Eta analysis on Run16 Au+Au collision at 200GeV

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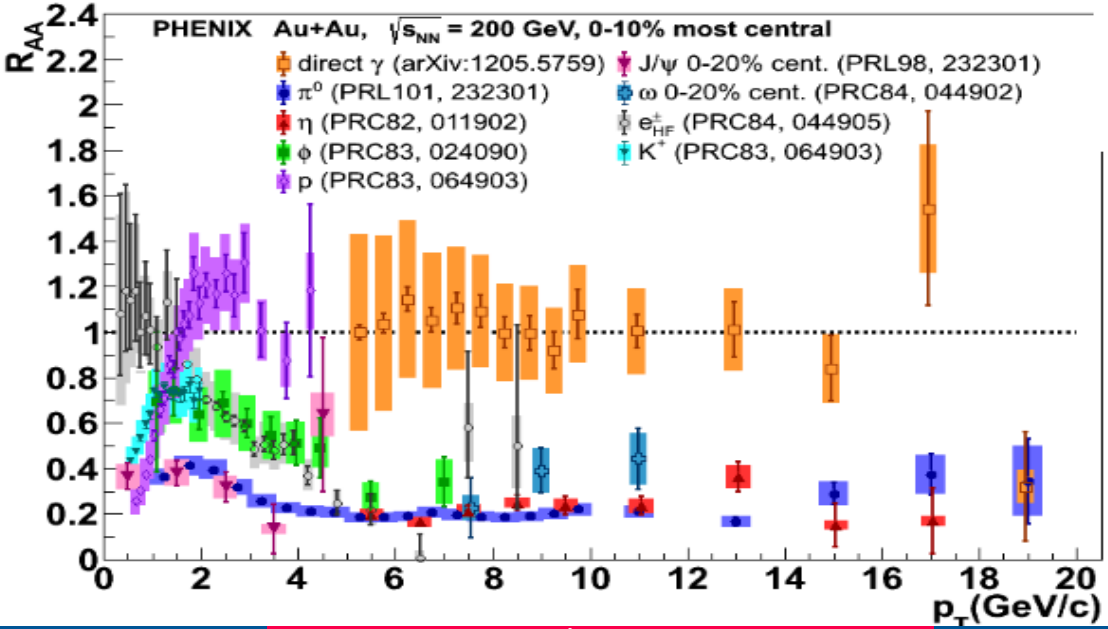
PHENIX

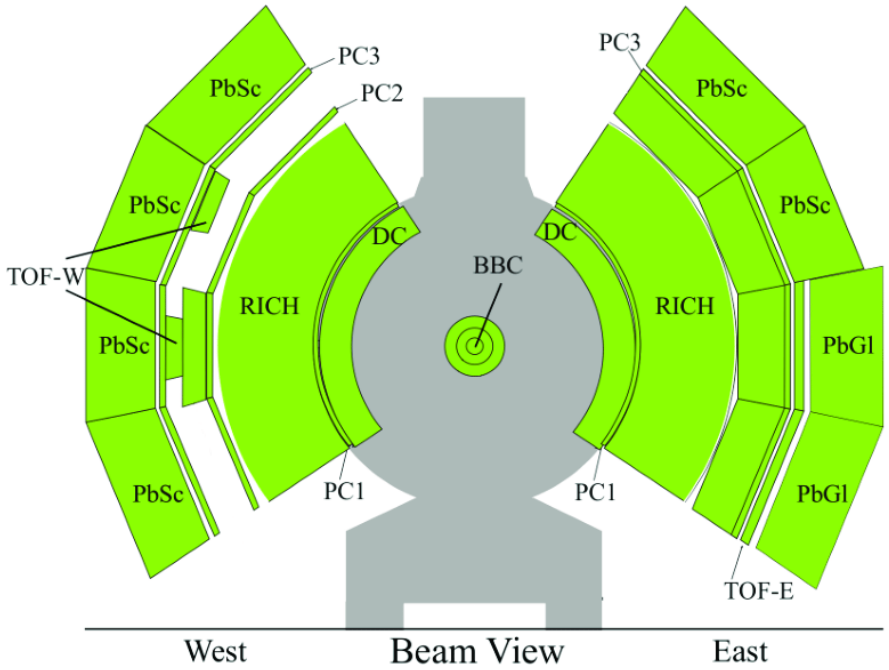
Motivation

- After the $\pi^0 \to 2\gamma$ decay channel, the $\eta \to 2\gamma$ decay channel produces the second highest amount of decay photons
- The η built up from $\frac{1}{\sqrt{6}}(\bar{u}u + \bar{d}d - 2\bar{s}s)$ which means, it should act differently than the π^0, still it act similar
- The Run16 collected a large amount of data, vastly exceeding the statistics of all similar data taken earlier
- This makes it possible to extend the transverse momentum range + improve the systematic uncertainties

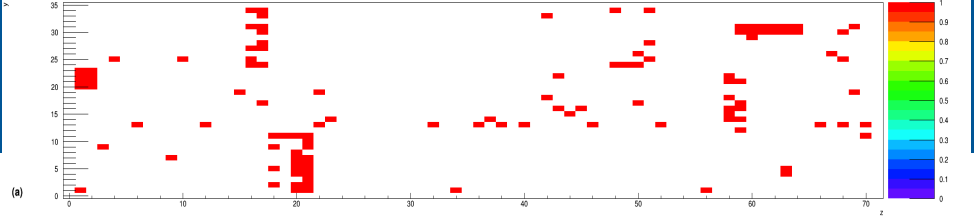


PHENIX Detector

- The η particels also decays into 2γ, like π^0
- $BR(\eta \to 2\gamma) = (39.5 \pm 0.2 \pm 0.3)\%$
- But the η has bigger mass, therefore the minimum opening angle will be also bigger, that means in case of η we also need to pay attention to the neighboring sectors

