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FIXED MASS π^0 FIT

FIXED/CONSTRAINED FITTING

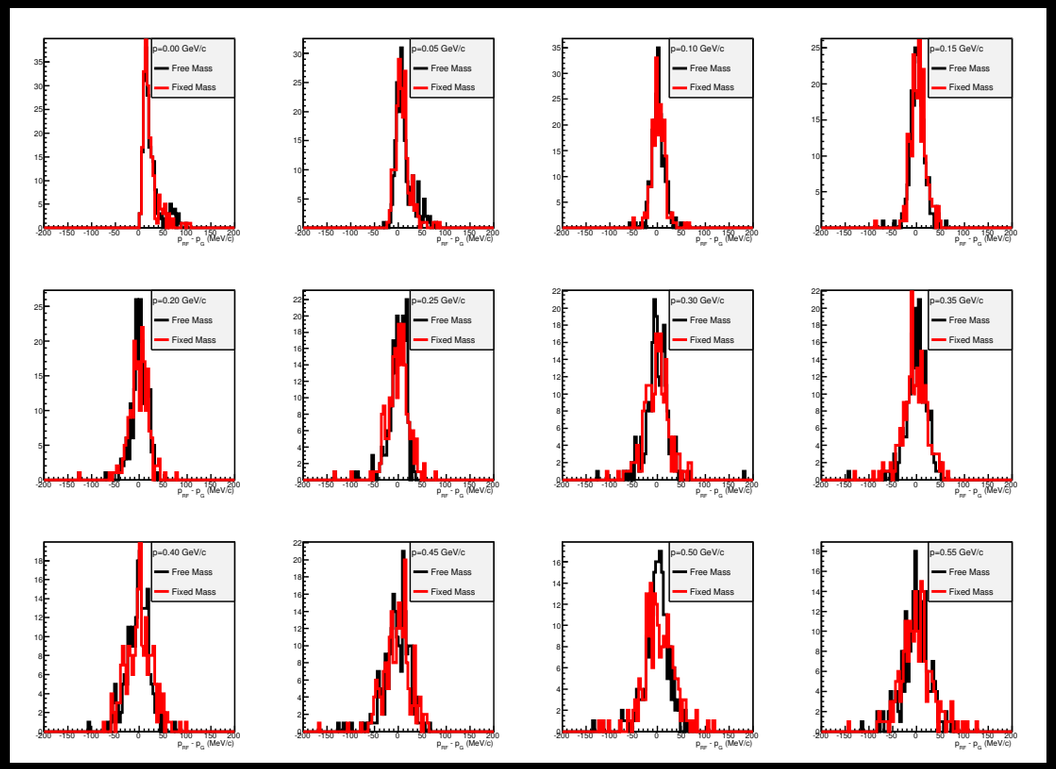
- Basic idea: add independent information to the fit
- e.g.:
  - photons from π^0 decay should point back to the same vertex
  - pions from kaon decay should come from a common point
  - total energy in an e^+e^- collision
  - **photons from π^0 decay should have $m_{\gamma\gamma} = m_{\pi 0}$**
- Resolutions, information from fit should be improved by additional assumptions (=information) in the fit.
  - benefits downstream: $p \rightarrow e^+ + \pi^0$
- Ring finding, π^0 rejection may also improve
- Nomenclature:
  - fixed: parameter is actually fixed to a value
  - constrained: parameter varies with external error/covariance
- Here, we are discussing “fixed π^0 mass fit”

