FCS Pi0 TSSA Update

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STAR Spin Meeting

December 4, 2024

Recap and Outline

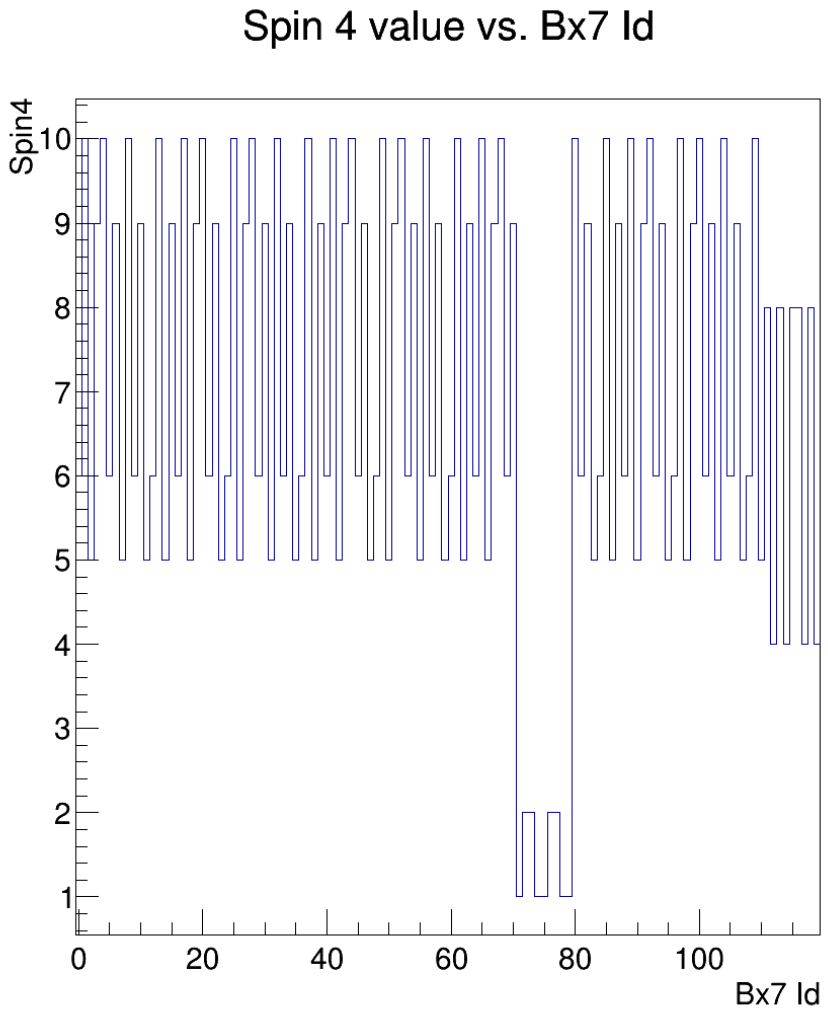
- Looking at Run 22 fwd_stream production
  - Request page: https://drupal.star.bnl.gov/STAR/blog/dkap7827/Run-22-Data-Production-Request
  - Used a file from every single run number greater than 23005043
    - Only runs after and including this run are calibrated
    - When I included runs before this one got bad results
  - Spin database check in progress
- Last update: Showed point level QA and using EPD to separate photons
- This update: Further refine cuts for Pi0 analysis and separate into bins energy and phi bins
  - Continuing investigations into Run QA

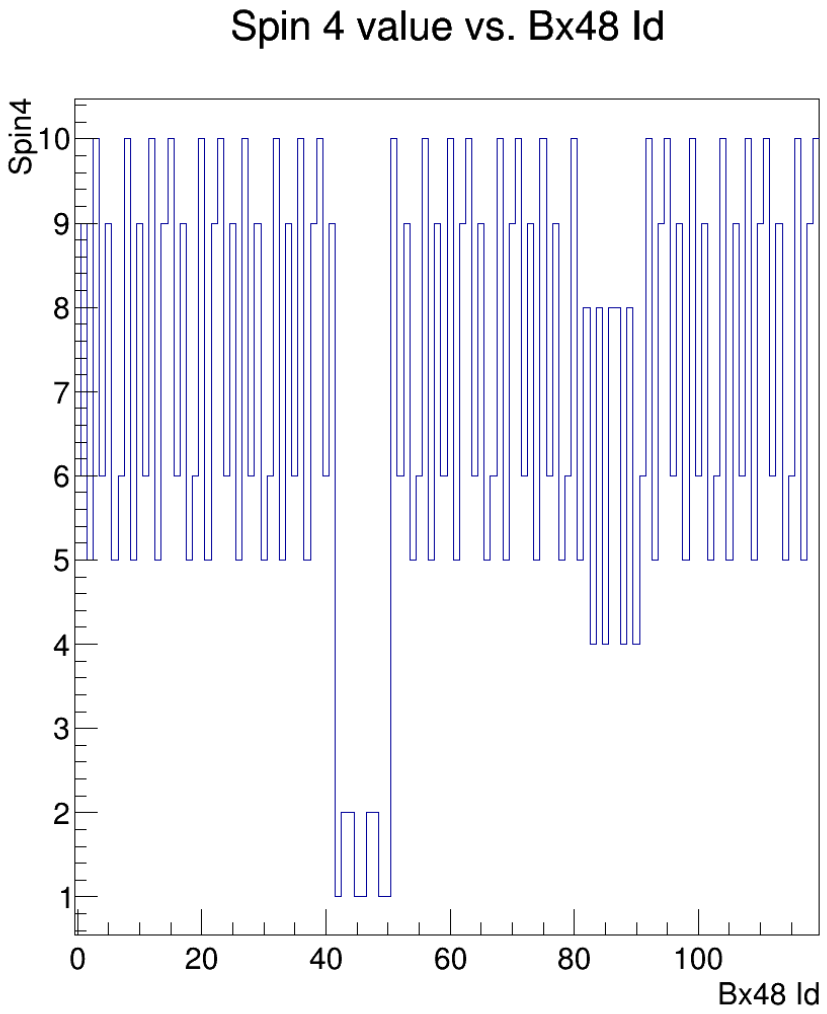
Current Analysis Method and Cuts

- Take highest energy point and pair with all other points
- Apply the following cuts on each point pair:
  1. -100 cm <= |vertex_z| <= 100 cm
  2. Zgg=|E1-E2|/(E1+E2)<0.7
  3. Both points have EPD nmip <0.7
     - Check if point intersects with any EPD tiles. If there is a hit take nmip<0.7 accept point as photon. If no hit but intersects also take as photon. If no intersection reject point
  4. FCS EM0,1,2,3 trigger
  5. Pi0 P_T is equal to or exceeds trigger threshold
- Currently use all possible pairs. Working on changing this in the future
- Five energy bins: 0-10,10-30,30-50,50-70,>70
- Eight phi bins so 4 phi values for analysis

