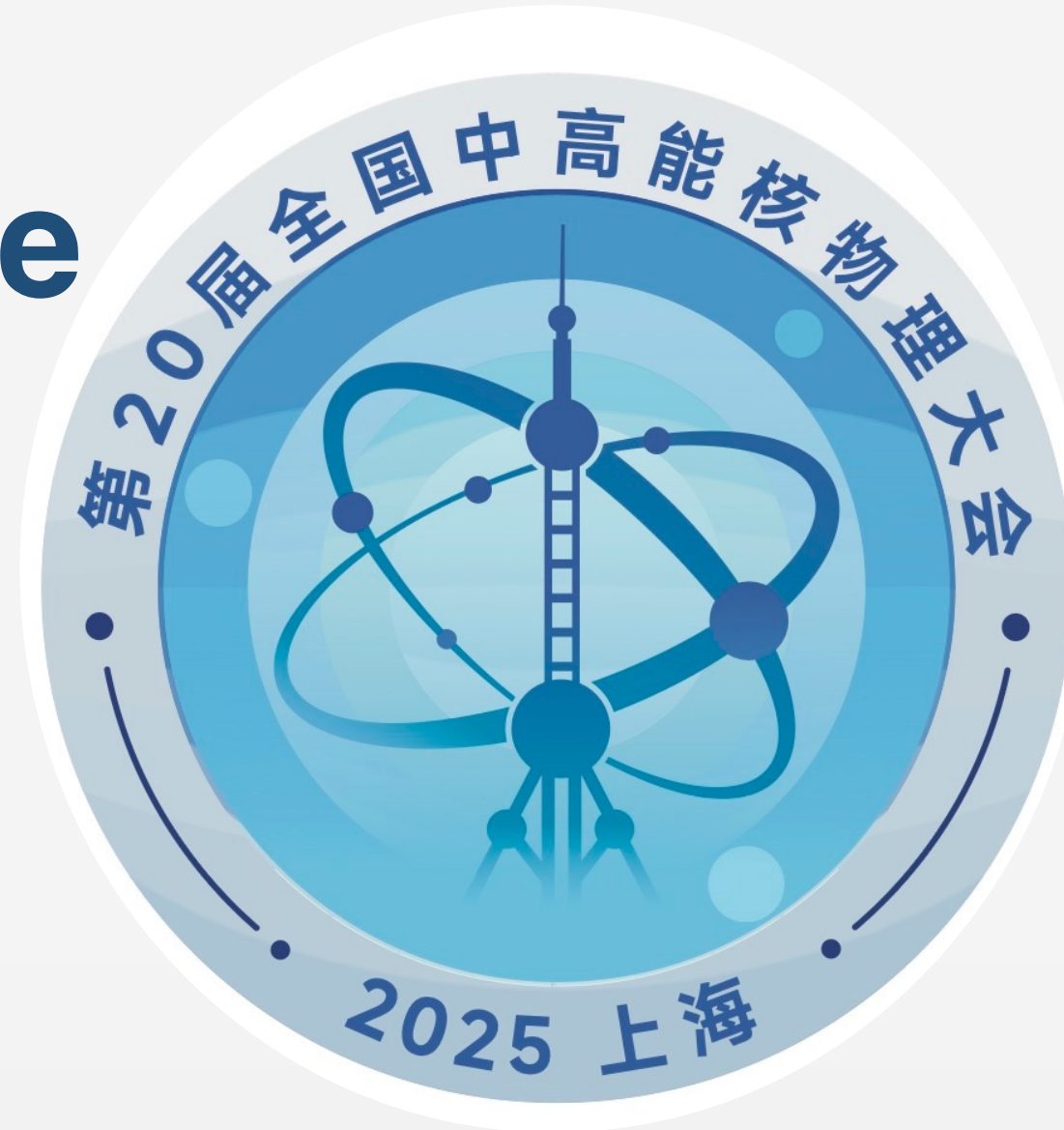


Investigating system size dependence of strange hadron production at 200 GeV at STAR

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Abstract

There are significant discussions in the field about the initial conditions, including the size of the system, needed to generate a quark-gluon plasma (QGP). Strangeness production serves as a sensitive probe into the properties of the QGP. It is expected that the Ω/ϕ ratios in different colliding systems may reveal the minimum colliding system size required to produce QGP.

