



R_{CP} Measurements of Identified and Unidentified Charged Particles at High p_T in Au+Au Collisions at $\sqrt{s_{NN}} = 7.7 - 62.4$ GeV in STAR

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Outline

- **Introduction and Motivation**
- **STAR Detector and Data Analysis**
- **Results and Discussion**
- **Conclusions**

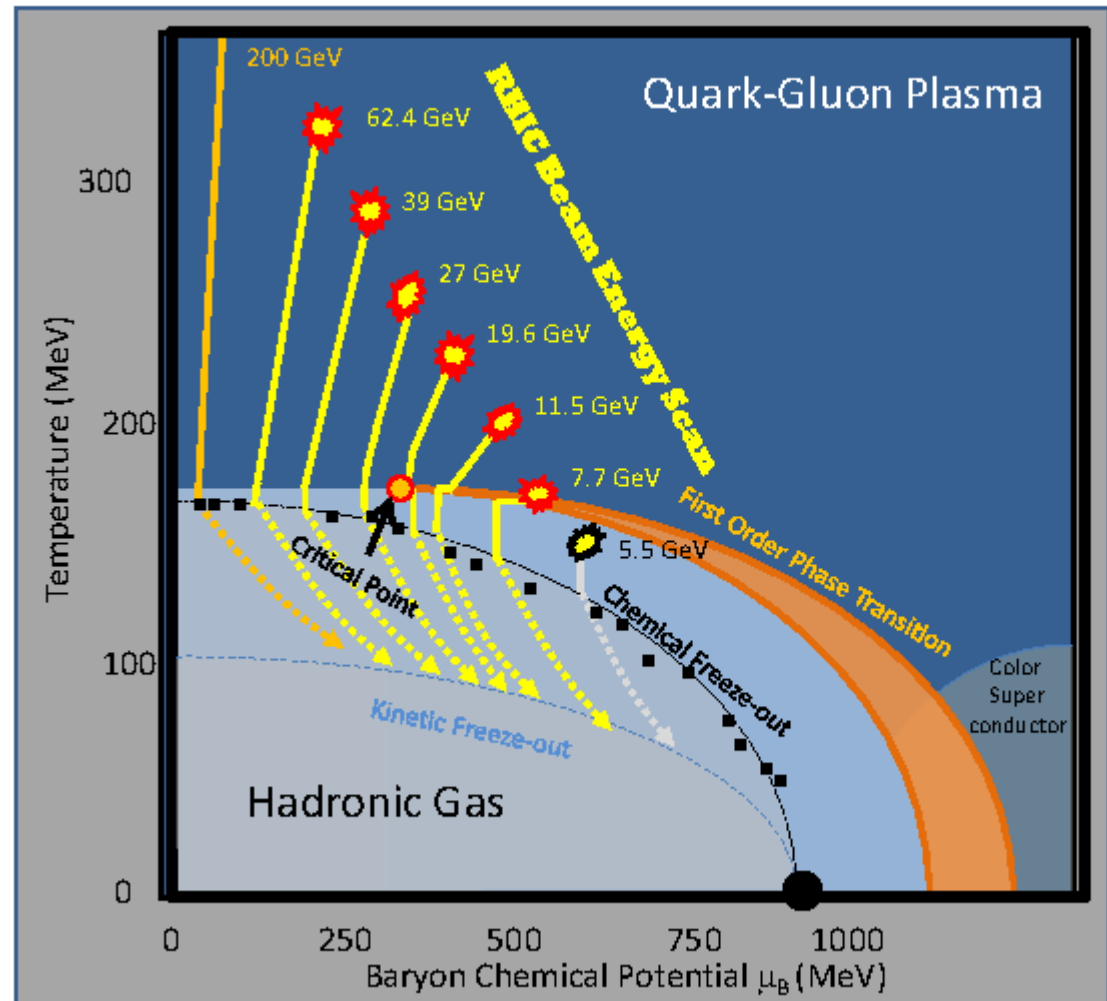
➤ The RHIC Beam Energy Scan (BES)

Main Goals:

To look for...

- I. Critical Point
 - II. Phase Transition
 - III. **Turn Off of QGP Signatures**
- ### Signatures

$\sqrt{s_{NN}}$ (GeV)	MB Events (10^6)
7.7	4.3
11.5	11.7
19.6	35.8
27	70.4
39	130.4
62.4	67.3



arXiv:1007.2613



Nuclear Modification Factors

Central AA collisions scaled by peripheral:

$$R_{CP}(p_T) = \frac{\langle N_{coll}^{AA} \rangle_{60-80\%}}{\langle N_{coll}^{AA} \rangle_{0-5\%}} * \frac{d^2 N_{AA}^{0-5\%} / dy dp_T}{d^2 N_{AA}^{60-80\%} / dy dp_T}$$

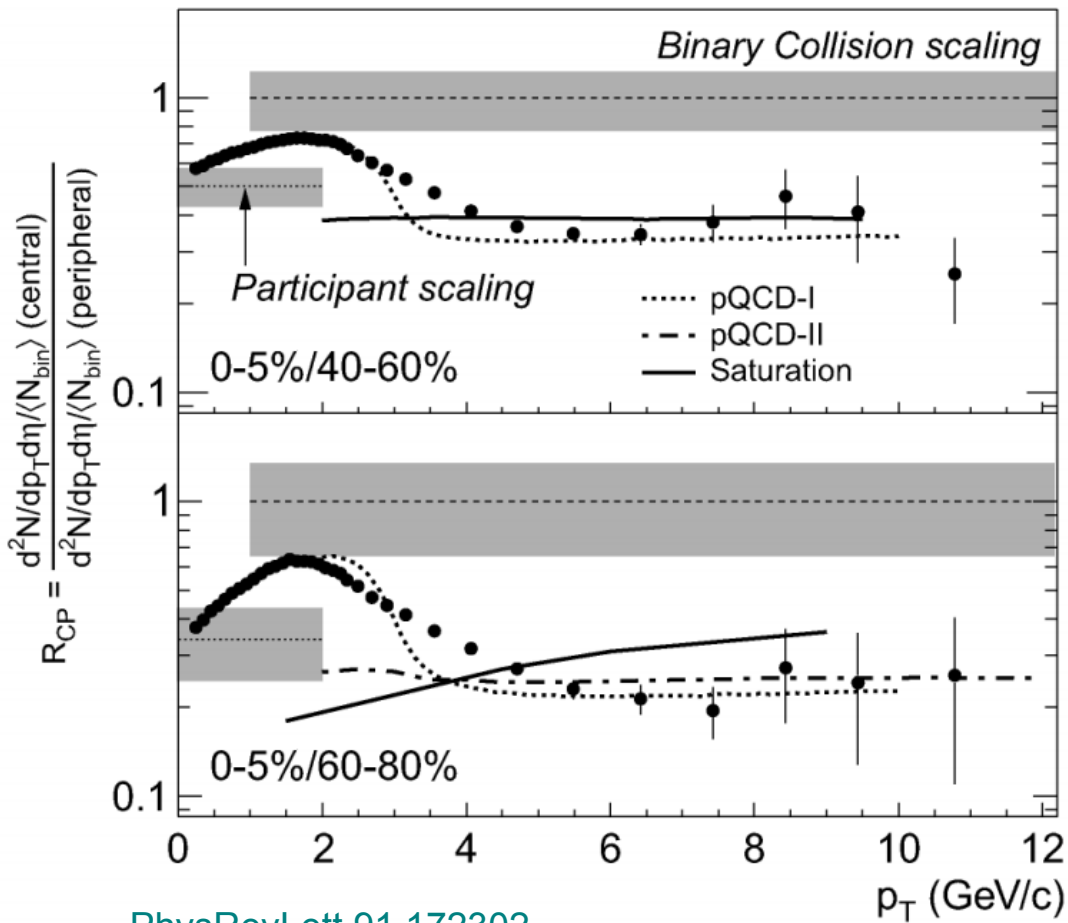
Central AA collisions scaled by pp:

$$R_{AA}(p_T) = \frac{1}{\langle N_{coll}^{AA} \rangle_{0-5\%}} * \frac{d^2 N_{AA}^{0-5\%} / dy dp_T}{d^2 N_{pp} / dy dp_T}$$

Central AA collisions scaled by pA:

$$R_{AA/pA}(p_T) = \frac{\langle N_{coll}^{pA} \rangle}{\langle N_{coll}^{AA} \rangle_{0-5\%}} * \frac{d^2 N_{AA}^{0-5\%} / dy dp_T}{d^2 N_{pA} / dy dp_T}$$

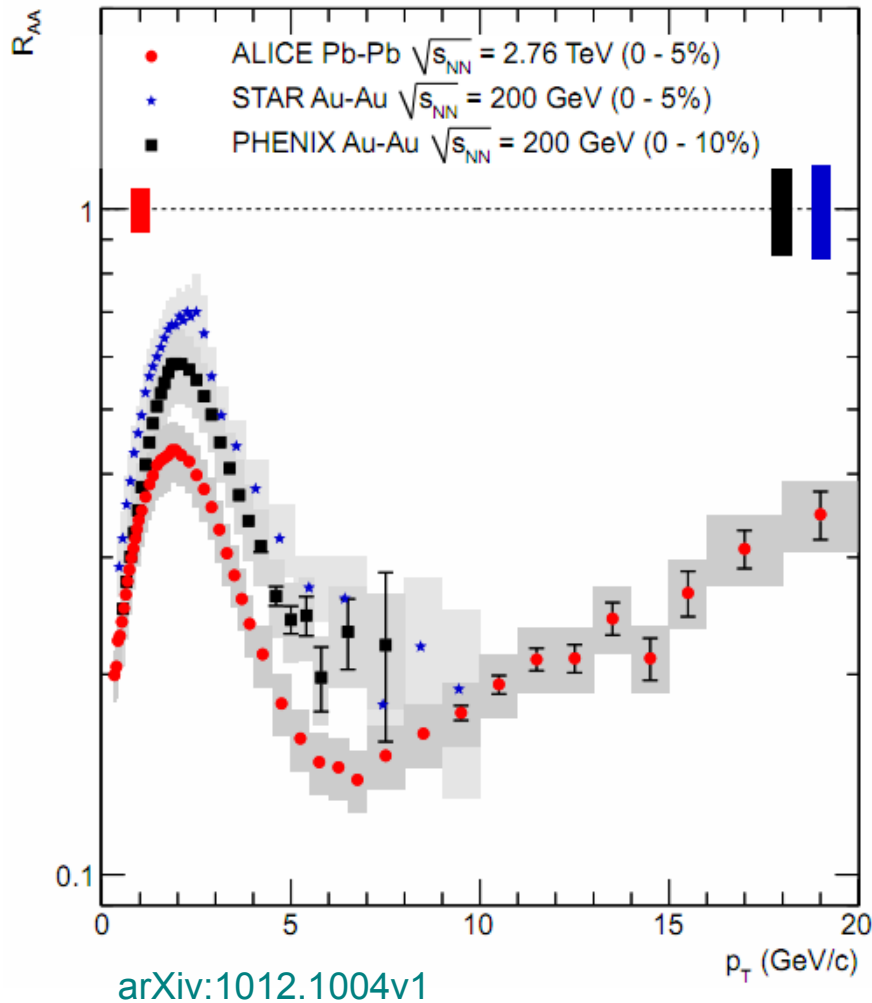
➤ Previous R_{CP} Measurements at RHIC



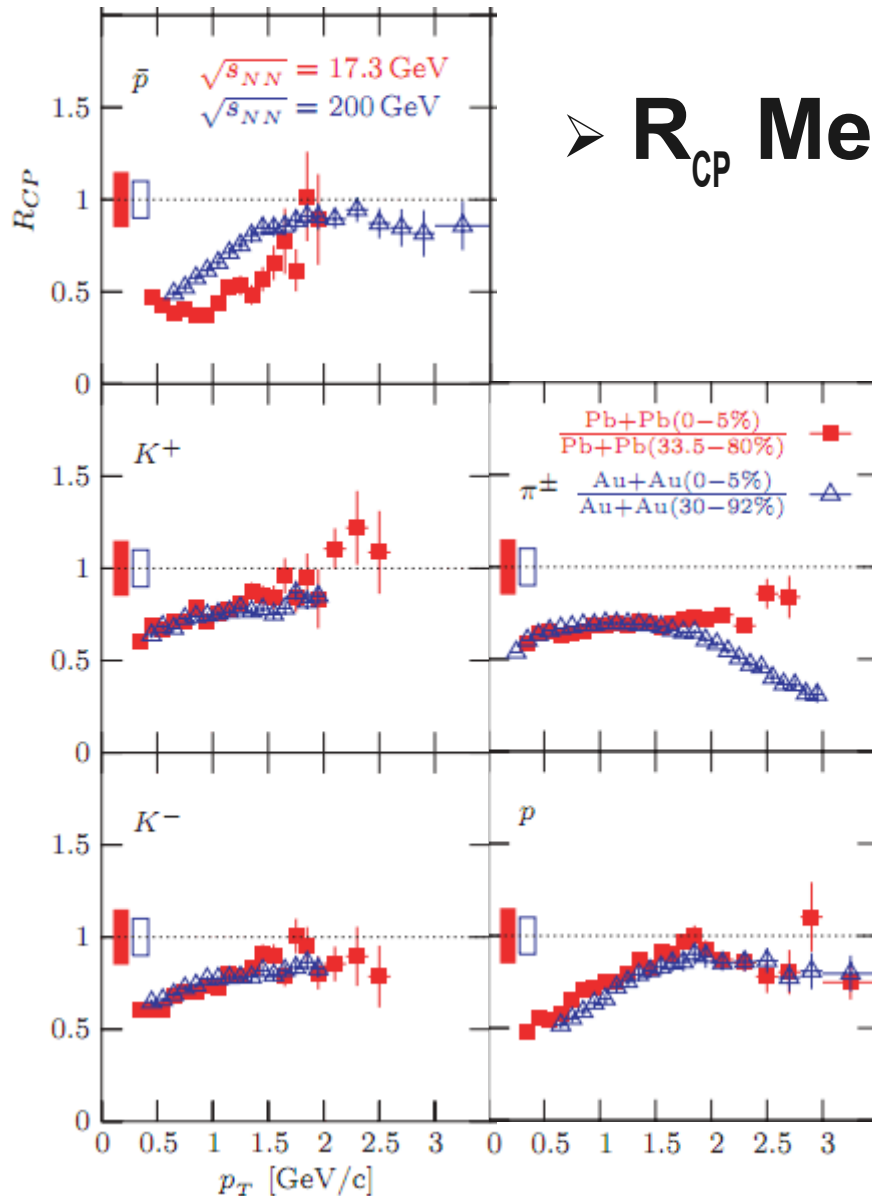
PhysRevLett.91.172302

- Clear suppression of high p_T particles
- Consistent with partonic energy loss models
- **Key signature of a dense colored medium**

➤ R_{AA} Measurements at LHC



- Increased suppression at higher collision energies
- Suppression extends to higher transverse momentum

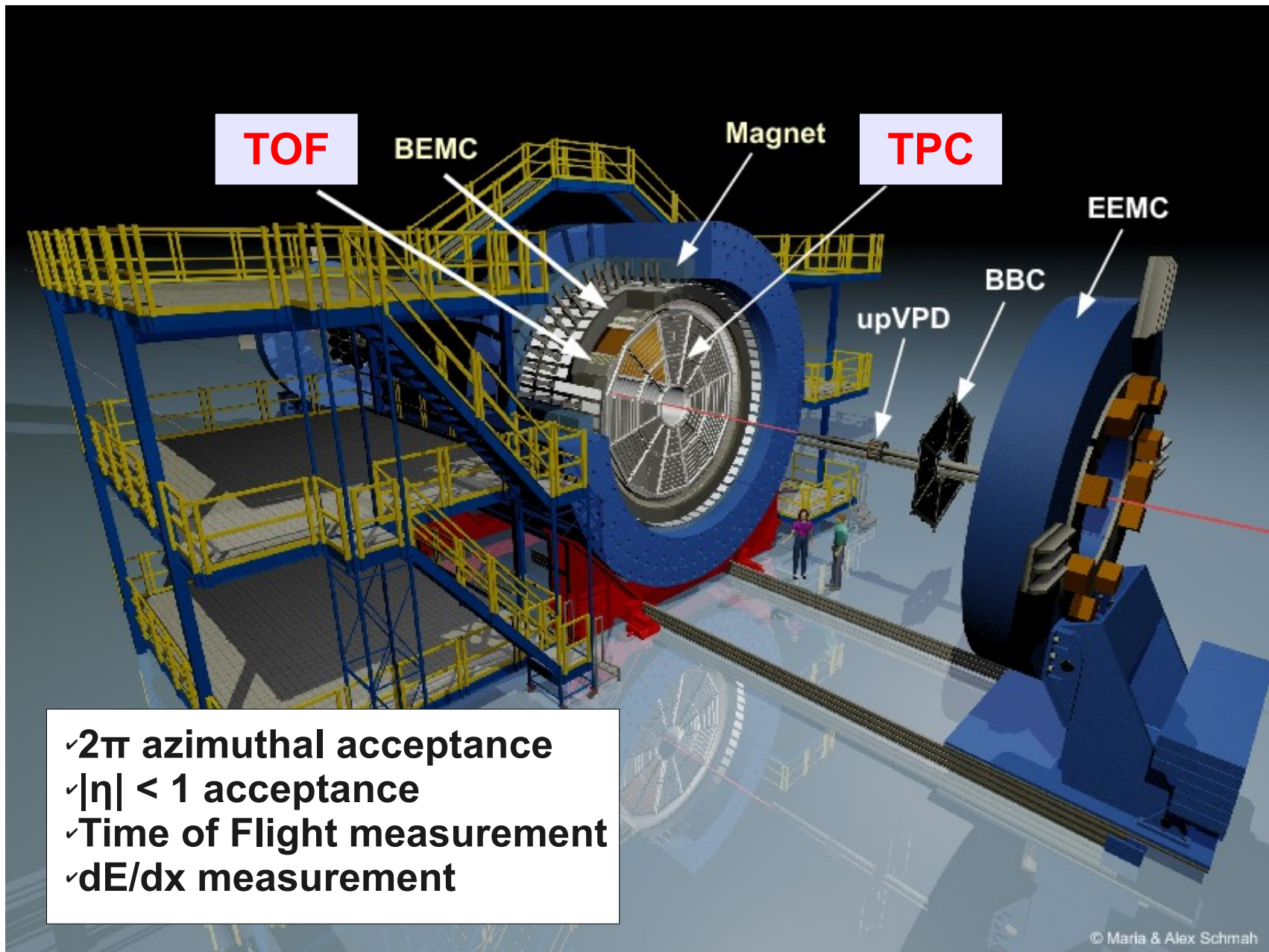


➤ R_{CP} Measurements at SPS

- Attempted to measure R_{CP} at $\sqrt{s_{NN}} = 17.3$ GeV
- Statistics too limited to make a firm statement about the extent of suppression