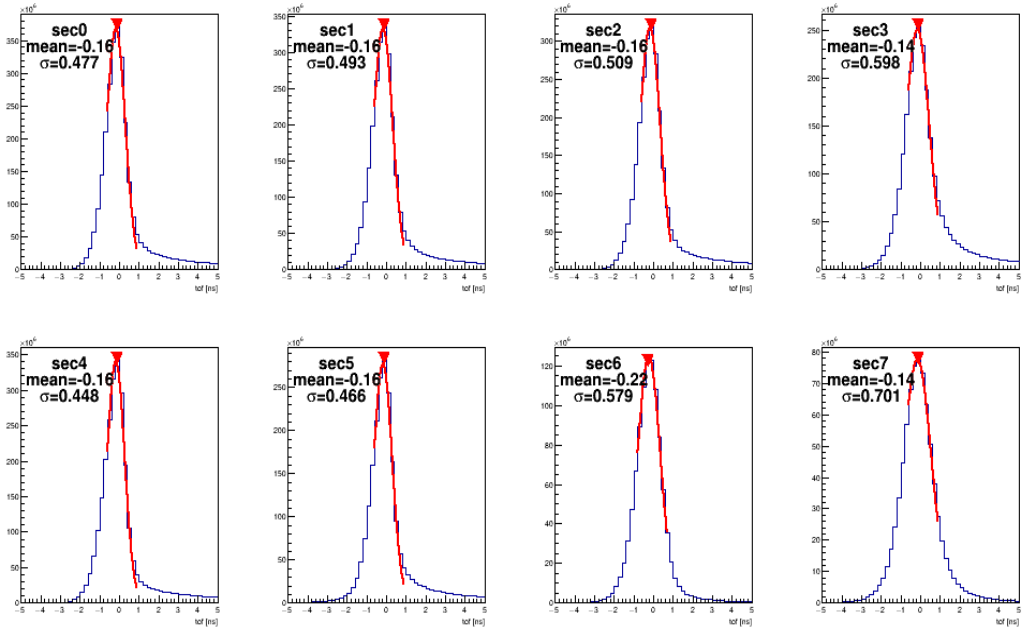


Dead Hot Map and Timing

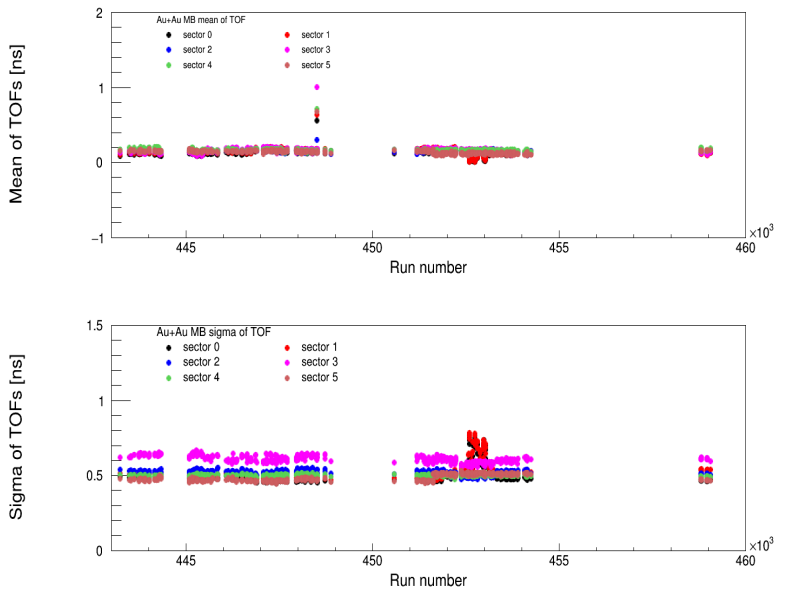


- Used an energy dependent cut for the DHM
- Every tower which has a signal 5σ or more above the mean, was cutted out from the analysis, total loss was 12%
- We fitted the towers with 5 parameter functions to get the raw TDC
- I get 500 pico sec σ, with energy dependent (slewing corrected) timing

Tof distribution:

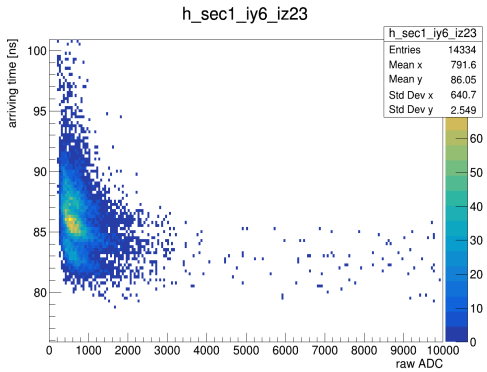


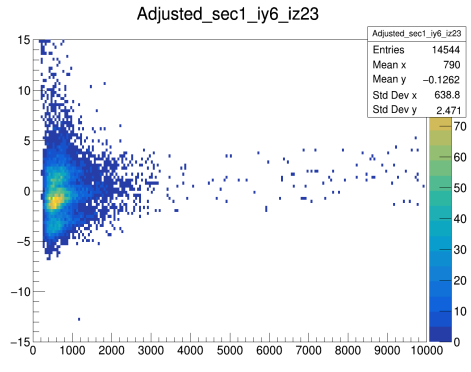
Mean and σ in every runnumber:

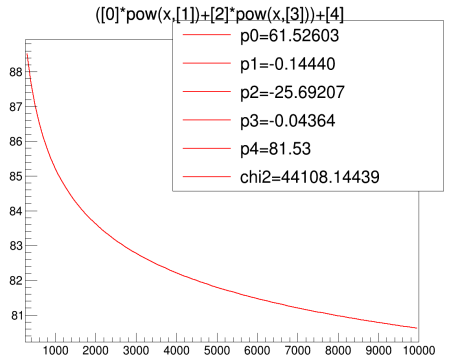


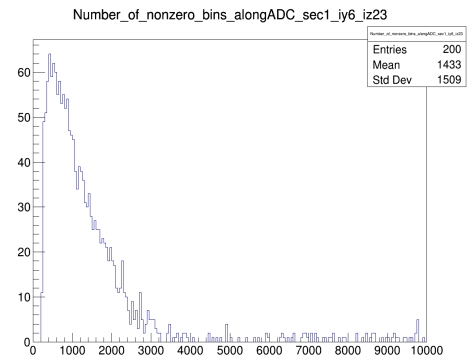
Dead Hot Map and Timing

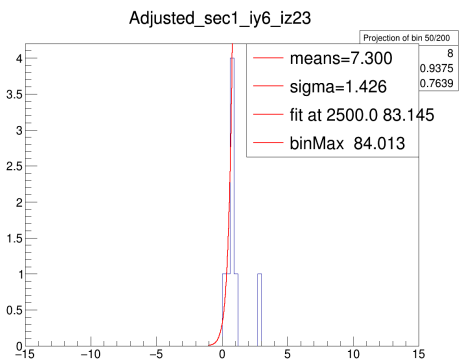
- For some 100 towers, we got results that we could not properly calibrate
- However, there was no need to worry, because we still managed to bring them within 5 ns
- Due to the timing calibration, it was not necessary to exclude additional towers from the analysis
- The fitting function: $([0]) * pow(x, [1]) + [2] * pow(x, [3])) + [4]$

