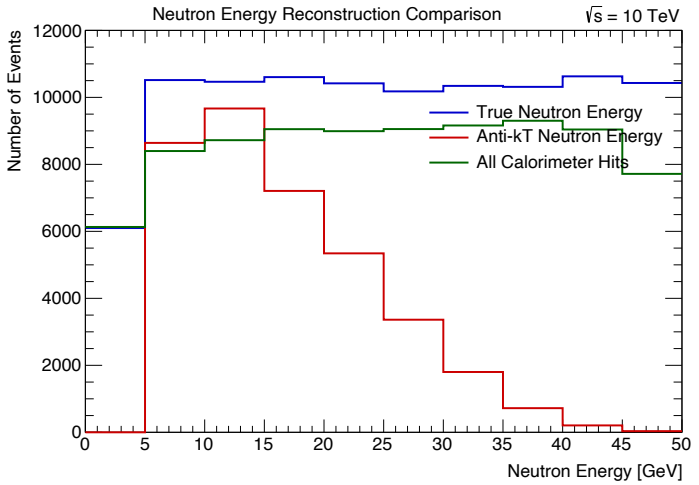
Single Neutron Studies without BIB

Last presentation

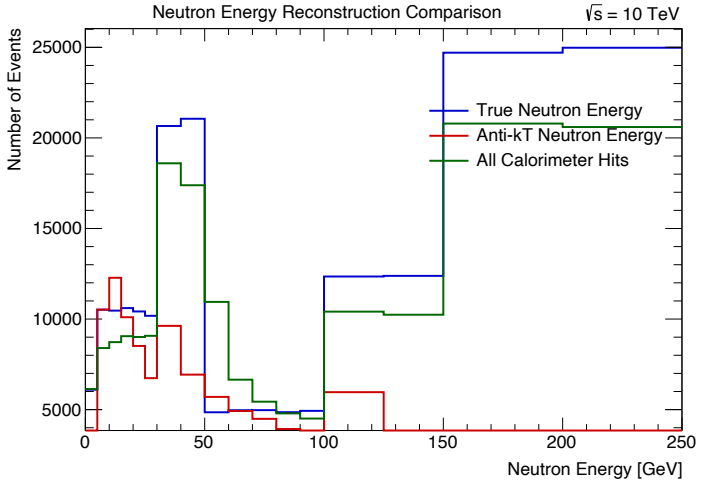
- **Summary**
  - High energy incident neutrons are not being reconstructed with R = 0.4 anti-kt jets as efficiently as low energy ones
  - There seems to be a discrepancy between the calorimeter response between the barrel and the end cap
    - Adding a theta cutoff, the response and resolution both seem good
- **Next Steps**
  - Look at the response and resolution for the barrel and endcap calorimeters individually
  - Compare anti-kt jet matching with summing up all calorimeter hits
  - Look into the theta cutoff requirement

Total Calorimeter Energy Deposition

- **Neutron Energy Reconstruction**
  - Total calorimeter hit energy is significantly closer to the true neutron energy (as expected)
  - Total hit energy also improves the anti-kt issue where there are almost no reconstructed neutrons with 0-5 GeV