HOW IT WORKS

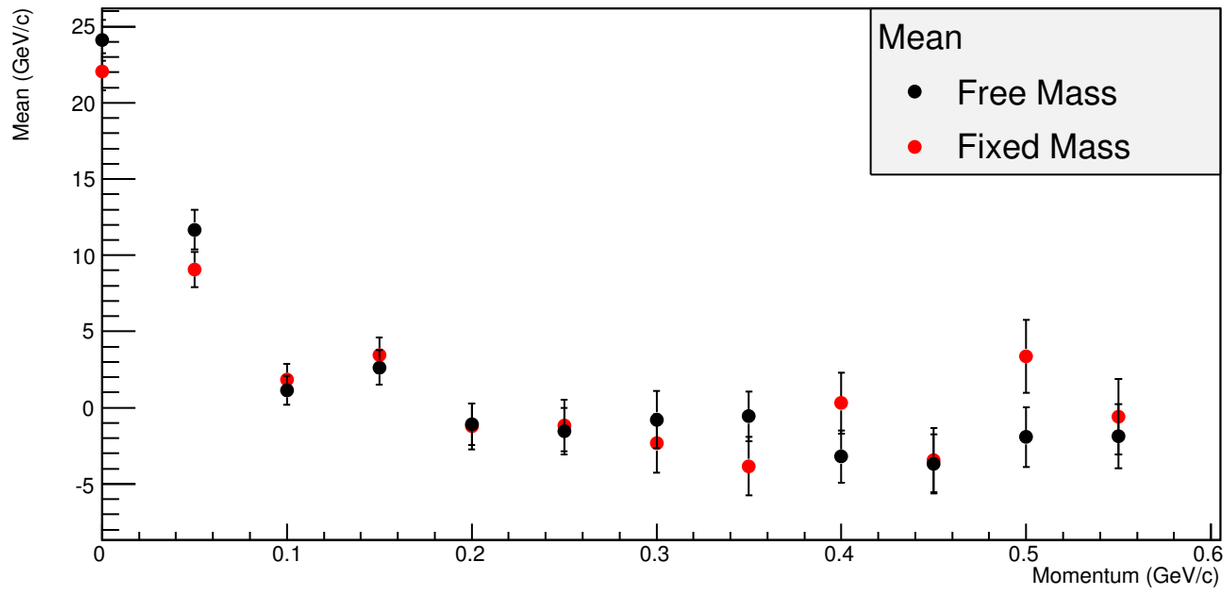
$$m^2c^4 = 2E_1E_2(1 - \cos\theta)$$

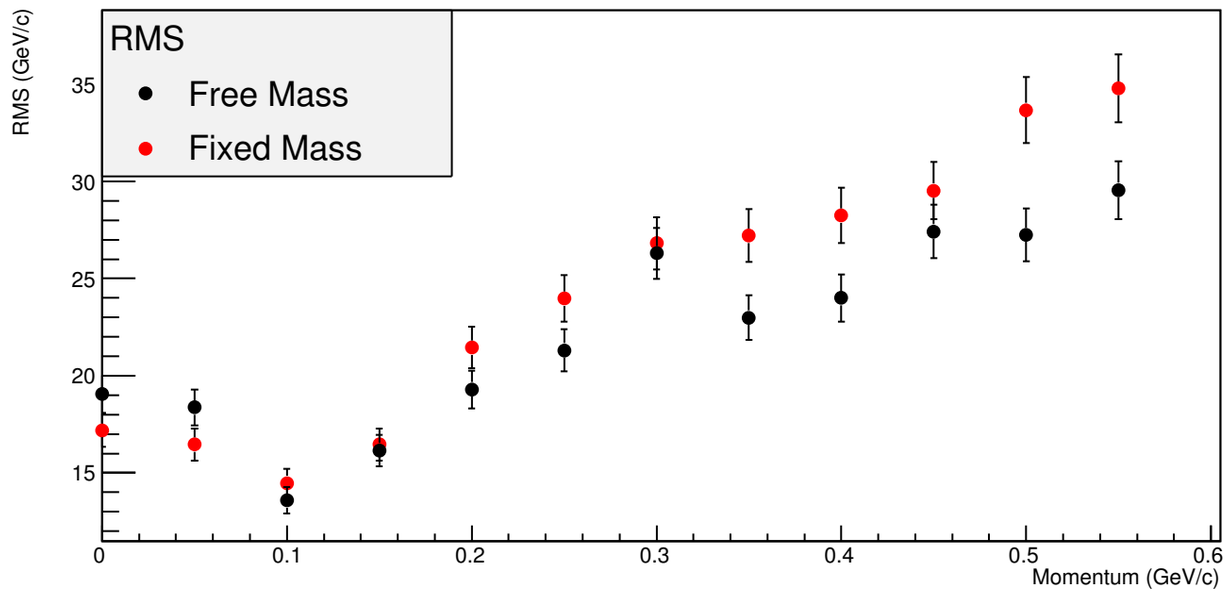
- In normal fit, there are 12 free parameters:
  - 4-vertex of π^0 decay (4 parameters)
  - momentum of each photon (6 parameters)
  - conversion length of each photon (2 parameter)
- In current fixed mass fit, E_2 becomes function of other parameters in order to give π^0 mass

INITIAL STUDY



- Performance (at least in terms of momentum resolution) appears worse for fixed-mass fit
- Need to investigate seeding, etc.
- First see “ultimate” performance with truth seeding