Checking Spin Database

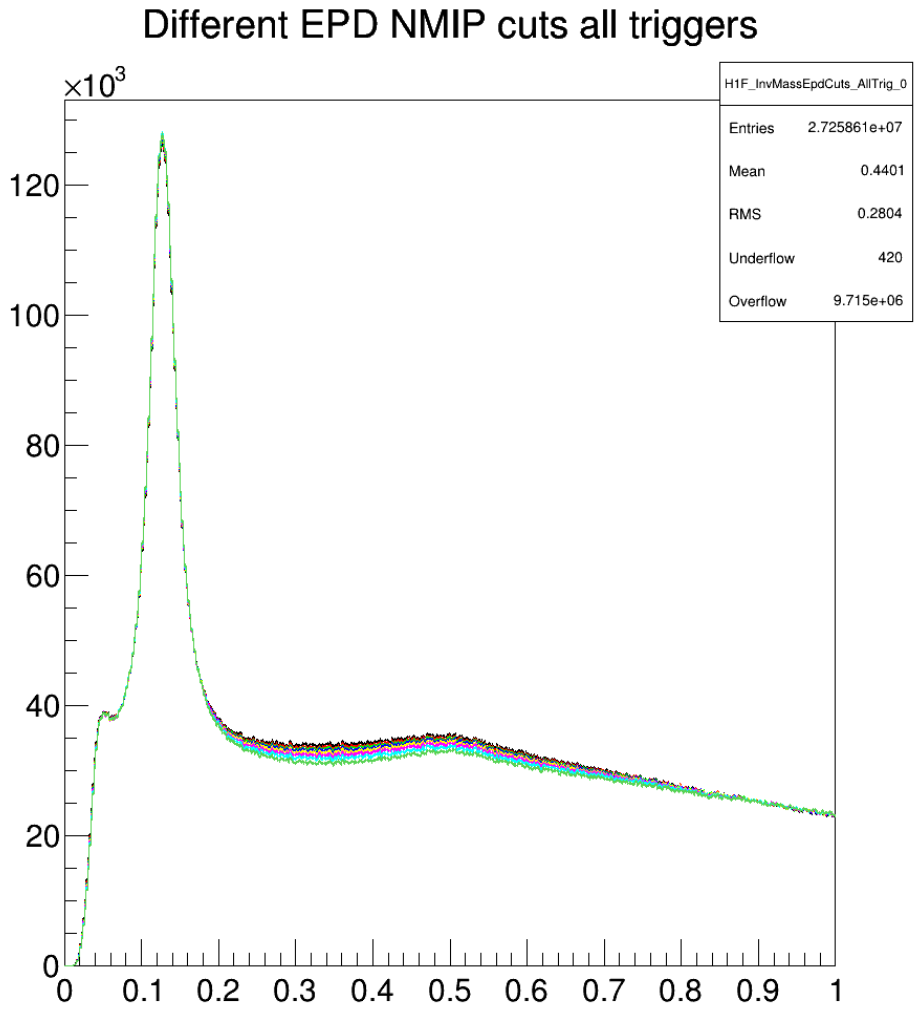
- Checking spin database spin 4 bit values vs. bx7 and bx 48 Id
- Consistent with database printout

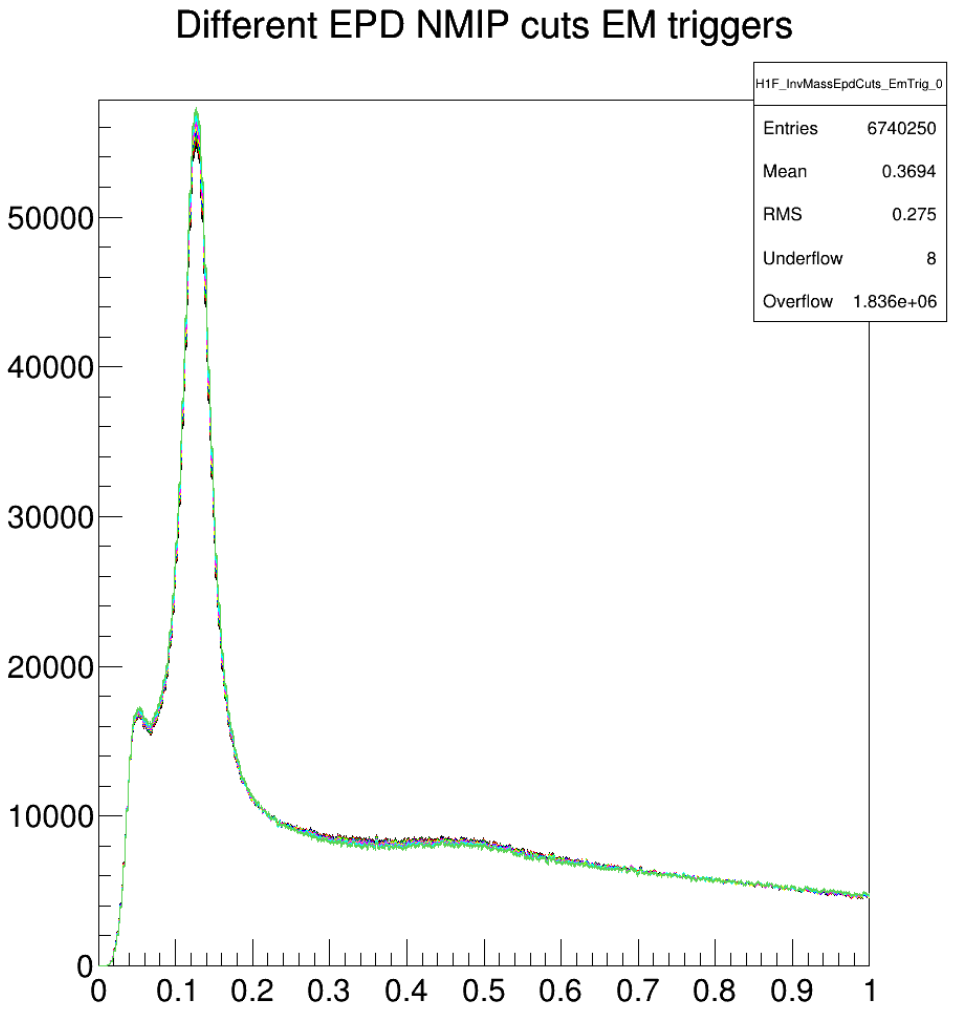




Checking the EPD Nmip cut

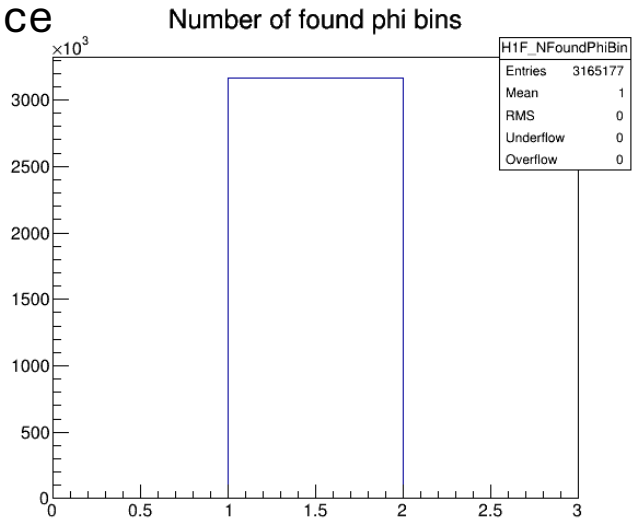
- Wanted to see how much things change if used a different cut value for EPD nmip
- Tried 0.2 to 0.9 in increments of 0.1
- Small change in yields
- EPD nmip<0.7 is fine to use