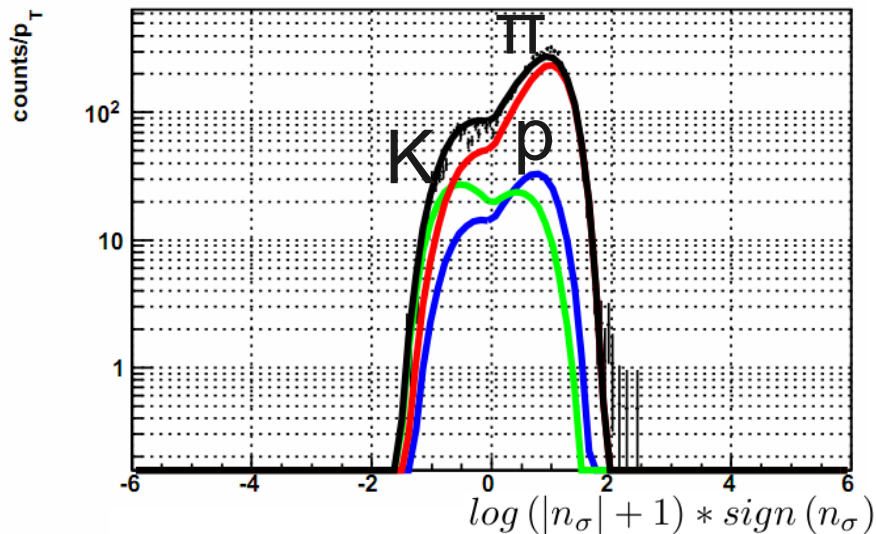
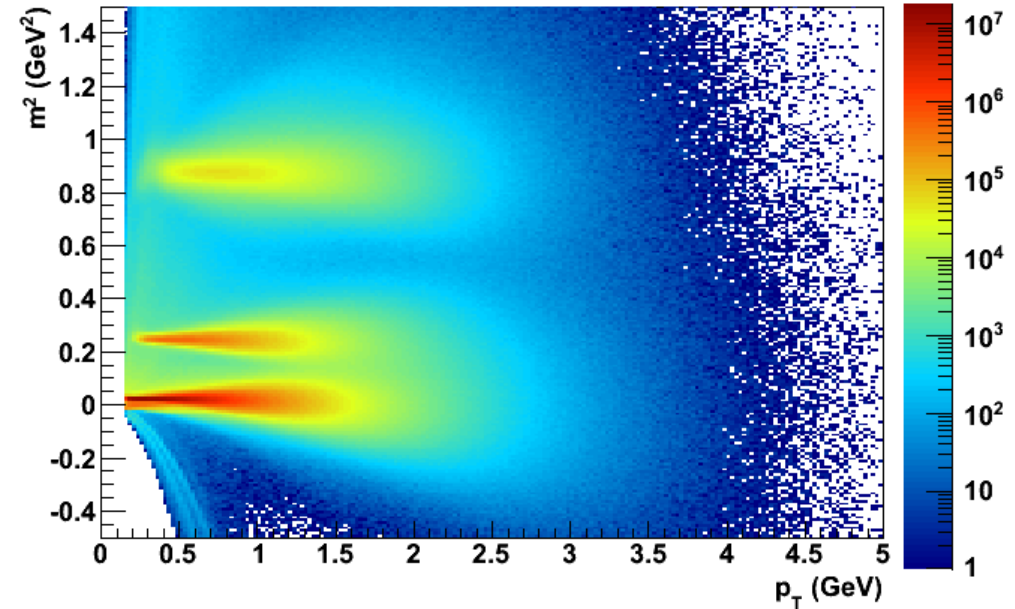
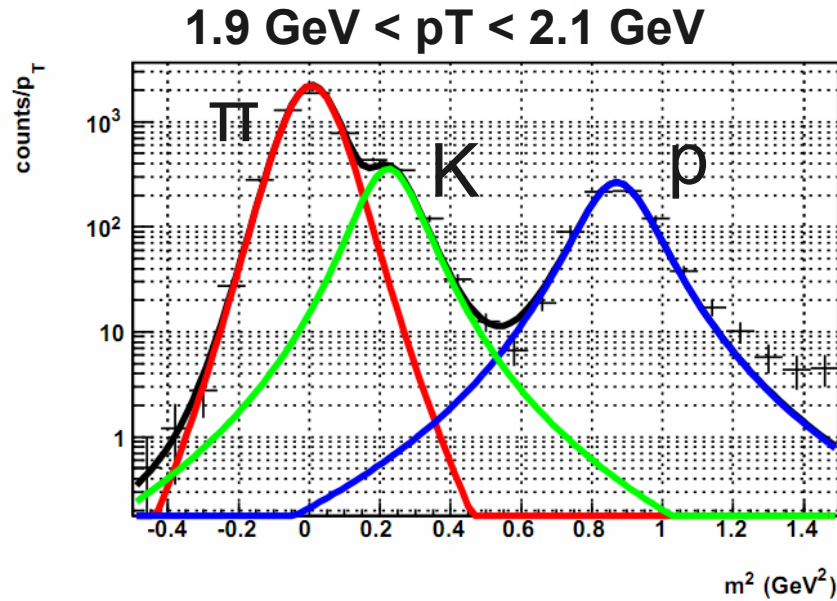


The STAR Detector



- ✓ 2π azimuthal acceptance
- ✓ $|\eta| < 1$ acceptance
- ✓ Time of Flight measurement
- ✓ dE/dx measurement