0-50 GeV Samples

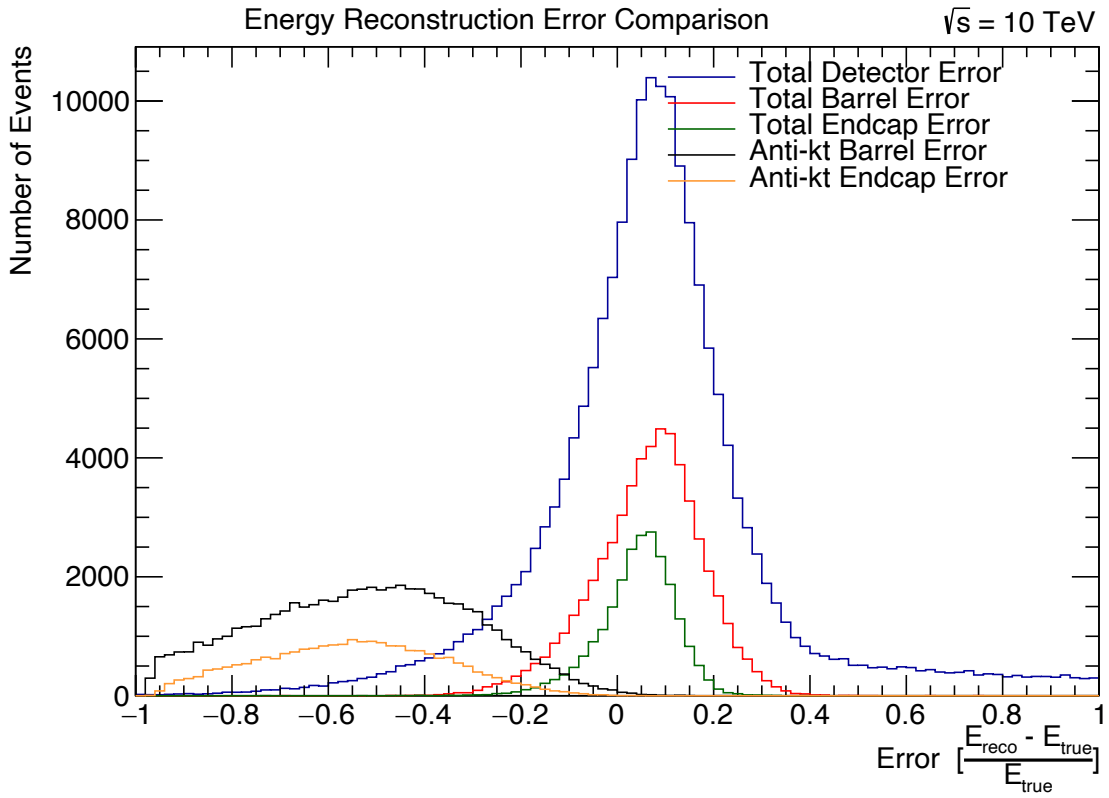


0-250 GeV Samples

Barrel and Endcap Jets

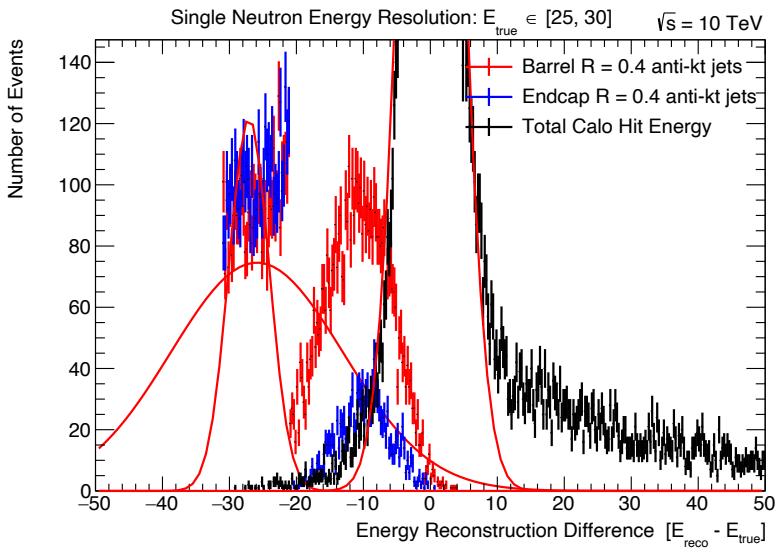
- **Jets vs Total Energy**
  - Definitions:
    - Total barrel energy = Σ(all ECAL + HCAL barrel hit energies)
    - Total endcap energy = Σ(all ECAL + HCAL endcap hit energies)
    - Total depo energy = Total barrel energy + total endcap energy
    - Anti-kt barrel energy = energy of jet for events where (total barrel energy / total depo energy) > 0.95
    - Anti-kt endcap energy = energy of jet for events where (total endcap energy / total depo energy) > 0.95
  - The potential discrepancy between barrel and endcap calorimeter responses was seen with the anti-kt samples
    - So, my analysis separately looks at barrel and endcap jets
  - Clearly, the total depo energy is closer to being accurate compared to the anti-kt jets (as is seen in later resolution/response plots)