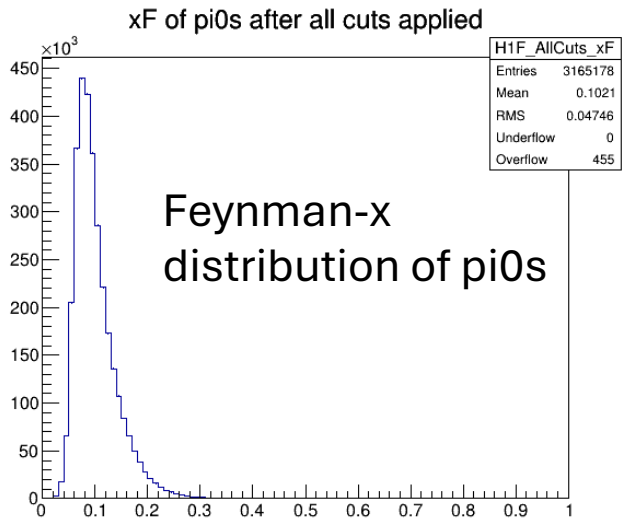


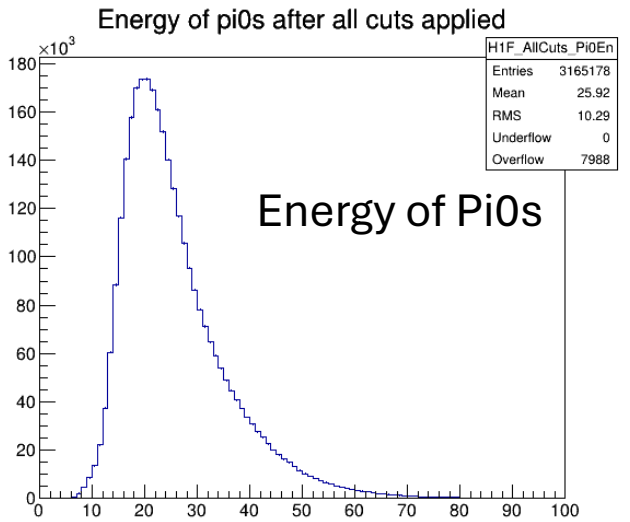


Pi0 Quantities after cuts

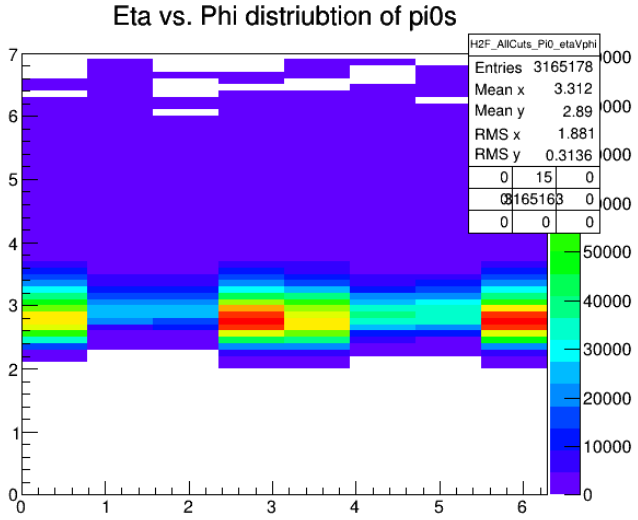
Sanity check to make sure each phi is only filled once