Particle Identification

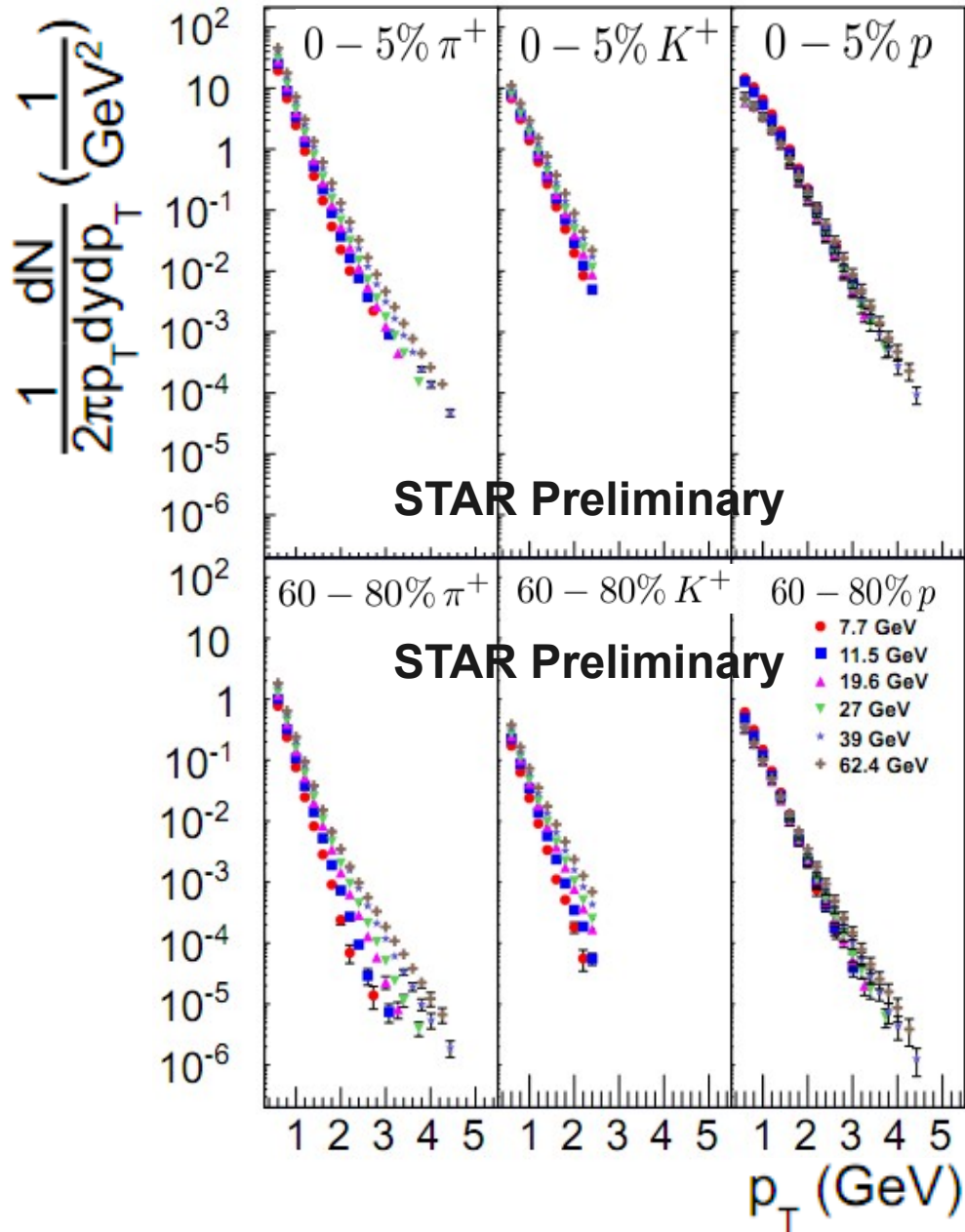


where n_σ is dE/dx after being shifted and scaled such that $\mu \approx 0$ and $\sigma \approx 1$ for protons

Particle identification is performed using simultaneous TOF (m^2) and TPC (dE/dx) fits