In this poster, we will present the transverse-momentum (p_T) spectra of strange hadron ($\phi, \Omega, \bar{\Omega}$) in isobar (Ru+Ru and Zr+Zr) and O+O collisions at $\sqrt{s_{NN}} = 200$ GeV at mid-rapidity ($y < |0.5|$) and the Ω/ϕ ratios in those colliding systems. The O+O system has the extended kinematic coverage benefit from the iTPC upgrade, which extended the rapidity coverage and enhanced the particle identification capability compared with previous results.

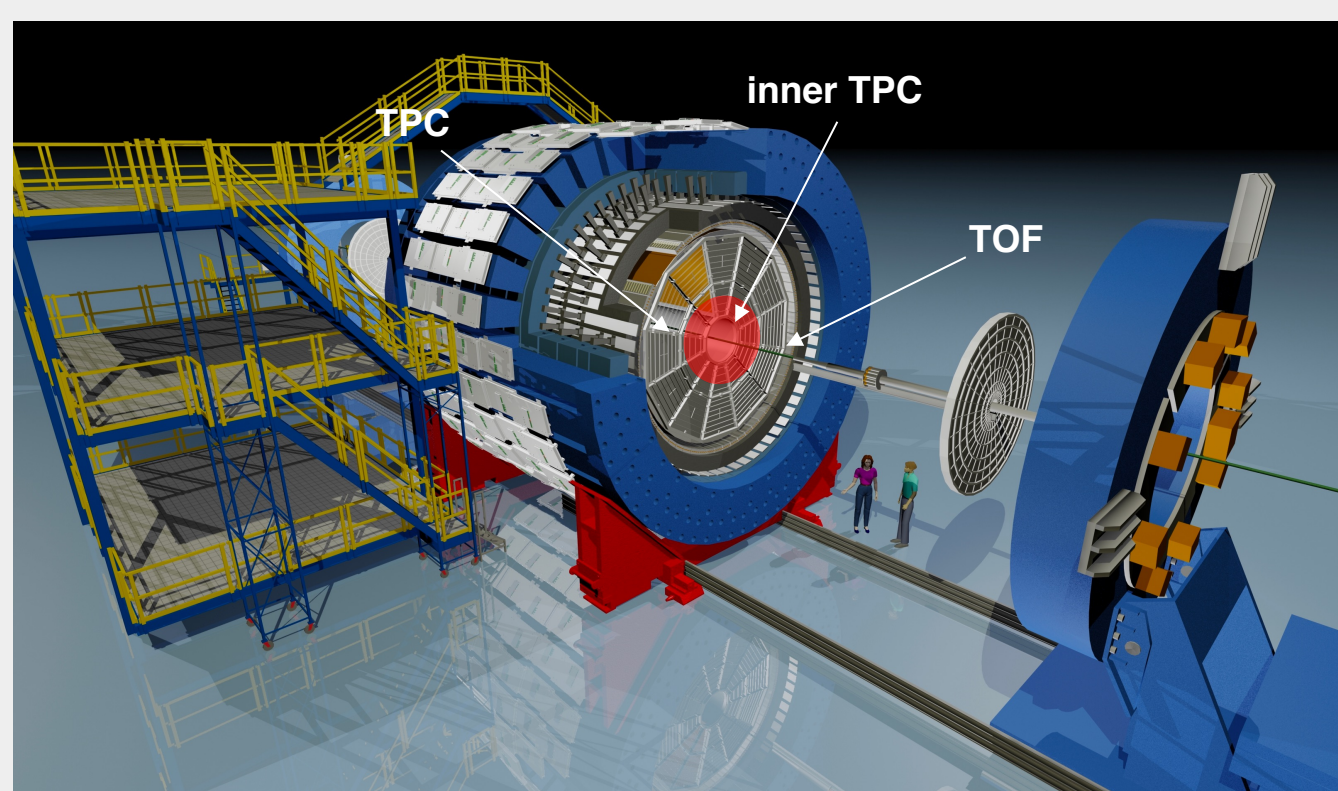
Motivation

- Update Ω/ϕ ratio as a function of p_T in different colliding systems to explore the minimum colliding system size required to produce QGP.
- Precise measurement of $\Omega(\bar{\Omega})$ yields to investigate the system size dependence of strangeness production.

