

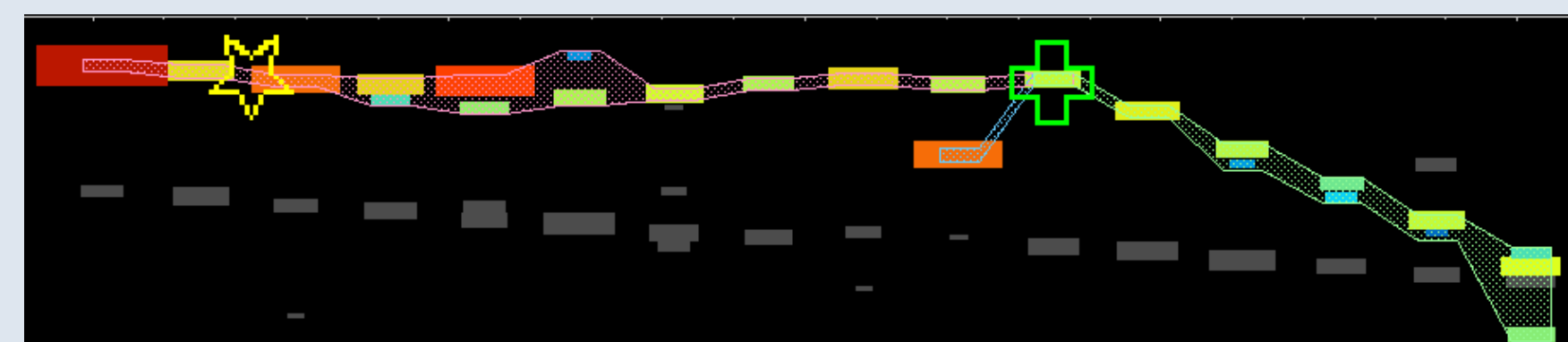
It's Possible: Status of a Single-Differential Cross Section By Charged Pion Kinetic Energy in the NOvA Near Detector



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Motivation

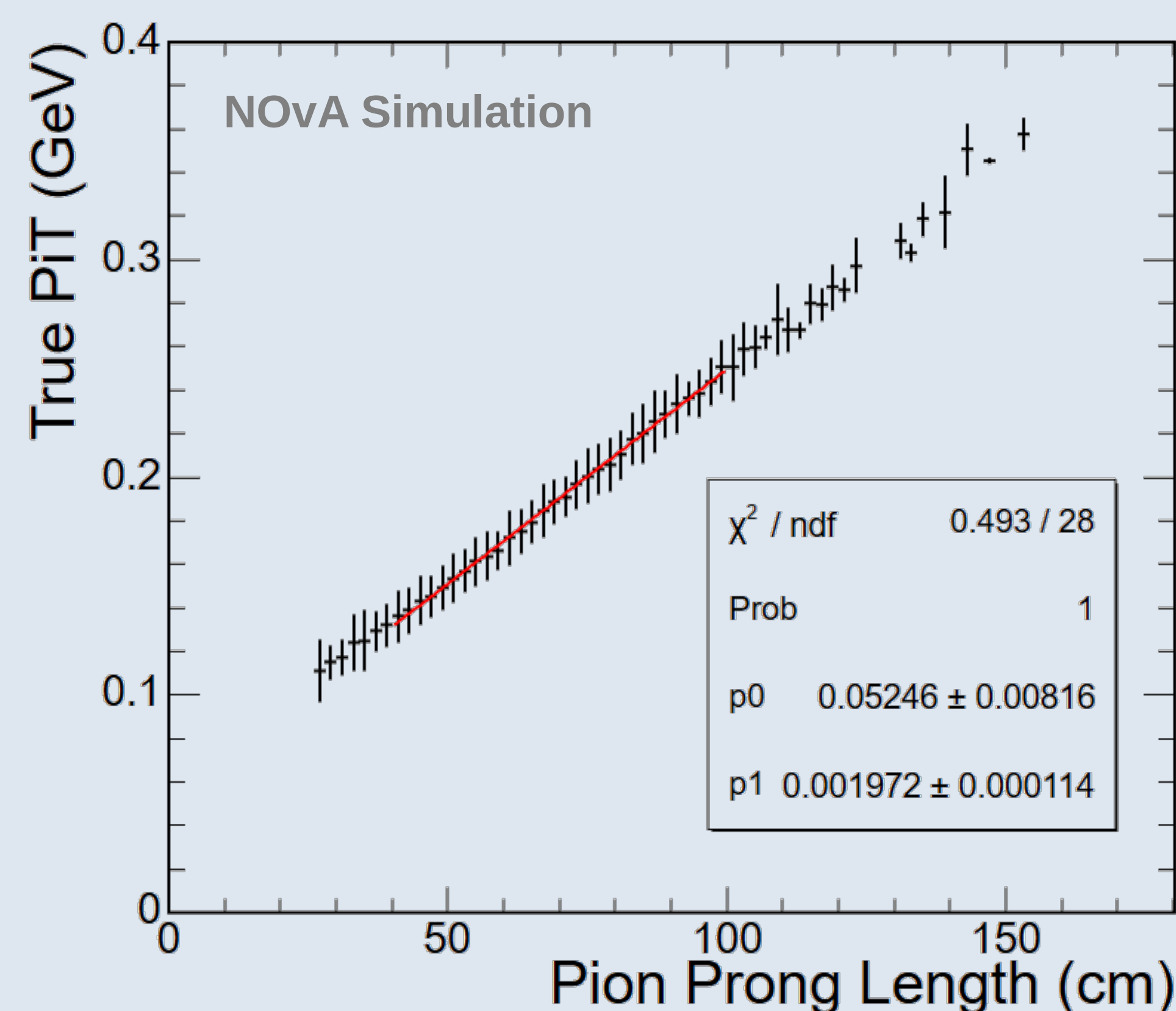
- Event modeling is a major systematic on oscillation measurements; cross-section measurements constrain it
- $\nu+A \rightarrow \pi^{\pm}+X$ will make up DUNE event majority
- NOvA can access the poorly-covered 100+ MeV regime in T_{π}
- Pion energy reconstruction is challenging in NOvA