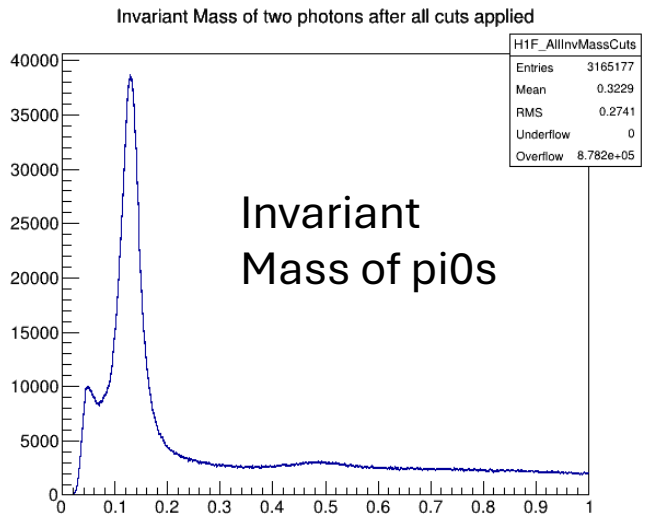


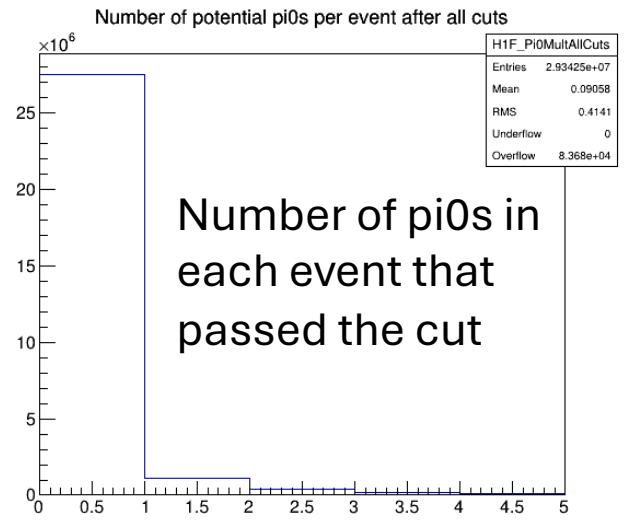




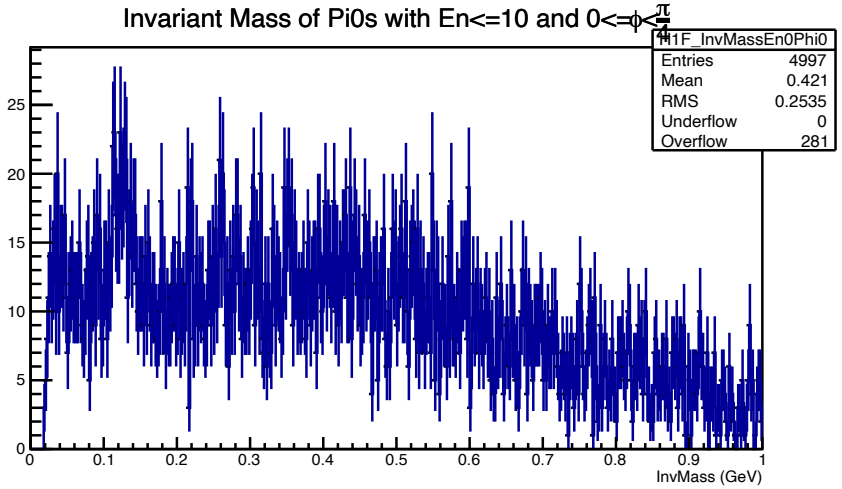
Pi0 distribution in eta and phi space

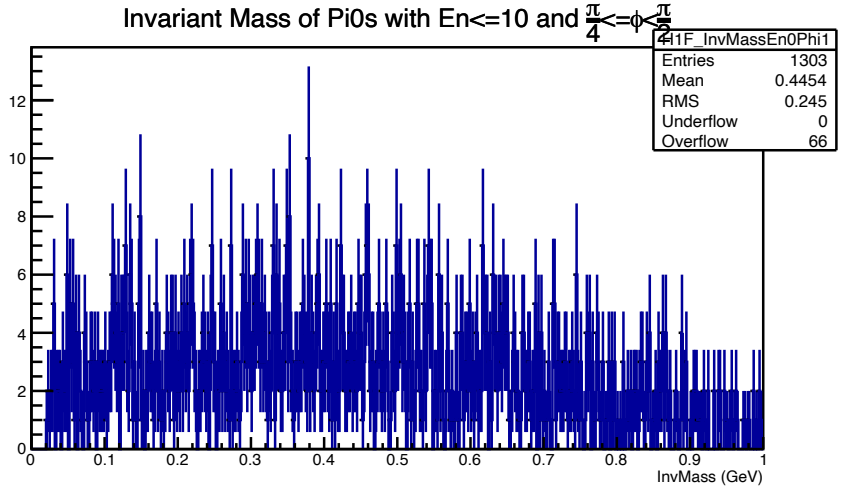


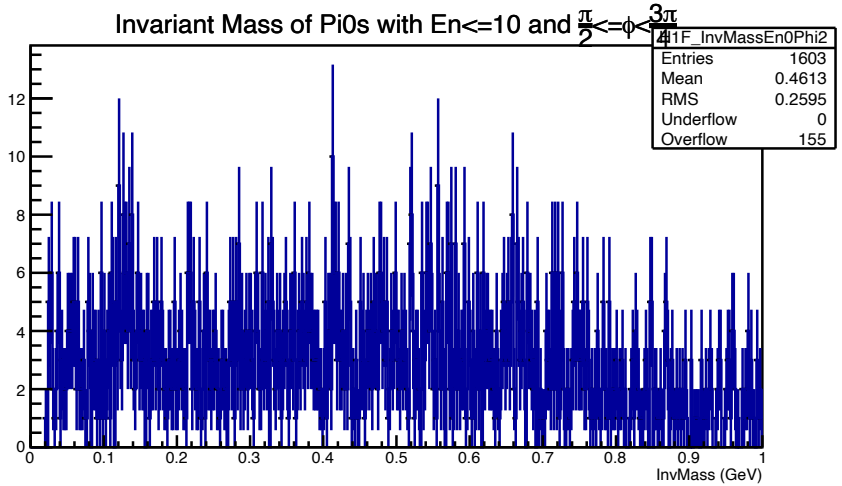


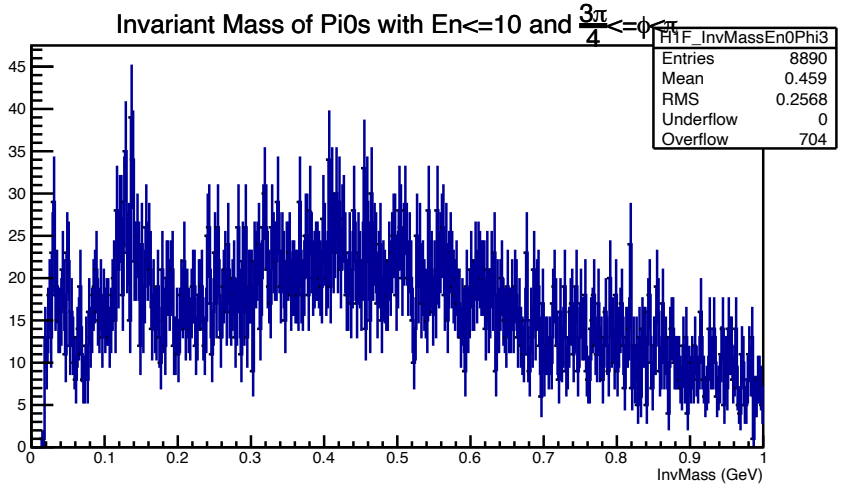