STAR Detector

iTPC (STAR Inner Sector TPC Upgrade) :

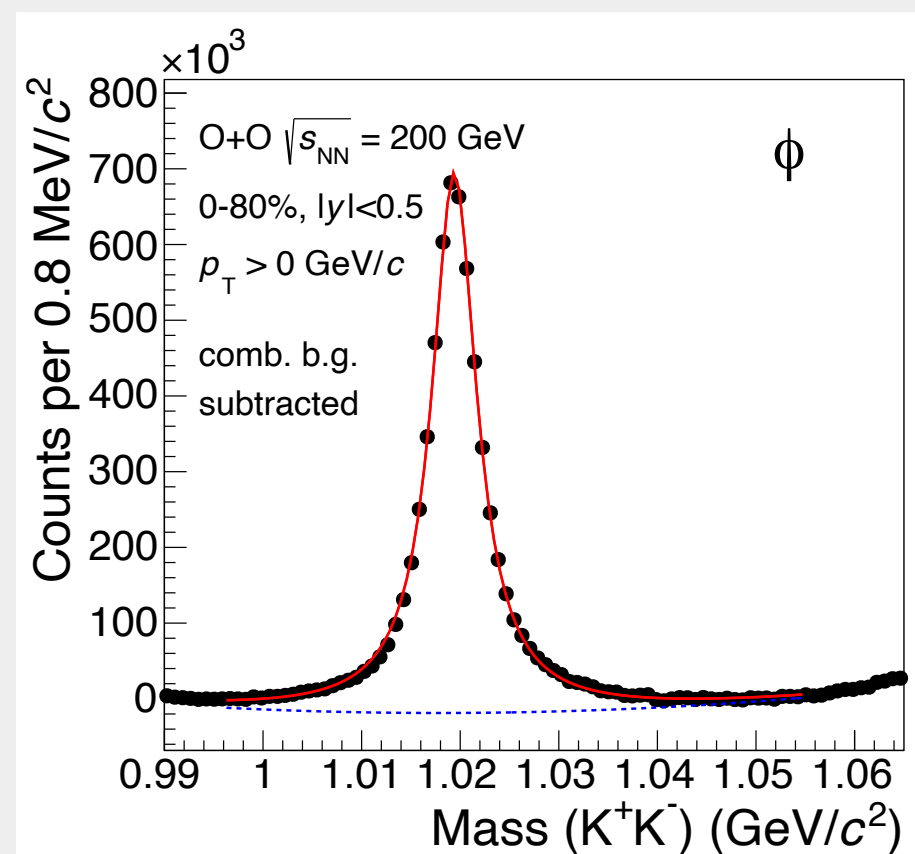
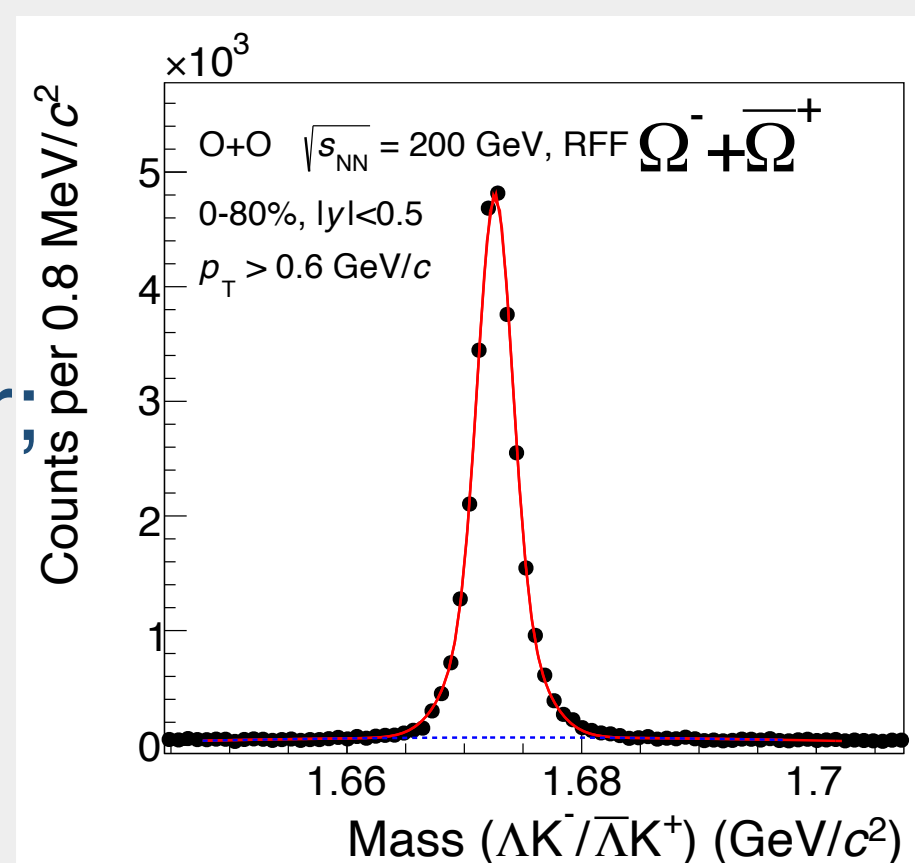
- Larger rapidity coverage — $|\eta|$ from 1.0 to 1.5;
- Better PID — improved dE/dx resolution;
- Lower p_T limit — from 125 to 60 MeV/c.



