Direct Photons in 200 GeV AuAu

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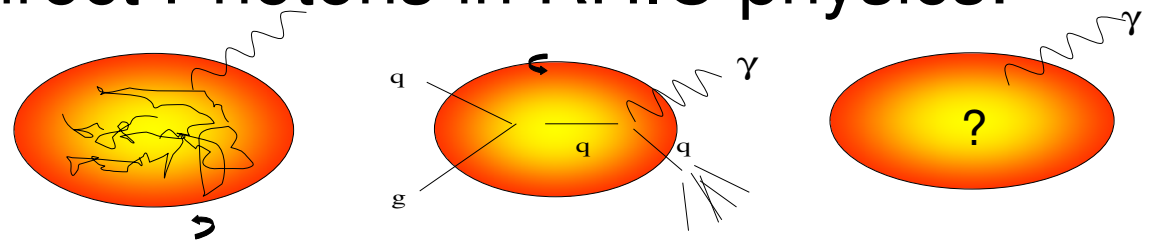
Physics Motivation

- Direct Photons in RHIC physics:



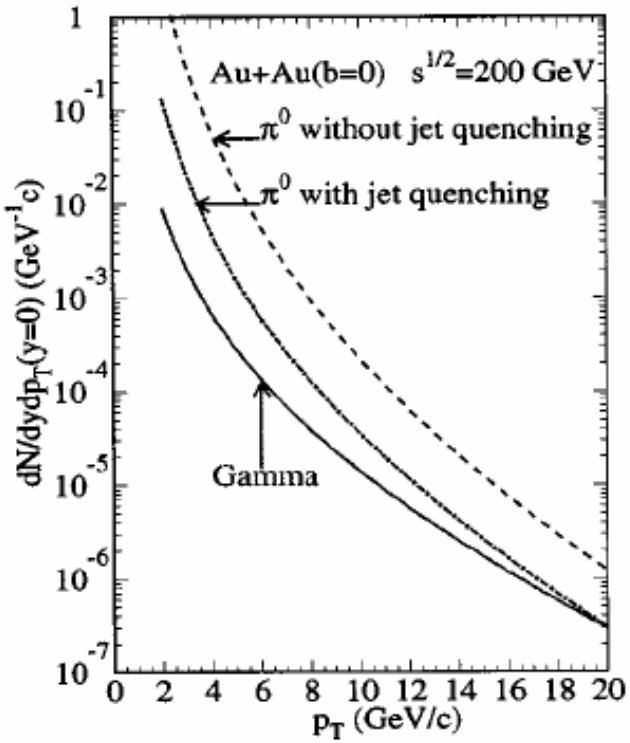
Thermal True Direct Any Non-Meson

- Direct" Photons are interesting probes of possible QGP for several different reasons
  - Thermal photons probe thermal states, phase transitions
  - Direct Photons should be uninhibited by strongly interacting QGP

Direct Photons?

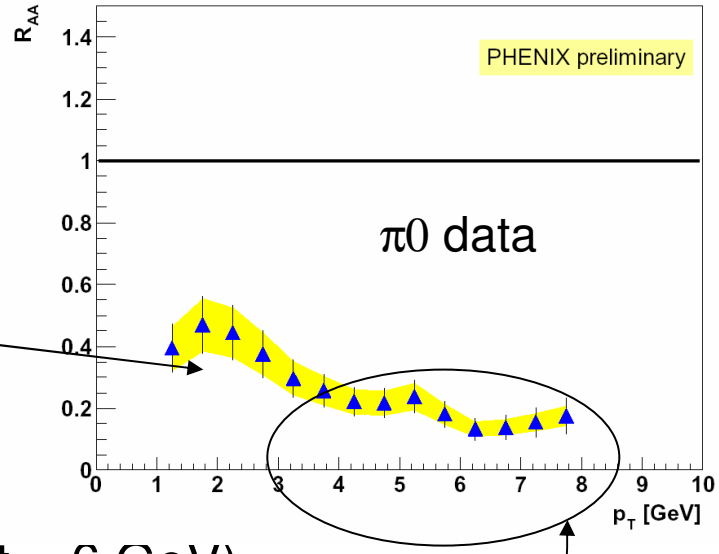
First of all, one must consider the difficulty of signal extraction due to large **BACKGROUND** of meson decay photons.

- **Thermal Photons** (pt < 3-4 GeV)
  - Signal small compared to **background**…more difficult measurement
- **Hard Scattered Photons** (pt > 3-4 GeV)— associated with (possibly medium quenched) Jets –
  - Normal p-p Signal/**Background** : ~10%, same for "Peripheral" AuAu collisions
  - In "Central" AuAu, where possible QGP is formed, enhanced with respect to suppressed $\pi 0$ **background** photons ([1]Wang & Huang (Phys Rev C55)
- So, is there suppression of Jet Pi0's?...



