Study of identified hadrons in Au+Au collisions at $\sqrt{s_{NN}}$ = 27 GeV using the STAR Detector at RHIC

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On Behalf of the STAR Collaboration
Quark Matter, Krakow. 6 April 2022

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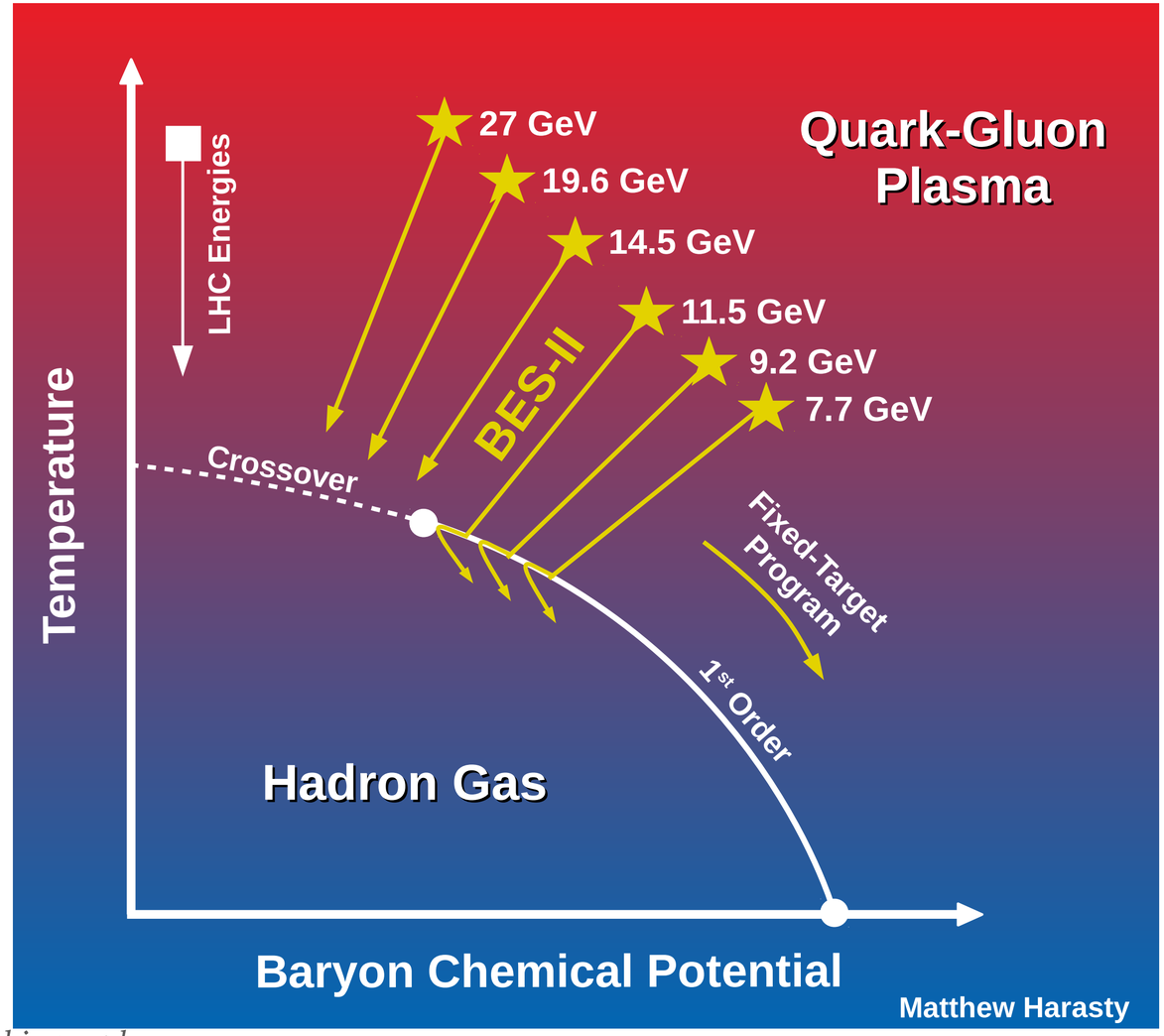
MOTIVATION

- Where are we on the QCD phase diagram?
- How does particle production change across centrality and rapidity?
- How does the chemical freeze-out temperature and baryon chemical potential change with centrality and rapidity?