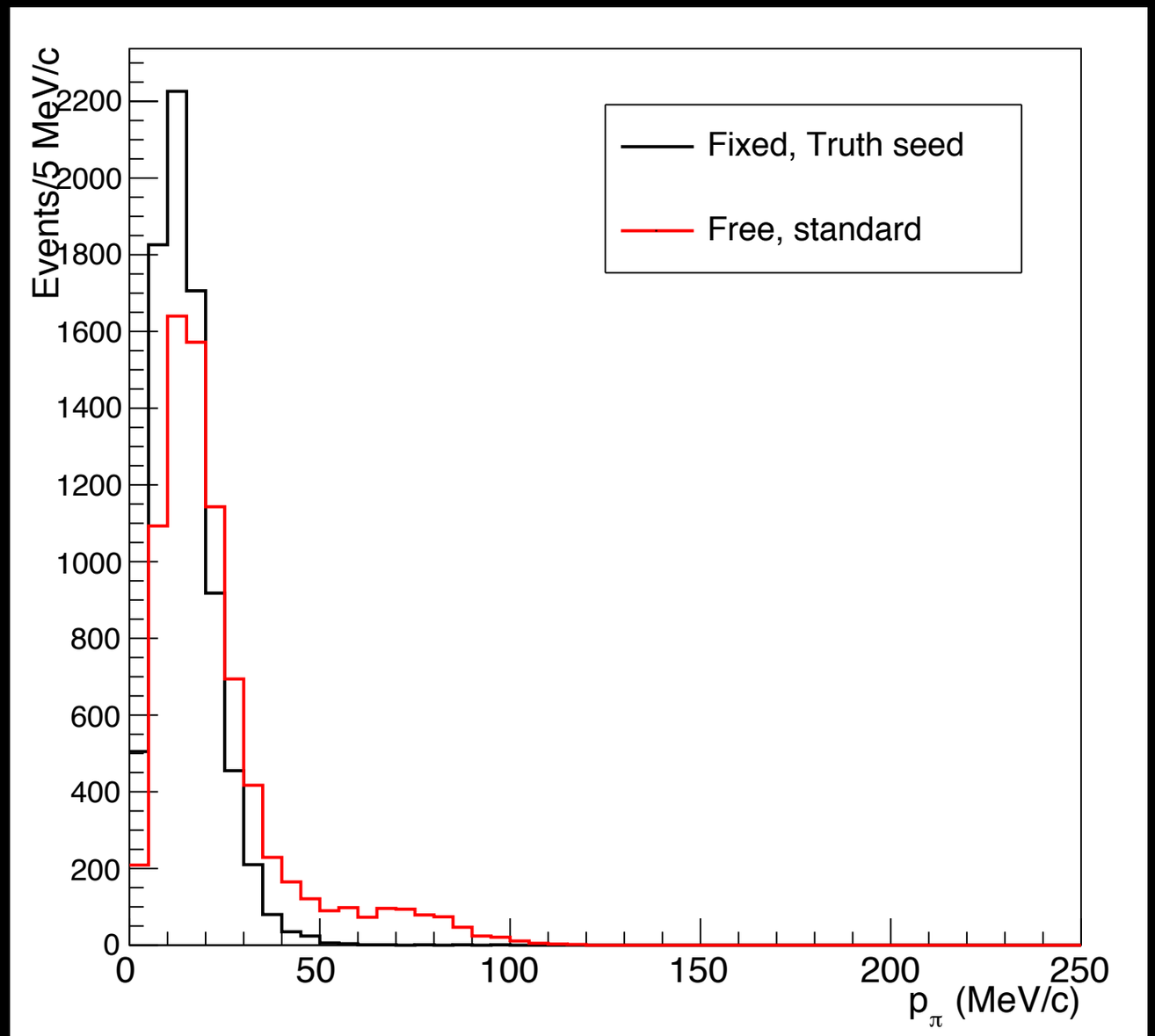


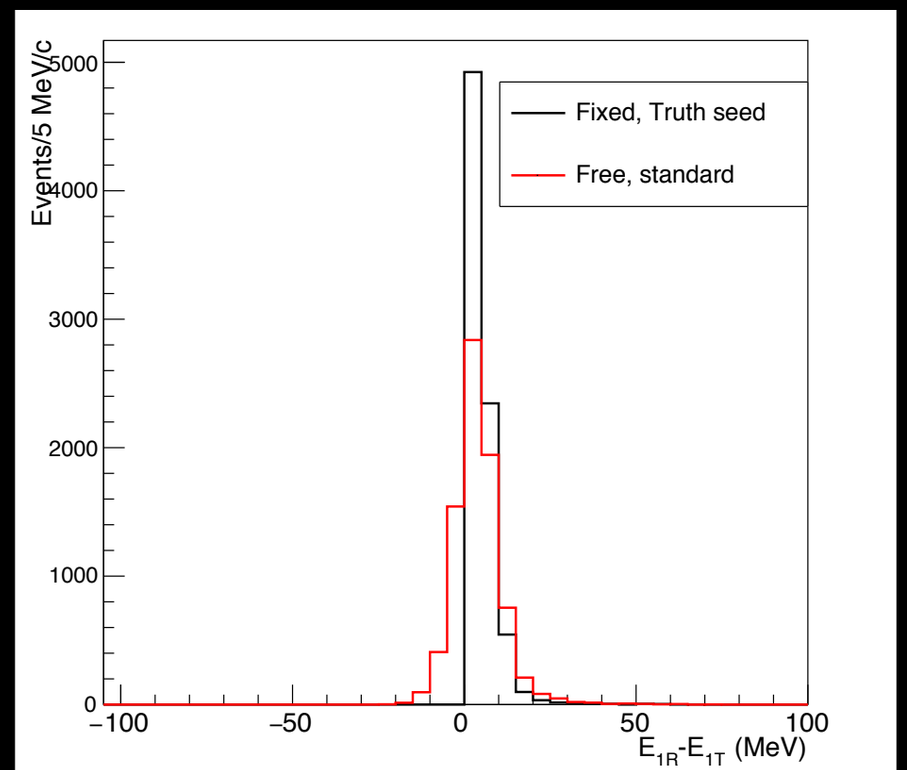


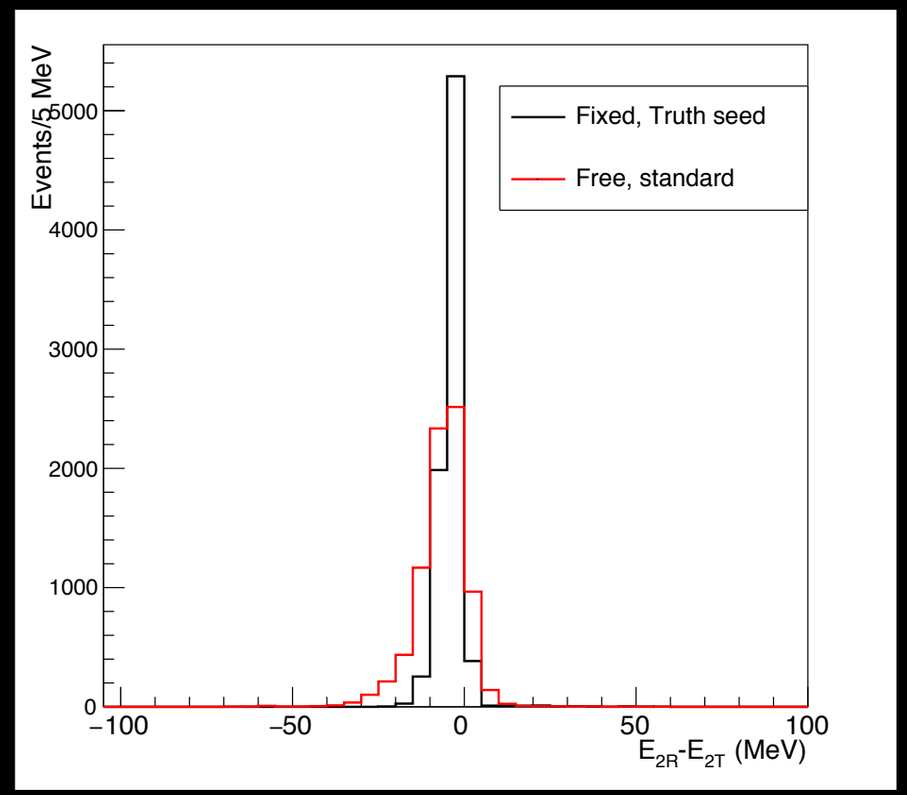
TRUTH SEEDING

- “Truth” seeding has been improved
- In past, photon conversion points were not set to true values
- With secondary information, we can now set these to the true point as well (conversion/scatter point)
  - for Dalitz decays
    - e^+e^- pair is called the “second photon”
    - vertex of “second photon” is at decay point
- Thanks to Sophie and Shimpei for help in extracting information from secondary stack

