Analysis Report

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Nitrogen Effective Nucleon Ratio

- Analysis has used an effective ratio of 1.
- Reports of ratio as high as 1.2.
  - Changes Purity factor from 0.74 to 0.68 for Kin3.
  - Changes Purity factor from 0.83 to 0.79 for Kin2.

Purity Factor

Expressed in this manner

$$R_{tgt} = \frac{N_n^n + N_p^n}{N_p^p + N_n^p} = \frac{\sigma_n \nu_n^n + \frac{Z_{tgt}}{N_{tgt}} \sigma_p \nu_p^n}{\sigma_n \nu_n^p + \frac{Z_{tgt}}{N_{tgt}} \sigma_p \nu_p^p} \ . \tag{1}$$

As an example, N_p^n is the number of observed neutrons from initial protons. The above can be presented more compactly as:

$$R_{tgt} = \frac{\frac{\sigma_n}{\sigma_p} \frac{\nu_n^n}{\nu_p^p} + \frac{Z_{tgt}}{N_{tgt}} \frac{\nu_p^n}{\nu_p^p}}{\frac{\sigma_n}{\sigma_p} \frac{\nu_n^p}{\nu_p^p} + \frac{Z_{tgt}}{N_{tgt}}} \ . \tag{2}$$

Here $\sigma_{p(n)}$ are the single nucleon cross sections, ν are the mixing coefficients, and $\frac{Z_{tgt}}{N_{tgt}}$ is the ratio of neutrons to protons (unique for each target, and may be dependent on perpendicular and parallel missing momentum) within the target. Obviously $N_{tgt} = 0$ for hydrogen, $\frac{Z_N}{N_N} \approx 1$ for nitrogen, and using a model $\frac{Z_{He3}}{N_{He3}} \approx 2$ for the ^{3}He, with a dependence on the applied cuts. In terms of these mixing coefficients, the purity factor is then

$$D_n = \frac{N_n^n}{N_n^n + N_p^n} = \frac{\frac{\sigma_n}{\sigma_p} \frac{\nu_n^n}{\nu_p^p}}{\frac{Z_{tgt}}{N_{tgt}} \frac{\nu_p^n}{\nu_p^p} + \frac{\sigma_n}{\sigma_p} \frac{\nu_n^n}{\nu_p^p}} \ . \tag{3}$$

Purity Factor

Using this information, it is possible to solve for the mixing ratios from the ratios of hydrogen, ^{3}He, and nitrogen

$$\frac{\nu_p^n}{\nu_p^p} = R_H \ , \tag{1}$$

$$\frac{\nu_n^p}{\nu_p^p} = \frac{\sigma_p}{\sigma_n}\left[\frac{R_{He}\frac{Z_{He3}}{N_{He3}} - \frac{Z_N}{N_N}R_N + \left(\frac{Z_N}{N_N} - \frac{Z_{He3}}{N_{He3}}\right)R_H}{R_N - R_{He}}\right] \ , \tag{2}$$

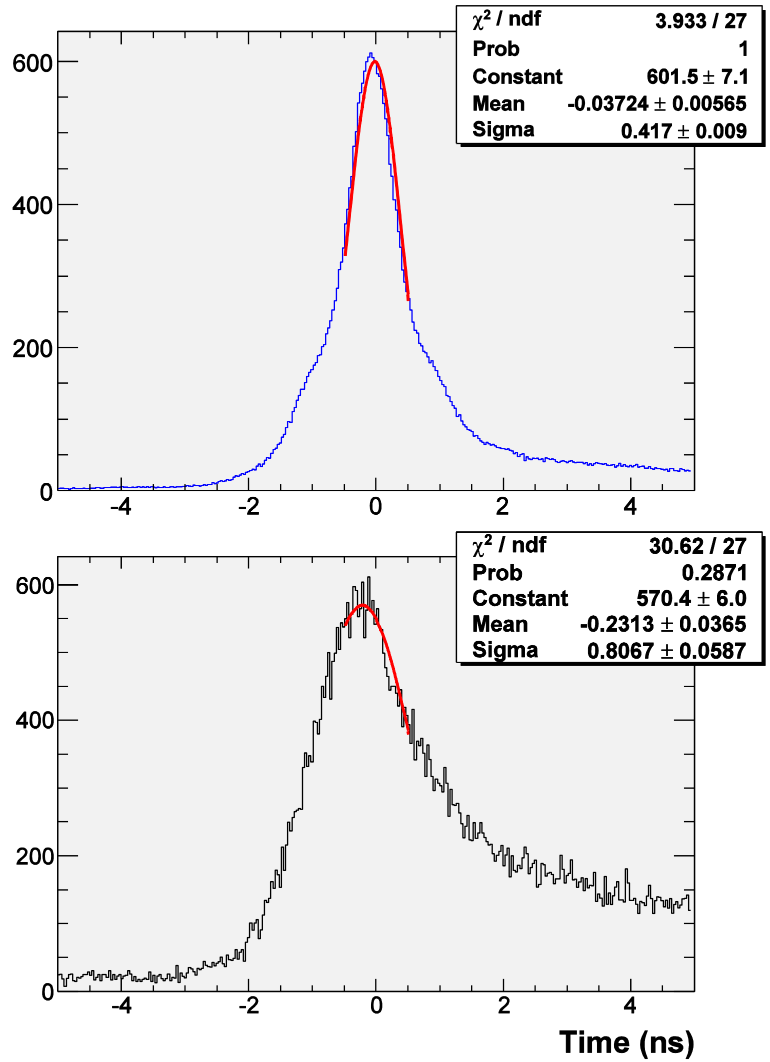
$$\frac{\nu_n^n}{\nu_p^p} = \frac{\sigma_p}{\sigma_n}\left[R_N\left(\frac{Z_{He3}}{N_{He3}} - \frac{Z_N}{N_N}\right)\frac{R_{He} - R_H}{R_N - R_{He}} - \frac{Z_N}{N_N}R_H\right] \ . \tag{3}$$