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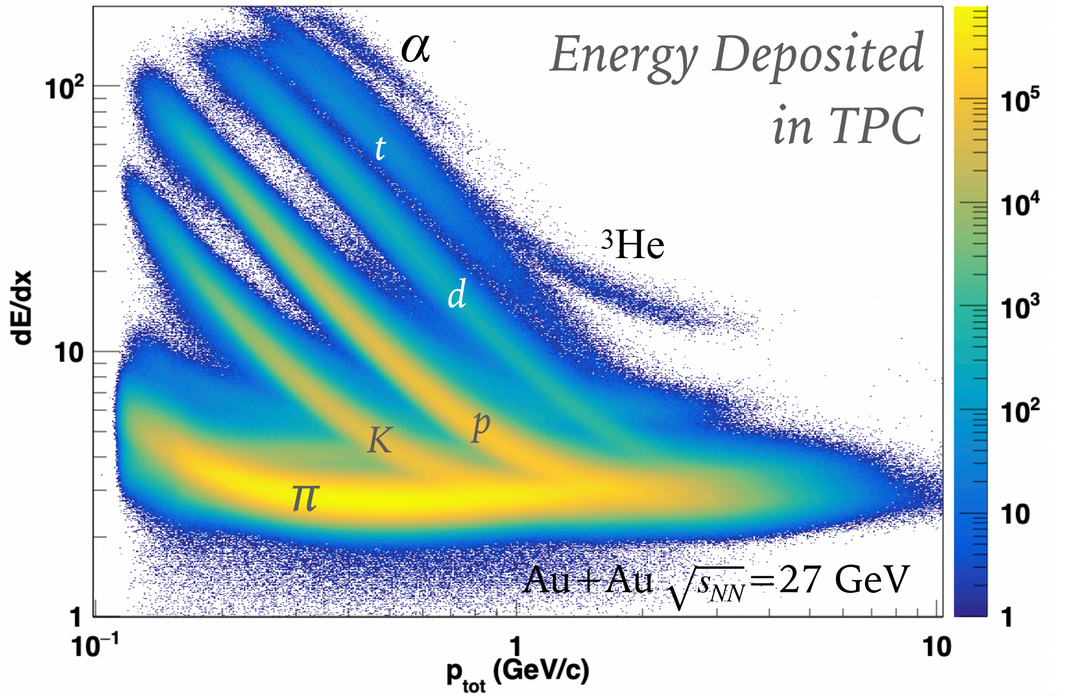
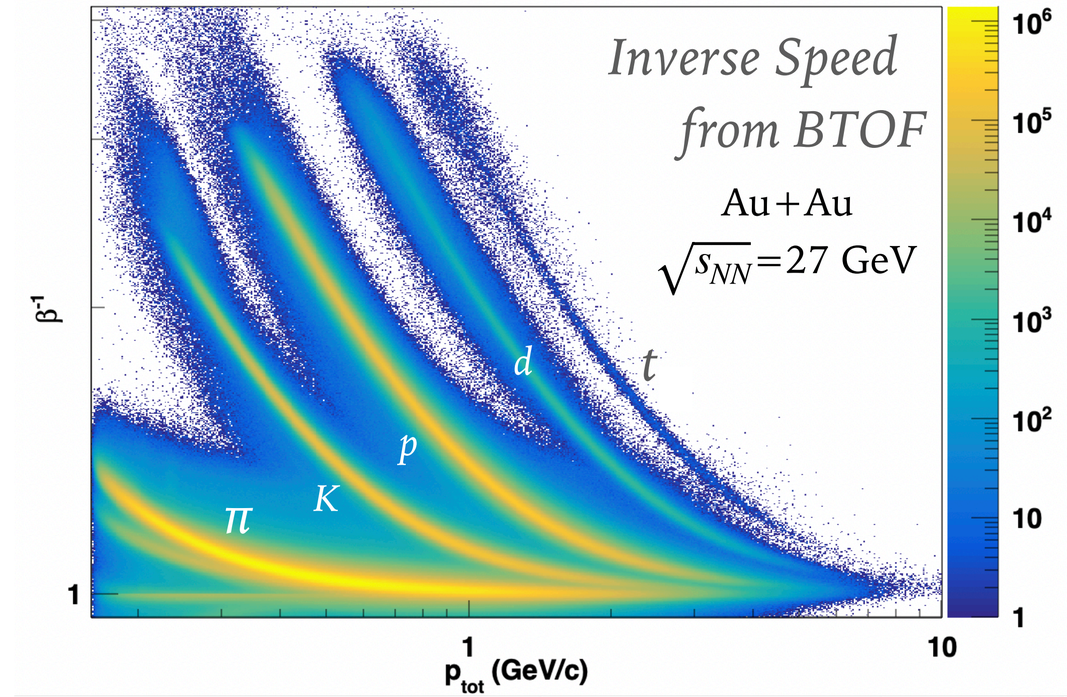
DATA AND METHODOLOGY