Invariant mass by Energy Bin 0-10 GeV and Phi bin



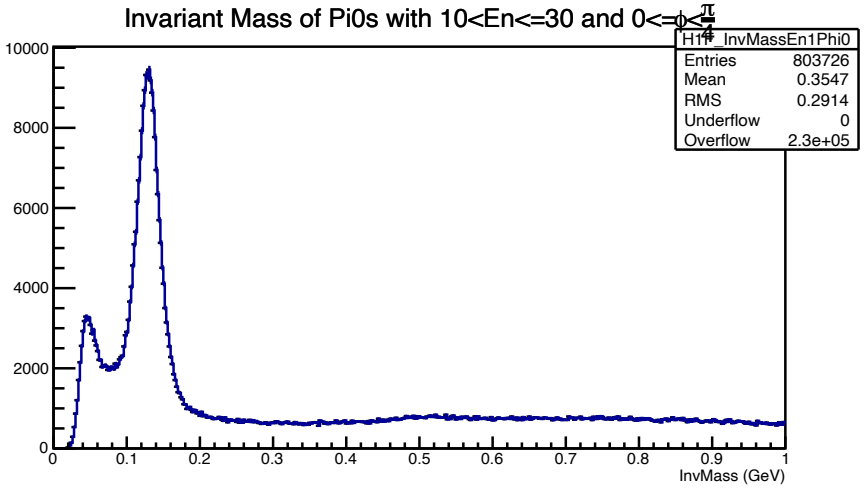


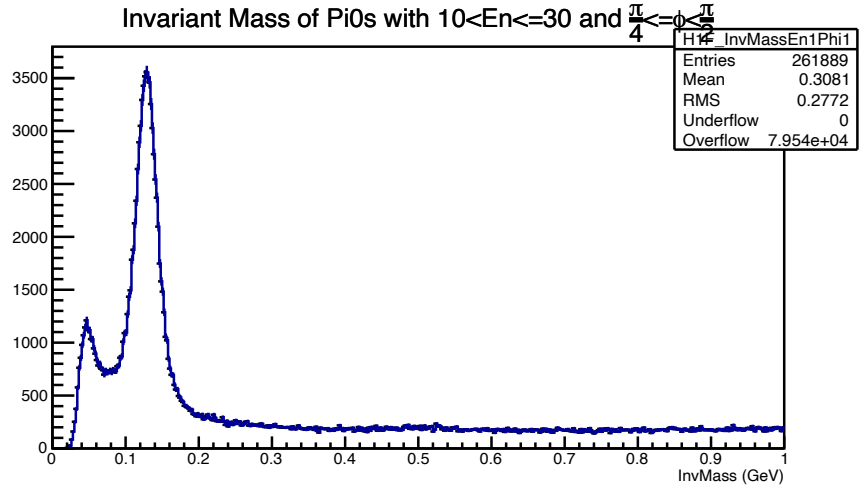


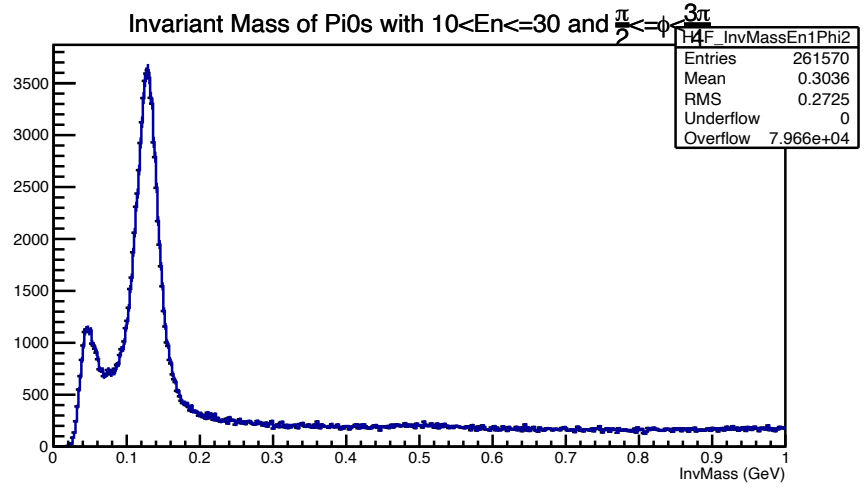


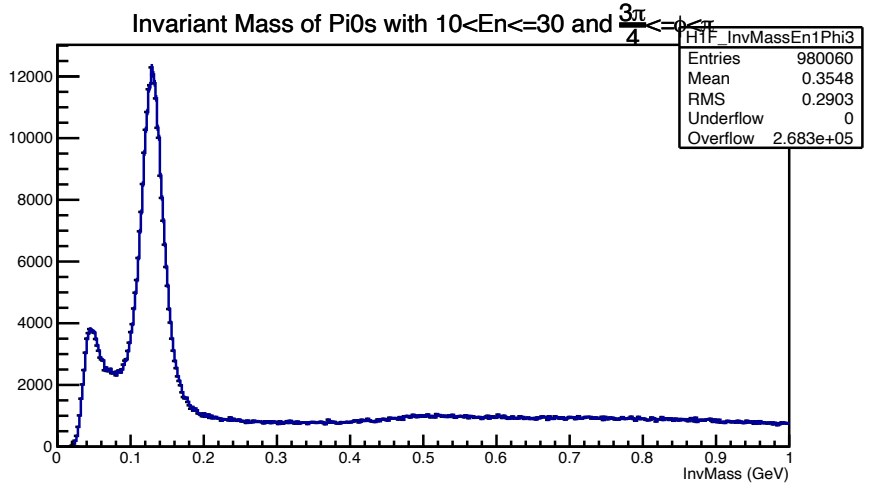
Limited entries as can also be seen by the pi0 energy plot