FIX W/TRUTH SEEDING (P=0 MEV/C)

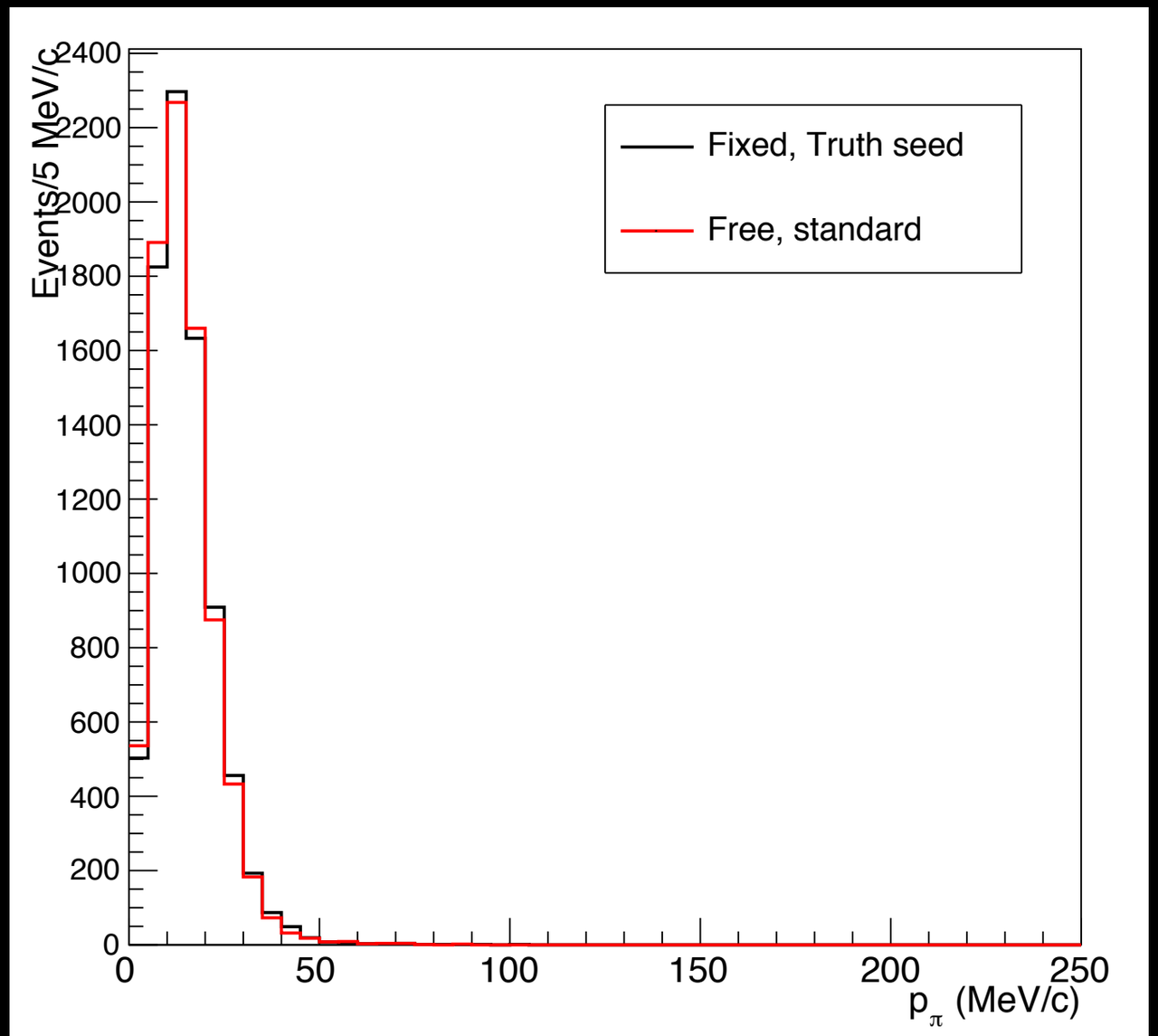




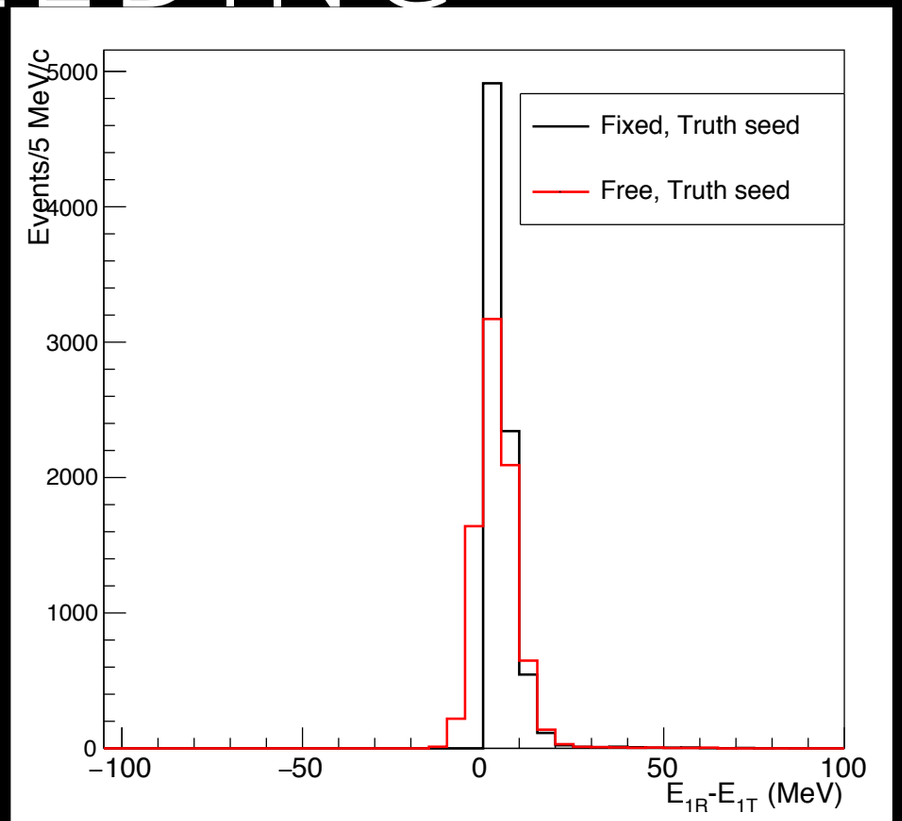


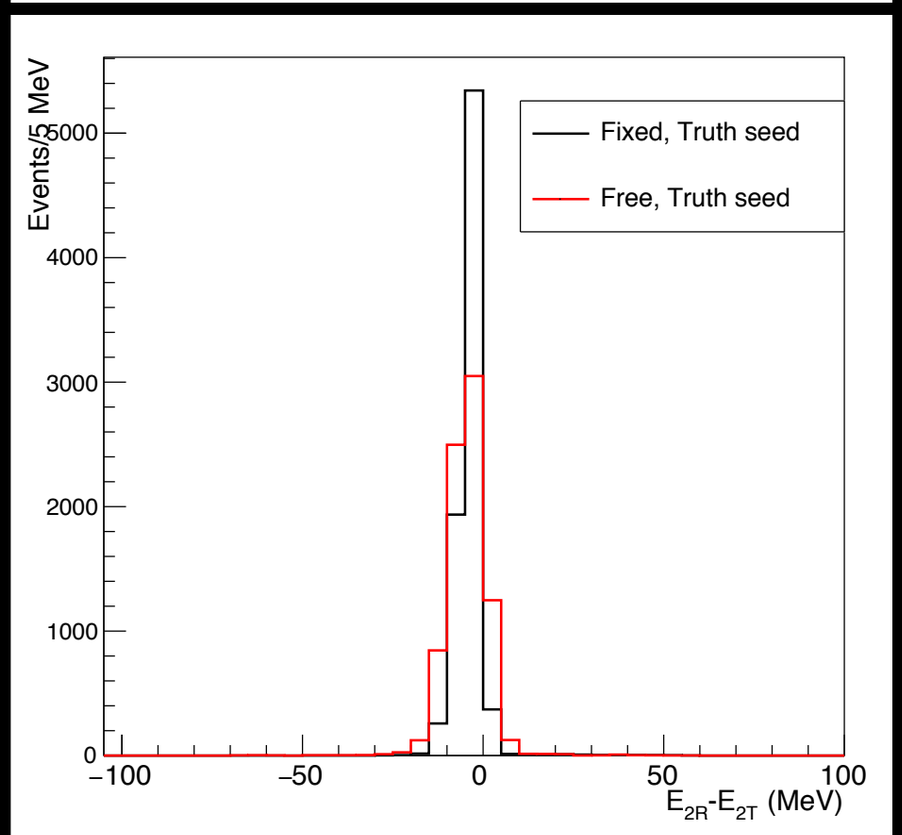
- Improvement in resolution of kinematic quantities.