Efficiency of strangeness reconstruction improved significantly.

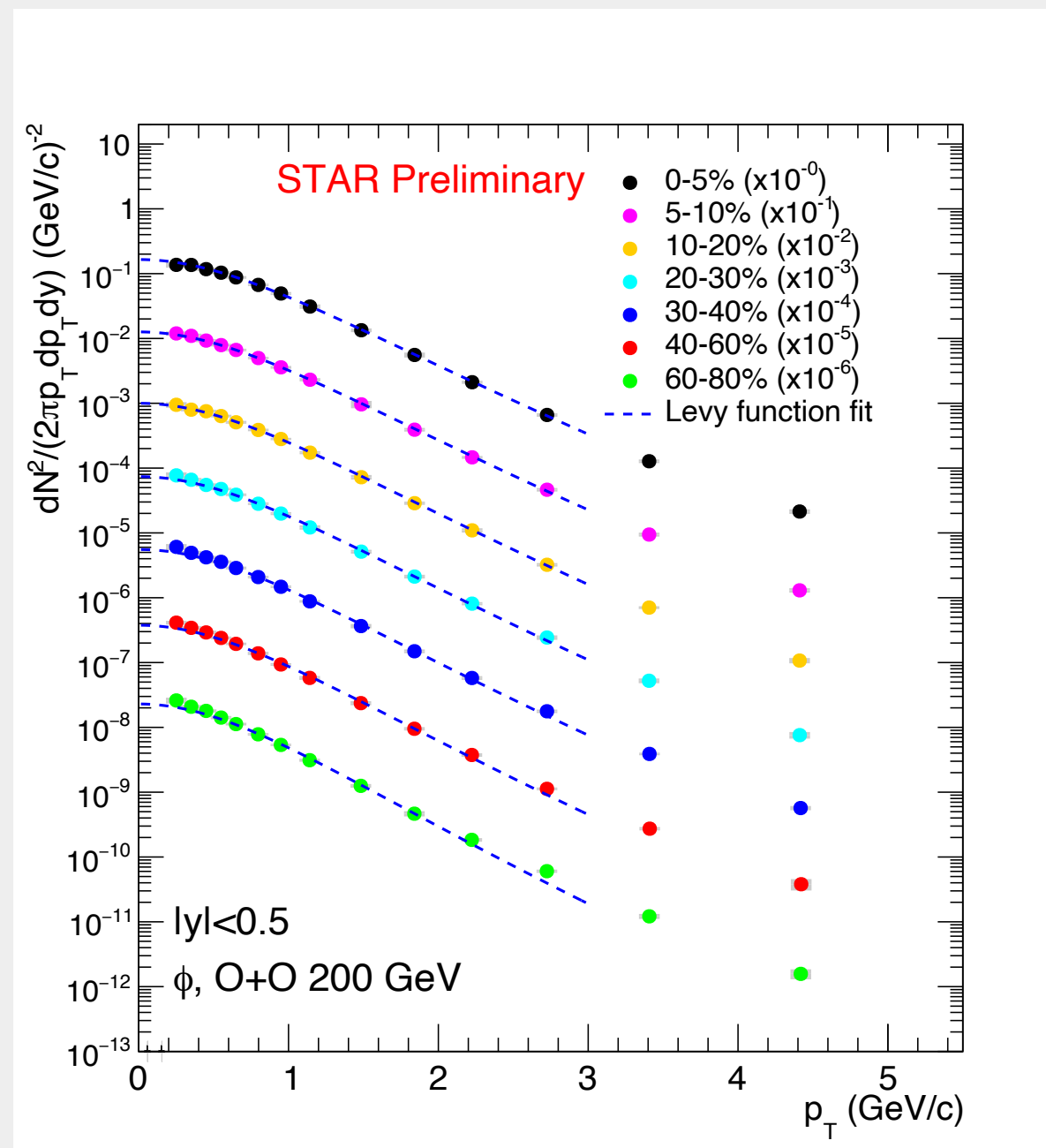
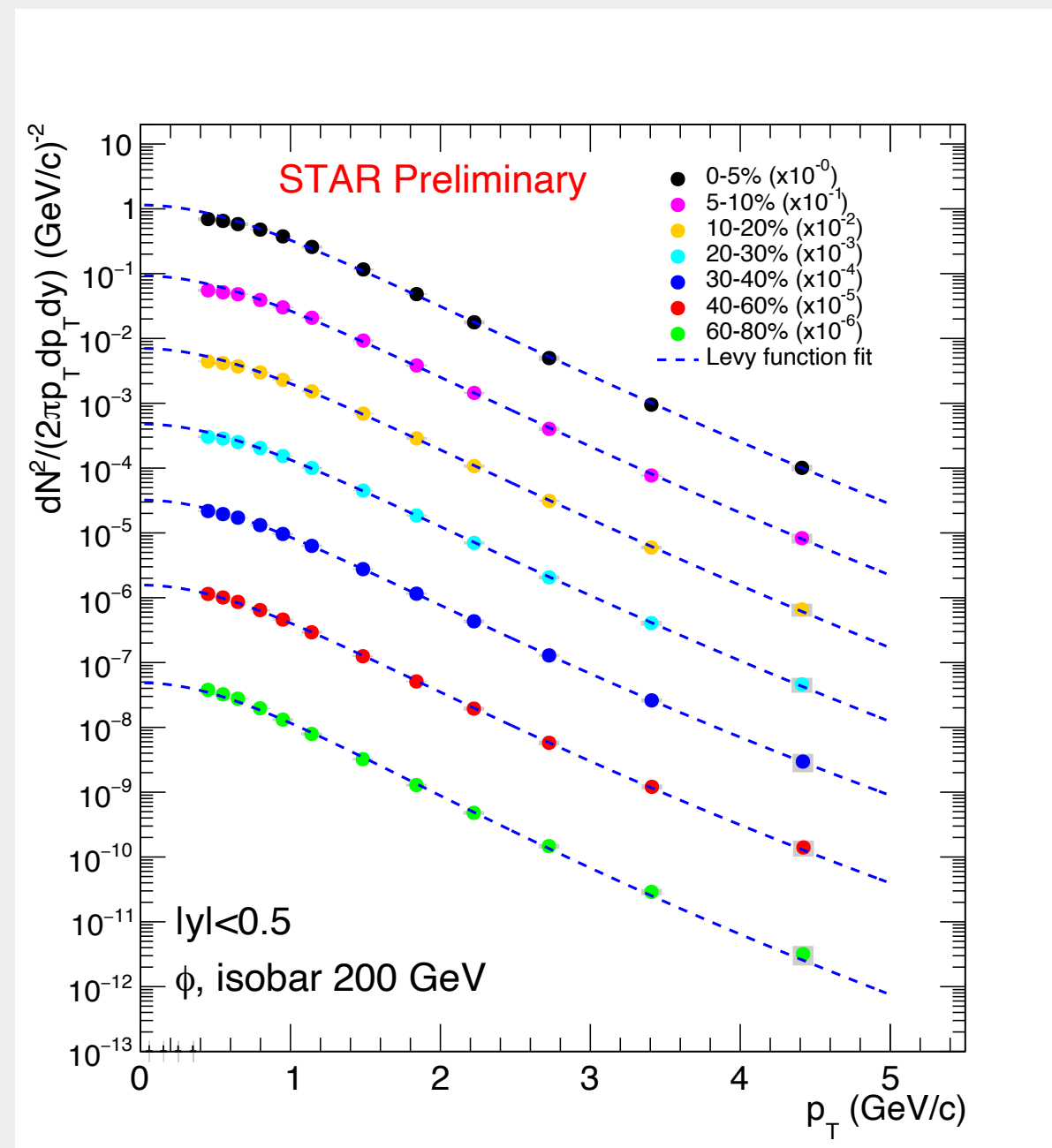
Analysis