Therefore the dilution due to the proton to neutron conversion in the sample,

$$D_n = \frac{R_{He}[(\frac{Z_{He3}}{N_{He3}} - \frac{Z_N}{N_N})R_N + \frac{Z_N}{N_N}R_H] - \frac{Z_{He3}}{N_{He3}}R_N R_H}{R_{He}\left(\frac{Z_{He3}}{N_{He3}} - \frac{Z_N}{N_N}\right)(R_N - R_H)} \ . \tag{4}$$

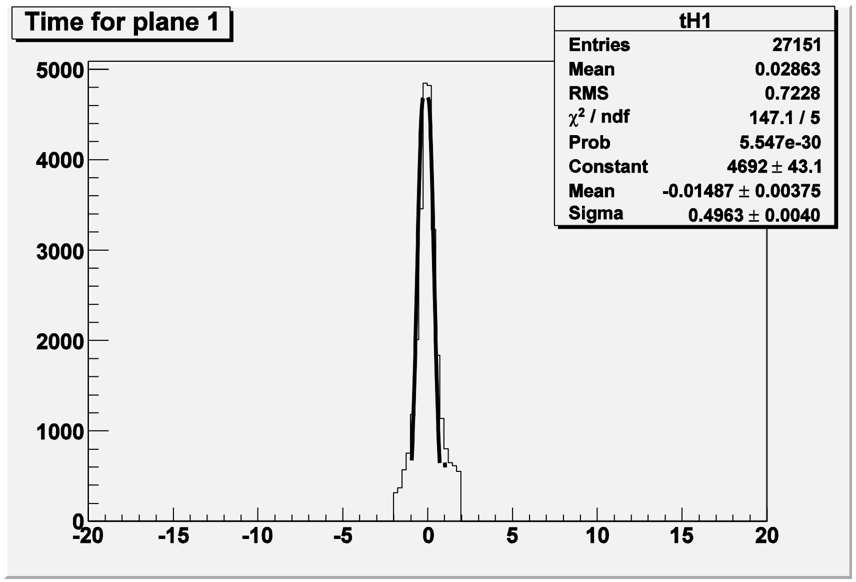
Peak Study

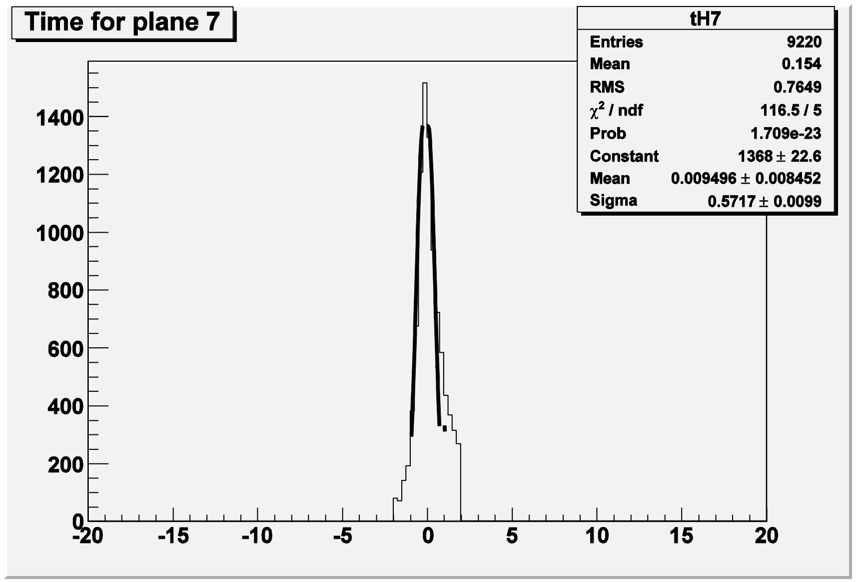
- Pictures to the right are from Analysis.
- This is Multi Track analysis.
- Sigma for the neutron is about 2x as large as for the proton.



