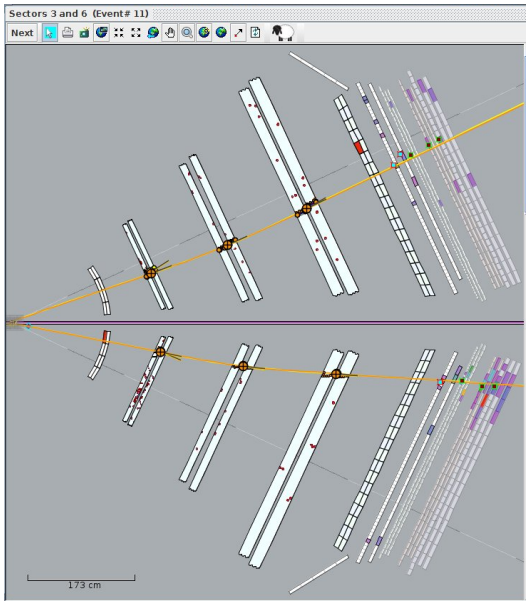
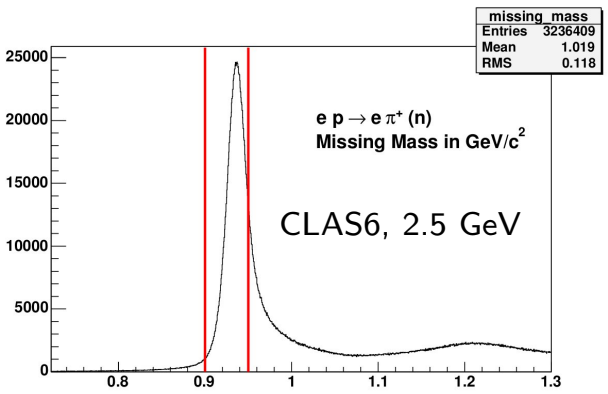
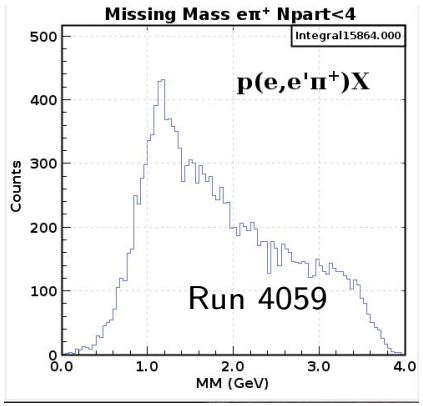
Extracting the Neutron Detection Efficiency

- Motivation - Necessary for NDVCS, G_M^n, ... measurements in Run Group B.
- Method - Generate tagged neutrons with the $p(e, e'\pi^+(n))$ reaction.
  1. Select $e'\pi^+$ final state with no other charged particles.
  2. Use missing mass to separate out neutrons.







3. Assume the missing particle is a single neutron and calculate it's 3-momentum and it's trajectory through CLAS12 from the $e'\pi^+$ vertex.