- Dataset: Run18 isobar 200 GeV and Run21 O+O 200 GeV;
- $\sim 730M$ minimum bias events for isobar;
- $\sim 370M$ minimum bias events for O+O.
- Particle identification with TPC(dE/dx) and TOF($1/\beta$).
- KFParticle method used in Ω reconstruction — efficiency improved at high p_T .
- p_T region of Ω : 0.8 \sim 4.6 GeV/c.
- p_T region of ϕ : 0.4 \sim 5.0 GeV/c.
- Signal extraction: rotational (for Ω) and mix-event (for ϕ) for combinational background, polynomial fit for residual background & double gaussian fit for signal.



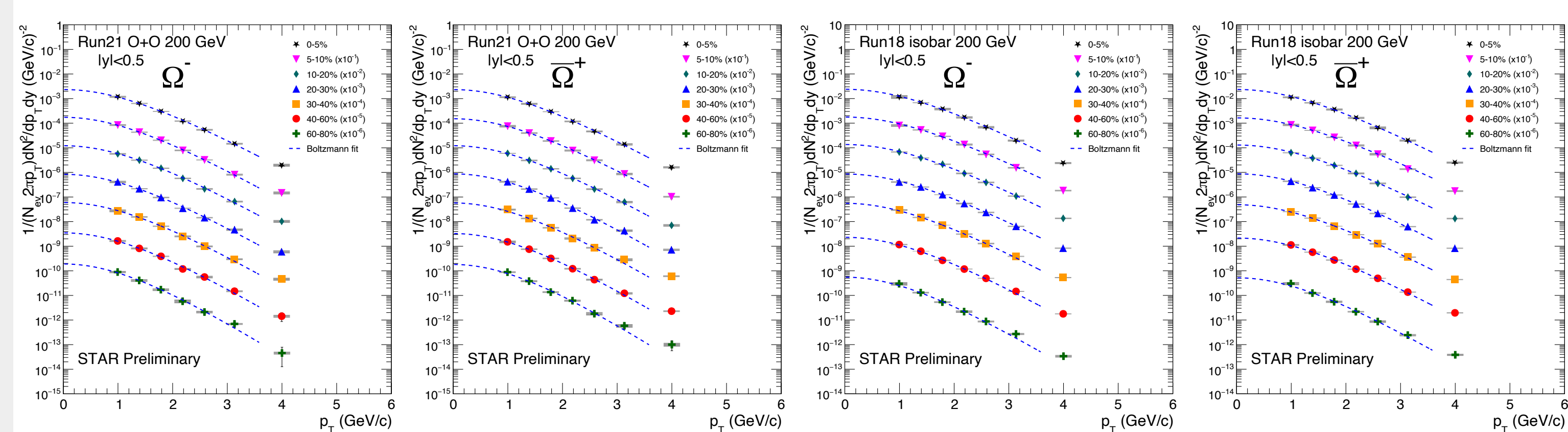
ϕ Meson p_T Spectra

- Precise measurement for 7 centrality bins.
- Maximum $p_T \sim 4.5$ GeV/c.



