

Measuring the Fragmentation Function of Jets in Heavy Ion Collisions Using Jet-Hadron Correlations

Charles Hughes
University of Tennessee

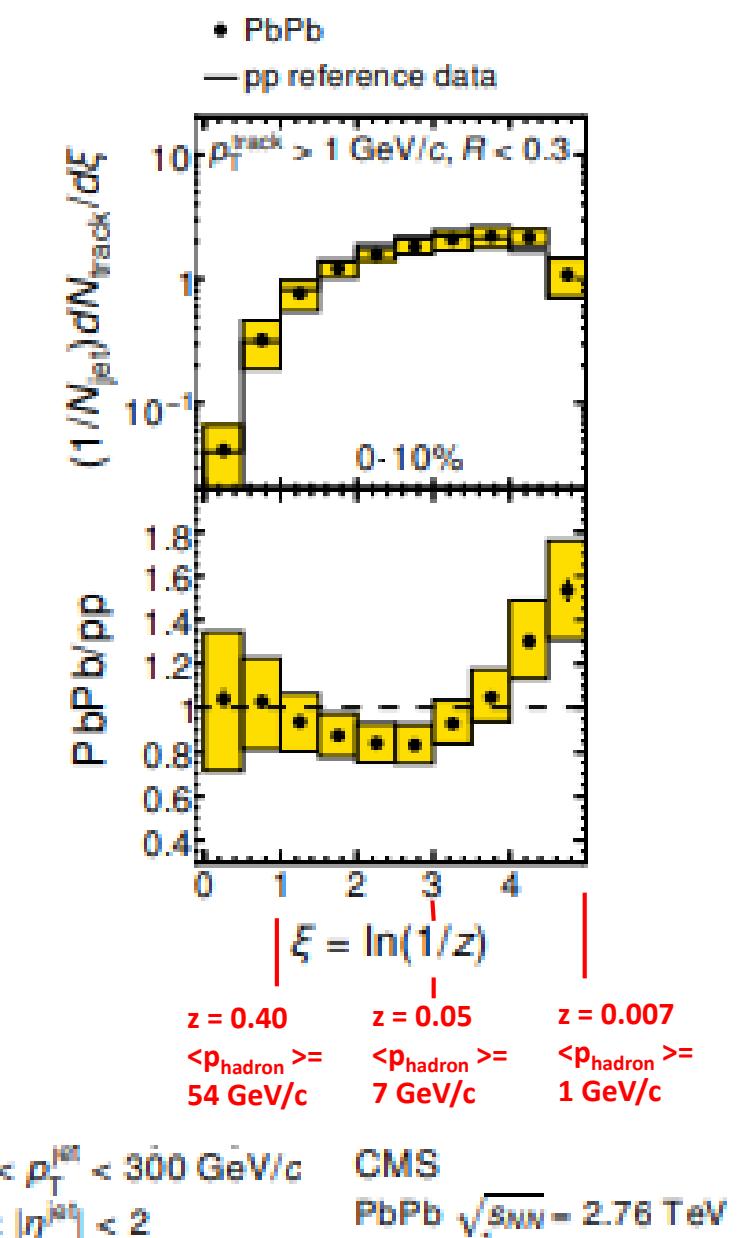
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Adam Matyja, Alexander Aukerman, Christine Nattrass, James Neuhaus, Redmer Bertens, Soren Sorensen, William Witt