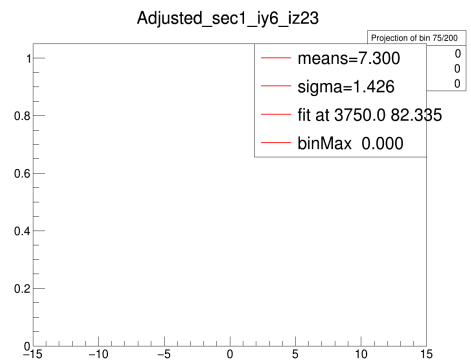






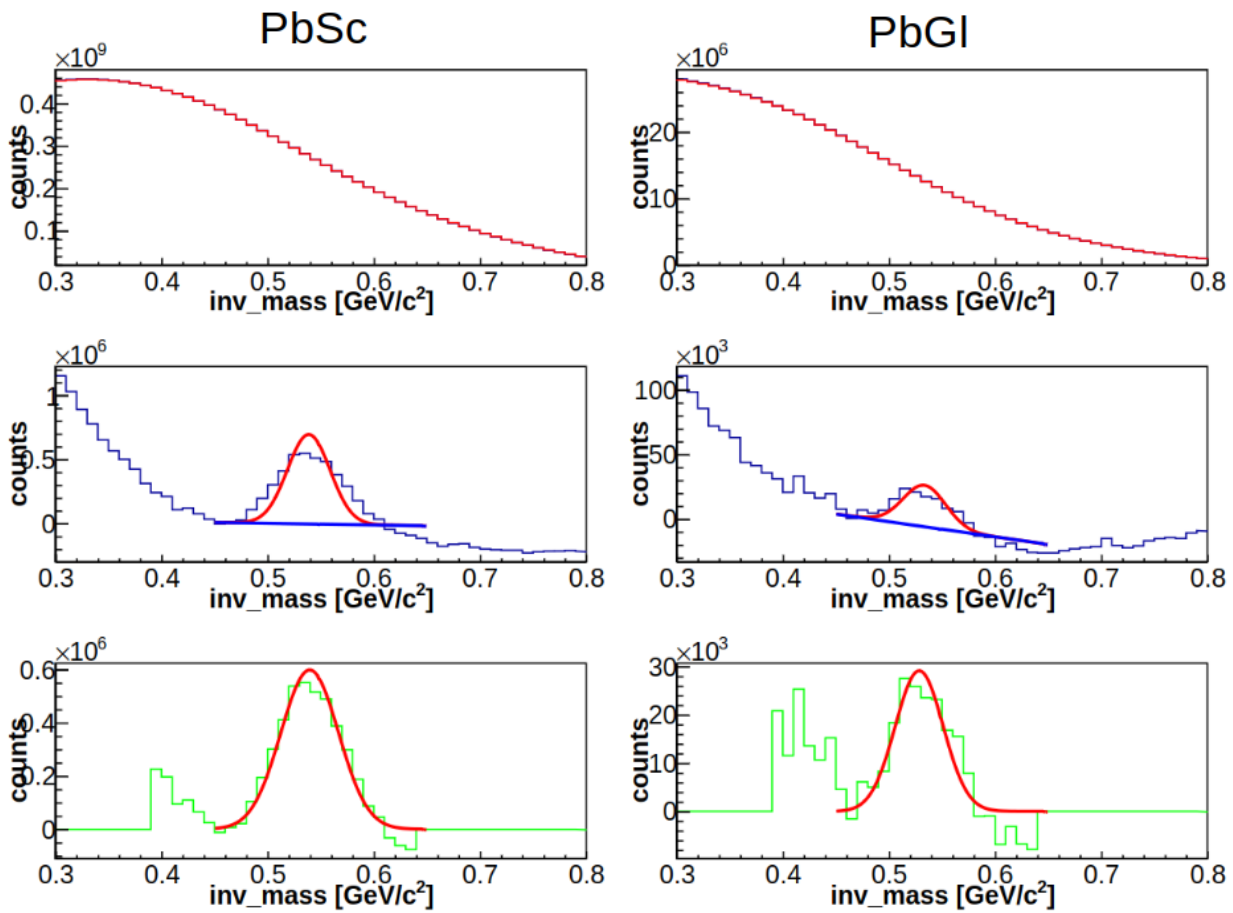






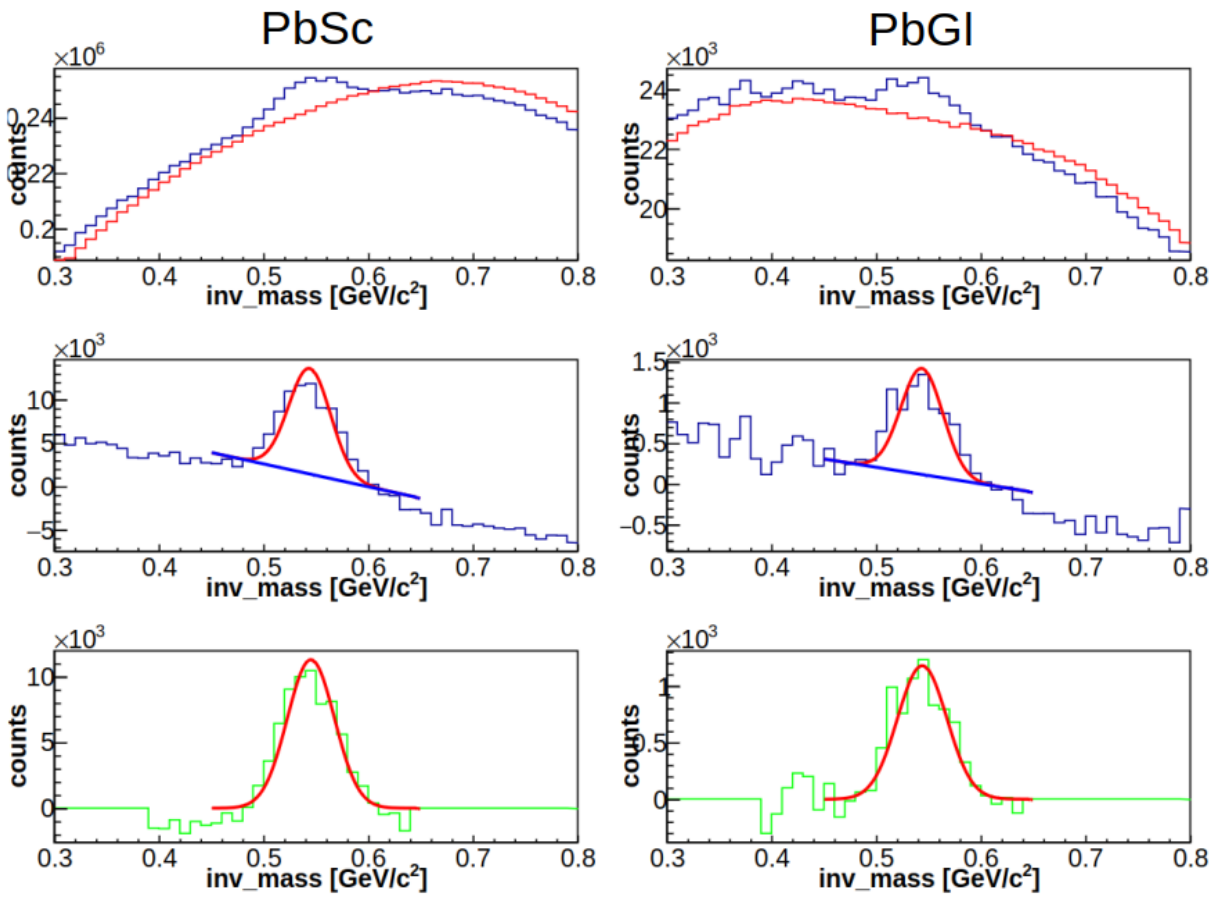
Raw invariant mass

- 2.0-2.5GeV
- 5ns tof cut
- No pid cut
- MB trigger (BBCLL1 $>$ 0 narrowvertex)
- MB centrality



