Study of particle production of identified hadrons in Au+Au collisions at $\sqrt{s_{NN}} = 54.4$ GeV using the STAR detector

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#### Beam Energy Scan (BES) program at RHIC

- Study of QCD Phase Diagram
- Search of QCD Critical Point
- Search of the first order phase transition

- **BES I (2010-2014)**
  \[ \sqrt{s_{NN}} = 62.4, 39, 27, 19.6, 14.5, 11.5, 7.7 \text{ GeV} \]

- **BES II (2017-2021)**
  Collider mode: \[ \sqrt{s_{NN}} = 54.4, 27, 19.6, 17.3, 14.6, 11.5, 9.2, 7.7 \text{ GeV} \]
  Fixed target program: \[ \sqrt{s_{NN}} = 13.7, 11.5, 9.2, 7.7, 7.2, 6.2, 5.2, 4.5, 3.9, 3.5, 3.2, 3.0 \text{ GeV} \]

The main idea behind the BES Program is to vary the collision energy and look for the signatures of the QCD phase boundary and QCD critical point.
Data set: Au+ Au collisions
Energy: 54.4 GeV
Particles studied: \(\pi^\pm\), \(K^\pm\), \(p\) and \(\bar{p}\)
Detectors for Particle Identification: TPC (Time Projection Chamber) and TOF (Time Of Flight)

The yields from TOF are obtained using the variable mass-square \((m^2)\) within rapidity \(|y| < 0.1\) for \(p_T > 0.7\) GeV/c for pions and kaons, and \(p_T > 0.9\) GeV/c for protons.
Centrality dependence of particle yields and ratios

- Levy function fitting for $\pi^\pm$ and $K^\pm$
- Double exponential fit for $p$ and $\bar{p}$
- $p_T$ integrated yields and particle ratios obtained from fits.
Energy dependence of particle ratios and kinetic freeze-out

Conclusions:
- Presented $\pi^\pm$, $K^\pm$, $p$ and $\bar{p}$ particle production in Au+Au collisions at $\sqrt{s_{NN}} = 54.4$ GeV.
- The $p_T$ integrated yields and yield ratios are in trend with other energies.
- The kinetic freezeout temperature ($T_{kin}$) and $<\beta>$ are anti-correlated, and in trend with other energies.