Identified particle spectra in isobaric collisions of Ru+Ru and Zr+Zr at $\sqrt{s_{NN}} = 200$ GeV with the STAR experiment

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Motivation & STAR detector

- Motivation: transverse momentum distributions of identified hadrons contain information of transverse expansion of the system and reveal the freeze-out properties of the matter created in relativistic heavy ion collisions.

STAR detector

- Time Projection Chamber (TPC)
  - Track reconstruction
  - Energy loss calculation

- Time Of Flight detector (TOF)
  - Particle identification
  - Pile-up rejection
Particle identification

- Particle identification at high momentum region is challenging when using $dE/dx$ or $m^2$ alone.
- PID capability could be improved if TPC and TOF information are combined.

\[ f_{\text{scale}} = \frac{\sigma(n\pi)}{\sigma(m^2(\pi))} \]
\[ x' = \frac{n(\pi) - \mu(n\pi)}{f_{\text{scale}}} \]
\[ y' = m^2 - \mu(m^2(\pi)) \]

Rotation angle:
\[ \alpha = \tan^{-1} \left( \frac{\mu(m^2(K)) - \mu(m^2(\pi))}{\mu(n\sigma_K) - \mu(n\sigma_{\pi})} \right) \]

Rotation:
\[ \begin{pmatrix} x(n\sigma_{\pi}, m^2) \\ y(n\sigma_{\pi}, m^2) \end{pmatrix} = \begin{pmatrix} \cos(\alpha) & -\sin(\alpha) \\ \sin(\alpha) & \cos(\alpha) \end{pmatrix} \begin{pmatrix} x' \\ y' \end{pmatrix} \]

Particle ratios between Ru+Ru and Zr+Zr collisions

- More particle production in Ru+Ru than Zr+Zr at same centrality.
- Similar centrality dependence for each particle species.
- For a given centrality, the particle ratio increases more rapidly with increasing particle mass, which could be driven by different radial flows in the two collision systems.
Double ratios between Ru+Ru and Zr+Zr collisions

Outlook:
- Extract freeze-out parameters from fully corrected spectra.
- Study connections between charge stopping and baryon stopping.

○ The double ratios of \( \frac{\pi^+}{\pi^-} \) and \( \frac{p}{\bar{p}} \) are larger than 1. Due to extra charge in Ru?
○ The double ratios of \( \frac{K^-}{K^+} \) is consistent with unity within uncertainties.