0-250 GeV Samples

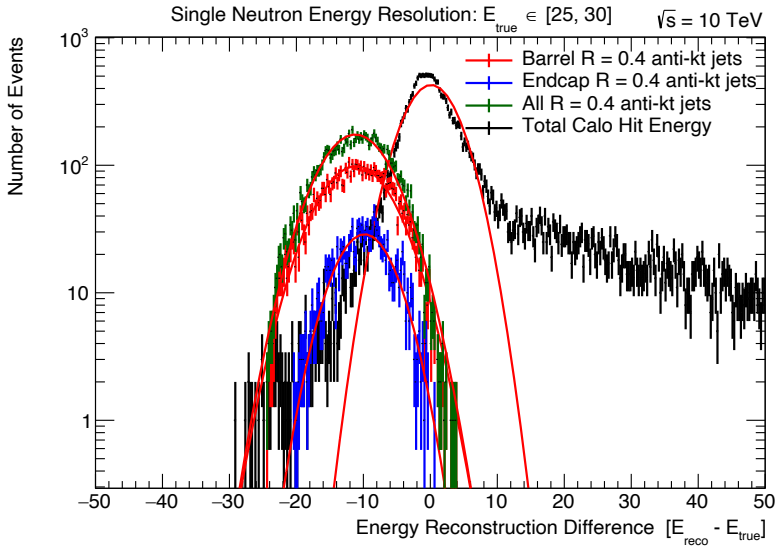


Fixing the discrepancy error

- **The fitting issue**
  - A cluster of samples outside of the main gaussian throws off the fits
    - Previously, I fixed this by ensuring 1 < theta < 2
      - However, since the cluster is apparent in both barrel and endcap jets, it cannot be caused by a discrepancy between the two
  - The issue is fixed by requiring theta >= 0 (removes theta = -1)
    - This ensures that and anti-kt jet exists for this event (removes the mismatched jet problem from before)