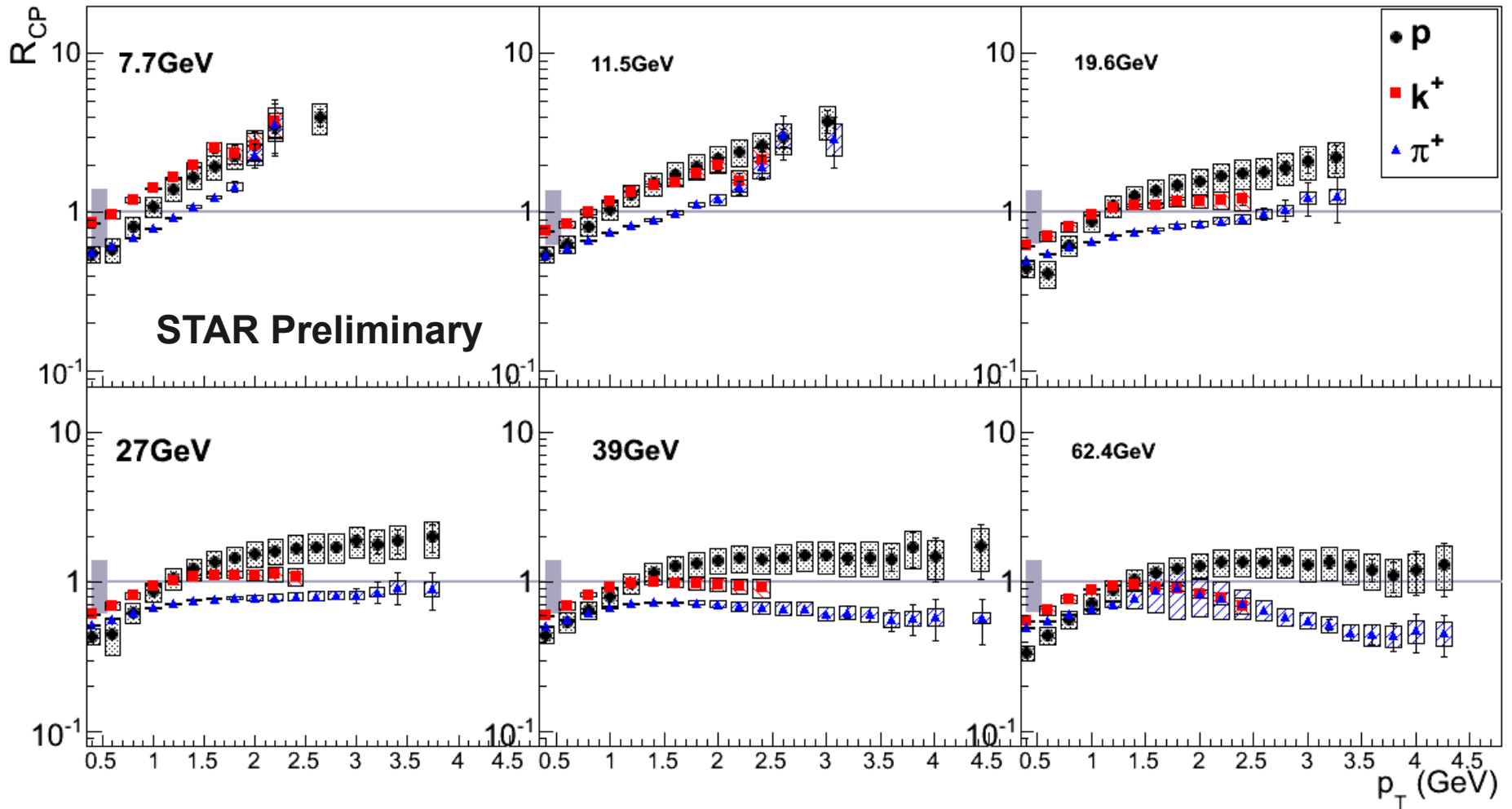


Charged Particle Spectra



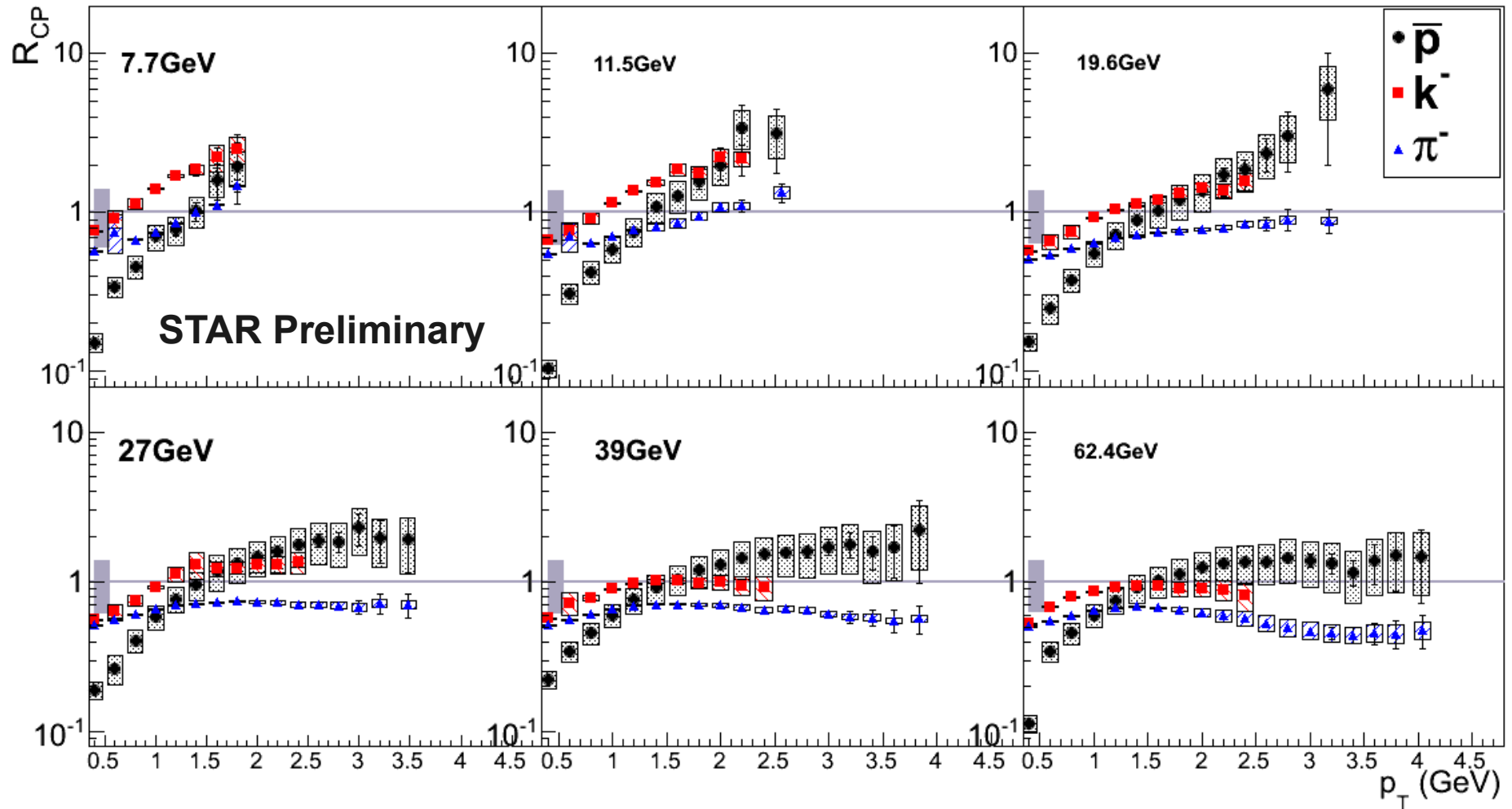
- Spectra for identified charged particles is extracted at each collision energy
- Efficiency and energy loss corrections are applied