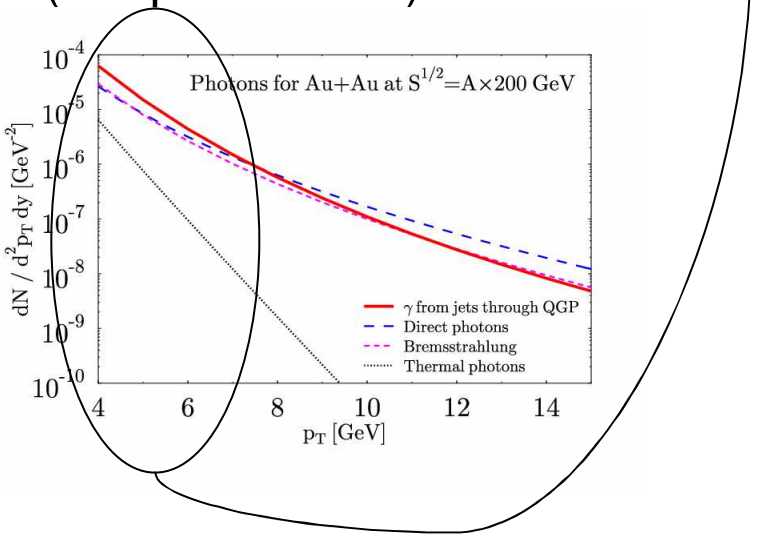
Direct Photons?

- …YES, Suppression is definite! Near Final Result from PHENIX
- Level of Suppression: "R_{AA}" ~ suppressed by a factor of 3-5
- But could the direct γ be suppressed also?



- **Jet-QGP Passage Photons** ? (4 < pt < 6 GeV)

- Fries,Muller,Srivastava [2] (Aug '02) nucl-th/0208001
- "Sparklers" produced by jet passing through the QGP.
- Dominant in pt region addressed by current AuAu data—which is also region where pi0 are suppressed!

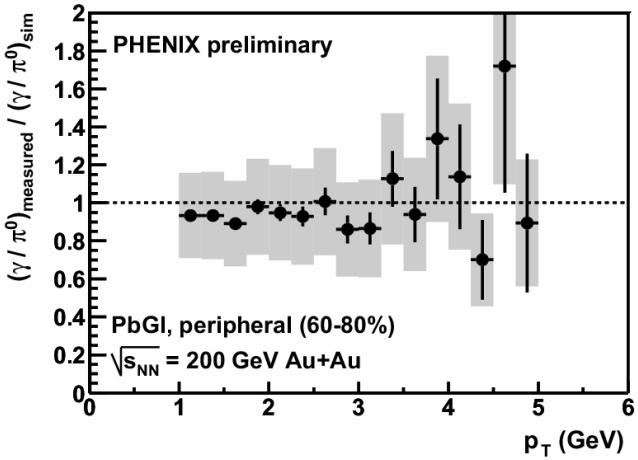


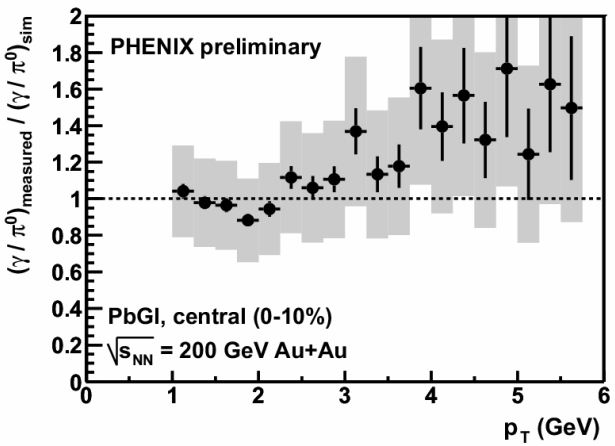
Measurement Technique

- Statistical Method:
  - Measure Pi0 Spectrum (Done)
  - Measure Inclusive Gamma Spectra
  - Divide Inclusive Gamma by Expected Background Gamma (based on Pi0)
  - Take “Ratio of Ratio” to cancel systematic errors: $[\gamma/\pi 0]$measured : $[\gamma/\pi 0]$expected

- Statistical Errors !!! Name of the Game…because of **background**!!!