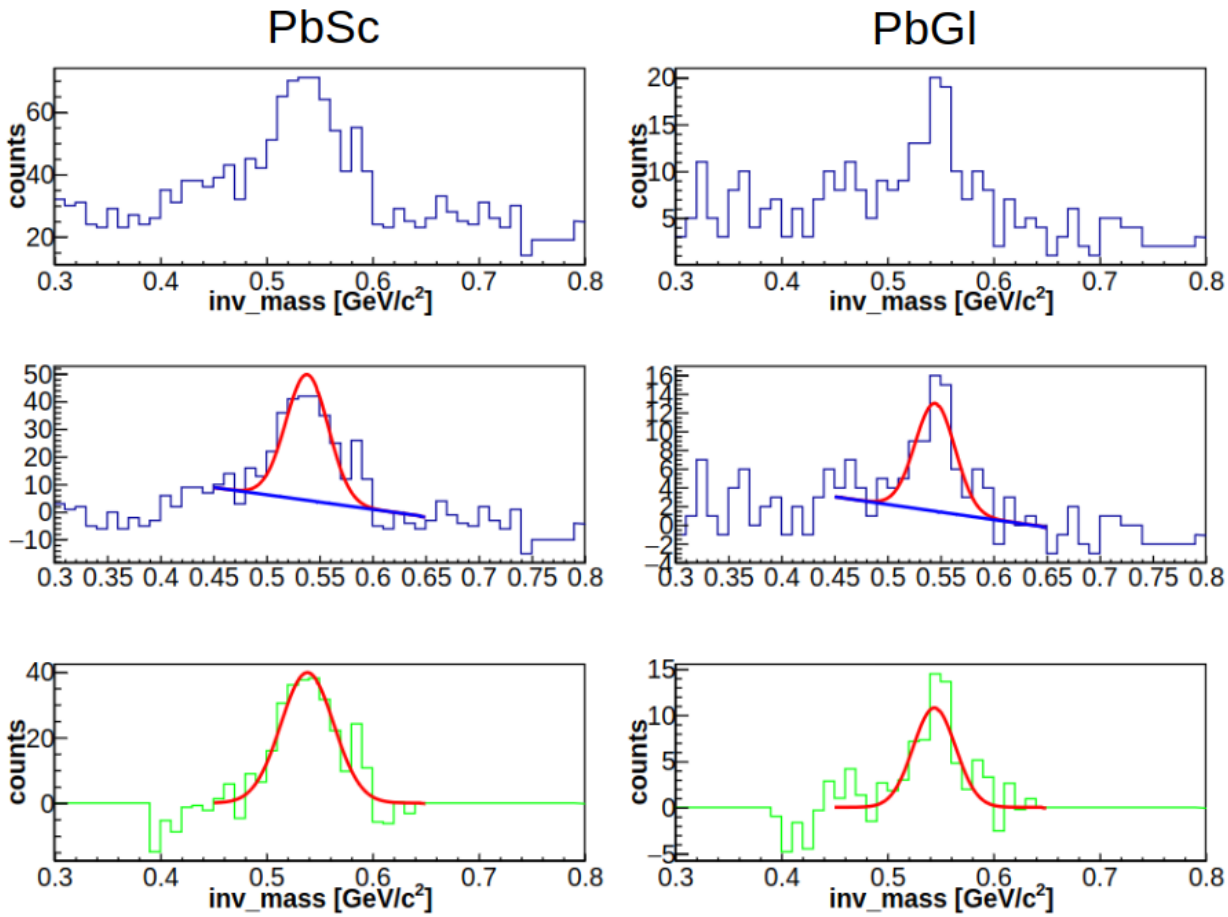
Raw invariant mass

- 4.5-5.0GeV
- 5ns tof cut
- No pid cut
- MB trigger (BBCLL1 $>$ 0 narrowvertex)
- MB centrality