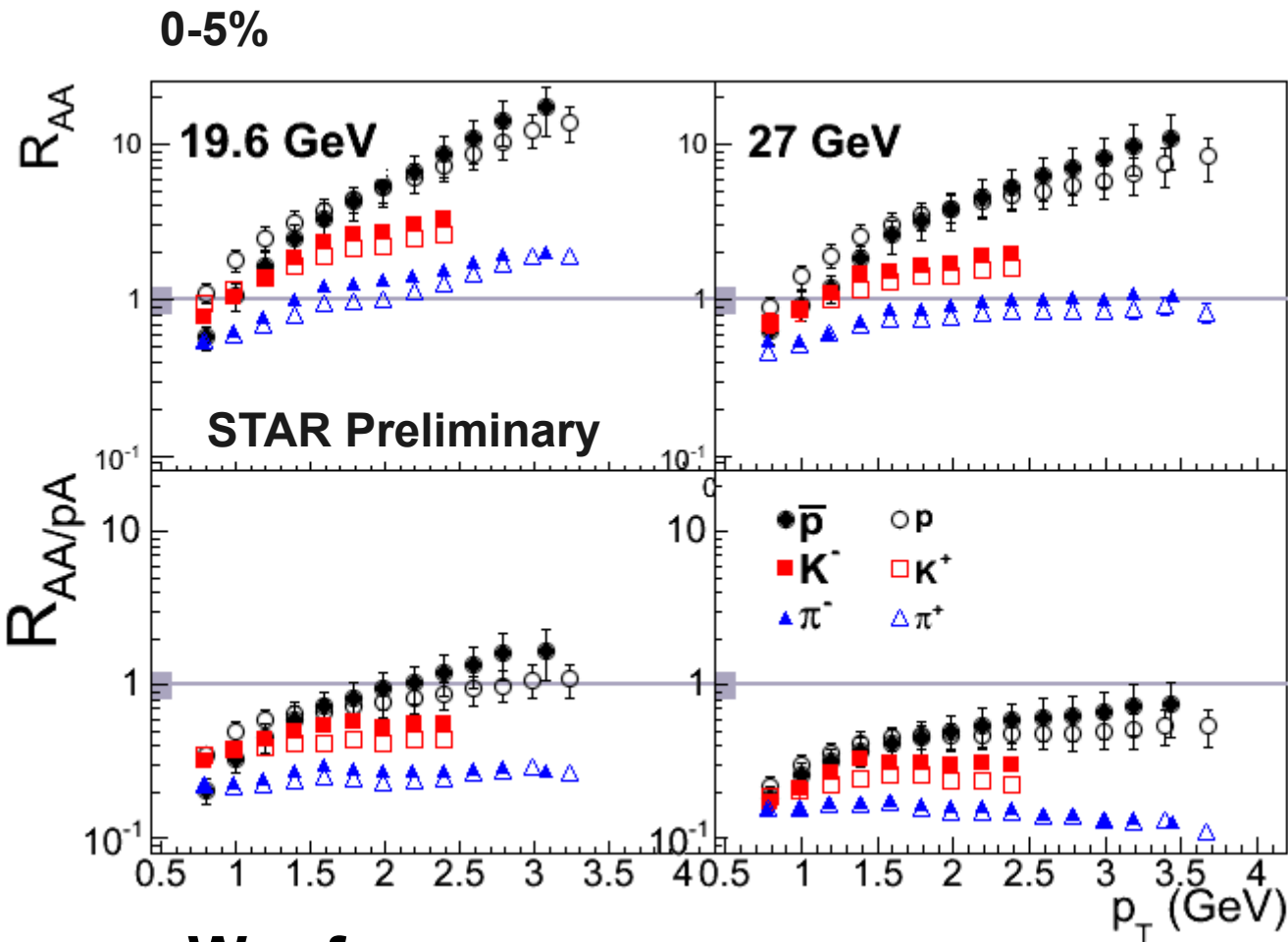
0-5% / 60-80%



Negative Charge R_{CP}

0-5% / 60-80%



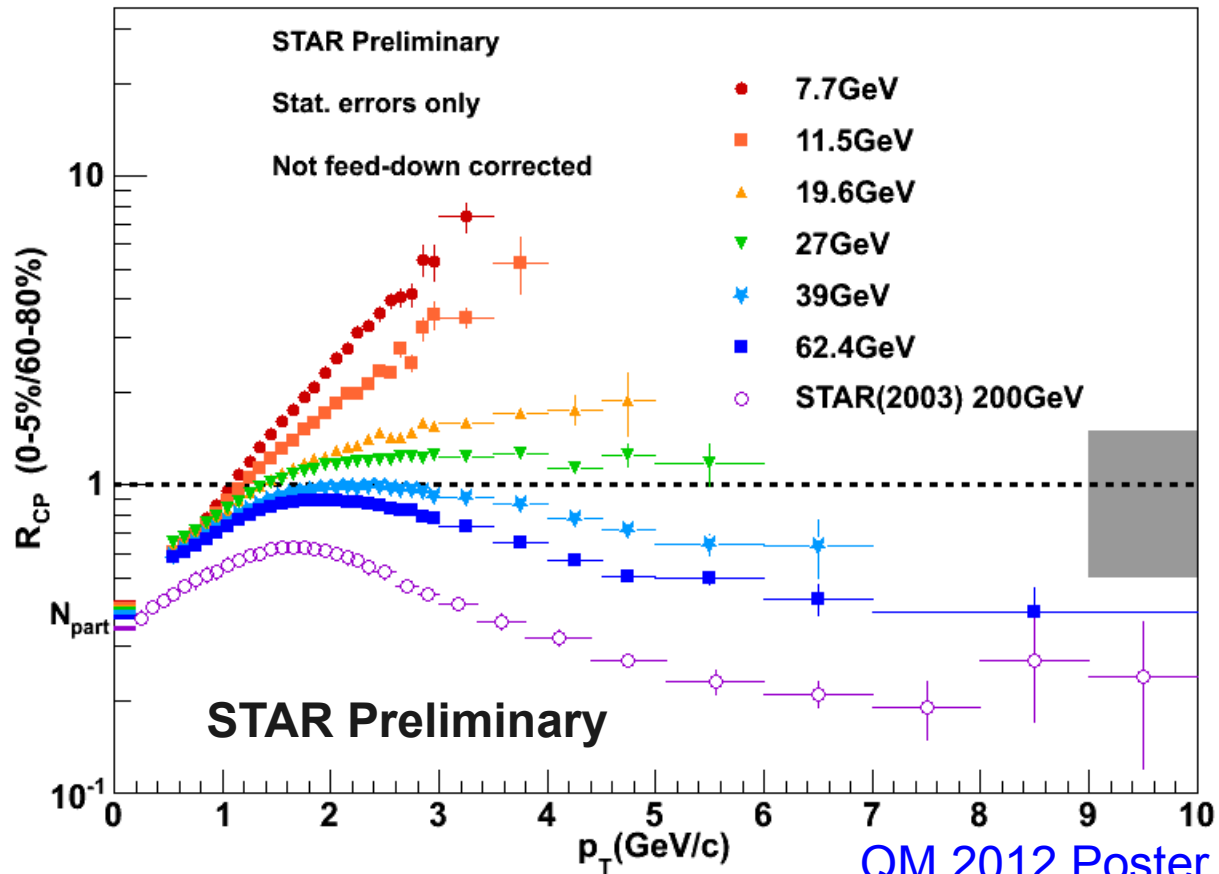


p+W reference

Phys. Rev. D 19, 764–778 (1979)