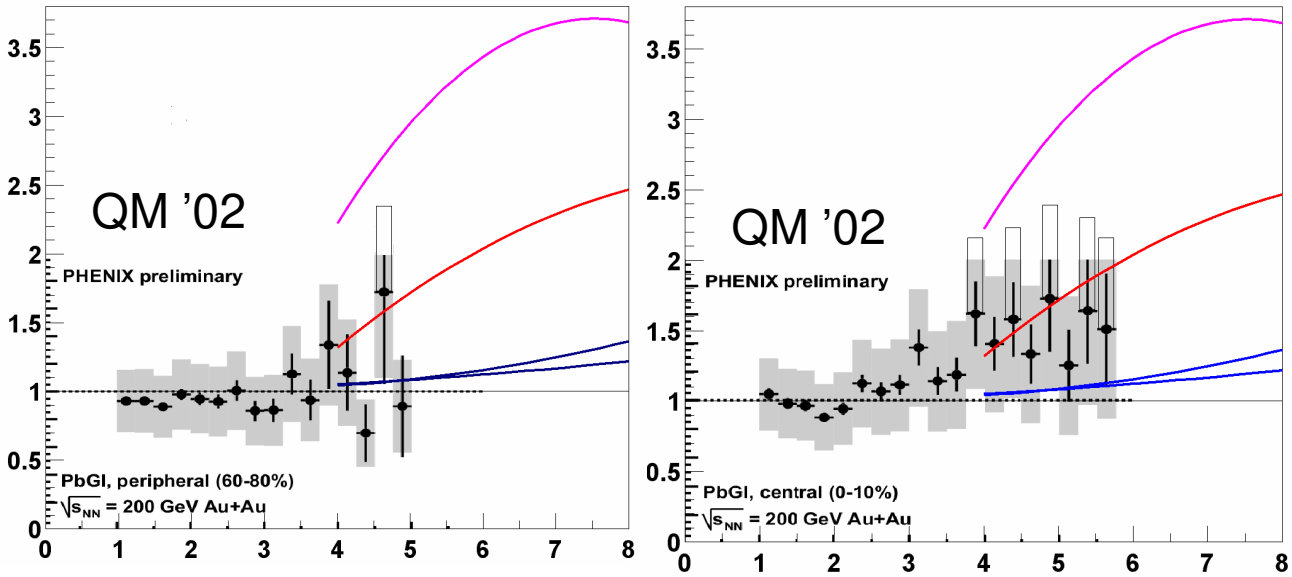
QuarkMatter '02





- Preliminary result consistent with no excess observed within uncertainty, which are large.
- Where does this get us?...

Implications?



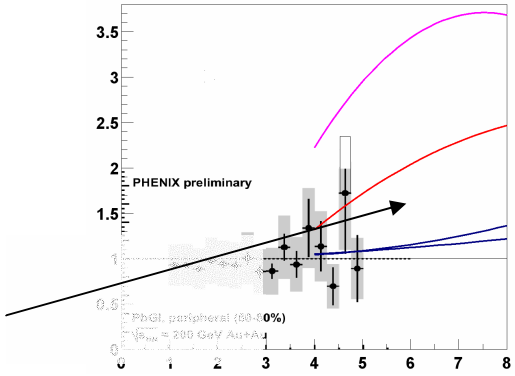
- w/ QGP-Induced γ, no γ suppression
([2] Fries, et al.)

-With π suppression, no γ suppression
([1] X.N. Wang,Huang)

–γ suppression or no π suppression
([1] , p-p scaling prediction)

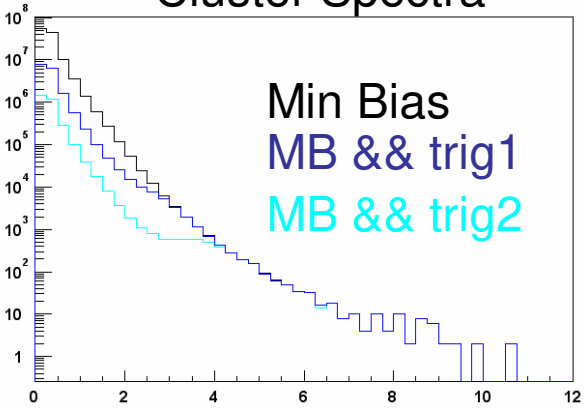
- Errors currently too big to distinguish any case
- Differentiate between no suppression/ suppression: interesting in either case. Definitive?