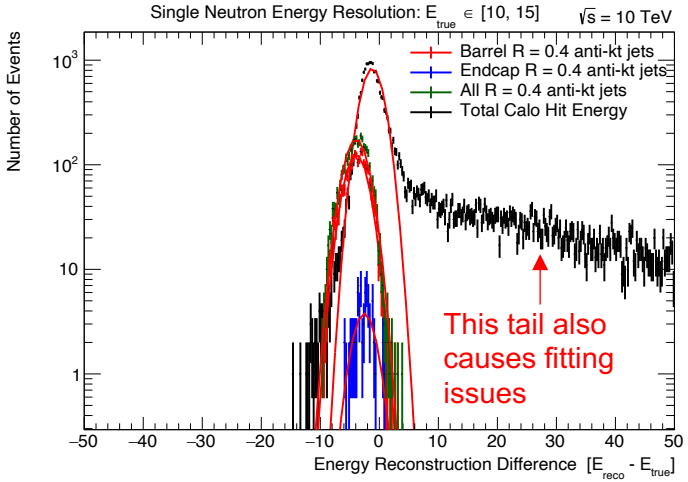


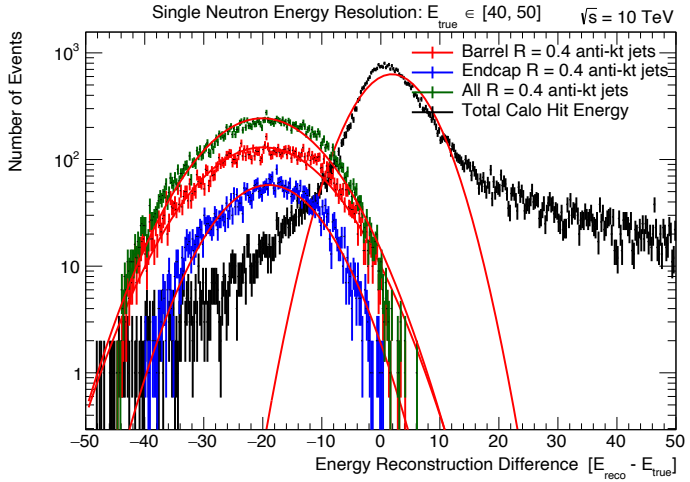
Pre-theta cut

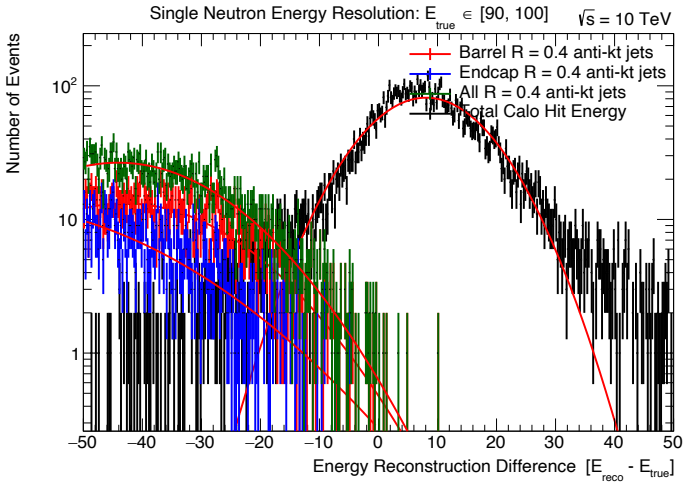


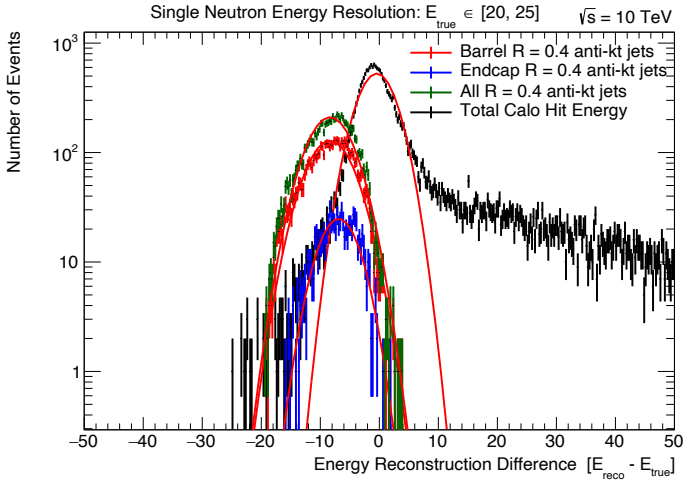
Post-theta >= 0 Cut

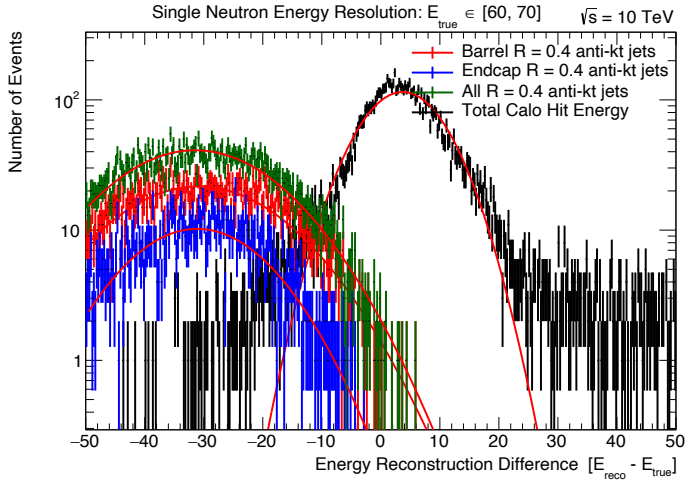
Individual fit examples with theta >= 0 cut