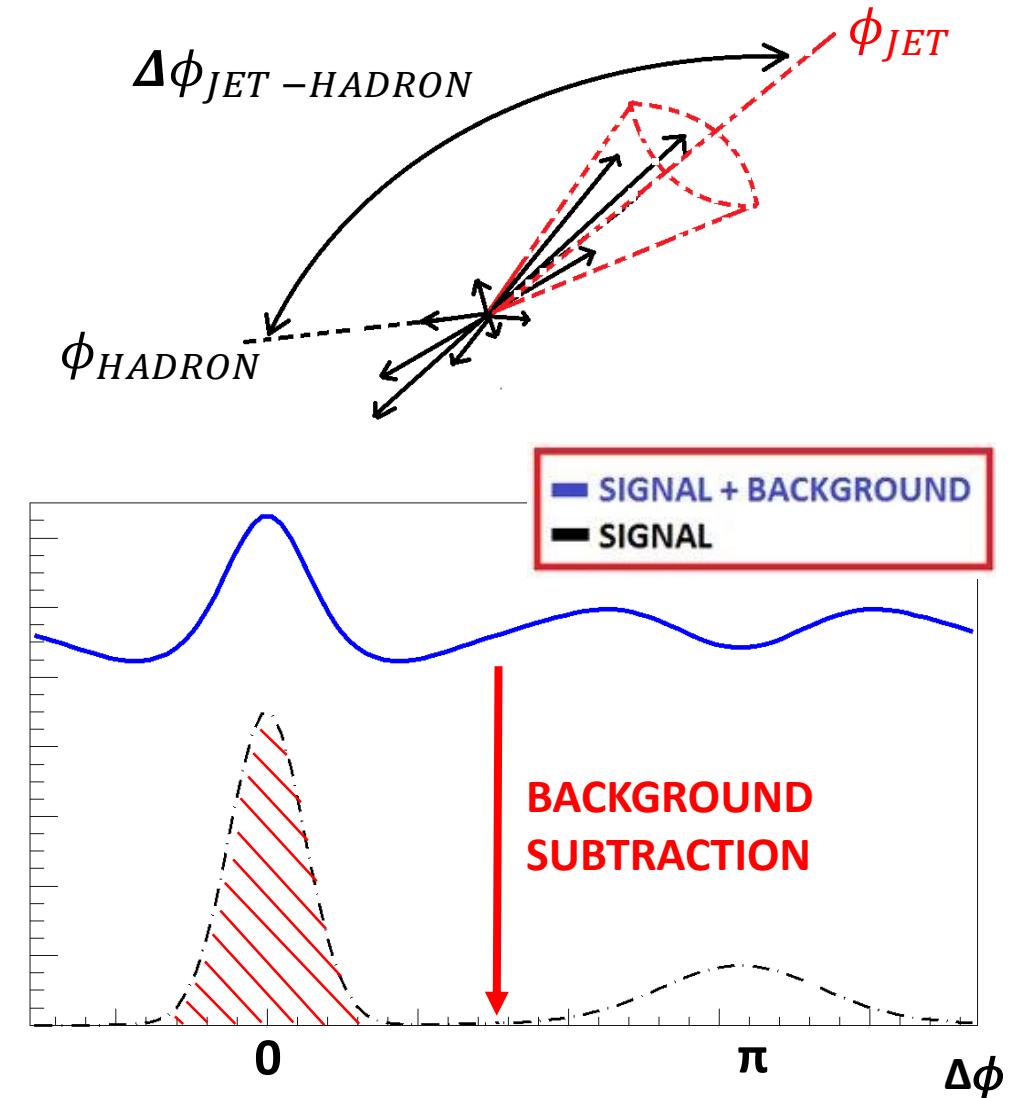
Introduction

- Jets are a unique probe of Quark Gluon Plasma (QGP) made in heavy ion collisions
- Jet Fragmentation Functions (dN/dz) are of particular interest
 - $z = p_T^{\text{constit.}} / p_T^{\text{jet}}$
- Wish to complement previous measurements by going to lower jet momenta
 - must deal with low momentum background