Plan

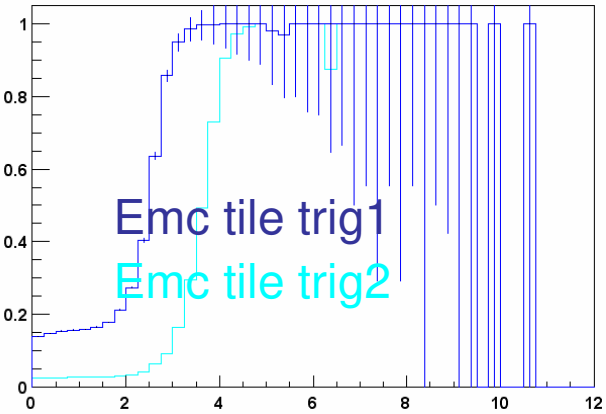


- Use Level2 Trigger data to address high pt area

Cluster Spectra



Trigger Efficiency

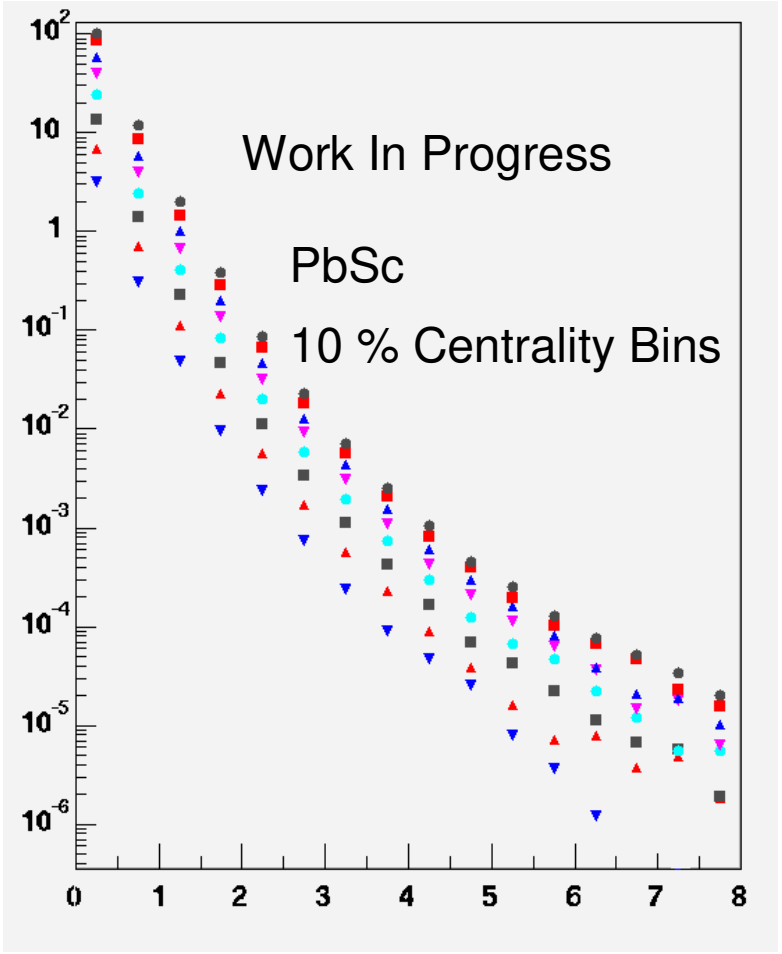


  - Factor of 2-3 times more data

- More sophisticated, e.g. embedding techniques for efficiencies
- Cross-check, Cross-check, Cross-check

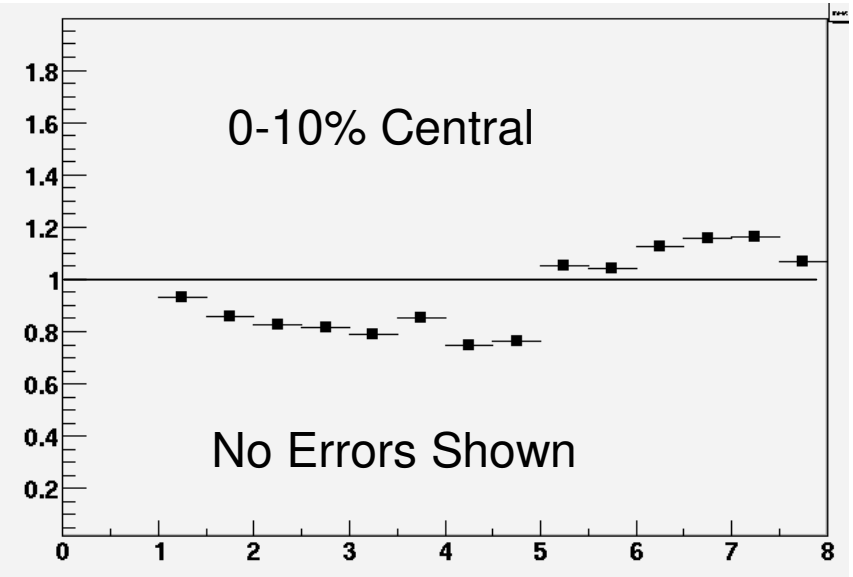
Inclusive Single γ Spectrum

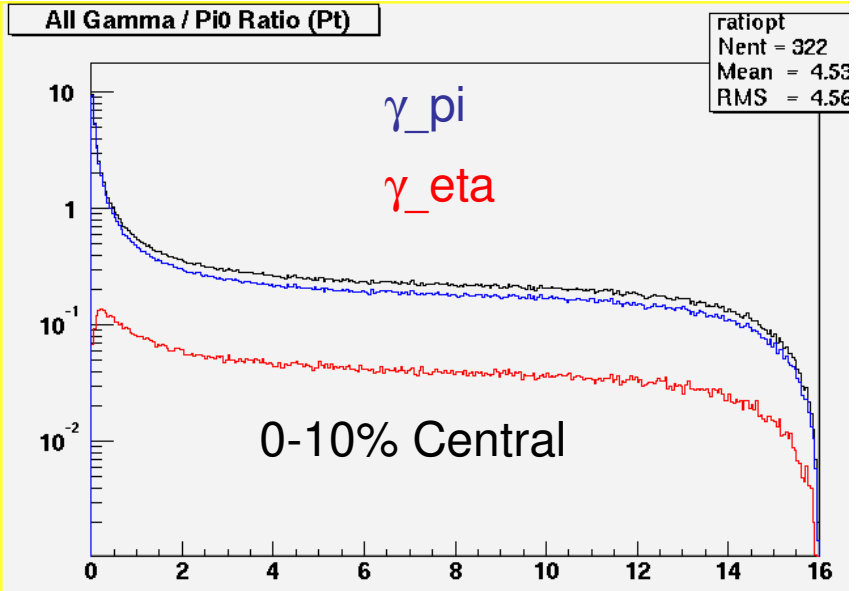
- Fully Corrected Spectra:



New work (Not for APS)