Single view of single pion production with inelastic scattering. The true vertex is the yellow star, the green cross is the reconstructed vertex.

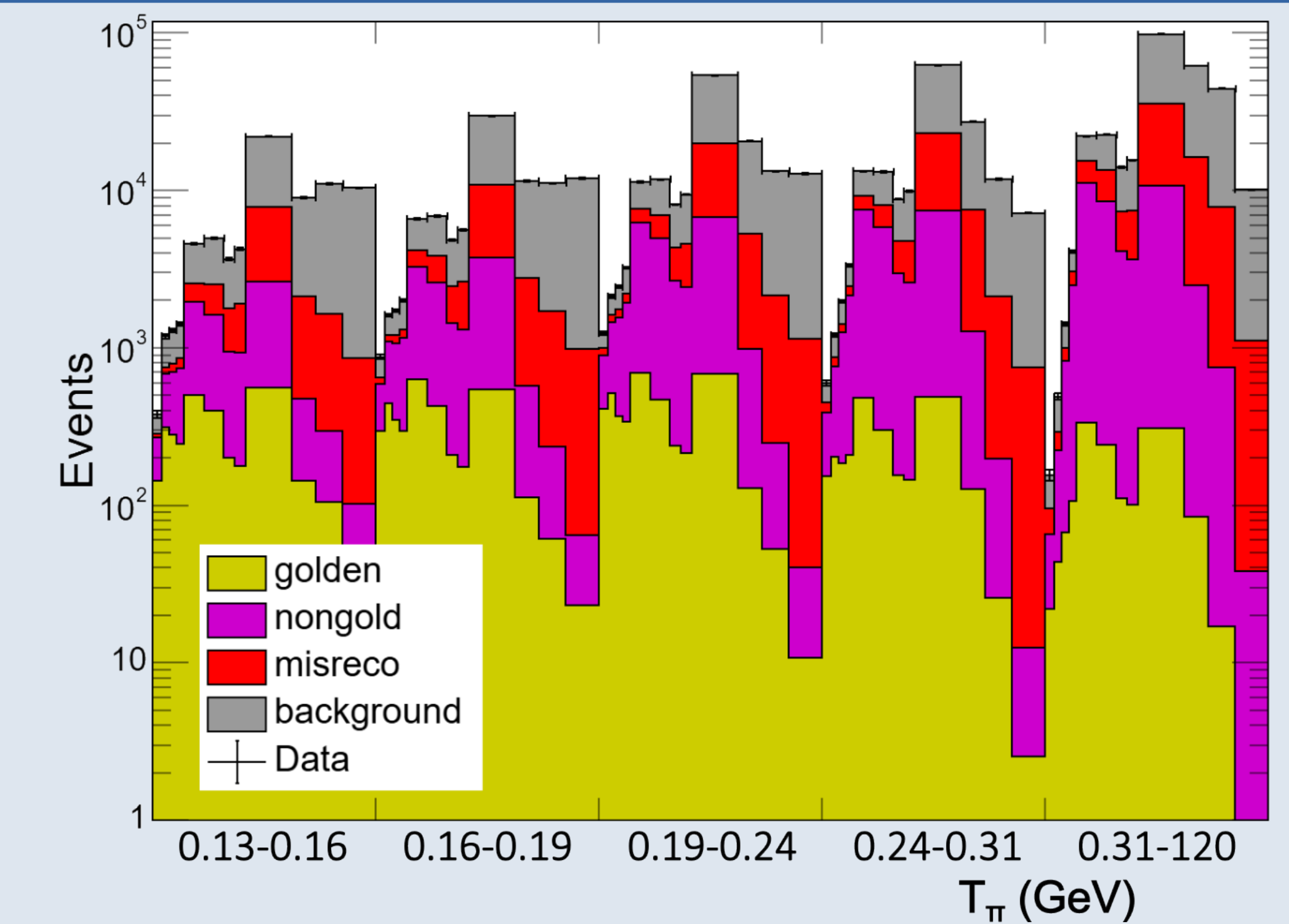
Energy Reconstruction

- Isolate “golden” sample of final-state non-scattering π^{\pm}
- Scattering “nongold” sample also selected and used to constrain final result