Proton Study

Plane 1 **Plane 7**

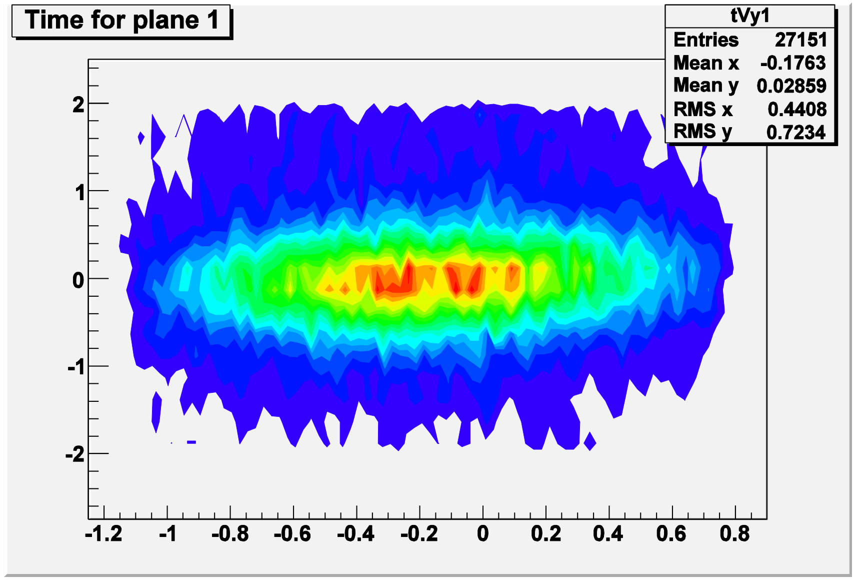




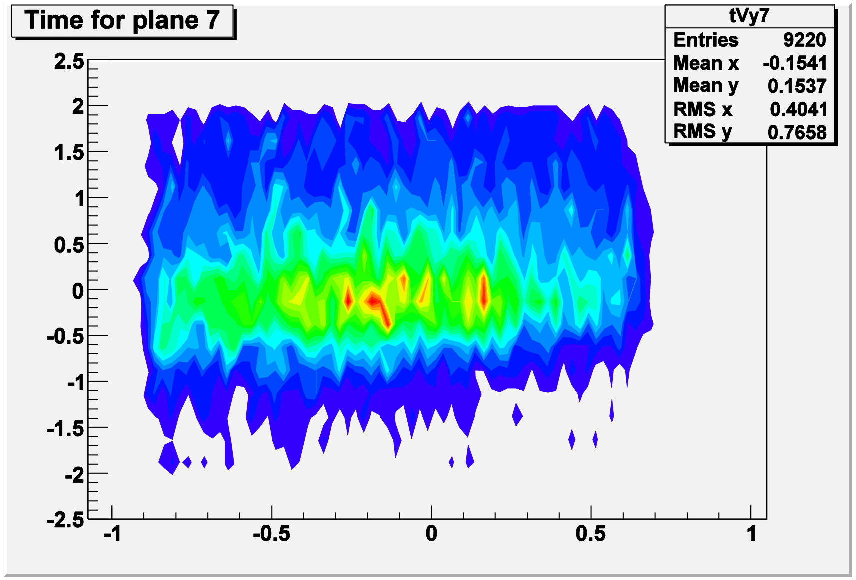
This is for proton events. This is not full statistics nor all selection tools. These diagrams show that the peak does not shift systematically or significantly. The sigma of the distribution is wider, but not significantly so.