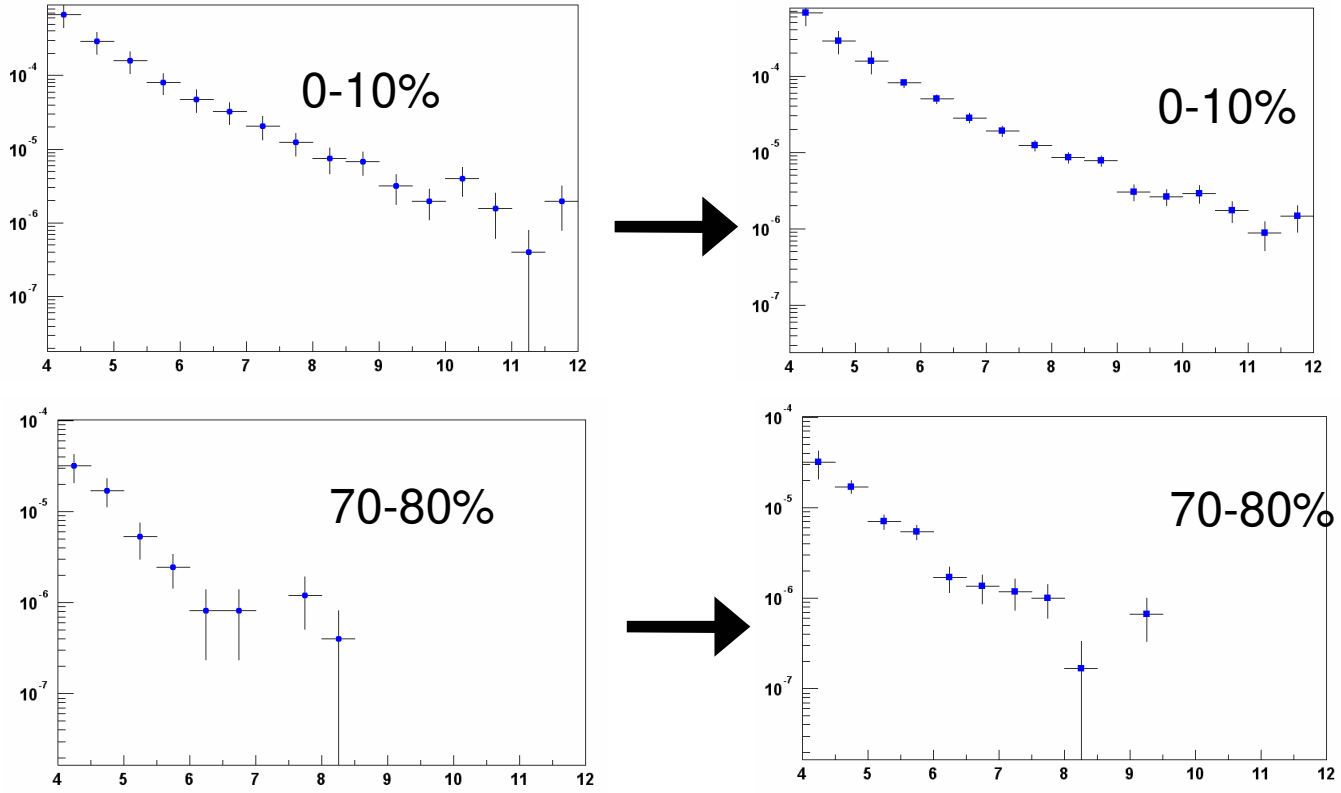
[γ/π0]my-pbscpi0 / [γ/π0]sim





Statistical Improvement of Level2 Trigger Sample

1/Nevt $dN_{cluster}/dpT$ for Tightest PID Cuts



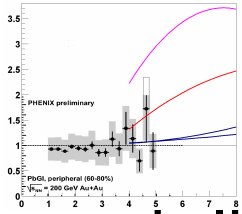
Without Lvl2 Trigger Sample

With Lvl2 Trigger Sample

Conclusions

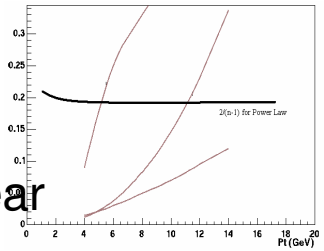
- Blah, Blah, Blah

Backup: How I made Theory exp. plots



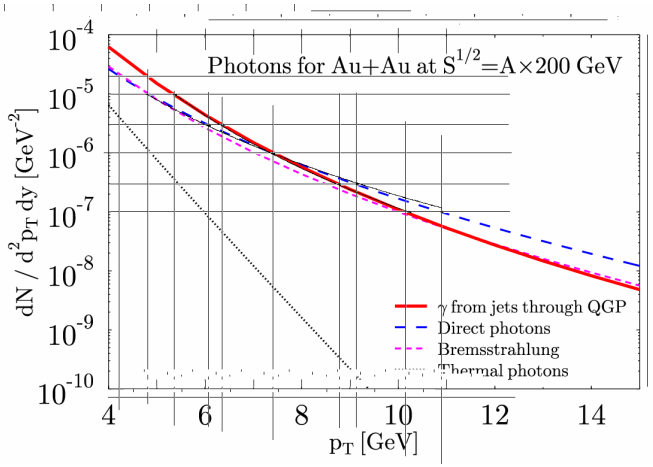
- Took $\gamma/\pi 0$ from my last year's aps talk