Invariant mass by Energy Bin 10-30 GeV and Phi Bin



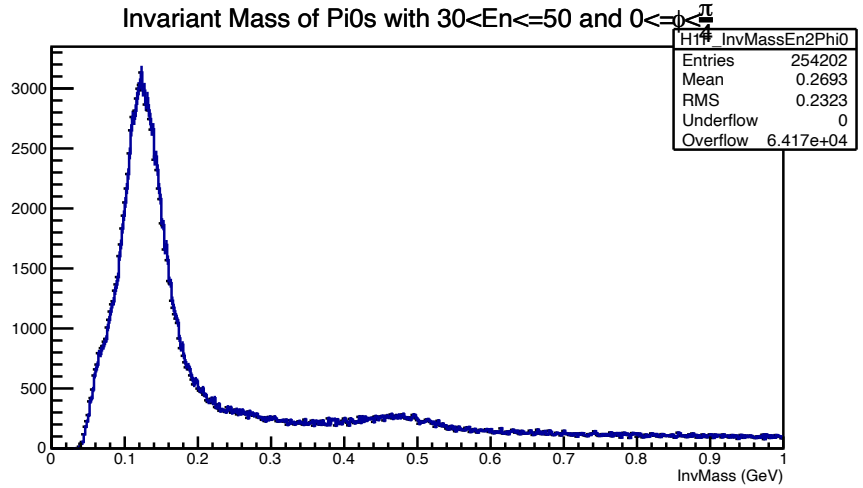


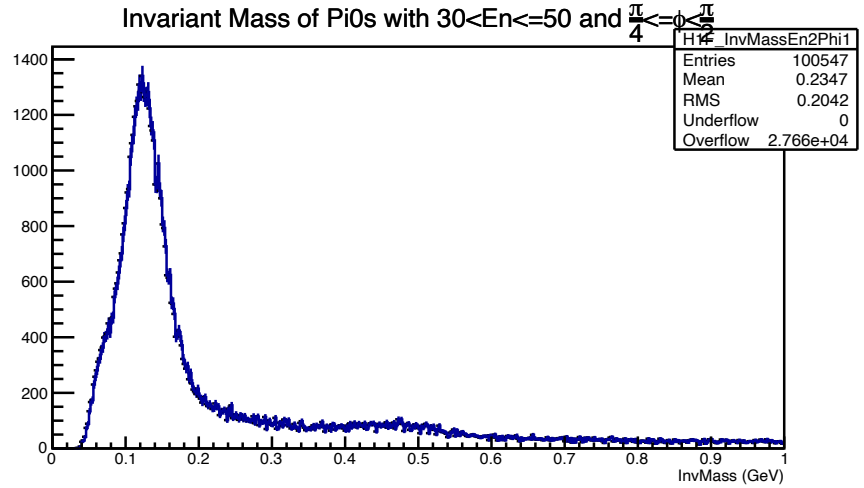


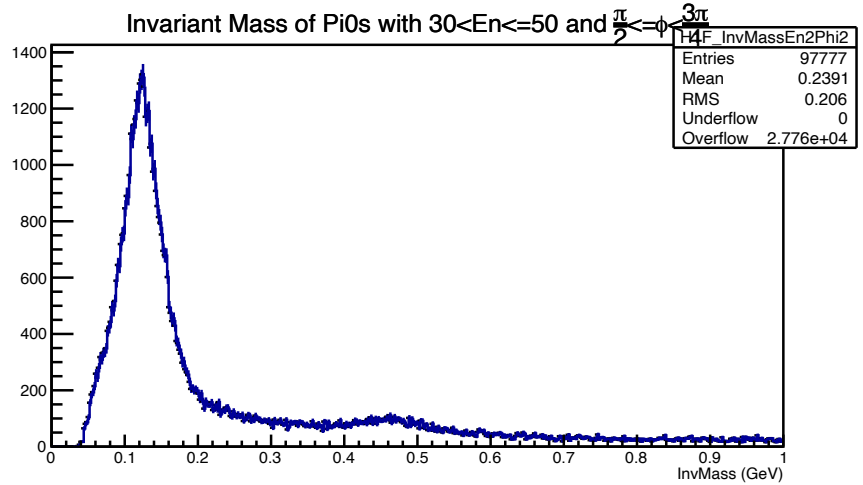


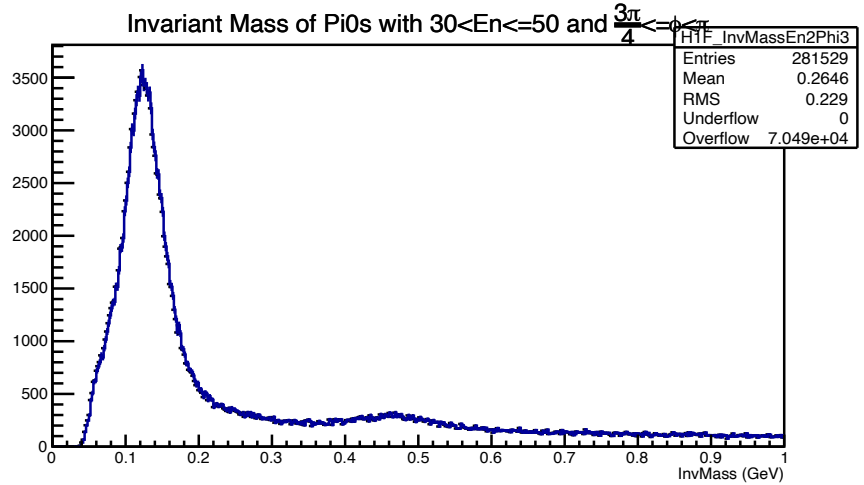
Clean pi0 peaks with clear background

Invariant mass by Energy Bin 30-50 GeV and Phi bin



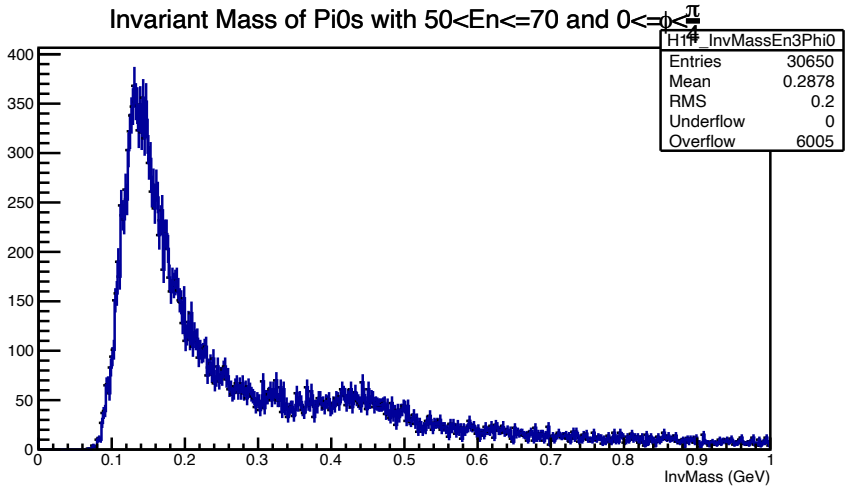


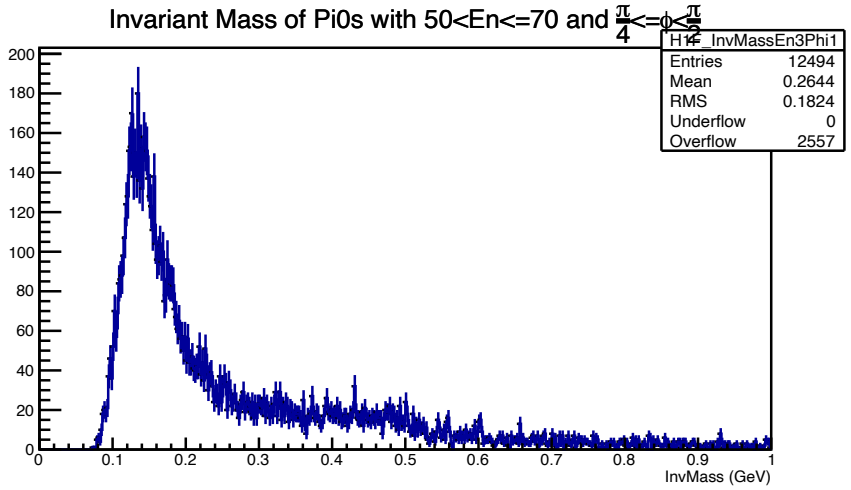


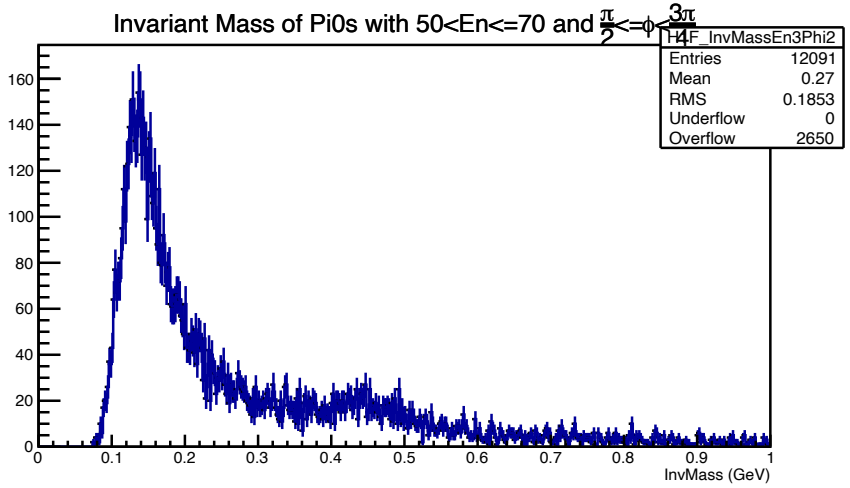


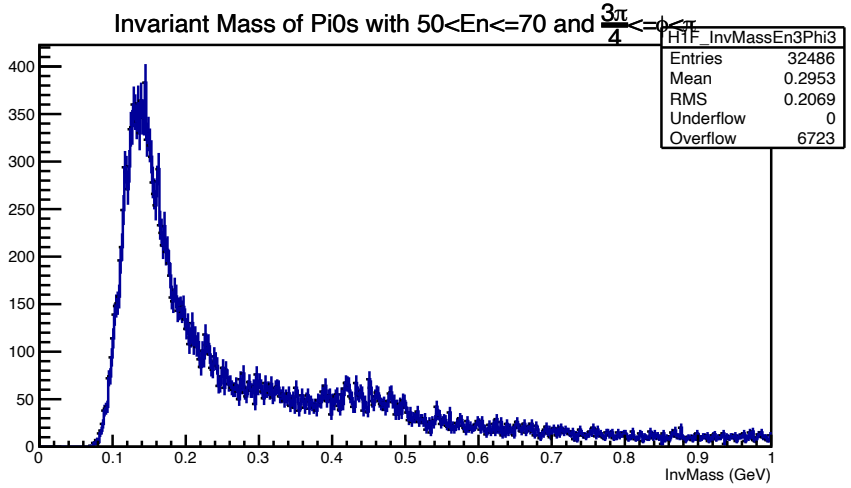
Wider peak for the pi0 merging with low mass background still good entries