FREE WITH TRUTH SEEDING

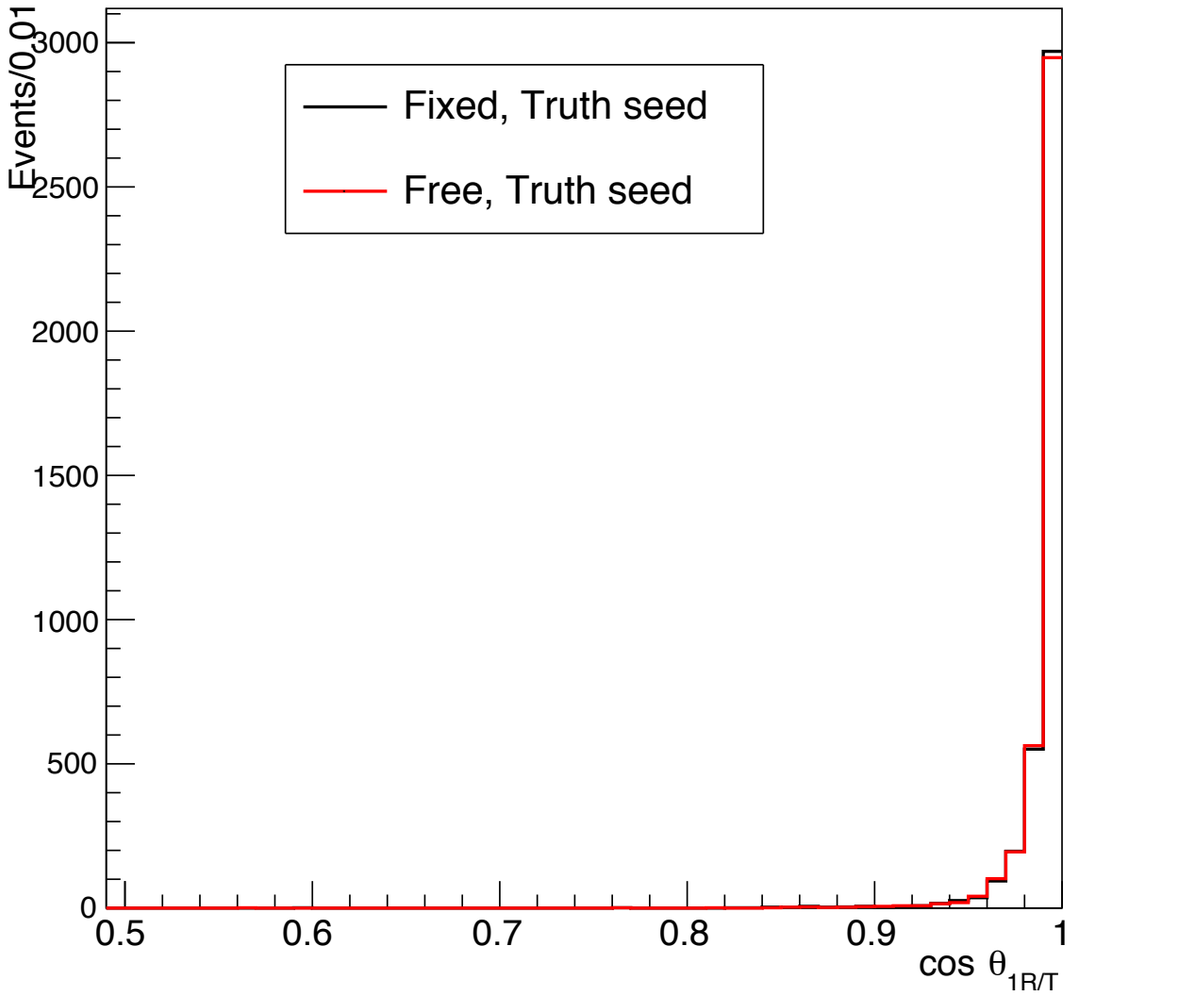


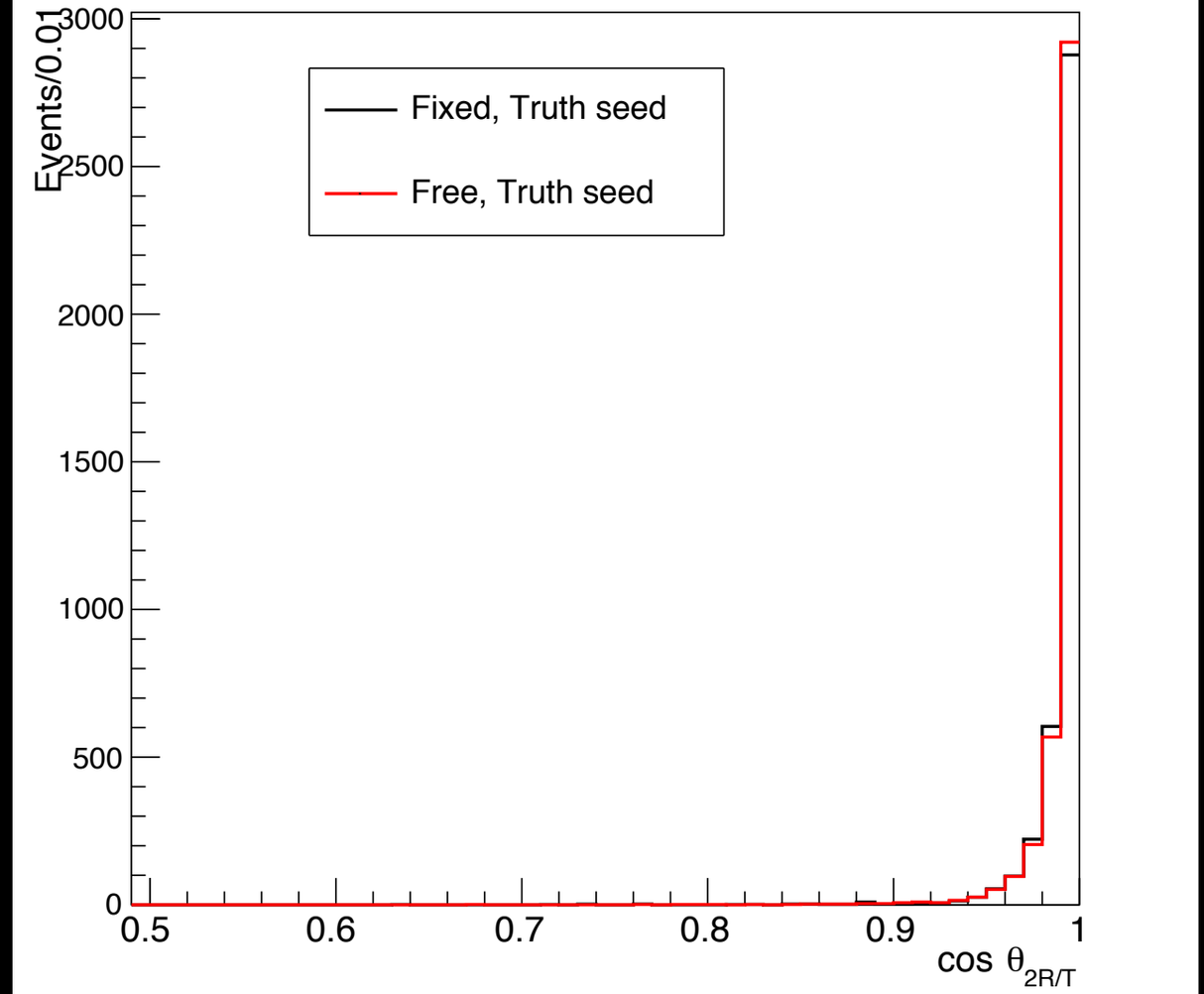
- Improvement(?) in overall momentum much less apparent but individual photon energies are still better.