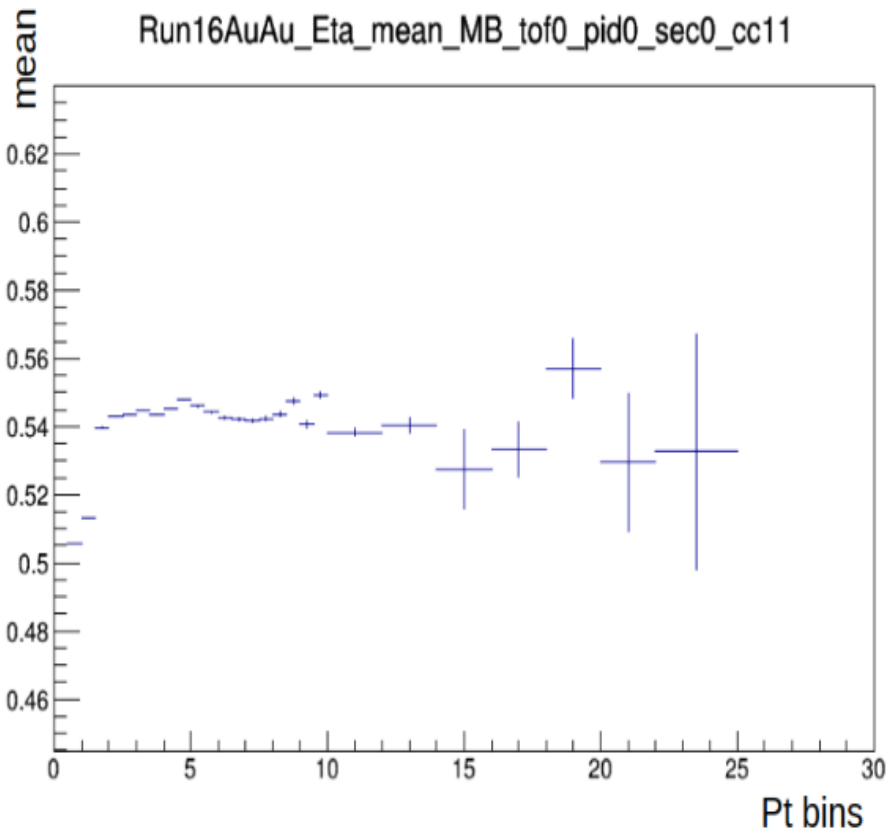


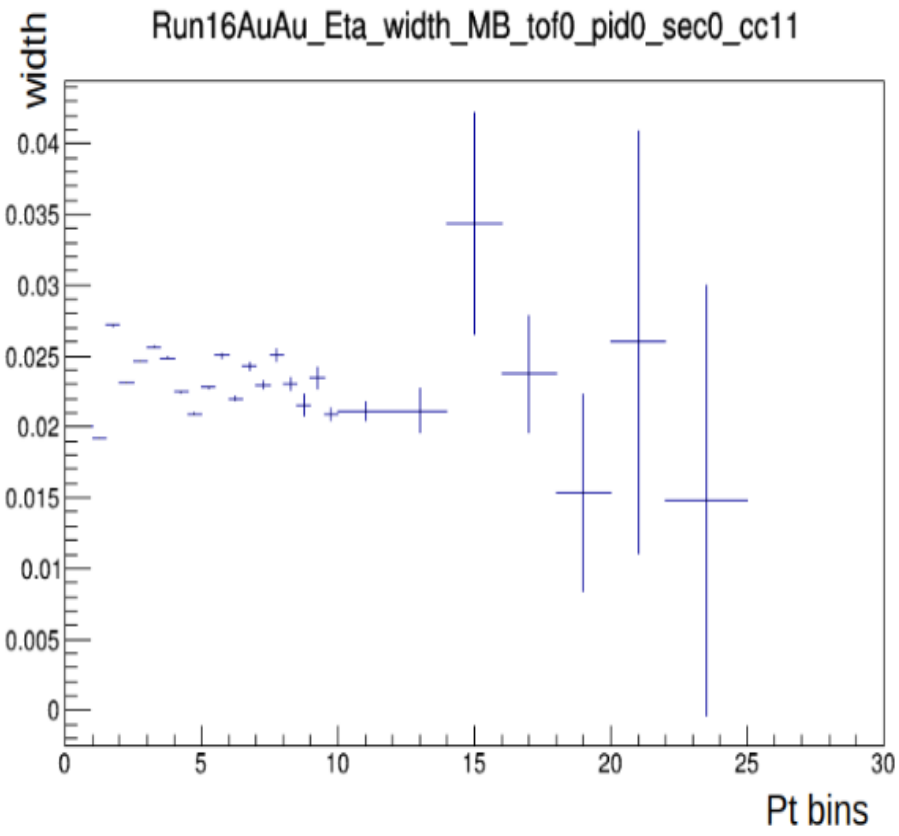
Raw invariant mass

- 14.0-16.0GeV
- 5ns tof cut
- No pid
- ERT trigger
- MB centrality



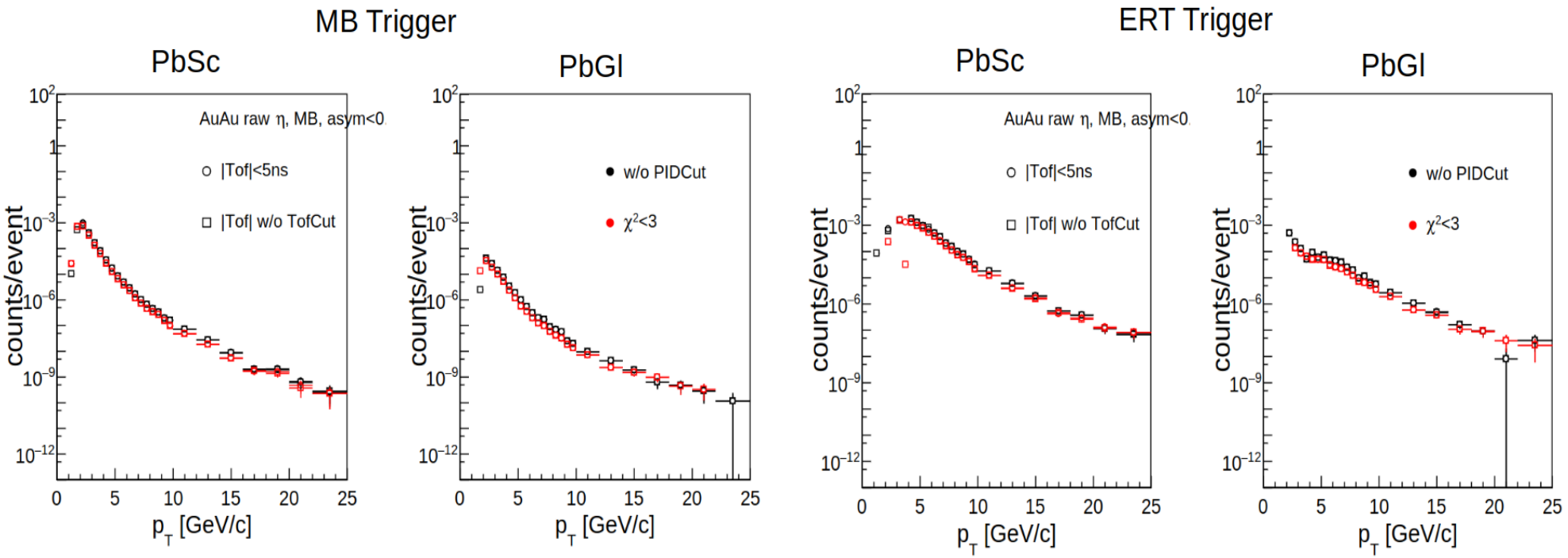
Peak mean and width





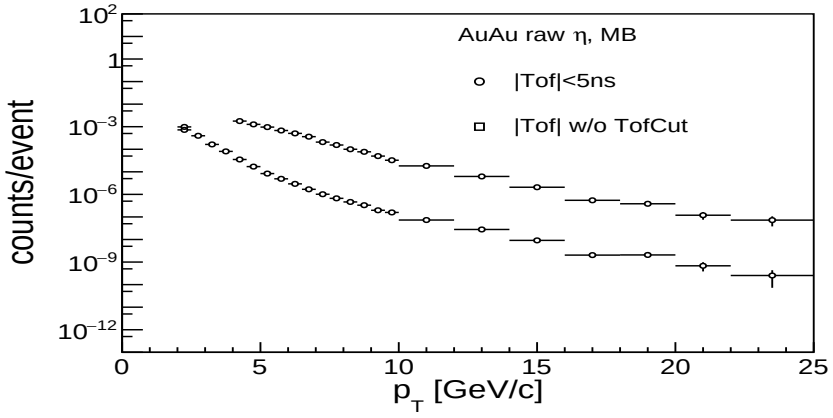
Raw spectra for MB and ERT

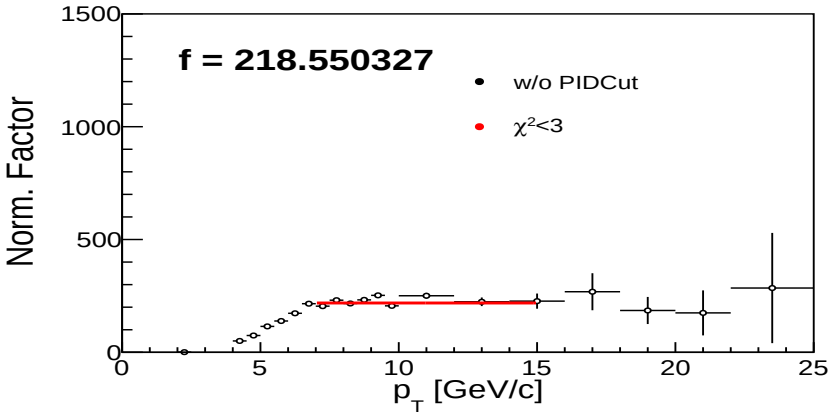
- Extract the peak content from every invariant mass peak all the 0-30GeV $\rightarrow$ got the Raw spectra

