1P0N and 3P0N Tau Reconstruction

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MAIA Detector Tau Studies

July 2, 2025

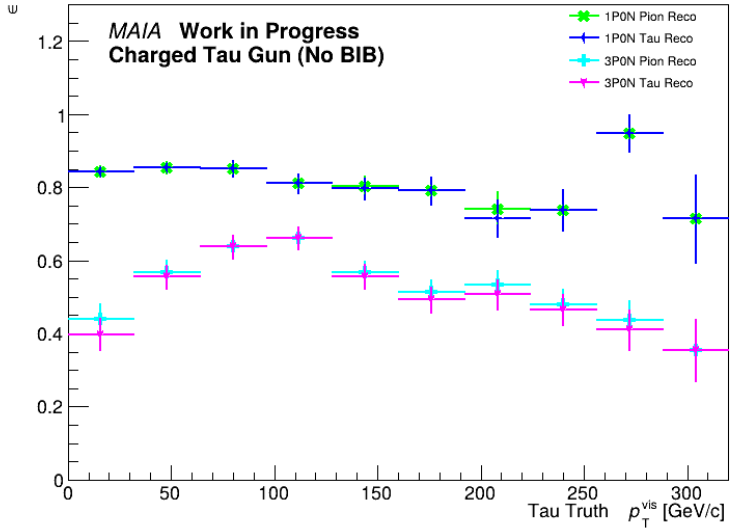
Overview

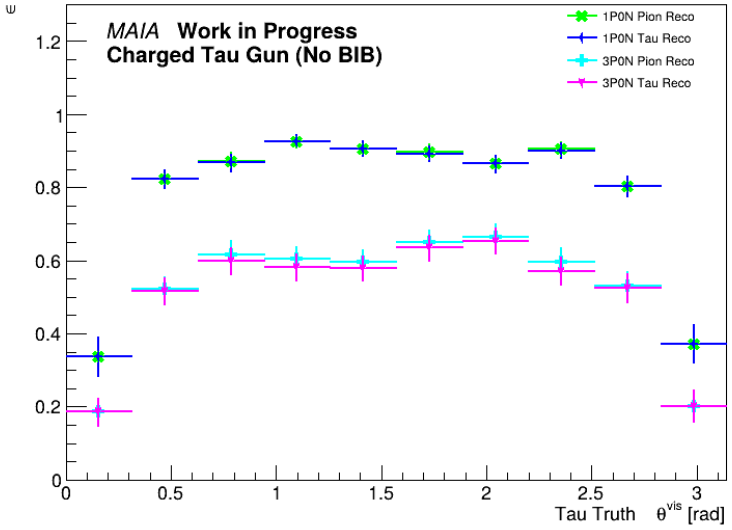
- Redefining $\pi^{\pm}$ and $\tau^{\pm}$ reconstruction efficiencies
- Additions to TauFinder
- Status of BIB simulation/overlay
- Conclusions and next steps

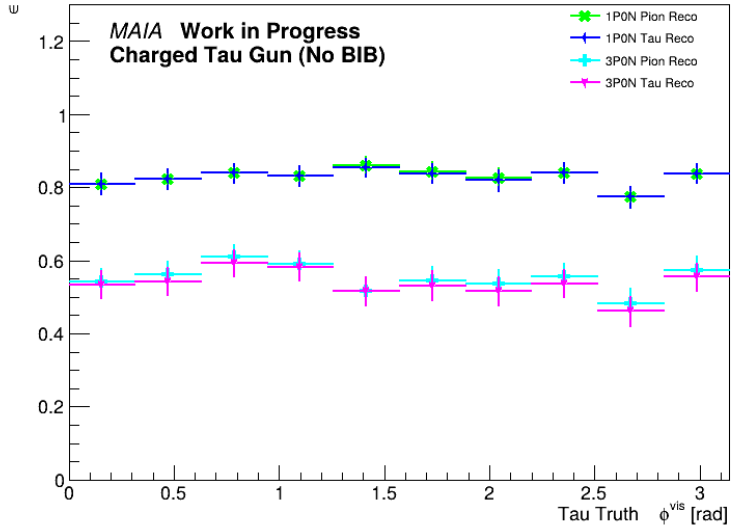
Redefining $\pi^{\pm}$ and $\tau^{\pm}$ Reco Efficiencies

