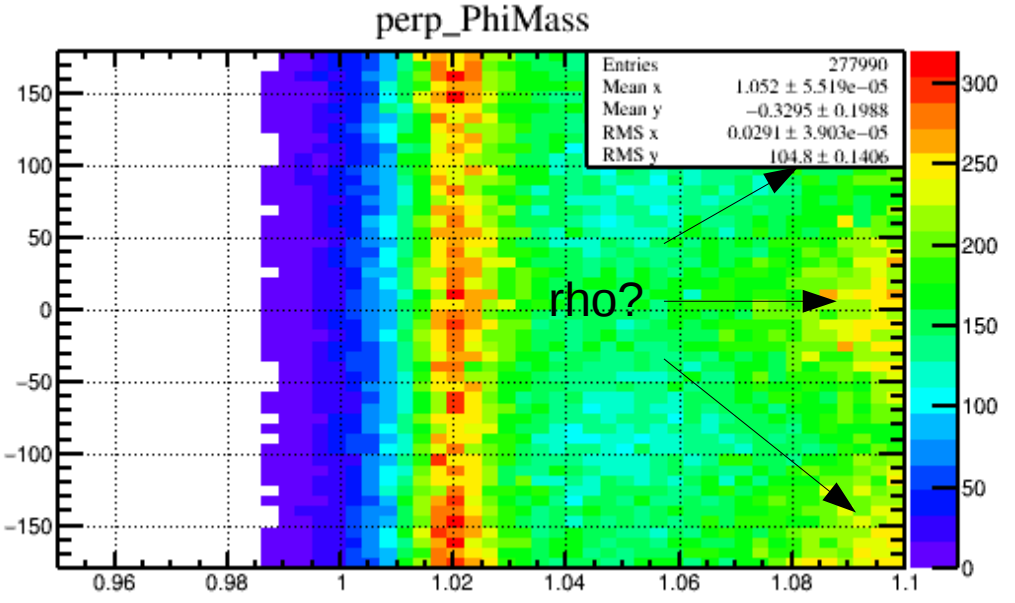


Row 1: Beam Energy vs Pol (no cuts)
Row 2: Phi Mass Vs Pol (Beam cut)