Proton Study

Plane 1



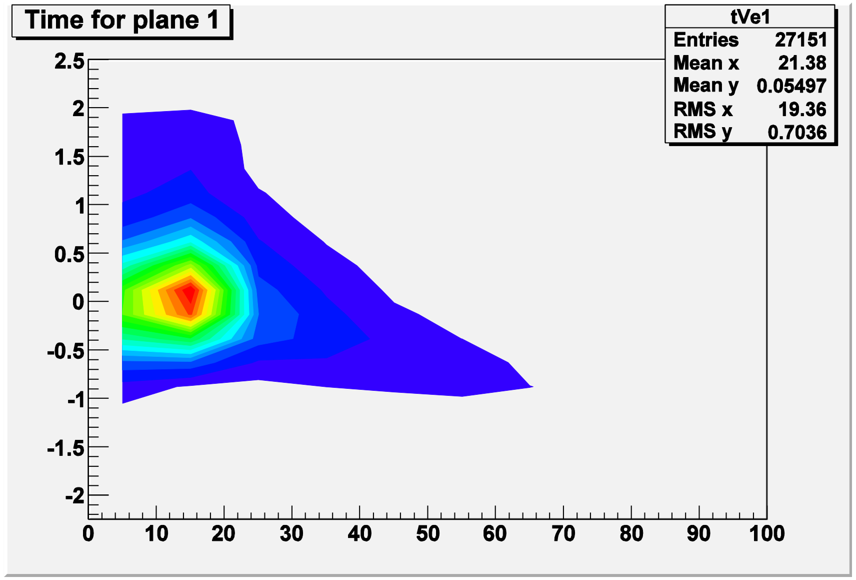
Plane 7



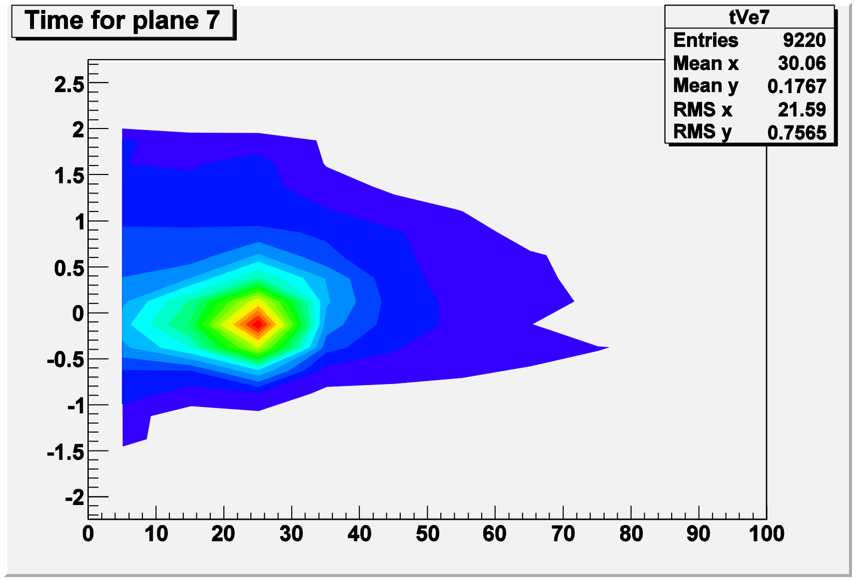
This is for proton events. This is not full statistics nor all selection tools. These diagrams show that there is not a significant systematic y dependence as we look deeper into the neutron detector.