- Solenoidal Tracker at the Relativistic Heavy Ion Collider (STAR)
- Beam Energy Scan - II
- $\sqrt{s_{NN}}$= 27GeV Au+Au year 2018
- 200 Million events
- V_z = [-30, 30] cm V_r < 2.0 cm
- Particle separation by dE/dx in TPC
- Particle separation by β^{-1} in barrel TOF
- $\eta \approx$ [-1,1] and 0-80% centrality
- $\pi^{\pm}, K^{\pm}, p,$ and $\bar{p}$





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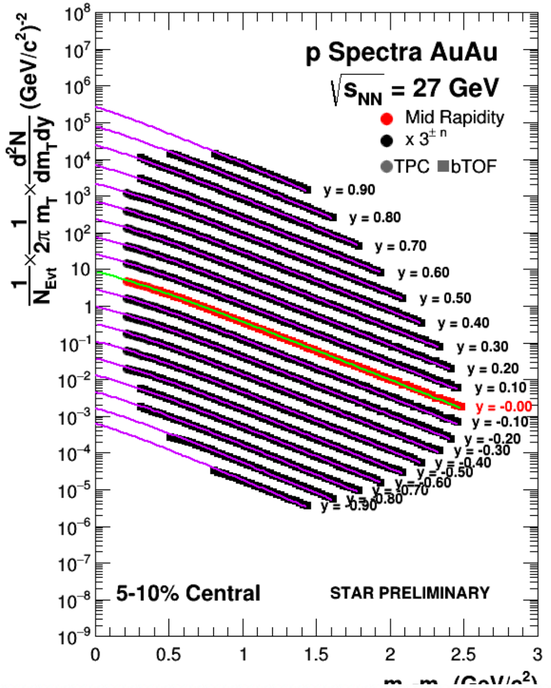
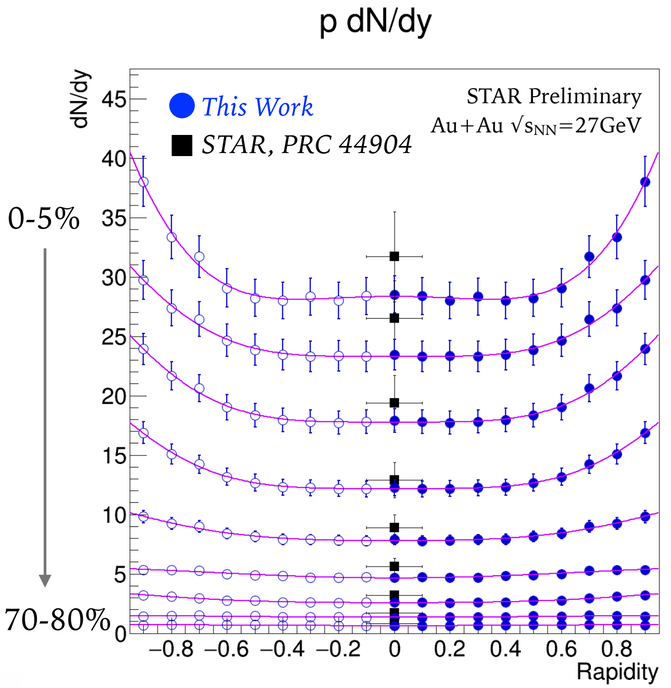
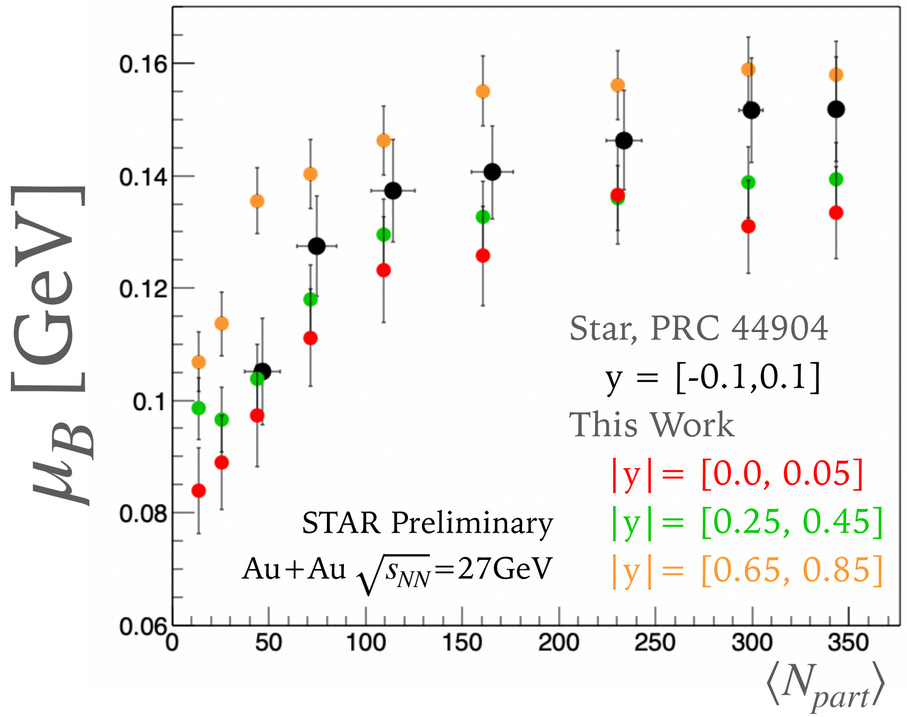
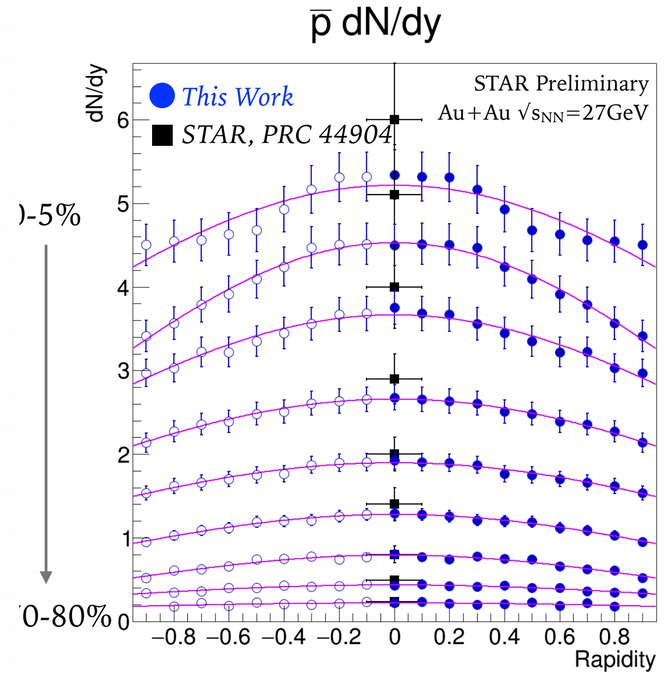
(ANTI-) PROTON YIELDS