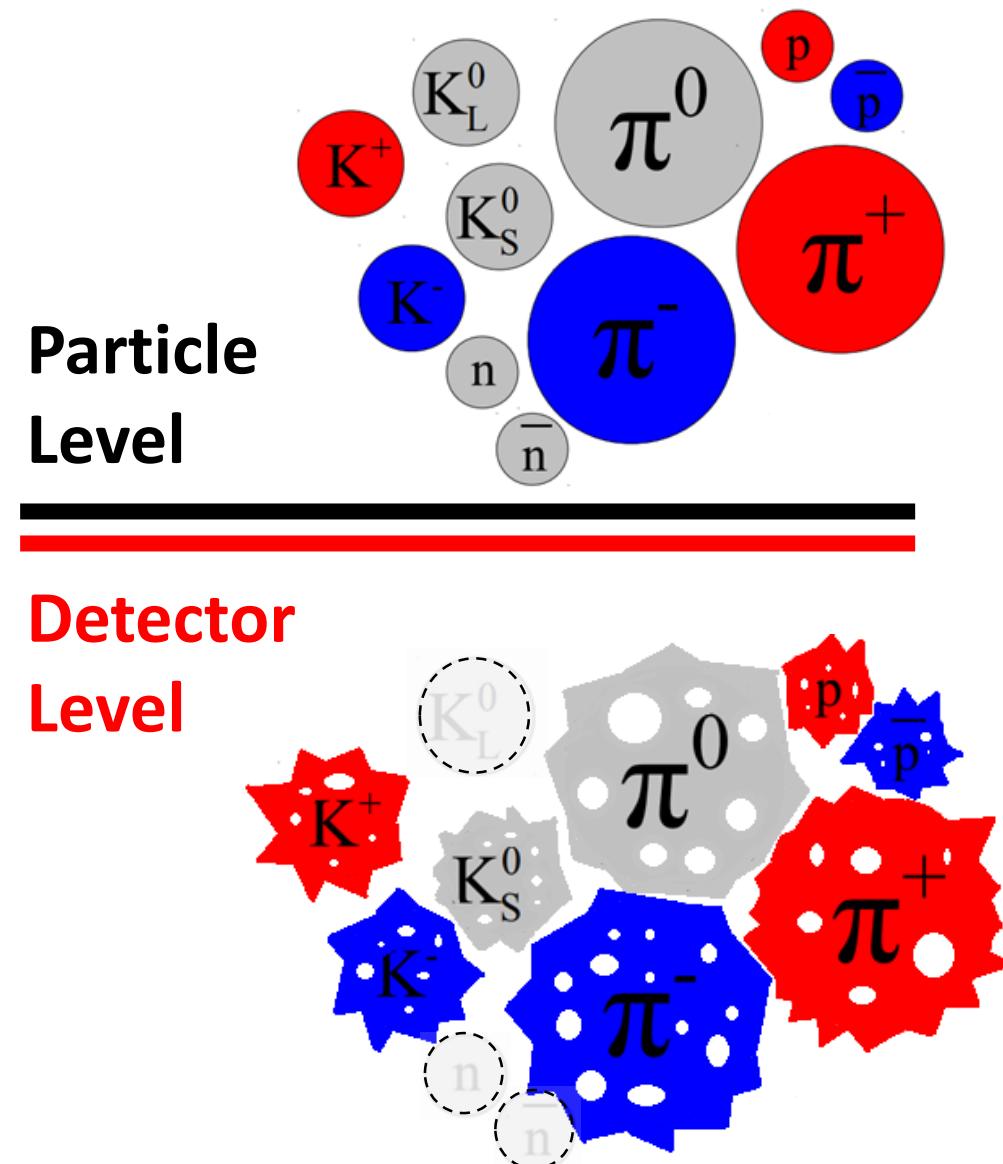
Model Study – Models and Background Subtraction

- Perform a feasibility study of method using models
 - Pythia – Lund String Model Monte Carlo
 - TennGen – Data Driven Heavy Ion Generator (<https://github.com/chughes90/TennGen>)
- Two sets of jets
 - Pythia only
 - Pythia + TennGen
- Two background subtraction techniques (using jet-hadron correlations)
 - Pythia only – Pedestal
 - Pythia + TennGen - Reaction Plane Fit Method
(Sharma *Phys.Rev.C* 93 (2016) 4, 044915)