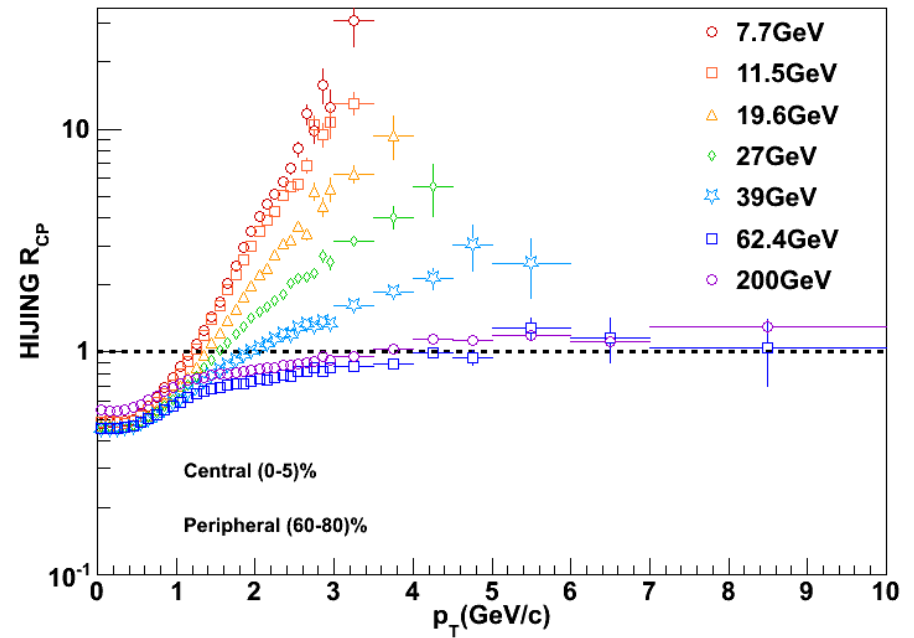
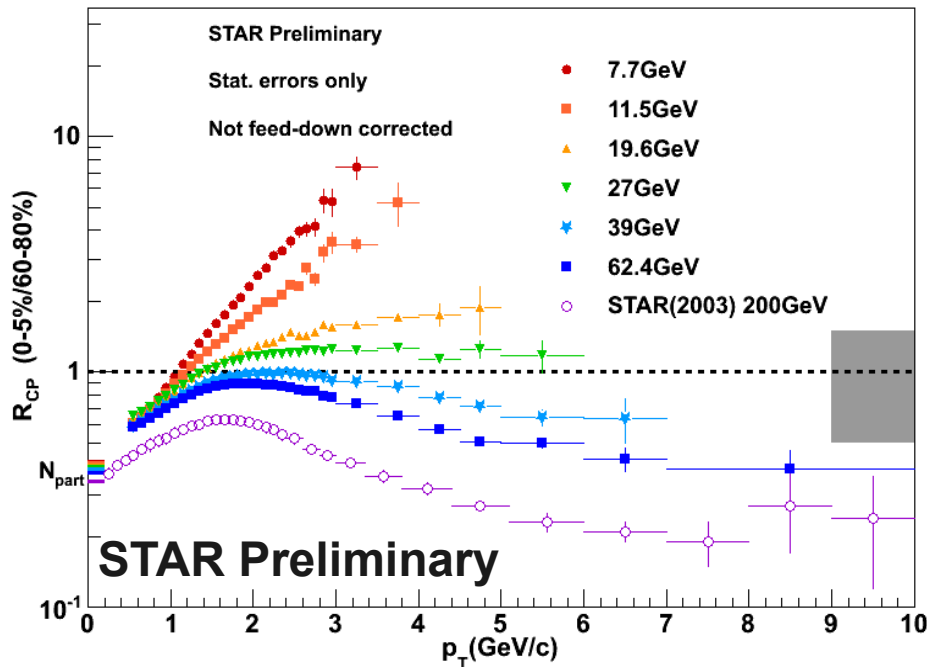
$R_{AA/pA}$ is meant to be qualitative, the Cronin effect scales in a more complicated way.