- Protons misreconstructed as pions in signal cannot be unfolded so are also separated



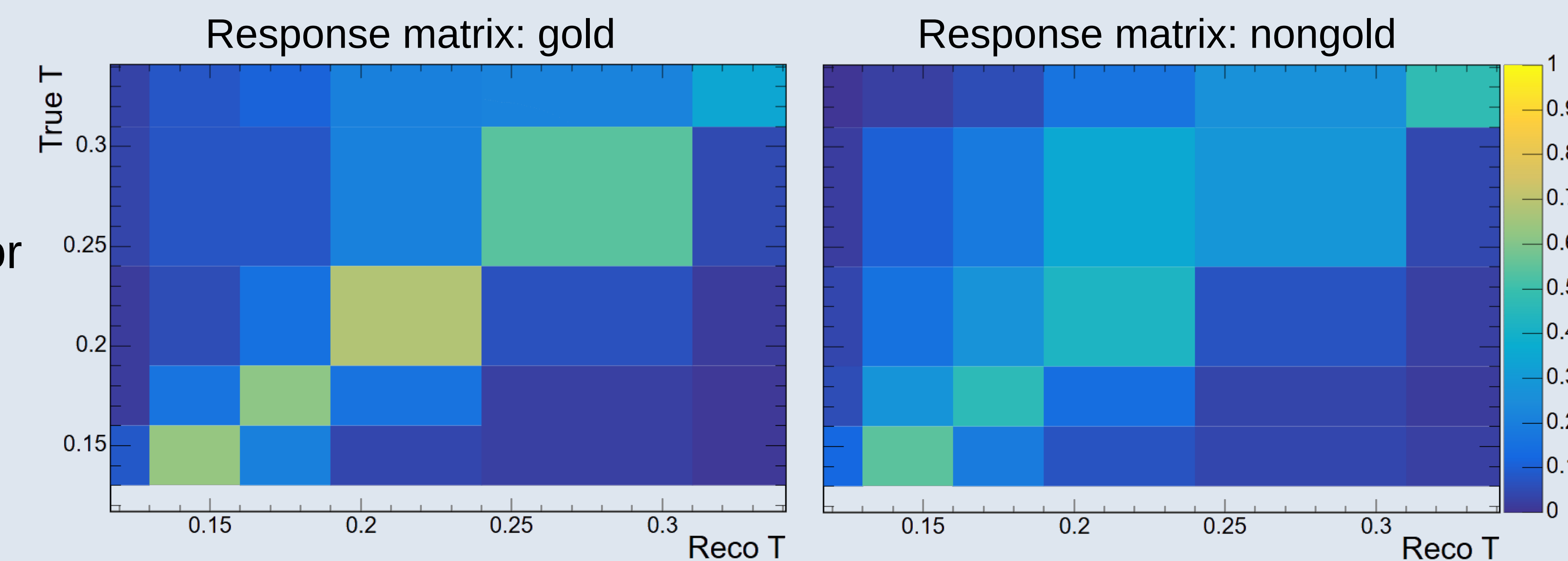
Template Fit

- Two usable signal templates, therefore two extracted purities
- Need **four template separation**
 - Solution: BDT, optimized to select background
- Largest background: $0\pi^{\pm}1p$
- Input covariance matrix to template fit dominated by GENIE