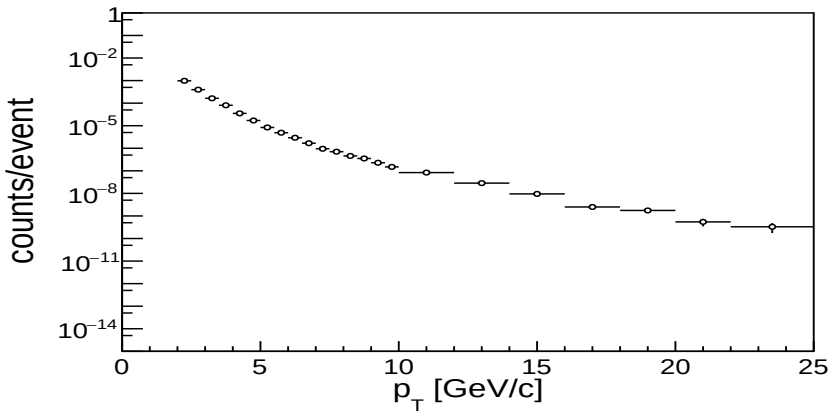


Normalization

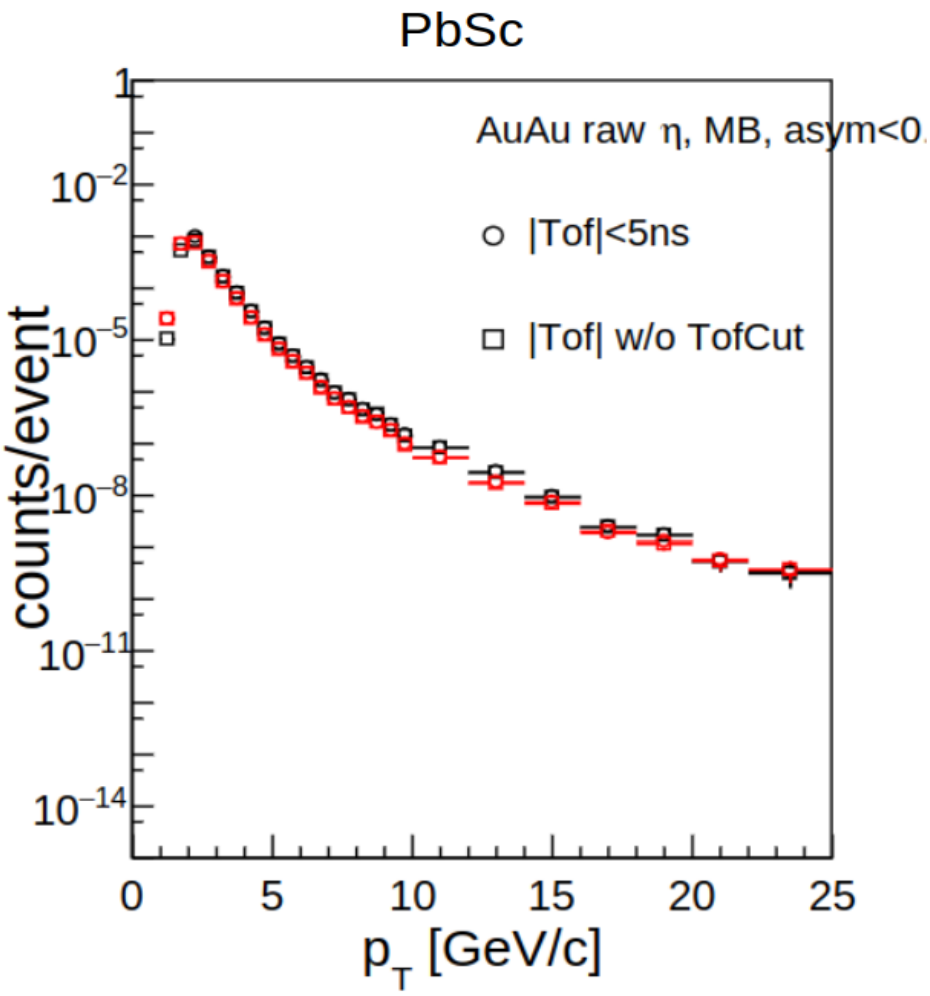
- Examine the MB and ERT spectra
- Normalization factor: $\frac{ERT}{MB}$
- With this ratio we correct the yield per triggered events to the yield per collision
- $\rightarrow$ Take the MB spectra until 7.5 GeV, and above that take the ERT spectra
- $\rightarrow$ Have better statistics in the high energy region