- Cronin enhancement stronger at high p_T
- Impact on R_{CP} and R_{AA} would be a reduction of apparent suppression



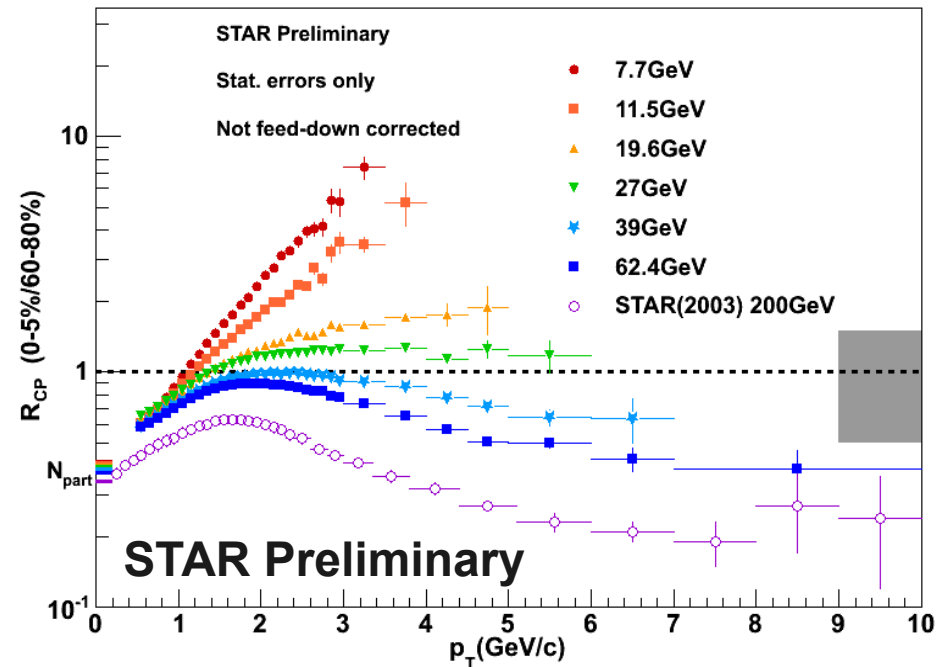
High p_T suppression turns off at lower collision energies.

Hijing Simulation



Hijing qualitatively describes trend between energies without jet quenching enabled.

- **Suppression turns off at lower collision energies**
- Possible disappearance of QGP?
- Cronin effect
- Relative contributions of soft physics and hard scattering



- Model comparisons are necessary



Conclusions

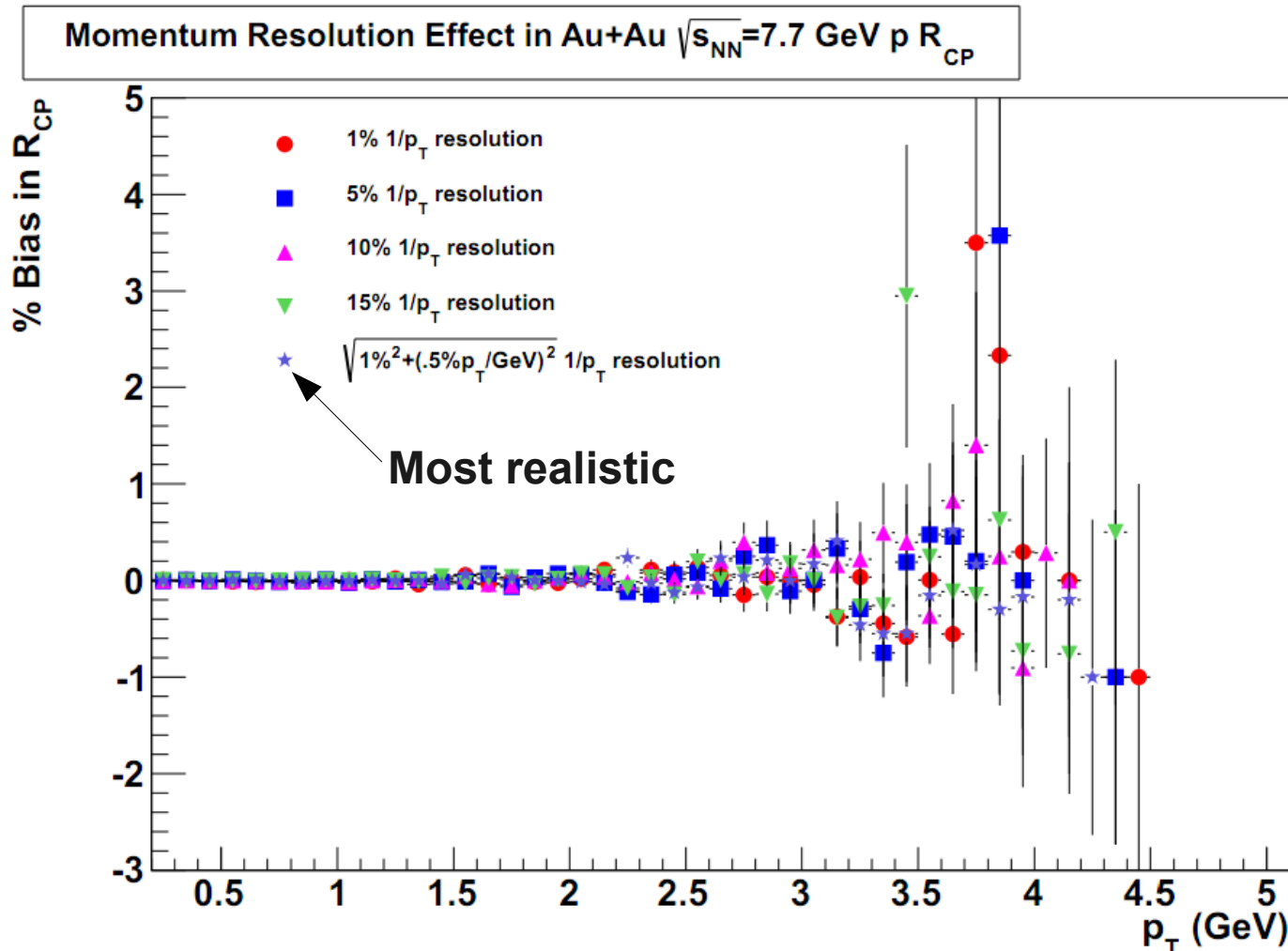
- R_{CP} , R_{AA} , and $R_{AA/pA}$ have been measured over a range of energies
- Smooth transition in behavior between energies
- Clear turn off of suppression ($R_{CP} < 1$) has been observed at 27 GeV and below
 - R_{CP} has varying sensitivity to jet quenching at different collision energies
 - Further studies are ongoing to disentangle effects



Backup Slides

Momentum Resolution

- Impact was evaluated using MC events generated from spectra fits to the data



The effect is negligible compared to other systematics at all energies in the p_T region we analyze.