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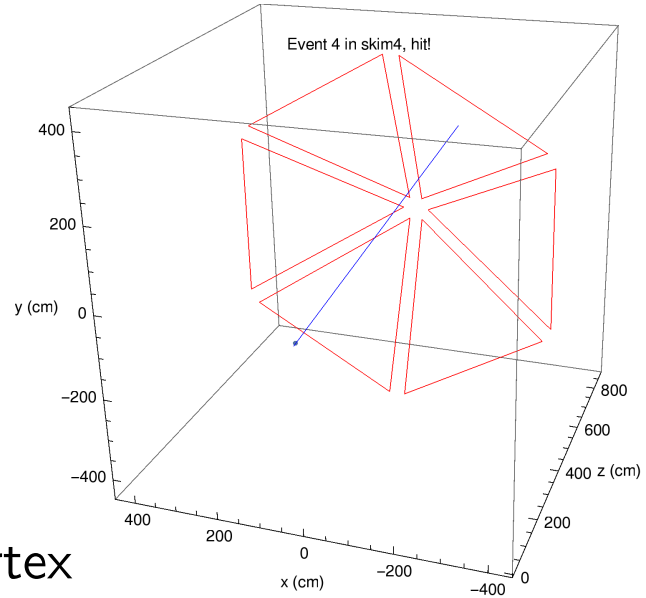
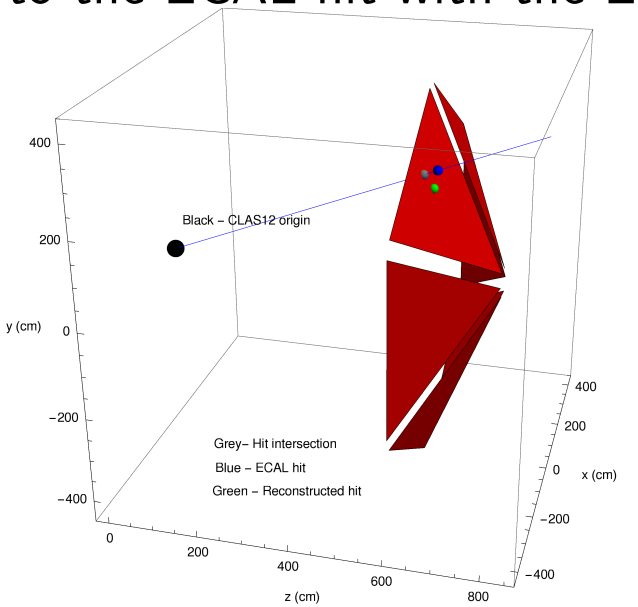
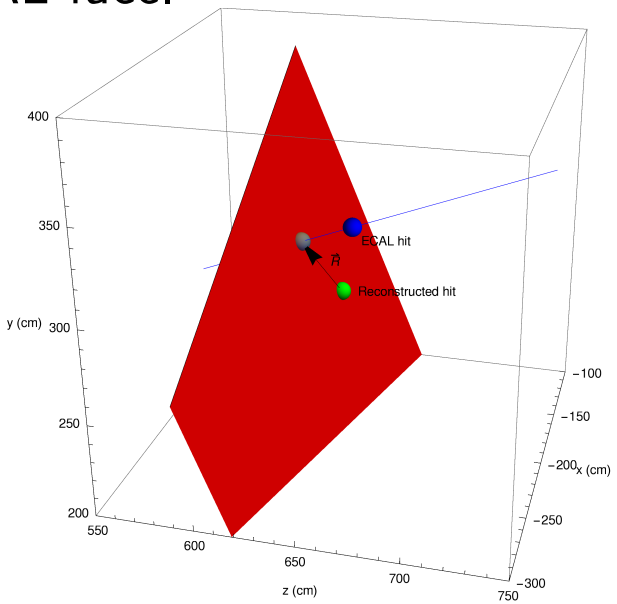
4. Does the neutron hit the ECAL?
   - Yes $\longrightarrow$ Keep reconstructed neutron.
   - No $\longrightarrow$ Skip event.
5. Get intersection of predicted neutron trajectory and front face of ECAL. Save.
6. Loop over neutral ECAL hits.
   - Get intersection of ray from the $e'\pi^+$ vertex to the ECAL hit with the ECAL face.







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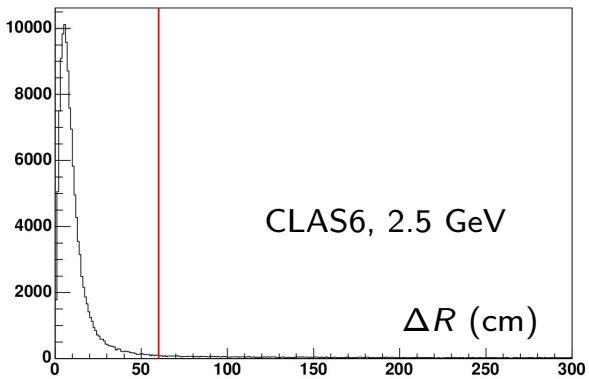
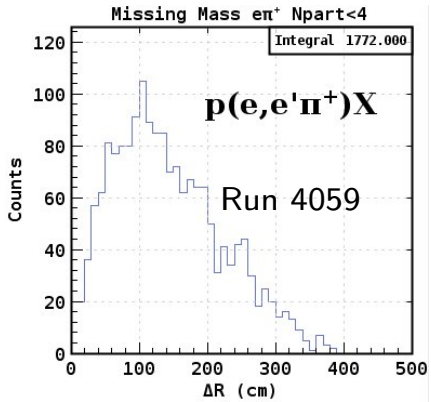
7. Continuing loop over neutral ECAL hits.
   - Calculate ΔR, the distance between the reconstructed neutron intersection and the ECAL hit intersection.
   - ΔR small $\rightarrow$ found neutron.
   - ΔR large $\rightarrow$ skip.