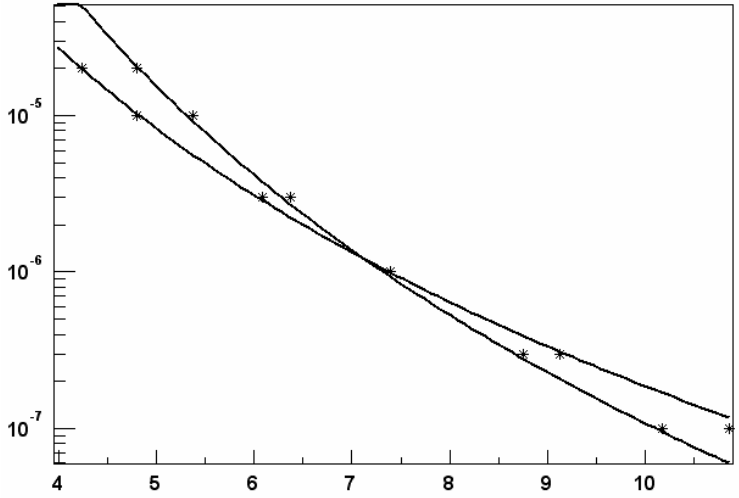
Last year



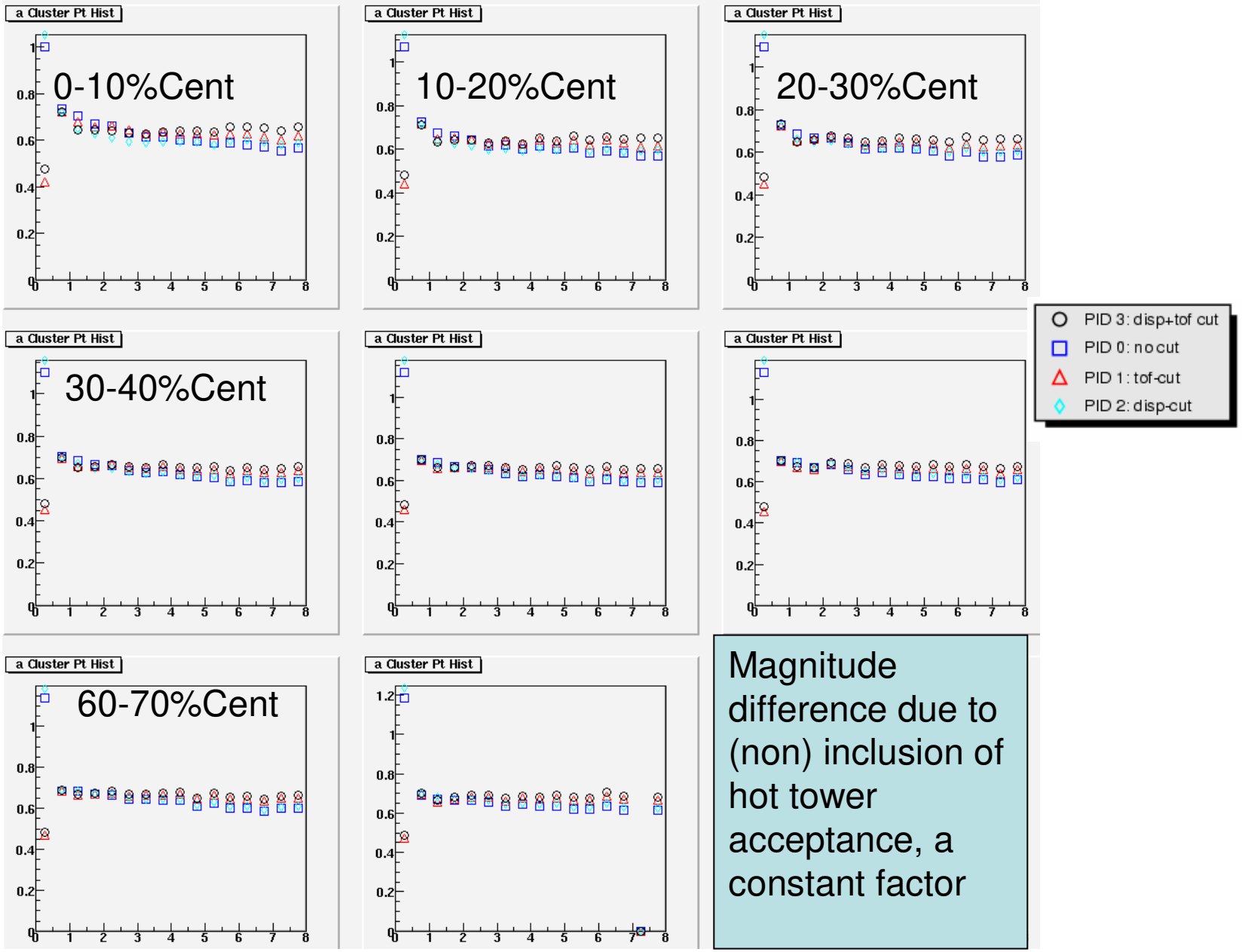
$$\frac{\gamma_{all}}{\gamma_{decay}} = \frac{\gamma_{direct}/\pi + \gamma_{decay}/\pi}{\gamma_{decay}/\pi} = 1 + \frac{[\gamma/\pi]XWang}{[\gamma/\pi]my}$$