Ω Baryon p_T Spectra

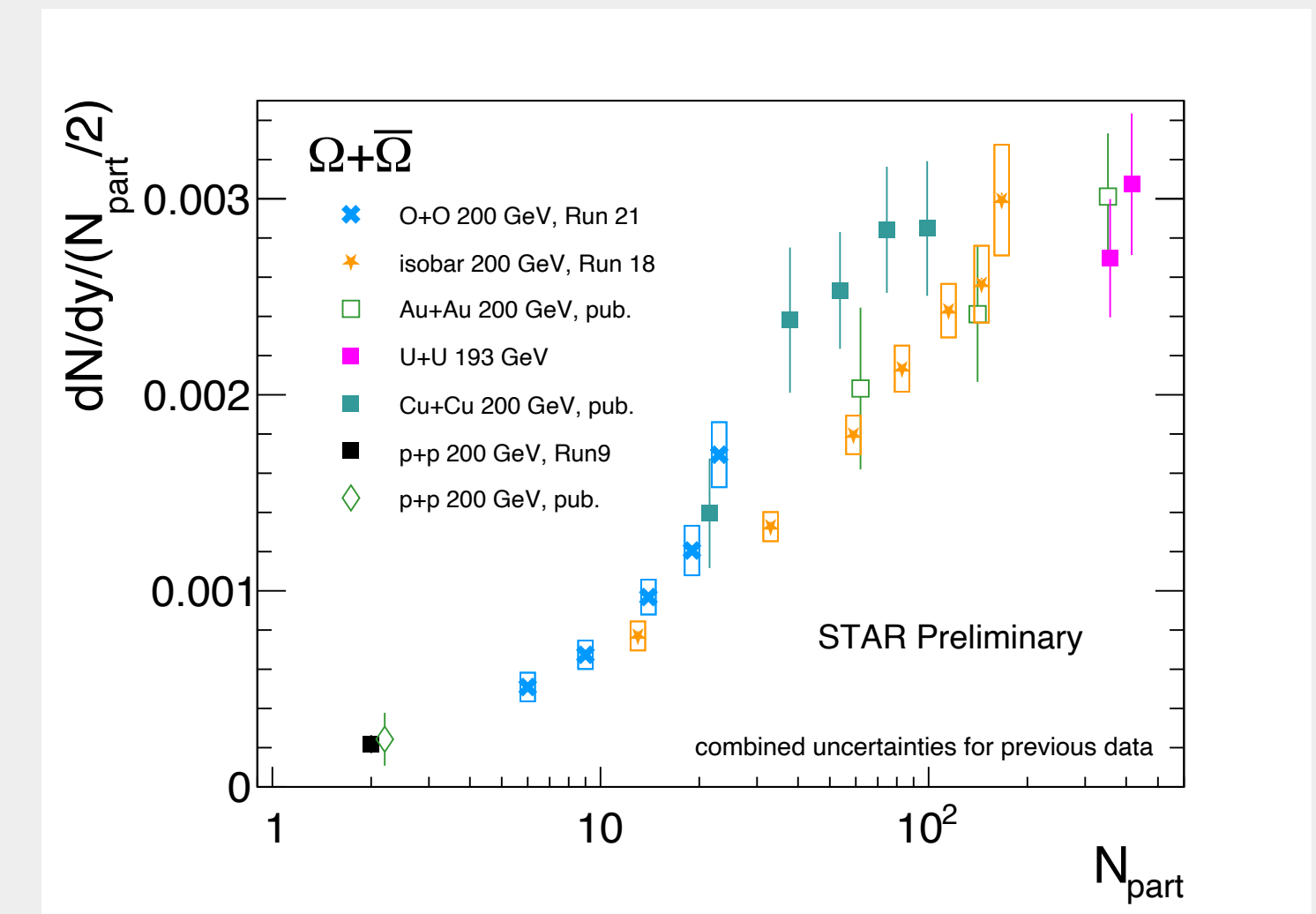
- Precise measurement for 7 centrality bins.
- Maximum $p_T \sim 4$ GeV/c.
- Low p_T extrapolation with Boltzmann function fit; fraction of the integral yield covered by the measured data points: 62 \sim 70%.



dN/dy Yields

- N_{part} (number of participant nucleons) scaled Ω yields increase with the increasing N_{part} .
- No significant system-size dependence observed.