Invariant mass by Energy Bin 50-70 GeV and Phi bin

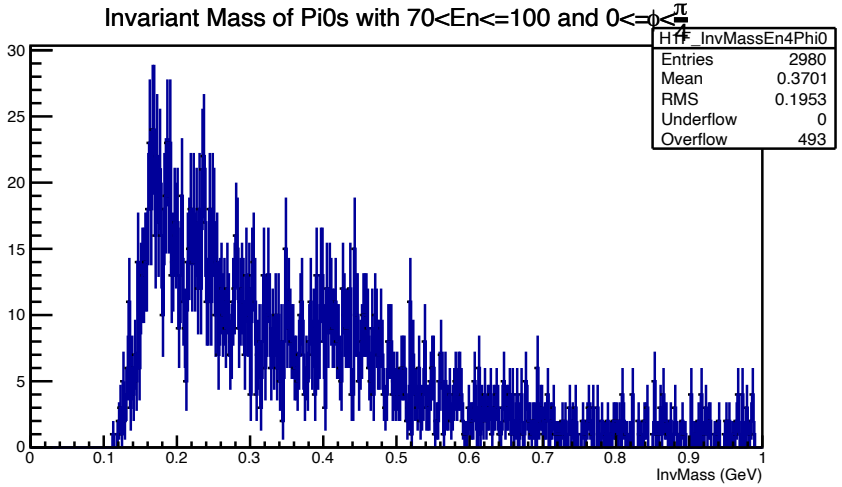


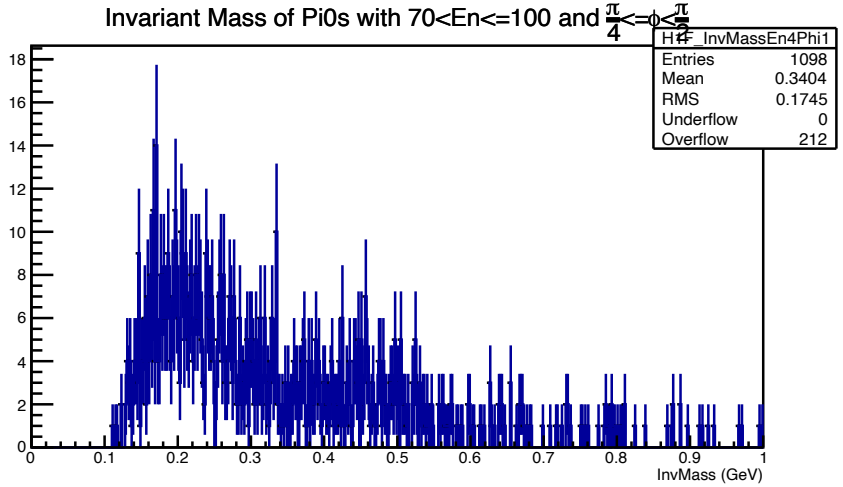


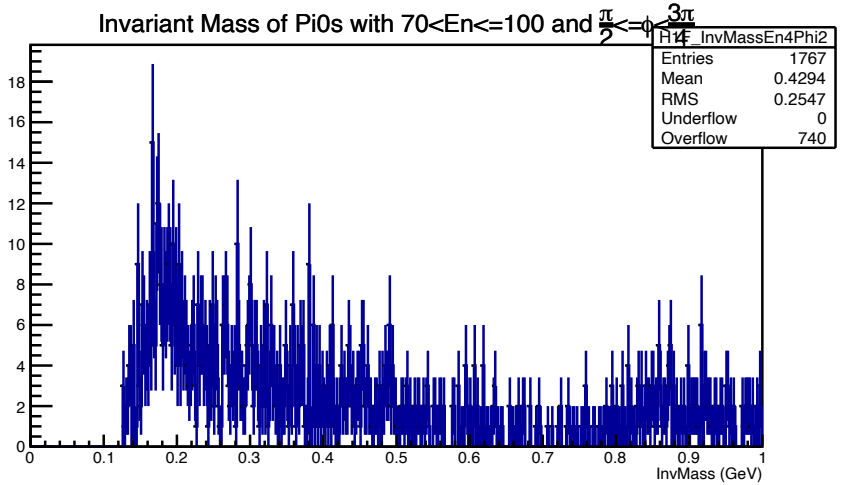


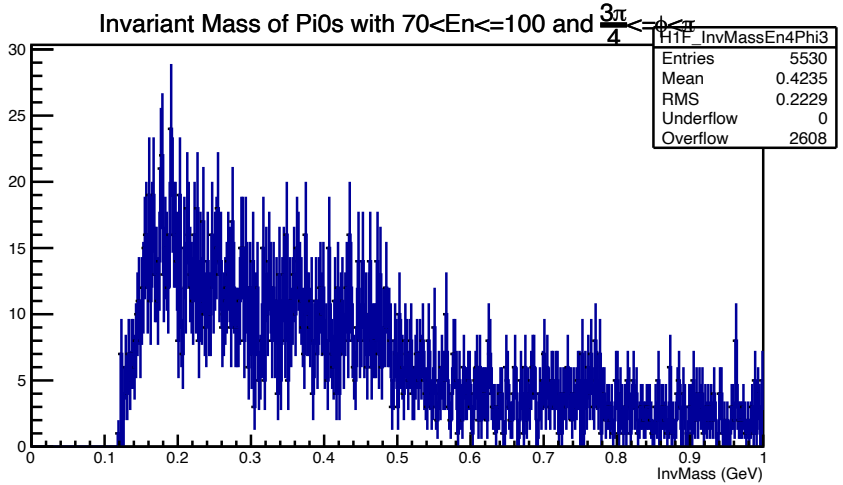


Invariant mass by Energy Bin 70-100 GeV and Phi bin



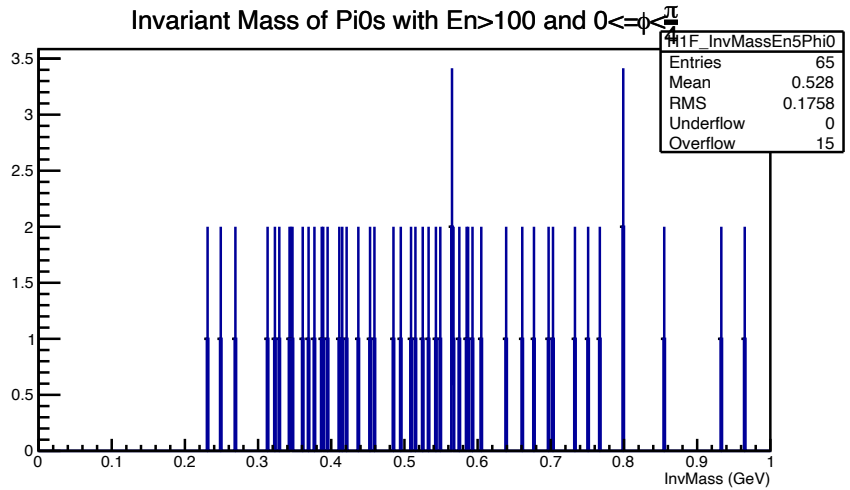


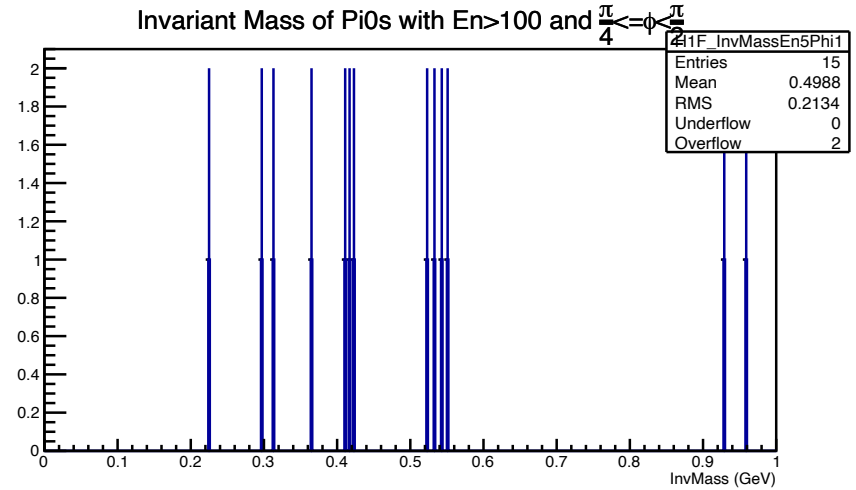


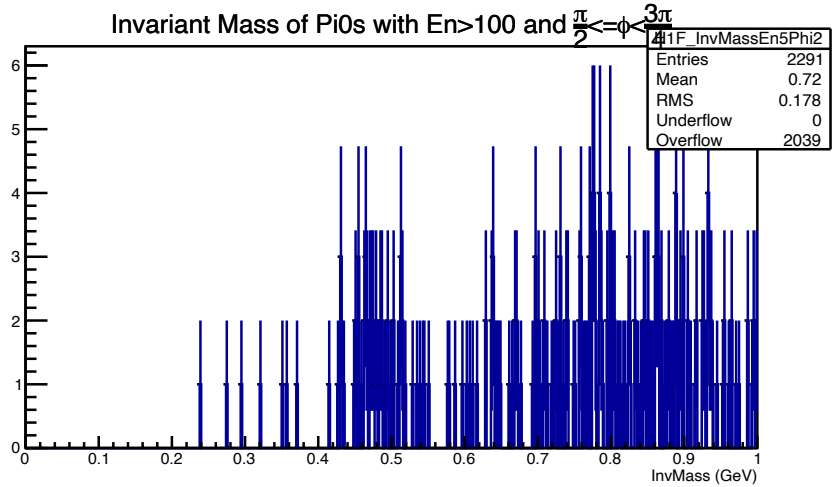


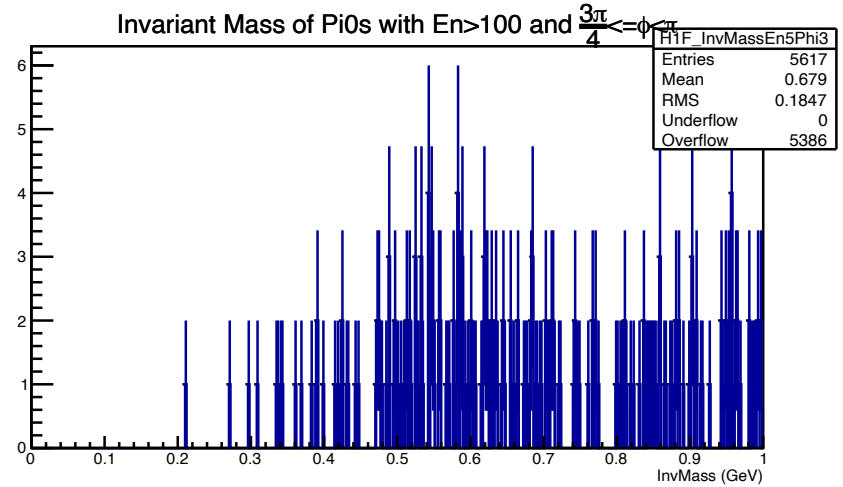
pi0 peak less apparent but still showing even with limited statistics

Invariant mass by Energy Bin >100 GeV and Phi bin









Pi0 peak is no longer apparent at the higher energies

Conclusion

- Spin database giving consistent results
- Varying EPD nmip cut has little effect
- Adding cuts cleans up pi0 peak significantly and even shows a hint of the eta peak.
- Looking at invariant mass by energy and phi bins we can see how well the reconstruction is working
- Need to identify better bins to use