For Fries, et. al. fit to eye-scanned-points, scaled up γ/π(pt)



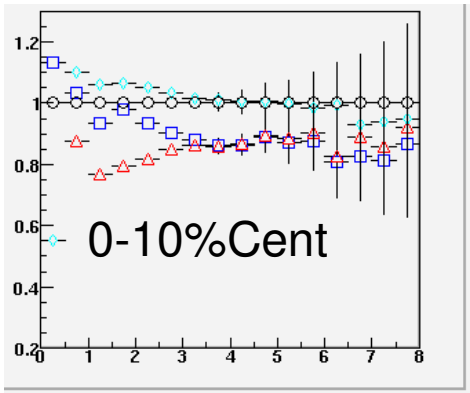


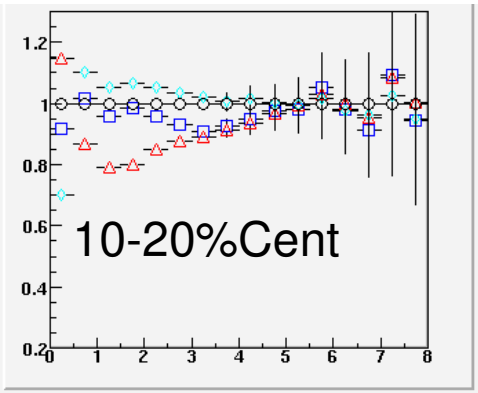
Ratio of my pbsc γ efficiencies / Muenster pbsc γ efficiencies (pt)

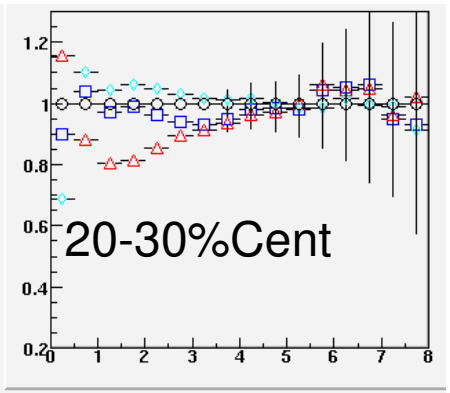


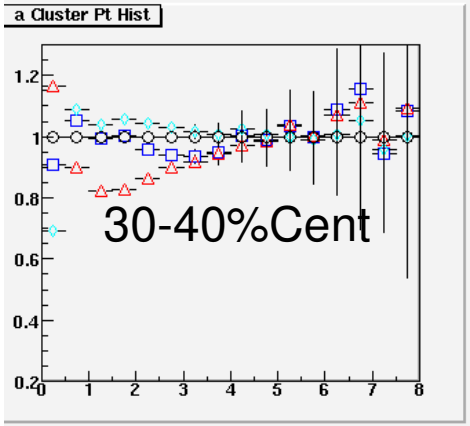
Magnitude difference due to (non) inclusion of hot tower acceptance, a constant factor

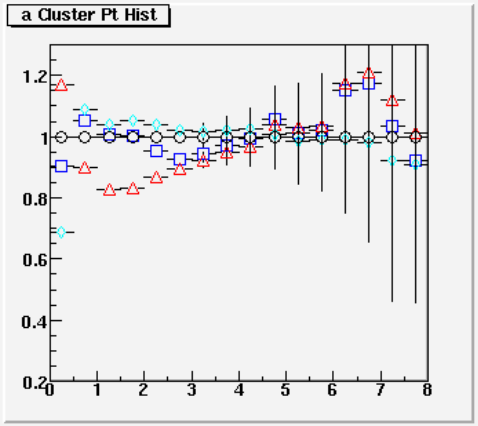
Ratios of my pbsc γ ALL Cuts / to my pbsc γ PID3 (pt)