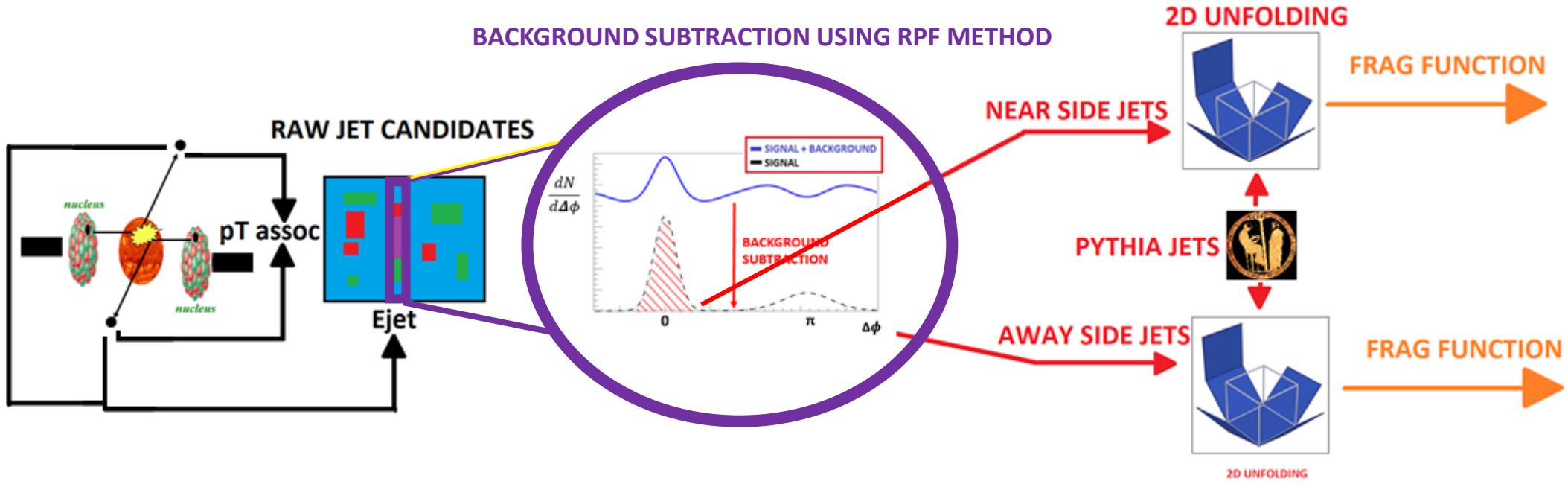


Model Study – Detector Effects and Unfolding

- Parameterized p_T dependent track reconstruction efficiency
- p_T smearing
- Jet matching to fill a response
 - Pythia w/o effects \leftrightarrow Pythia w/ effects
 - Pythia w/o effects \leftrightarrow Pythia + TennGen
- Unfold Correlation Yields, Y_{ij} background sub.
 - Compare to pythia truth (constituent method).



