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

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

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?

Supported in part by
DATA AND METHODOLOGY

➤ Solenoidal Tracker at the Relativistic Heavy Ion Collider (STAR)
➤ Beam Energy Scan - II
➤ $\sqrt{s_{NN}} = 27$GeV 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 $\beta^{-1}$ in barrel TOF
➤ $\eta \approx [-1,1]$ and 0-80% centrality
➤ $\pi^\pm, K^\pm, p$, and $\bar{p}$
**(ANTI-) PROTON YIELDS**

- Blast-Wave Fit to extract $dN/dy$
- Thermal production of $p$ and $\bar{p}$ at $y = 0$
- Participant protons stopped ($y = 3.4 \rightarrow 1.6$)
- THERMUS fit of $\pi^\pm$, $K^\pm$, $p$, and $\bar{p}$ for measurement of $\mu_B$
- $\Delta \mu_B \sim 25$ MeV for $\Delta y = 1$
- Centrality dependence expands measurement range in phase diagram
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 $\mu_S$ results in 1/3 excess of $K^+$ over $K^-$
  - THERMUS fit of $\pi^\pm, K^\pm, p$, and $\bar{p}$ for measurement of $\mu_S$
- Rapidity dependence of $\mu_S$ from shape of $dN/dy$ of stopped participant protons
**References**