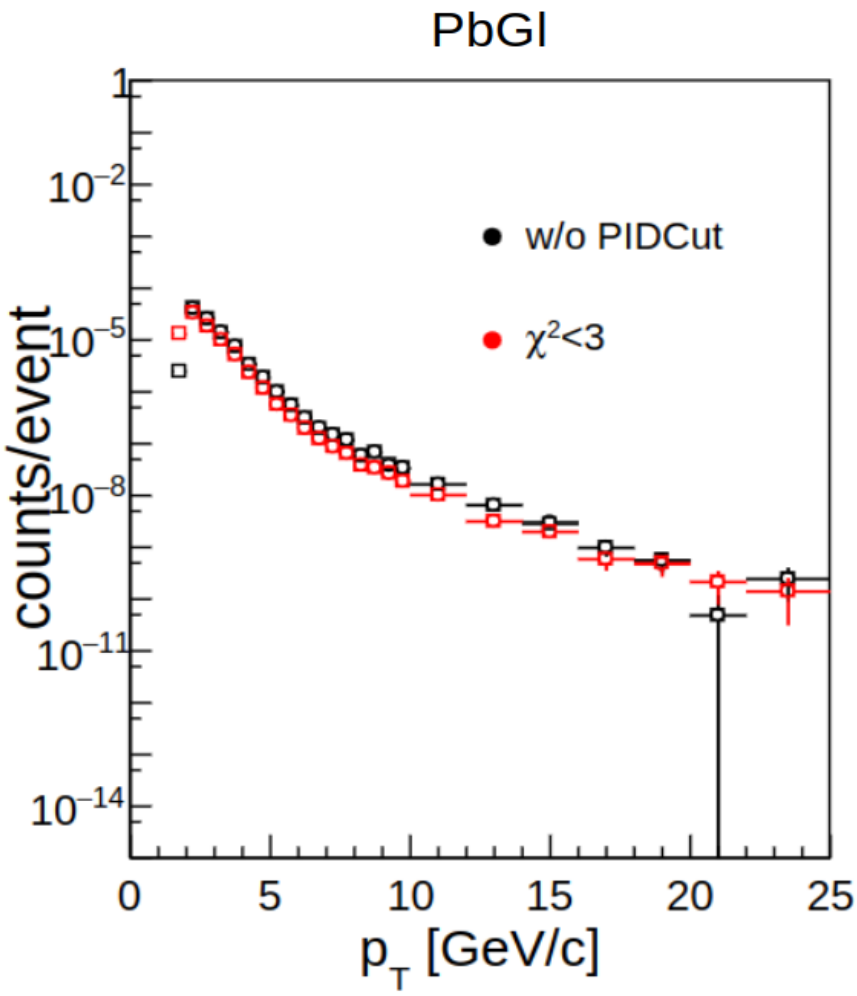






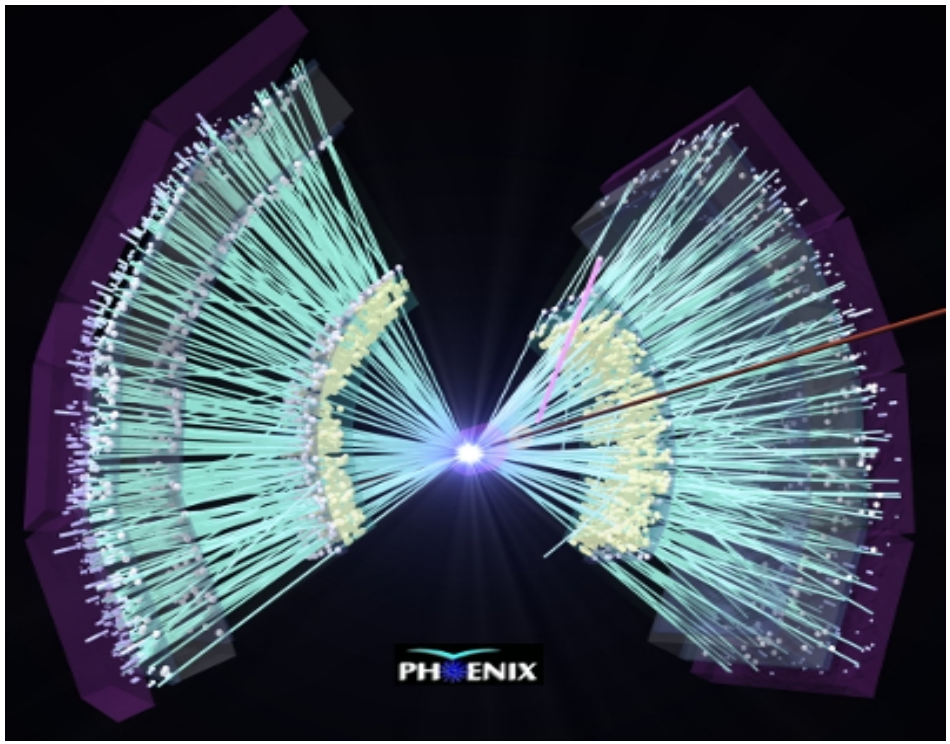
Raw Combine Spectra between MB and ERT





Pisa Simulation

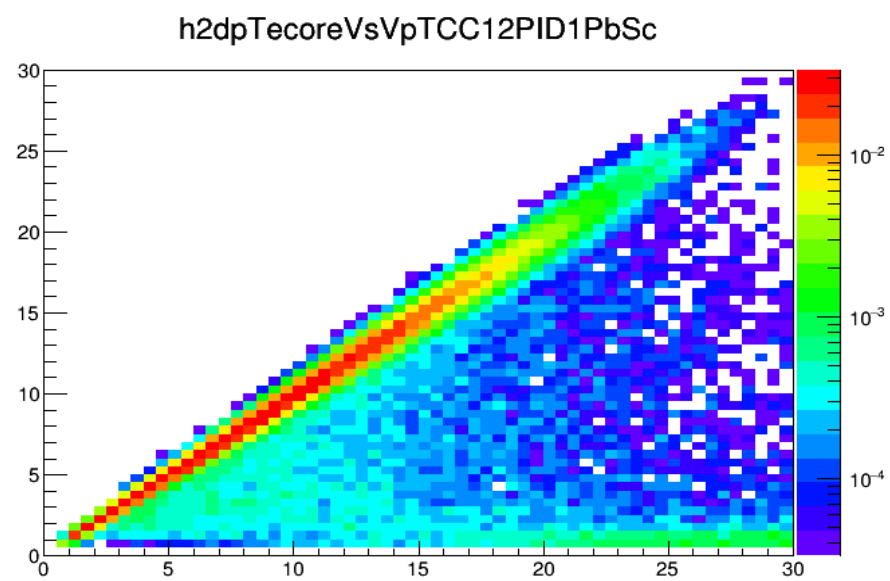
- PISA stands for PHENIX Integrated Simulation Application
- What does it do? $\rightarrow$ PHENIX's GEANT3 based simulation package for geometry and event particle tracking software
- I used this simulation to create the simulated data and getting a 2D response matrix