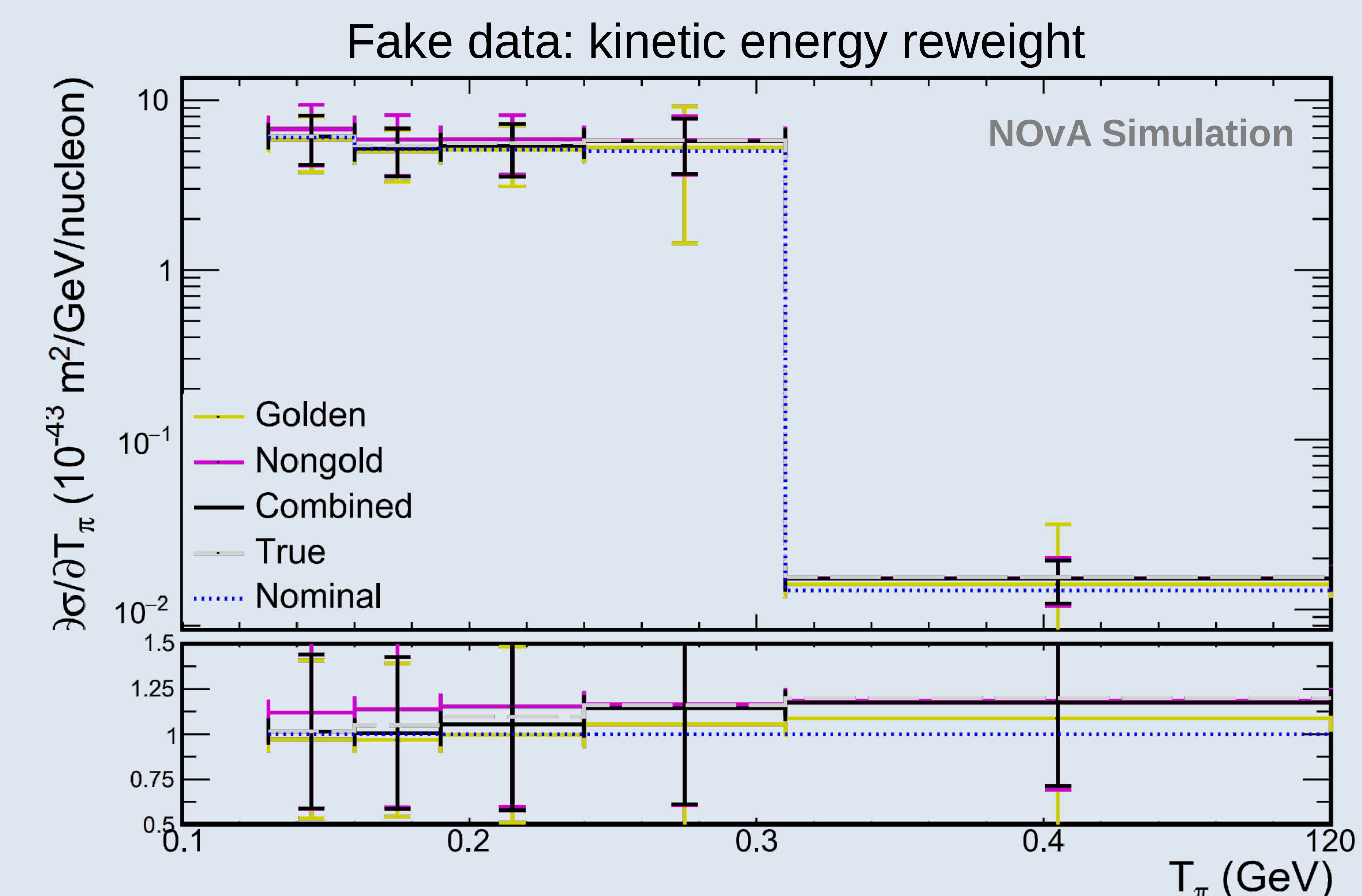
Unfolding & Efficiency Correction

- Steps must be done separately for each signal subset
- Iterative unfolding is used, one iteration for golden and nongold
- Efficiency: selected signal of that **category** over all signal events **regardless of category**



Fake Data Studies and Conclusions

- Golden, nongold cross-sections computed separately (including covariance matrices)
- Results combined via Best Linear Unbiased Estimators method
- GENIE uncertainty still dominates. Uncertainties around 30% for all bins but final
- Fake data studies imply general conclusions can be drawn in generator comparison with this analysis



Results on fake data. The fake data was generated by reweighting events based on the true leading charged pion's kinetic energy, from 1.0 at the 130 MeV threshold to 1.2 at the 310 MeV penultimate bin edge. The range was restricted to avoid grossly unphysical changes.