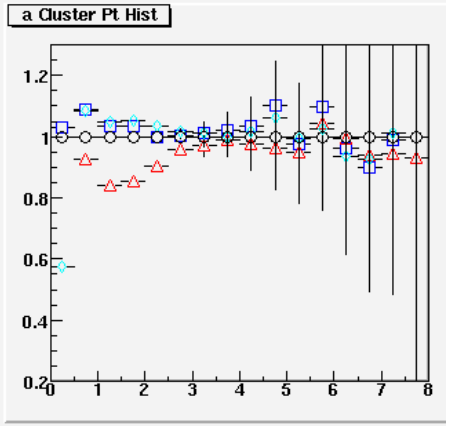


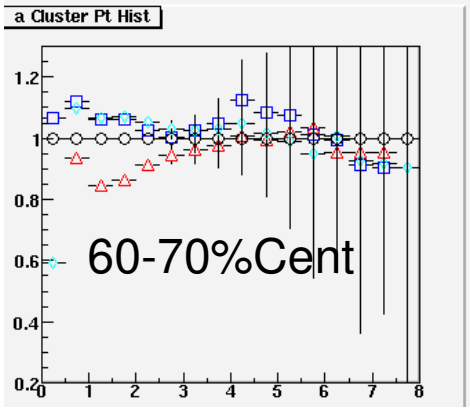


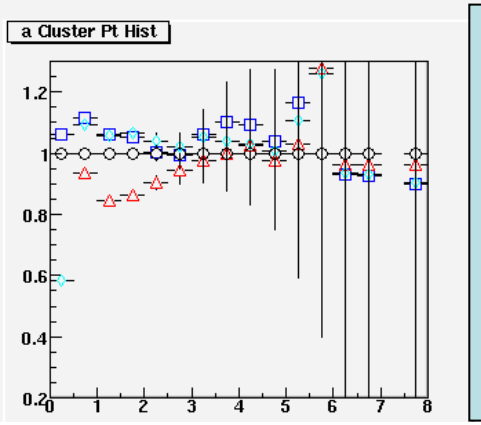




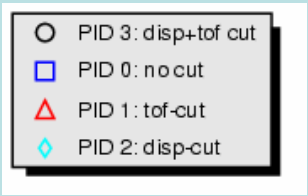
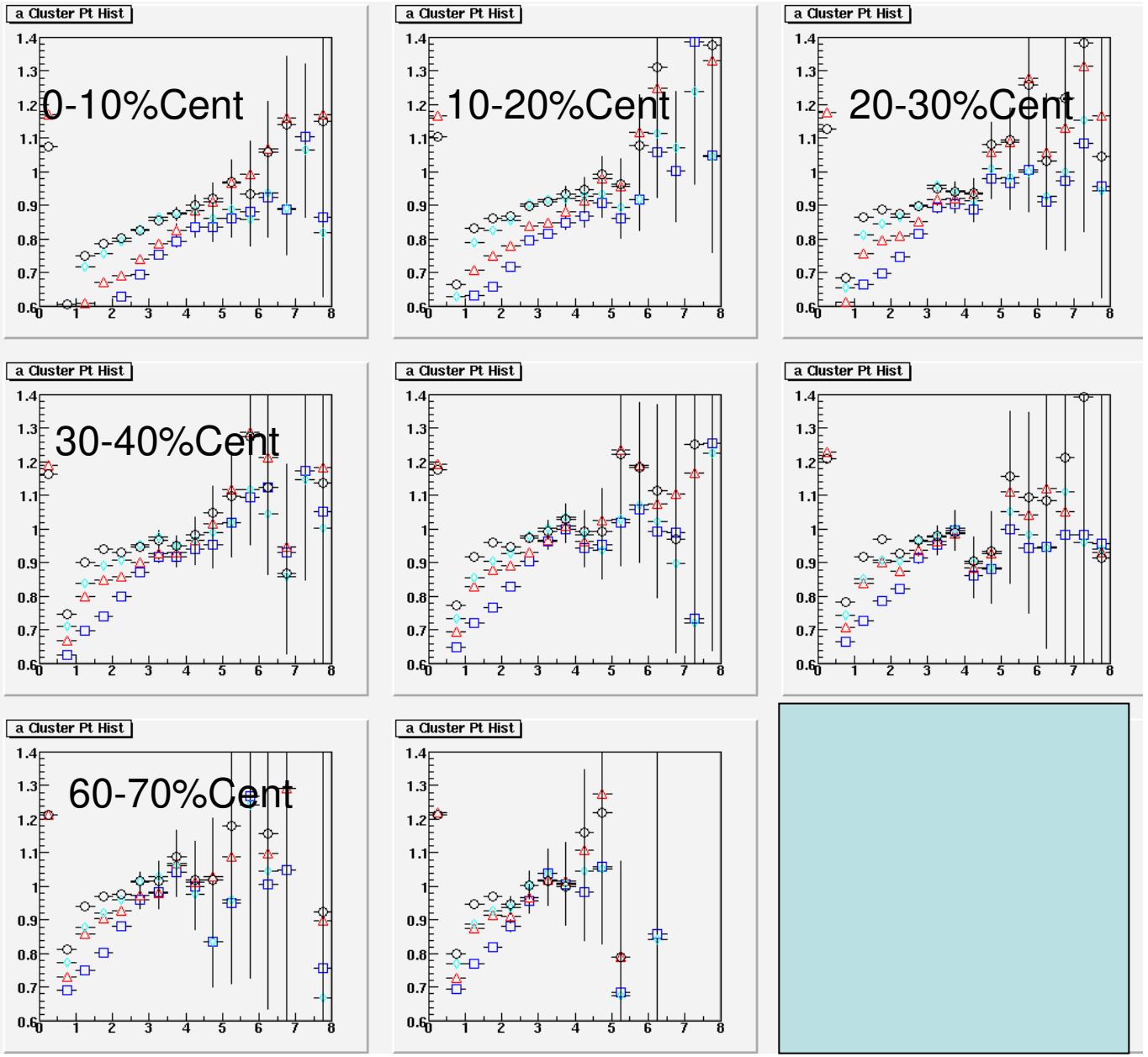








Use to estimate PID systematics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