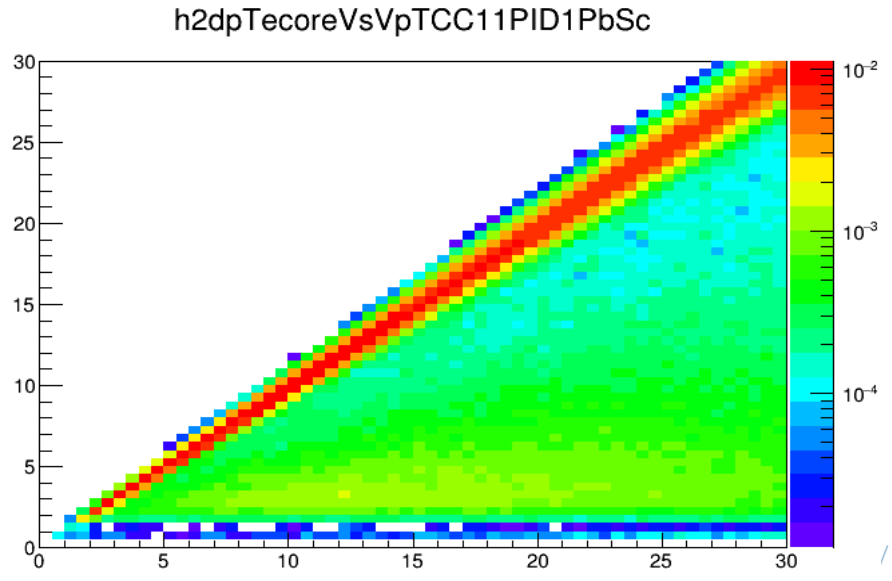
2D response Matrix

- The response matrix describes the probability that a true value x is reconstructed at value y, where y belongs to the set of all possibilities
- A two dimensional matrix is created with the x axis as the generated Pt and the y axis as measured or reconstructed Pt
- This takes care in one single step of the acceptance, reconstruction efficiency and energy smearing.

π^0:

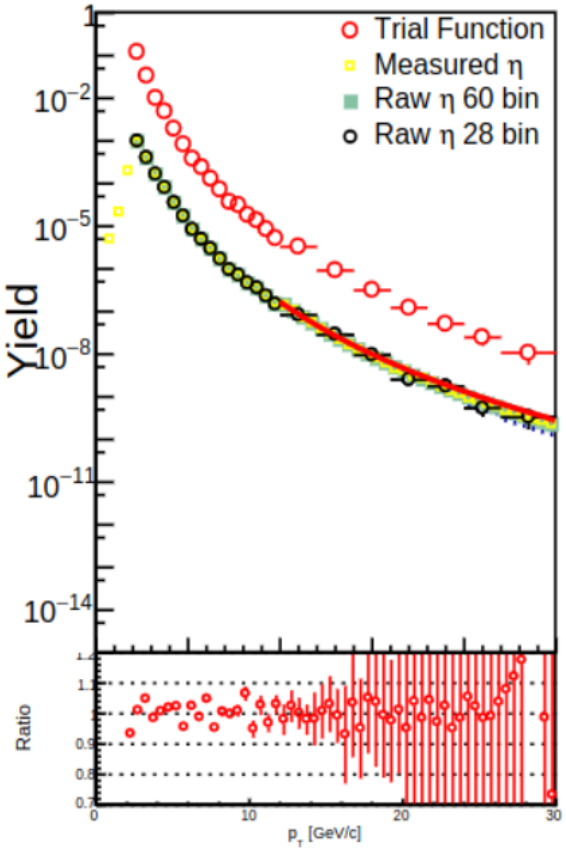


η:

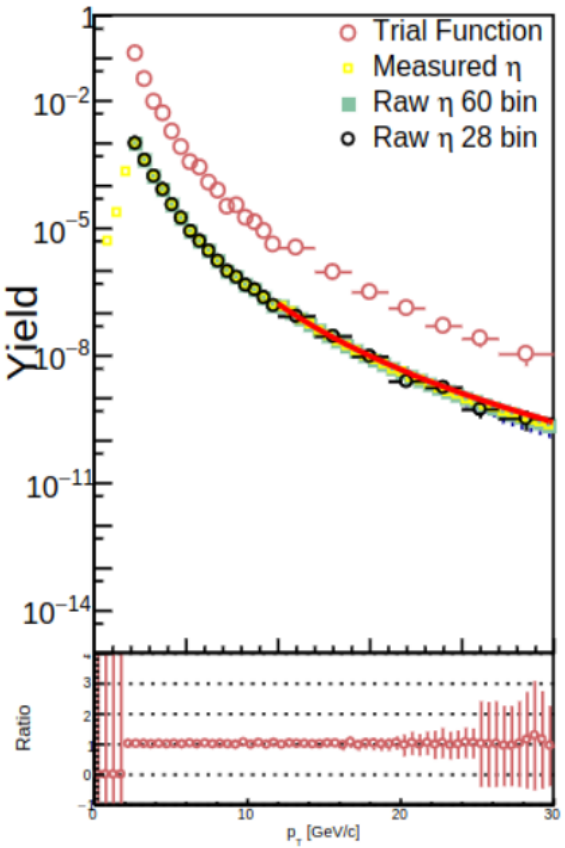


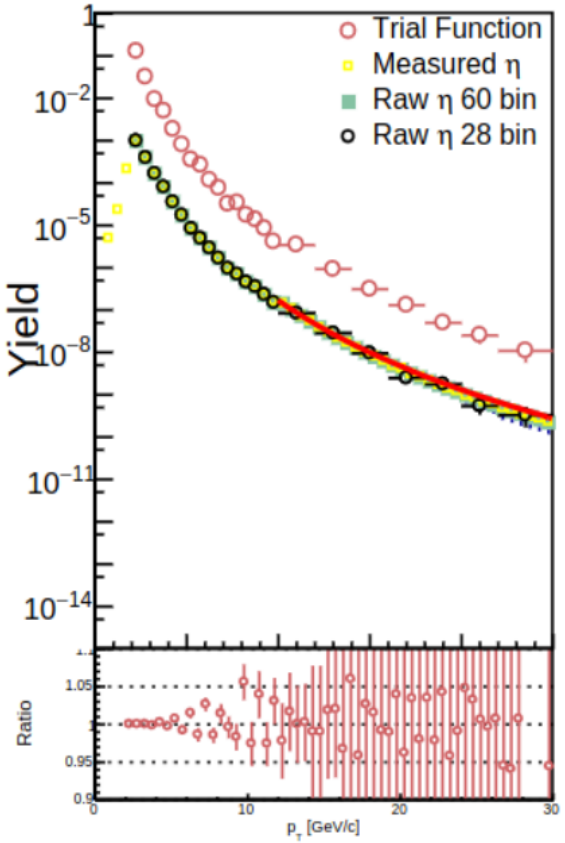
Unfolding - some technical plot

1. Iteration



Last Iteration





Summary and Outlook

- The ($\eta \to 2\gamma$) decay channel produces the second highest amount of decay photons
- With the Dead Hot Map and Timing calibration we exclude out all the wrong towers
- Reconstructed raw invariant mass $\to$ Raw η for MB and ERT $\to$ Normalization $\to$ Combine spectra
- PISA Simulation $\to$ 2D Response Matrix $\to$ Unfolding
- Work in progress, no physics results yet, combinatorial background subtraction needs more attention, unfolding improved
- Consistency between results with various cuts studied
- $+$ The systematic uncertainties still necessary

Thank you for your attention!

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Dr. Gábor Dávid