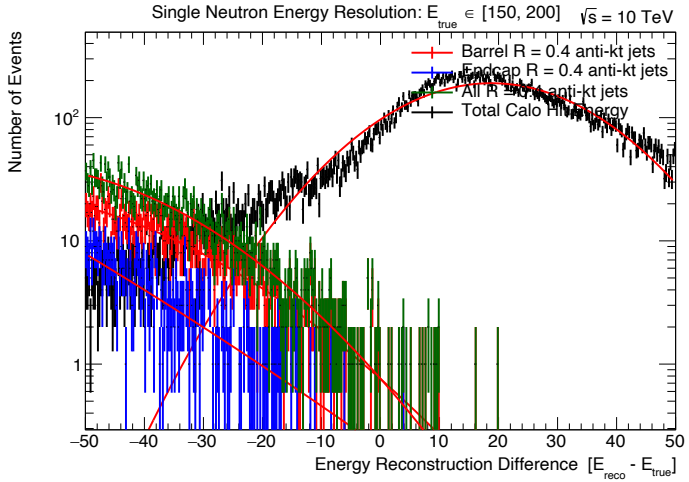






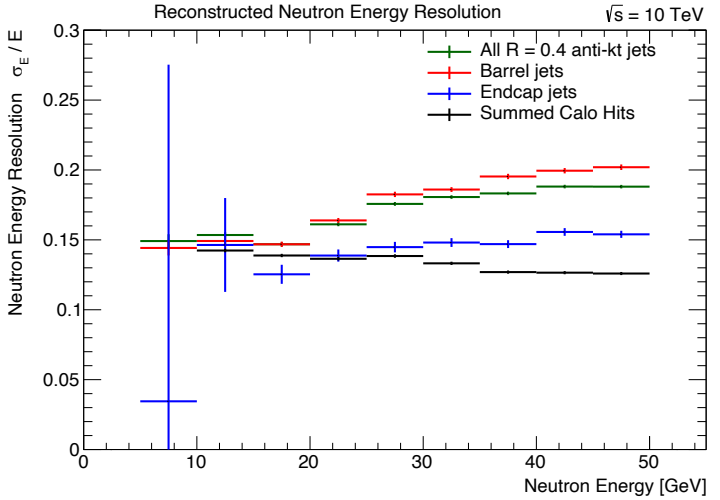




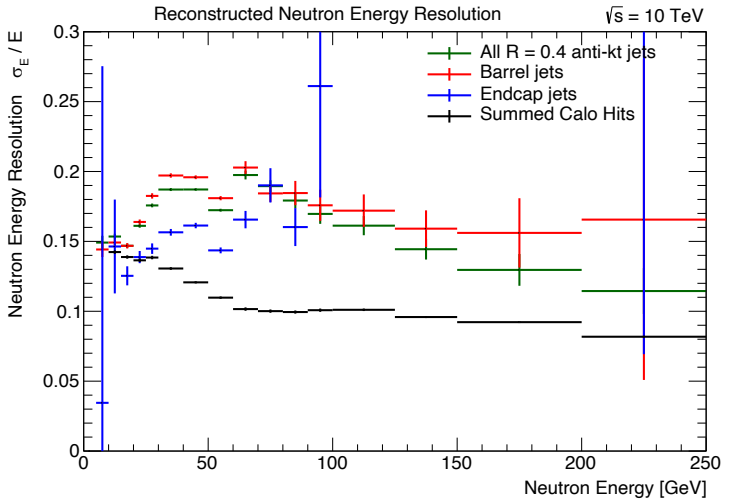


Neutron Energy Resolution

- **Resolution Plots**
  - Split into the same categories
  - Barrel jets are better at higher neutron E while endcap jets at lower neutron E
  - Total depo energy response is uniformly better than the anti-kt jet approach (as expected)