- Blast-Wave Fit to extract dN/dy
- Thermal production of p and $\bar{p}$ at y = 0
- Participant protons stopped (y=3.4→1.6)
- THERMUS fit of $\pi^{\pm}, K^{\pm}, p,$ and $\bar{p}$ for measurement of μ_B
- $\Delta\mu_B \sim 25$ MeV for $\Delta y = 1$
- Centrality dependence expands measurement range in phase diagram









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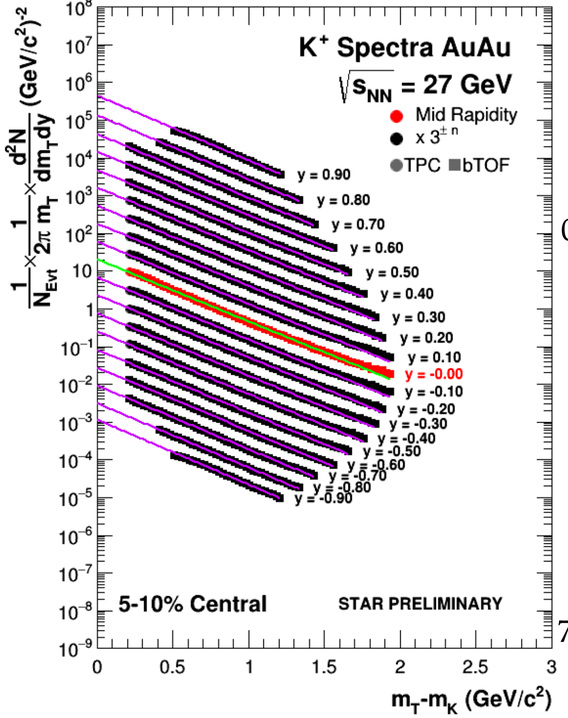
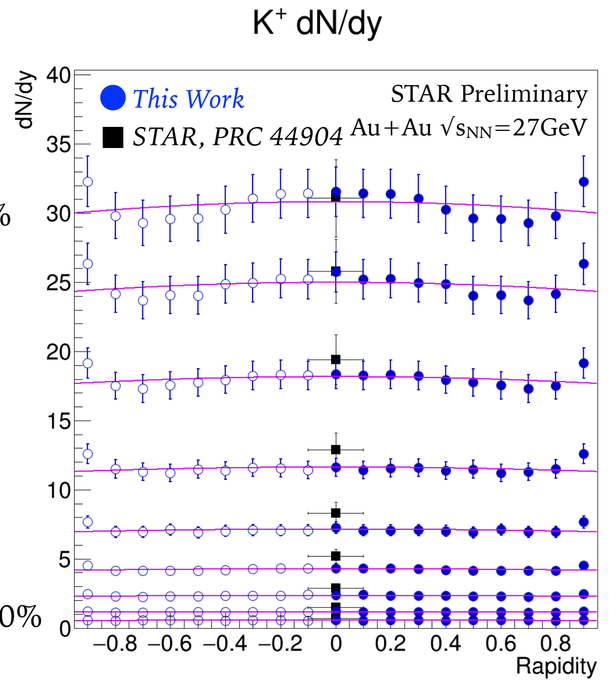
CHARGED KAON YIELDS

- m_T exponential fit to extract dN/dy
- Interpretation based on hadronic interaction:
  - K^- dominated by pair production of $K^+$and K^-
  - 1/3 of K^+ from associated production

$$NN \rightarrow N\Lambda K^+$$

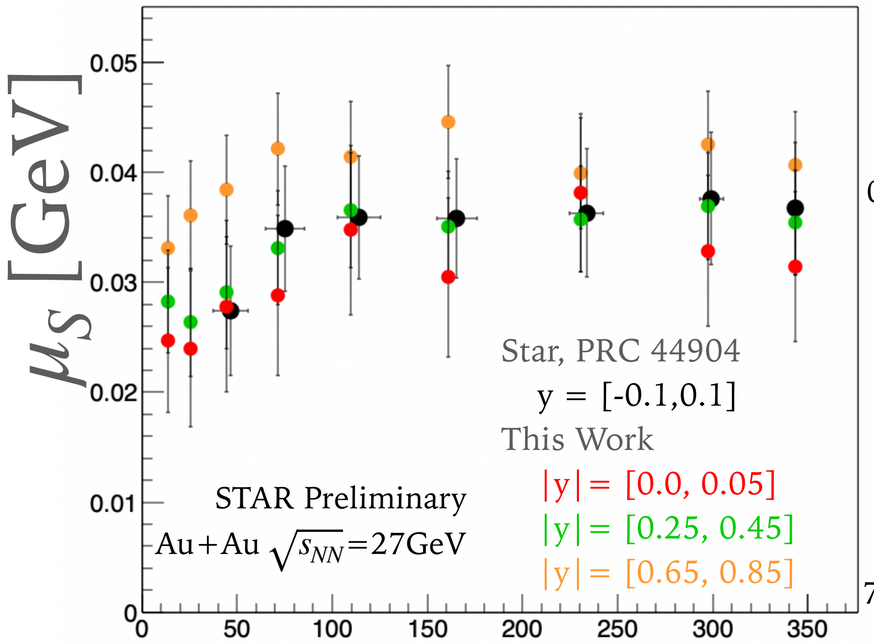
- Interpretation based on thermodynamics:
  - Finite μ_S results in 1/3 excess of K^+over K^-
  - THERMUS fit of $\pi^\pm, K^\pm, p,$ and $\bar{p}$ for measurement of μ_S
- Rapidity dependence of μ_S from shape of dN/dy of stopped participant protons