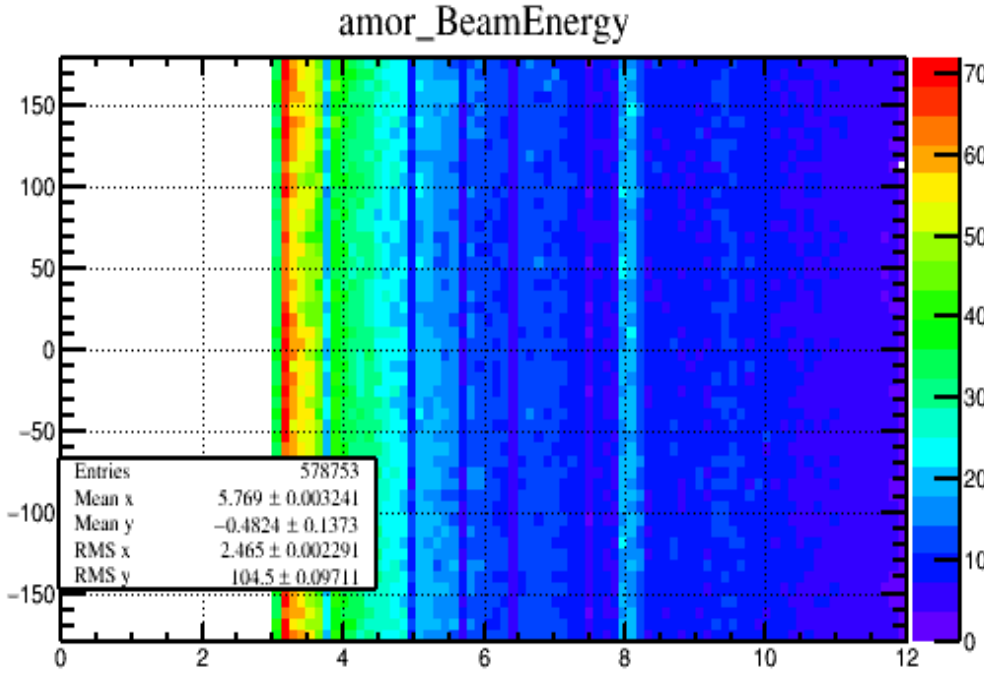


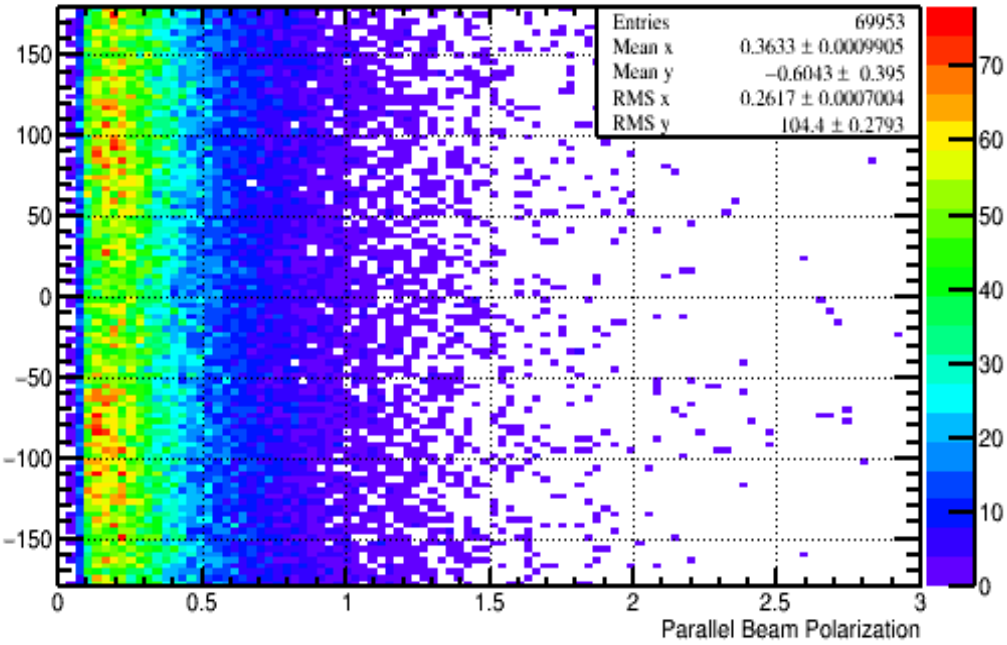


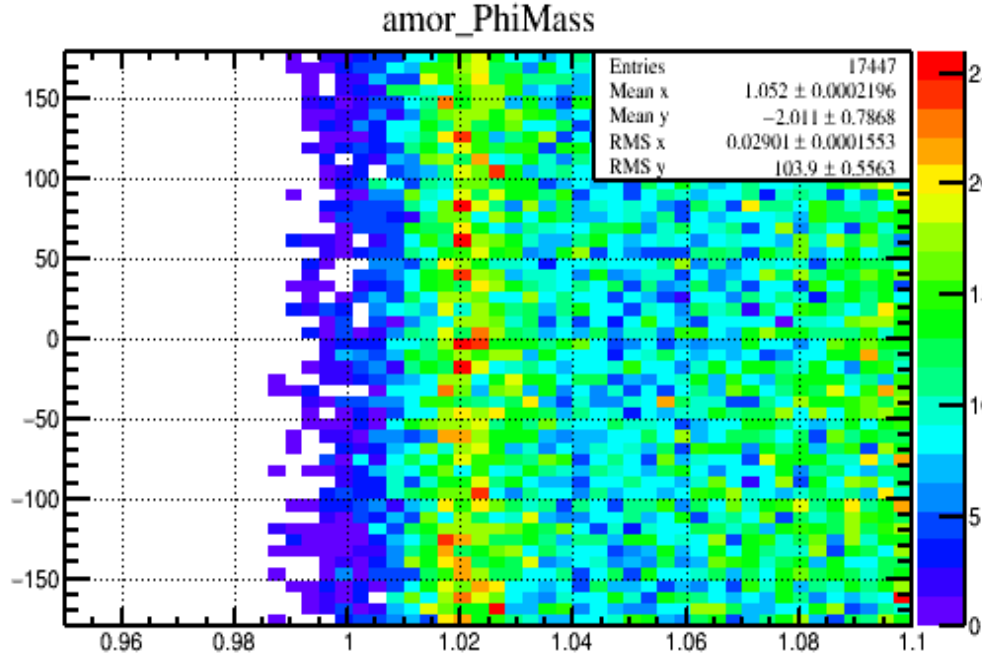


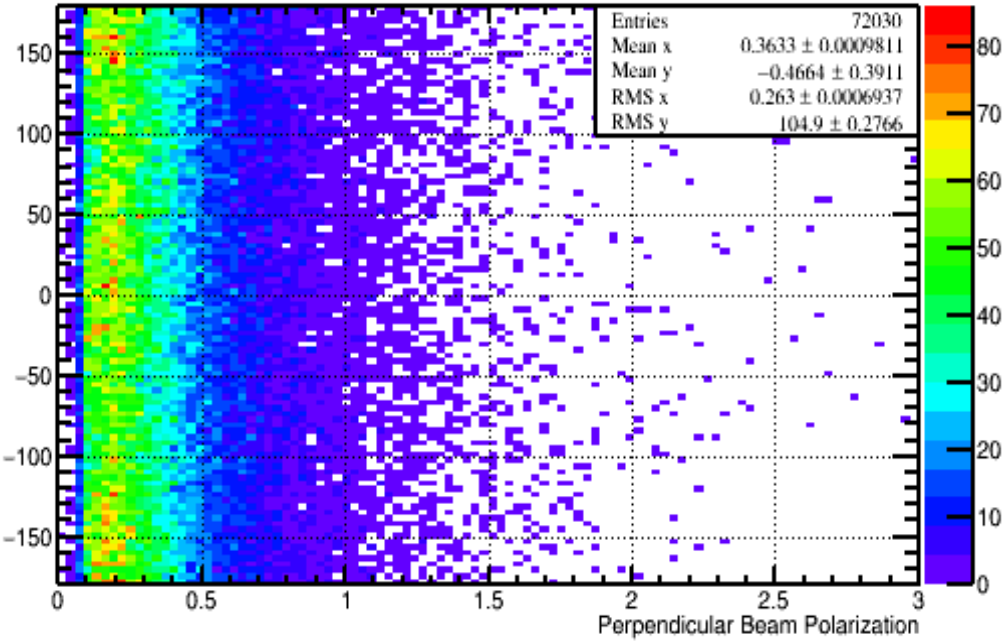


Left Col: Amor Info; Right Col: Pol vs t









Conclusions & Plan

- Clearly these results are supremely better than the last (ver05)
- Why does the perp polarization look worse than the para, even though both plots look identical throughout? Acceptance effect?
- Plan:
    - I will send this talk to Justin Stevens to get his input. Possibly present this in an upcoming meeting...
    - Start producing more results to compare with Ballam et al.
- Thoughts?