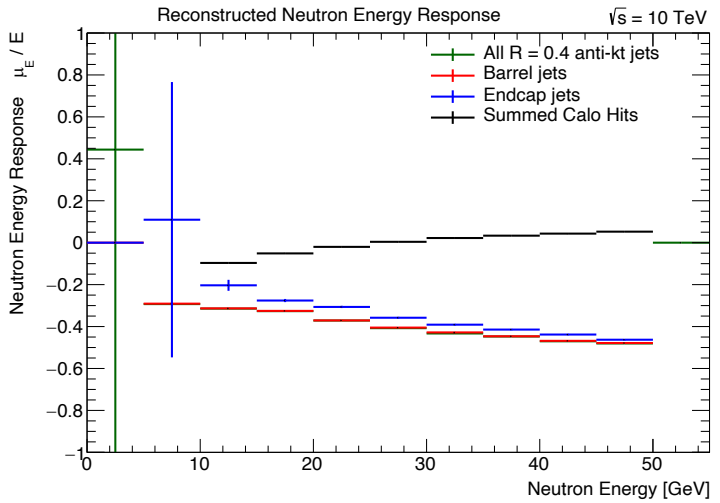
0-50 GeV Samples



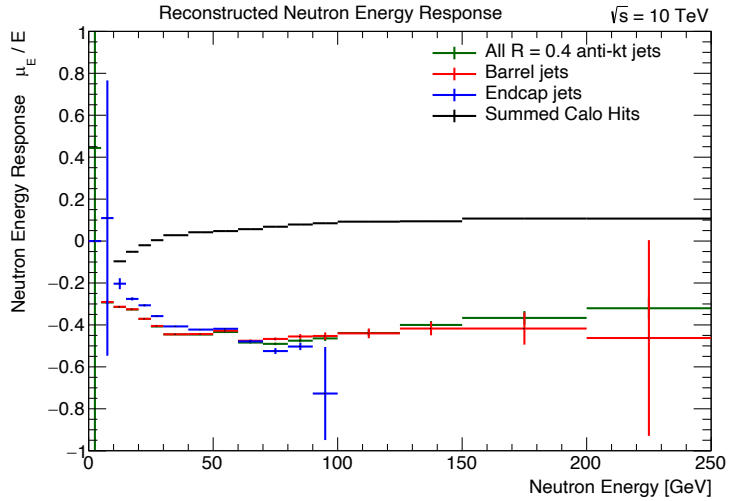
0-250 GeV Samples

Neutron Energy Response

- **Response Plots**
  - Split into the same categories
  - Once again, it seems that barrel jets are better at higher initial energy and endcap jets at lower E
  - Total depo energy response is again better than the anti-kt jet approach (as expected as well)
  - It is interesting that both energy resolution and response for the anti-kt jets seem to be the worst around 60 GeV



0-50 GeV Samples



0-250 GeV Samples

Summary and Next Steps

- **Summary**
  - I found that the cluster causing fitting issues was not due to barrel vs endcap discrepancies rather it was due to mismatched jets
  - Response and resolution plots show that total calorimeter energy deposition is significantly better than the anti-kt jet approach
  - Barrel and endcap jets have similar performance for low initial E
    - For high E incident neutrons, however, the barrel seems to perform better

- **Next Steps**
  - Moving forwards, should I keep doing my analysis with anti-kt jets or with total calorimeter sums?
    - Should I incorporate the anti-kt jet correction or the total calorimeter sum correction?
  - Create reconstruction efficiency plots with respect to E, theta
  - Look at response and resolution dependence on theta as well as energy
  - Add in energy response correction factor and re-do analysis
  - Add in more cuts (eg: remove events in the nozzle)