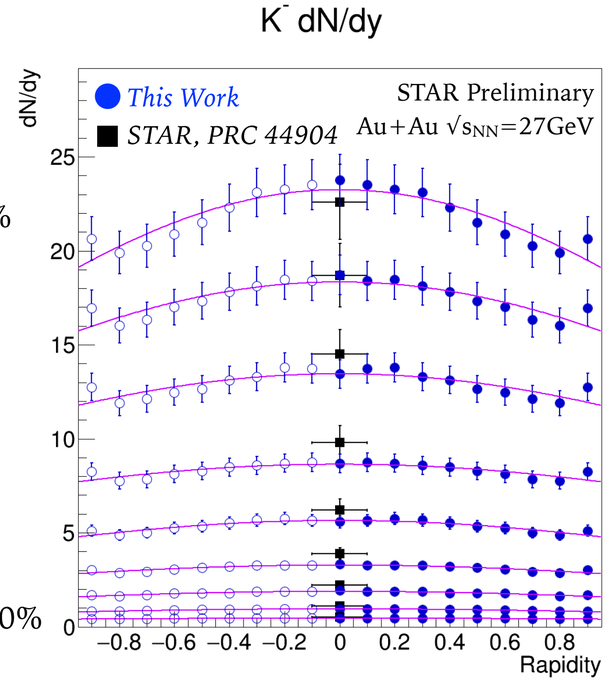




0-5%

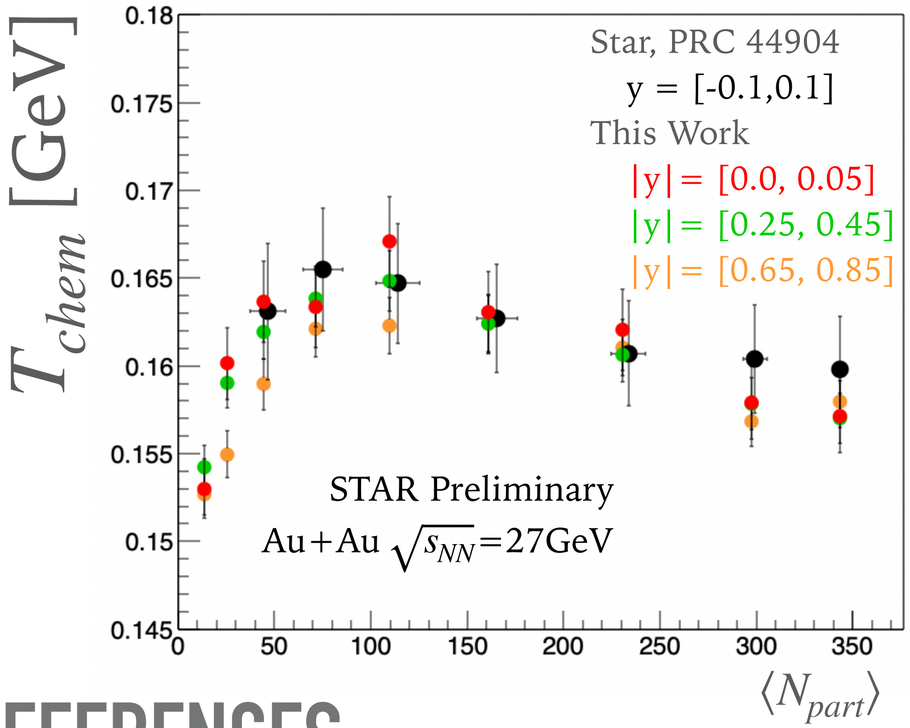
70-80%





T_{CHEM} AND CONCLUSIONS

- Analysis of other BES-II data underway
- $\sqrt{s_{NN}}$ = 27 GeV: $\pi^{\pm}, K^{\pm}, p,$ and $\bar{p}$ production has been measured beyond mid-rapidity and across many centralities
- Stopping of participant protons causes $\Delta\mu_B \sim 25$ MeV for $\Delta y = 1$
- Increasing of μ_B (stopping) and conservation of strangeness would cause significant excess of K^+ over K^- with $\Delta\mu_S \sim 10$ MeV for $\Delta y = 1$
- Future Work:
  - $\sqrt{s_{NN}}$: 19.6, (17.1), 14.6, 11.5, 9.2, 7.7 GeV
  - End-cap ToF to extend rapidity coverage



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