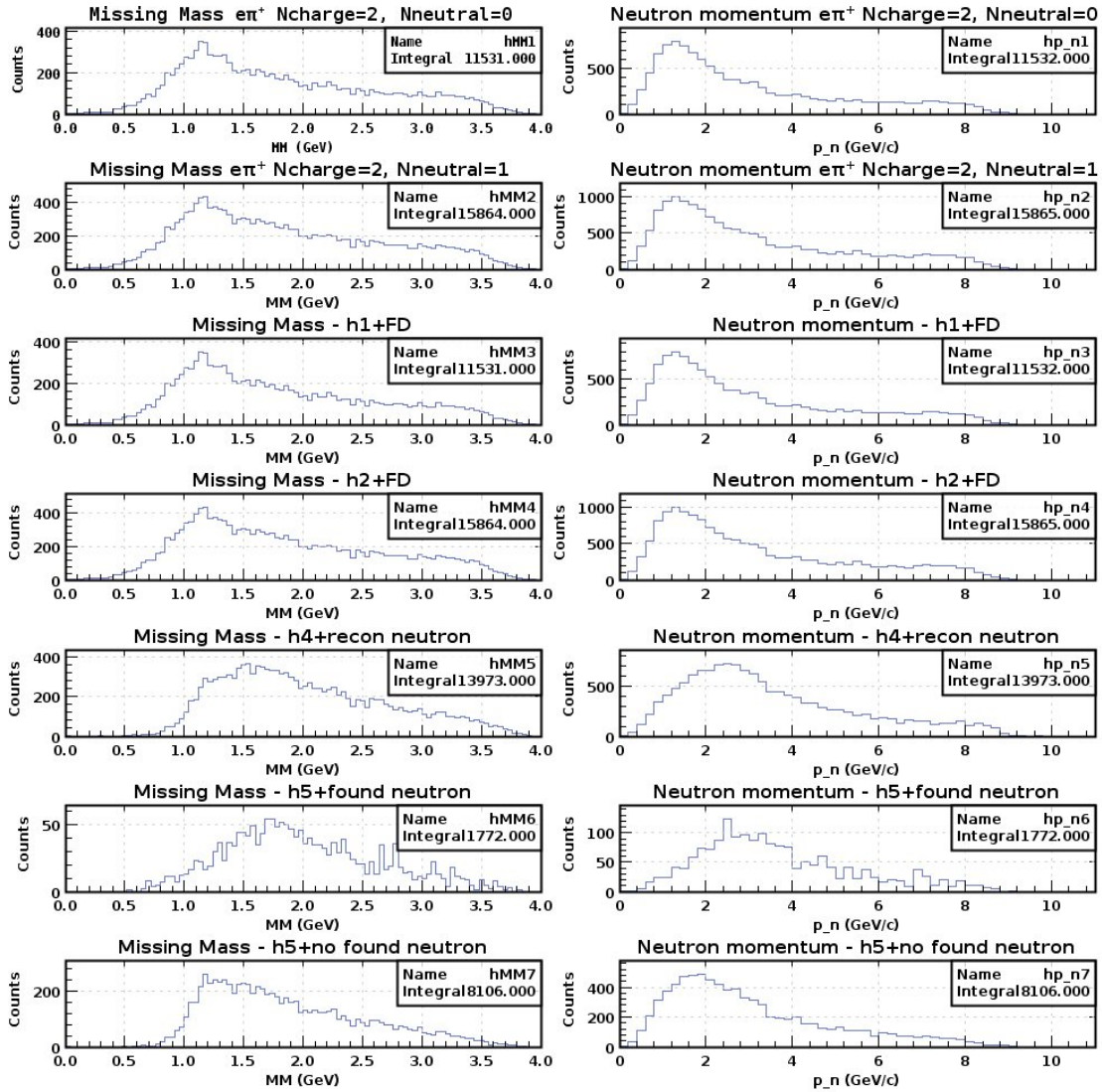




8. $$NDE = \frac{found}{reconstructed}$$

Extracting the Neutron Detection Efficiency

9. Test plots Run 4059.



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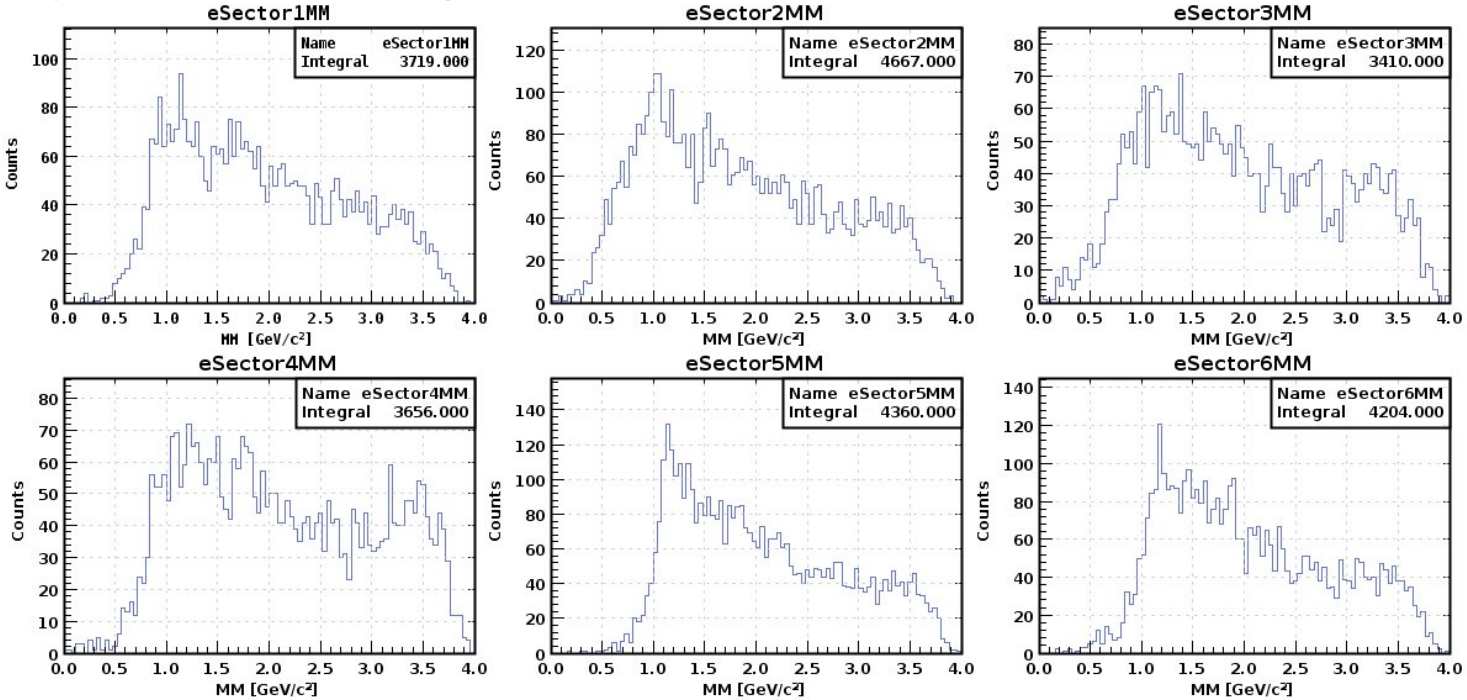
10. Sector-by-Sector Missing Mass plots.



11. Next Steps

- Continue studying the ΔR cut.
- Test codes on lower energy data.
- Test codes on simulations.

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12. Early NDE run 4059.