Model Study – Overview



1. Generate Events with Pythia & TennGen

2. Calculate Jet-Hadron Correlation & Subtract background Using RPF Method

3. Fill 2D array with subtracted correlation yields & Unfold

4. Obtain dN/dZ from unfolded 2D array

Correlation Functions

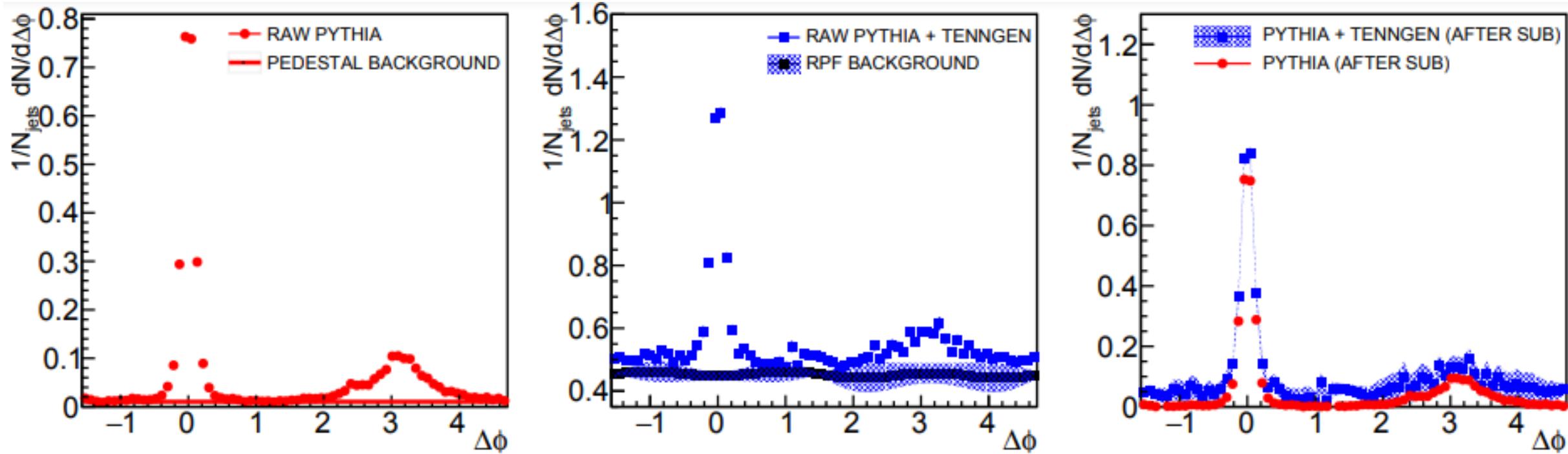


Figure 2: Examples of Correlations Functions and Subtraction Methods for $p_T^{\text{jet}} = 8\text{-}9 \text{ GeV}$ and $p_T^{\text{assoc.}} = 3\text{-}4 \text{ GeV}$ for Pythia and Pythia + TennGen.

- Pedestal method applied to red points (Pythia)
- Reaction Plane Fit Method applied to blue points (Pythia + TennGen)
- Agreement to within error bars; signal is recovered