- Want to avoid counting duplicate tracks in efficiency definitions
  - Duplicate tracks refers to multiple reconstructed $\pi^{\pm}$s matched to the same MC $\pi^{\pm}$
  - In old definition, 2 unique reconstructed $\pi^{\pm}$s with 1 duplicate track would count as an "efficient" event but 3 unique reconstructed $\pi^{\pm}$s with 1 duplicate track would not
- New definitions: Require that reco $\pi^{\pm}$s match with unique MC $\pi^{\pm}$s
  - Single $\pi^{\pm}$: $\frac{\#\ of\ Events\ with\ 1\ Reco\ \pi^{\pm}\ Matched\ with\ 1\ \mathit{Unique}\ MC\ \pi^{\pm}}{Total\ \#\ of\ Events\ with\ 1\ Unique\ MC\ \pi^{\pm}}$
  - Triple $\pi^{\pm}$: $\frac{\#\ of\ Events\ with\ 3\ Reco\ \pi^{\pm}\ Each\ Matched\ with\ 1\ \mathit{Unique}\ MC\ \pi^{\pm}}{Total\ \#\ of\ Events\ with\ 3\ Unique\ MC\ \pi^{\pm}}$
- 1P0N and 3P0N $\tau^{\pm}$ reconstruction efficiencies defined similarly

Updated 1P0N and 3P0N Reco Efficiencies







Decay Mode	$\pi^{\pm}$ Reco Efficiency	$\tau^{\pm}$ Reco Efficiency
1P0N	82.82%	82.65%
3P0N	55.30%	53.95%

- Not shown, but lose ~2% in 3P0N reconstruction efficiencies due to new definition
  - Negligible effect on 1P0N reconstruction efficiencies
- Total efficiencies are shown in table

Additions to TauFinder

- Added collections of reconstructed taus which failed at each stage in TauFinder reconstruction
  - Allows for easier browsing and visualization of taus that failed reconstruction

```
registerOutputCollection( LCIO::RECONSTRUCTEDPARTICLE,
                          "RecoTauCollection",
                          "Collection of Tau Candidates",
                          _outCol ,
                          std::string("RecoTaus"));

registerOutputCollection( LCIO::RECONSTRUCTEDPARTICLE,
                          "RecoTauChargedTrackCollection",
                          "Collection of Tau Candidates which Failed Number of Charged Tracks Selection",
                          _outColNChargedTrks ,
                          std::string("RecoTaus_NChargedTrks"));

registerOutputCollection( LCIO::RECONSTRUCTEDPARTICLE,
                          "RecoTauInvMassCollection",
                          "Collection of Tau Candidates which Failed Invariant Mass Selection",
                          _outColInvMass ,
                          std::string("RecoTaus_InvMass"));

registerOutputCollection( LCIO::RECONSTRUCTEDPARTICLE,
                          "RecoTauMergeCollection",
                          "Collection of Tau Candidates which Failed Merge",
                          _outColMerge ,
                          std::string("RecoTaus_Merge"));

registerOutputCollection( LCIO::RECONSTRUCTEDPARTICLE,
                          "RecoTauNParticlesCollection",
                          "Collection of Tau Candidates which Failed Number of Particles Selection",
                          _outColNParticles ,
                          std::string("RecoTaus_NParticles"));

registerOutputCollection( LCIO::RECONSTRUCTEDPARTICLE,
                          "RecoTauIsoEnergyCollection",
                          "Collection of Tau Candidates which Failed Isolation Energy Selection",
                          _outColIsoEnergy ,
                          std::string("RecoTaus_IsoEnergy"));
```

Status of BIB Simulation/Overlay

- BIB simulation should be complete by end of the day
  - Will overlay with larger τ^- simulation once complete
- Plan to run TauFinder on BIB only first to see how many fake taus we expect to be reconstructed

Conclusions and Next Steps

- New reconstruction efficiency definitions decrease 3P0N efficiencies by ~2%, but are more consistent
- Additional collections output by TauFinder will make it easier to browse reconstructed taus which failed selection stages
- Should begin BIB studies at the start of next week