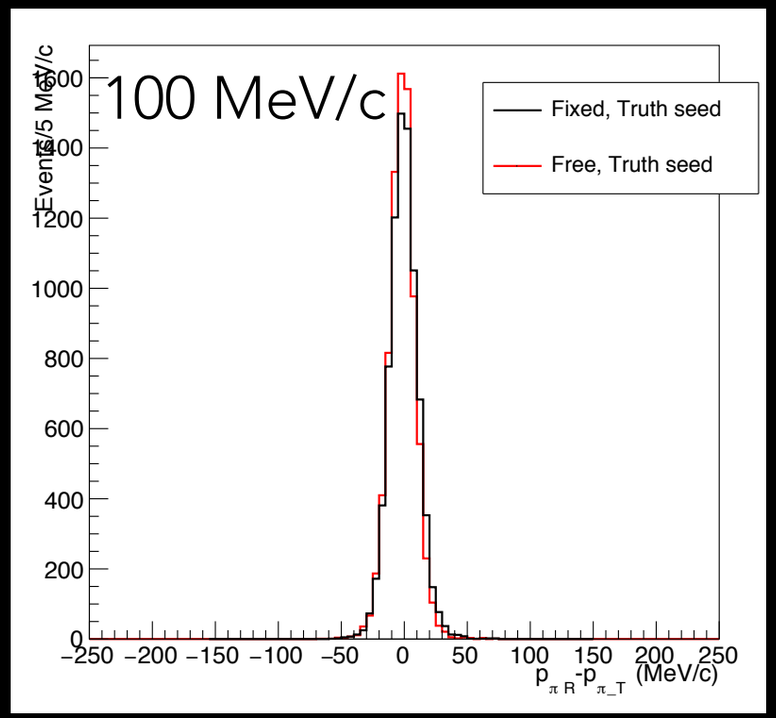
ANGULAR RESOLUTION

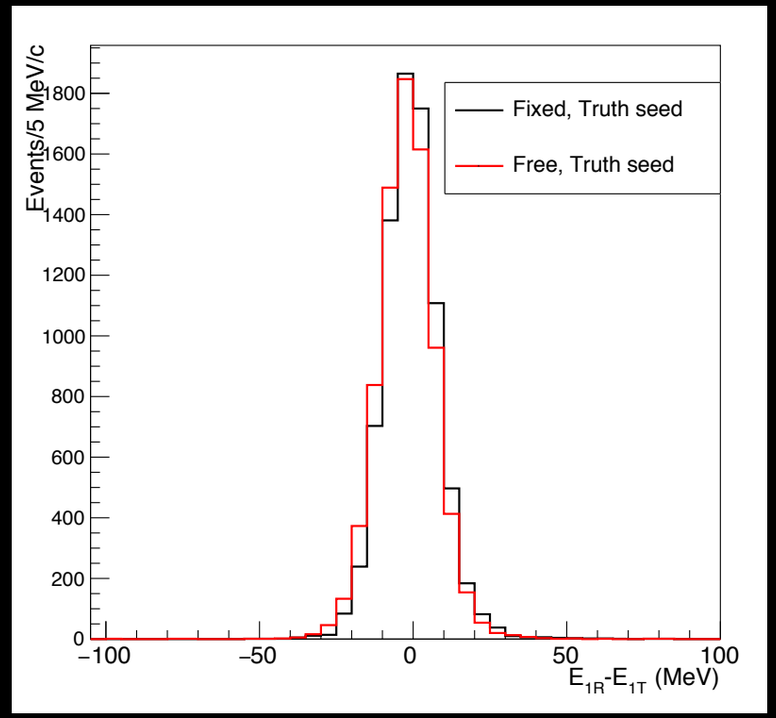


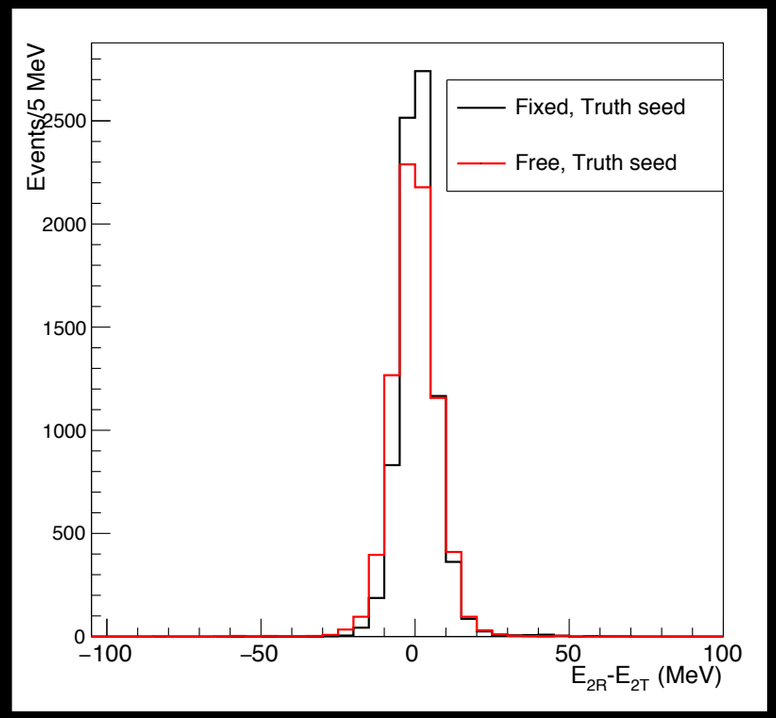


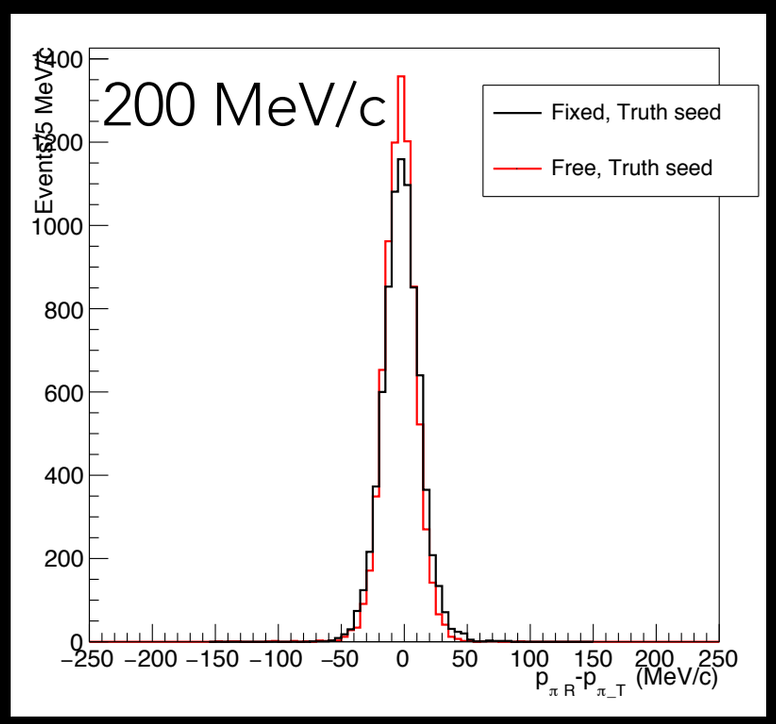
- Little improvement in angular resolution

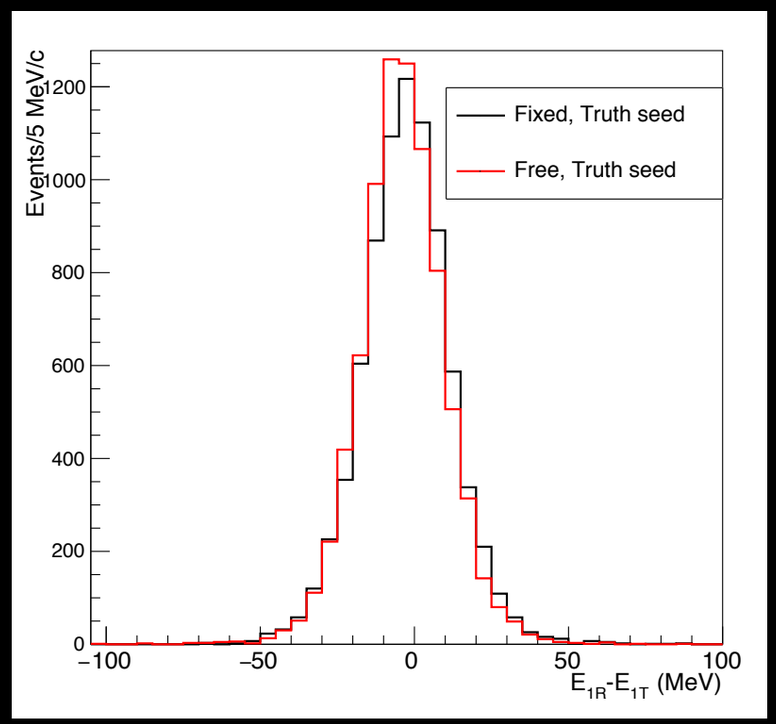
100 AND 200 MEV/C (TRUTH SEED)

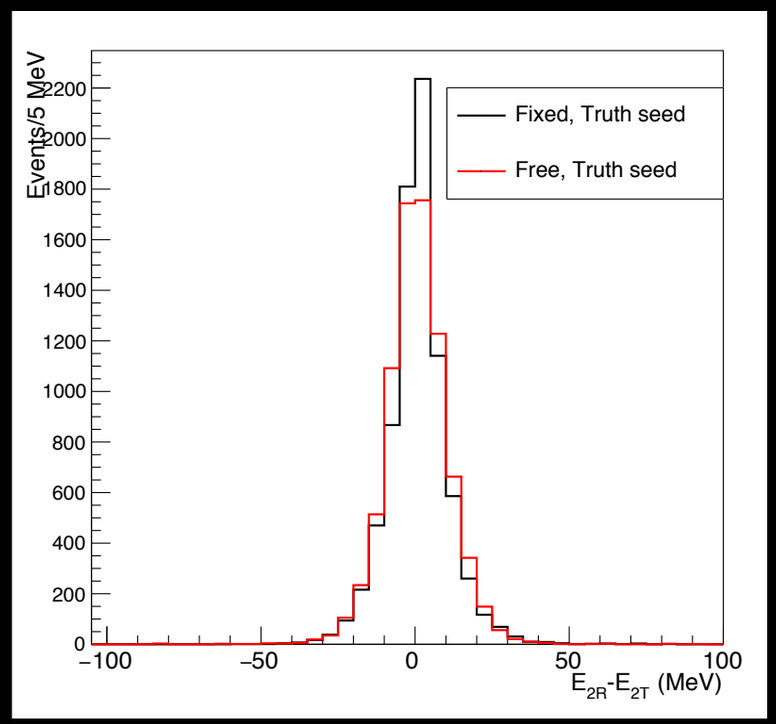












- Improvement in E_2 but degradation overall?

THOUGHTS:

- Why is fit performance worse?
- Is setting E_2 somehow hampering the fit?
  - some other way of imposing mass?
- Constrained fit with large penalty term for deviation from π^0 mass?
- Maybe this just doesn't help in this case?
  - why?

CONCLUSIONS

- Nominal fixed-mass π^0 fit seems to have worse performance than standard free mass fit
- Improved truth seeding to obtain true photon conversion points
- Performance of fixed mass fit with truth seeding is still worse than free mass fit with truth seeding
- Good news?
  - Appears that there is room from improvement in π^0 fit, at least at very low momentum
- Try some other ways of imposing mass condition
  - any other ideas?