Proton Study

Plane 1



Plane 7



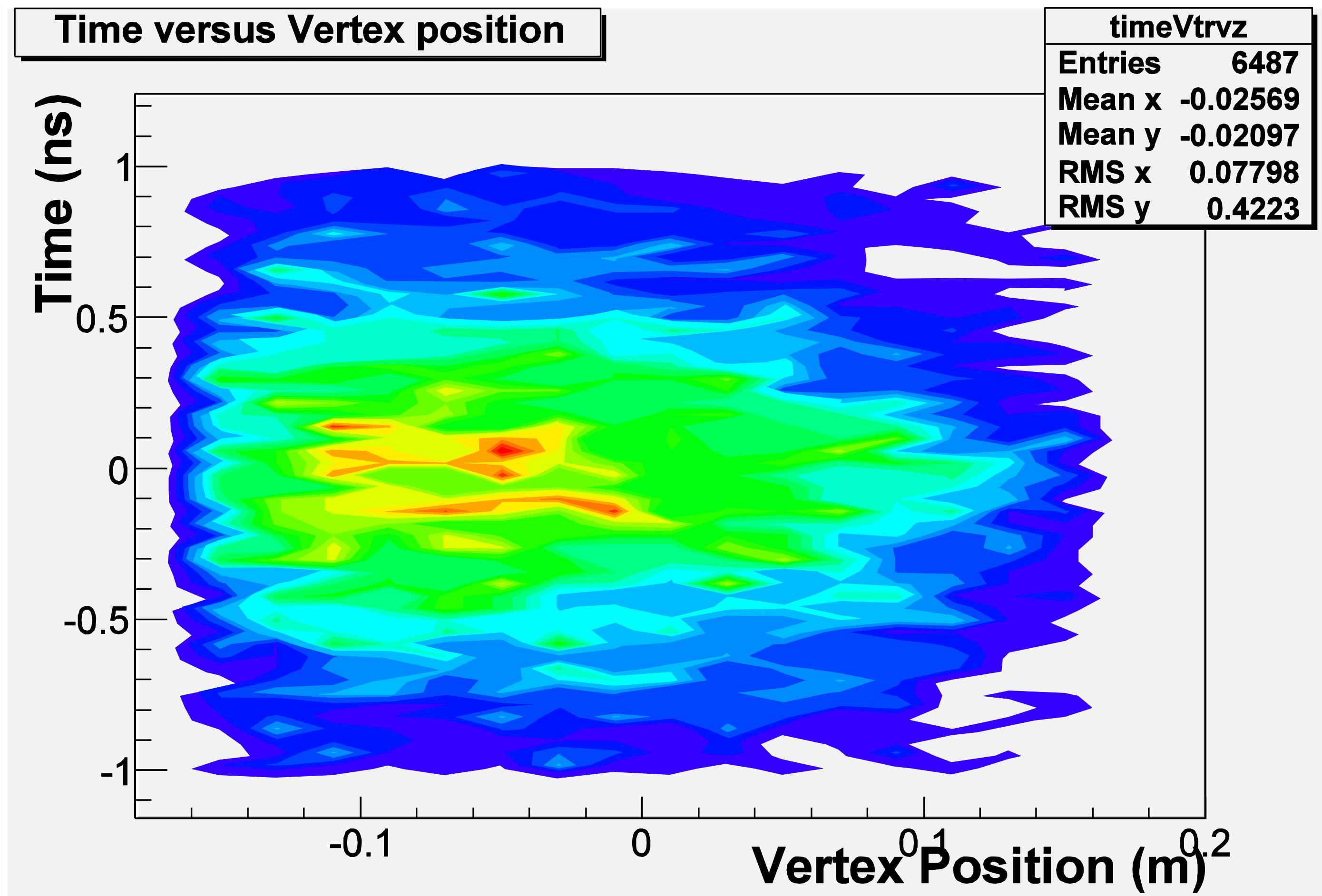
This is for proton events. This is not full statistics nor all selection tools. These diagrams show that at all depths that the large amplitude events are not as well centered at 0.

Kinematic 2 - B

Name	Value	Statistical Error	Systematic Error	Fractional Error
Raw Asymmetry	0.0421	0.0069		0.164
Background D.	0.9945	0.0274	0.0031	
Purity Factor	0.8265	0.0341	9%	
Target Polarization	0.4932		0.020	
GMn	-0.0953		0.0019	
Lambda	0.2180	0.0363	0.0442	
GEn (Q2 = 2.493)	-0.0208	0.0035	0.0042	0.167

- Cuts
  - Qperp < 0.15 GeV
  - Abs(t) < 1 ns
  - Abs(W-0.9)<0.2 GeV
- Comparison to Earlier Analysis
  - Raw Asymmetry from 0.0397 to 0.0421
  - Purity Factor from 0.85 to 0.82
  - GEn from -0.0152 to -0.0208
  - Counts from 23152 to 21057

Vertex For Kin3



Conclusions

- A change of the effective nucleon ratio within the target nuclei produces a large effect in the purity factor.
- There is no shift in the time of proton type events as you go deeper within the neutron arm.
- There does appear to be a correlation with time and amplitude for large amplitude.
- The Vertex is handled correctly.
- Kinematic 2 A is still difficult to analyze due to the threshold shift. I was unsuccessful at including runs before 3100.
- Kinematic 2 B results is shifted up, this is partially the result of a >5% increase in the raw asymmetry.

Future Analysis Goals

- Check through final error analysis.
- Include later part of Kin2.
- Use Seamus MC.
- Calculate Nitrogen Dilution Factor.
- Investigate behavior of Neutral Candidates for later bars.
- Cut dependence of Asymmetry.
- Investigate runs with abnormal distributions.