Response Matrix: Pythia w/o effects \leftrightarrow Pythia w/ effects

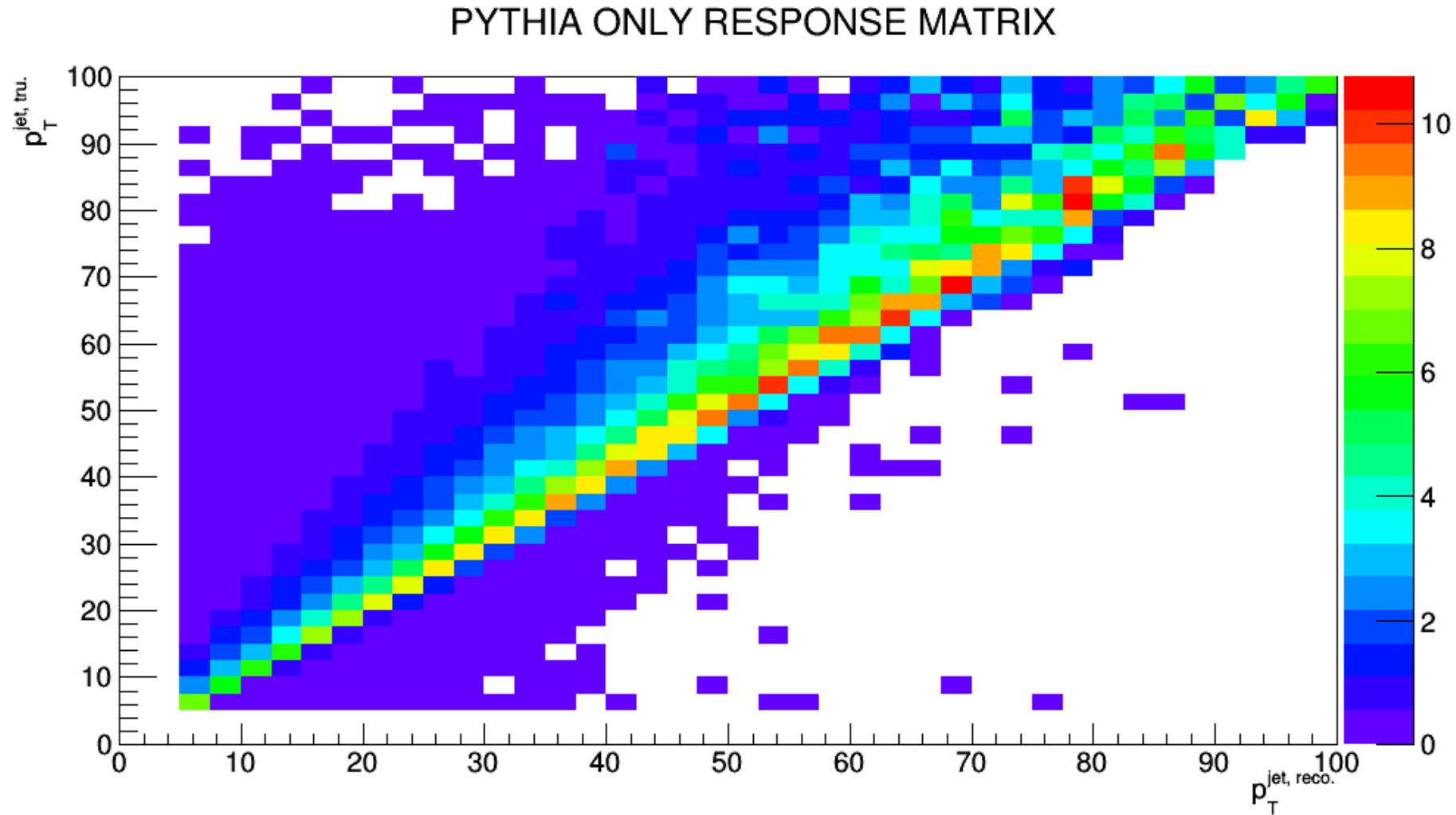


Figure 3: Projection of PYTHIA only Response Matrix along jet axes

Response Matrix

Pythia w/o effects \leftrightarrow Pythia + TennGen w/ effects

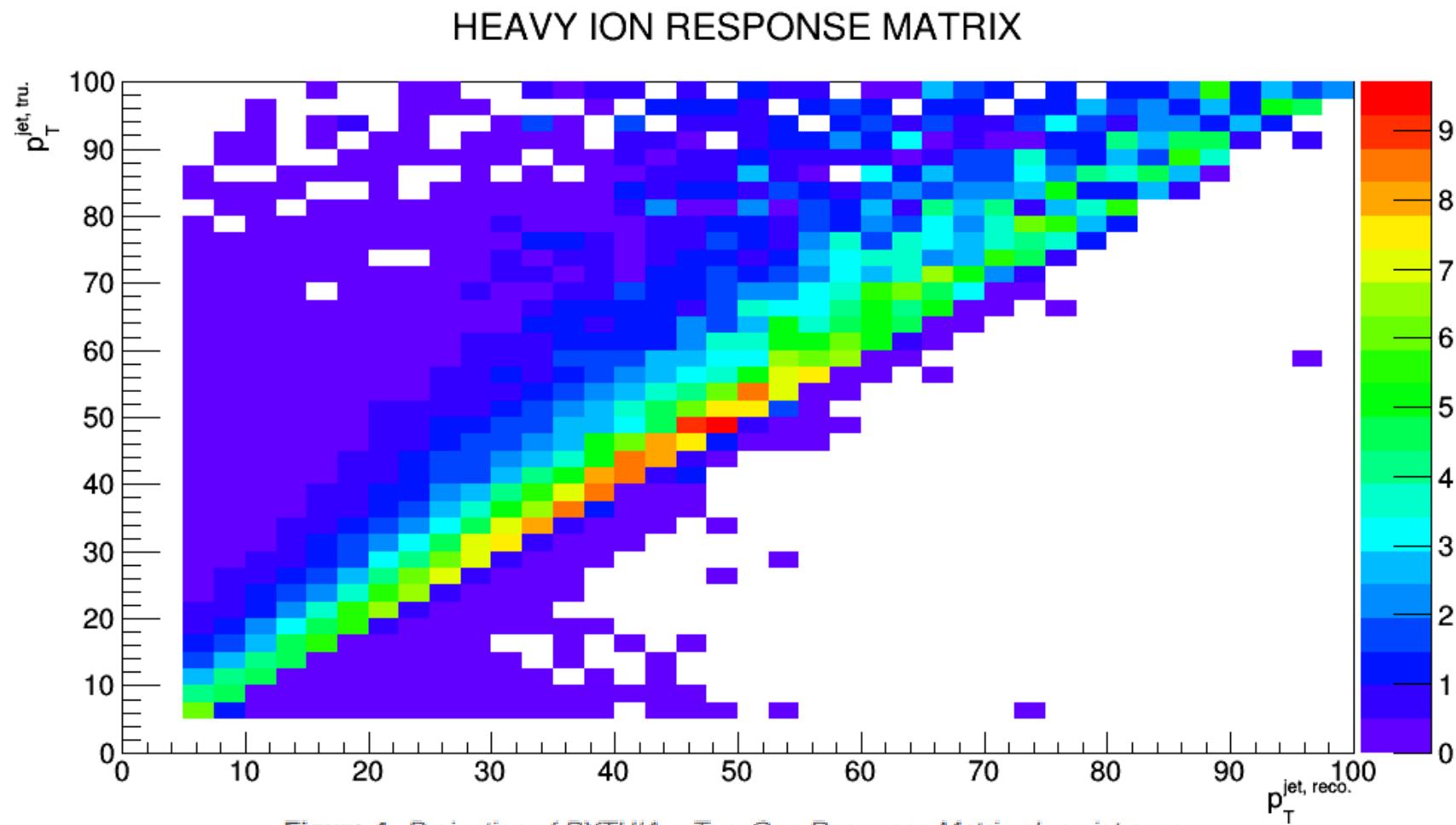


Figure 4: Projection of PYTHIA + TennGen Response Matrix along jet axes

Results

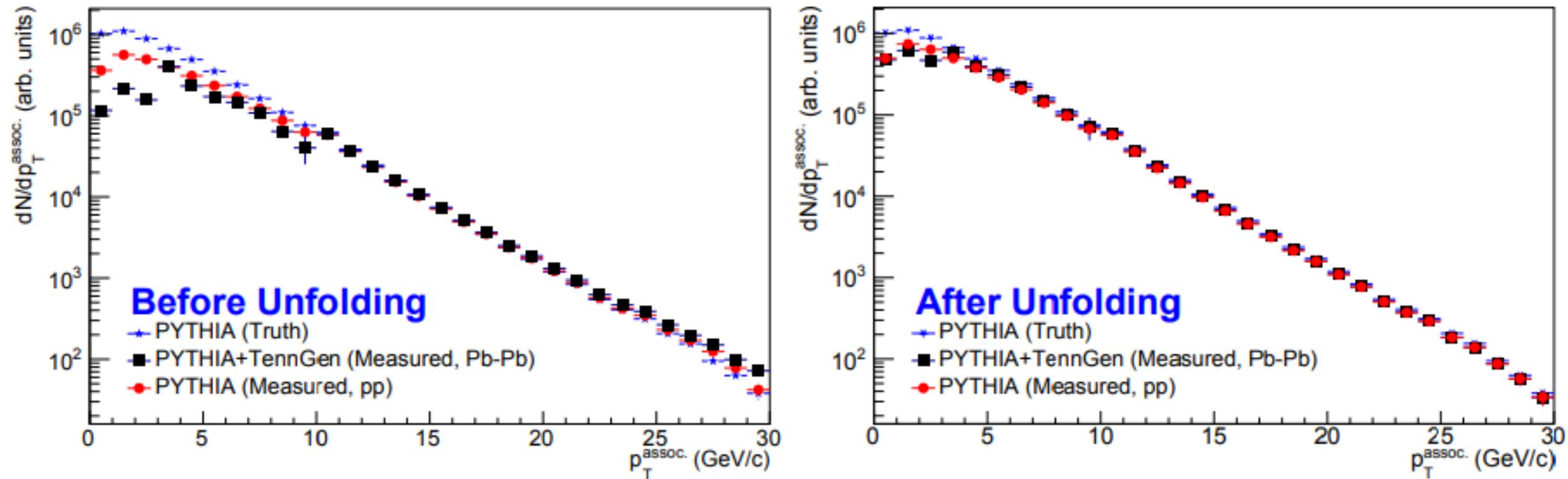


Figure 5: Momentum spectra of particles for $10 < p_T^{\text{jet}} < 30 \text{ GeV}/c$ for Pythia at truth level, Pythia including detector effects, and Pythia+TennGen with the background subtracted (left) before unfolding and (right) after unfolding.

- Pythia Truth, $p_T^{\text{constit.}} > 150 \text{ MeV}$ (no sub.)
- Pythia Meas., $p_T^{\text{constit.}} > 150 \text{ MeV}$ (pedestal sub.)
- Pythia + TennGen Meas., $p_T^{\text{constit.}} > 3 \text{ GeV}$ (RPF sub.)

Conclusions & Future Work

- Shows how a fragmentation function can be obtained from correlation functions
- Unfolding method shows good correction for detector effects*
- Demonstrates success of the method in obtaining low jet pT fragmentation functions
- Future Work: Applying method to data, away side yields

*except at low z,
due to different jet
constit. biases and
no subtraction in
truth