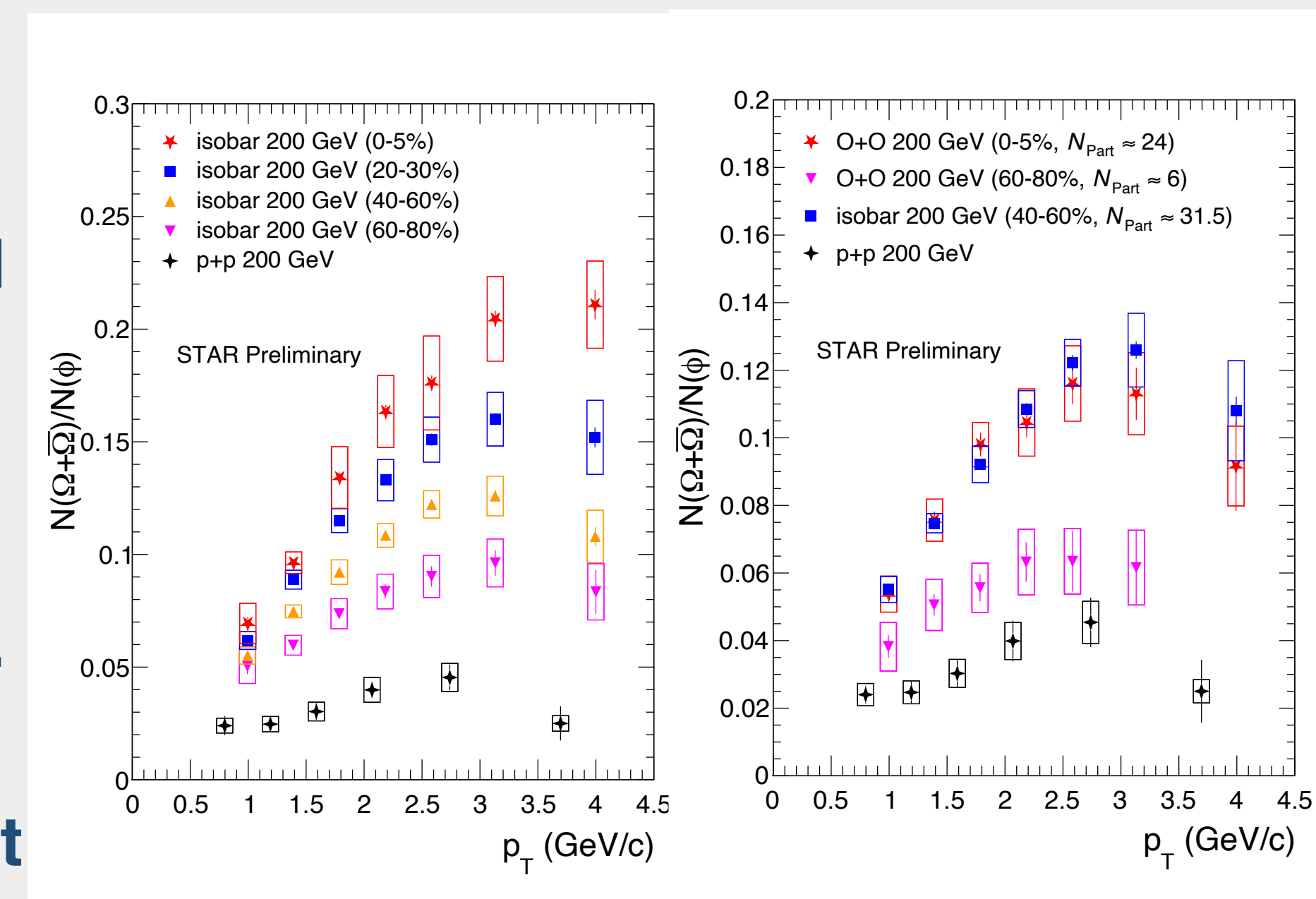
$p+p$: STAR, Phys. Rev. C 75 (2007) 064901
 $Au+Au$: STAR, Phys. Rev. Lett. 98 (2007) 062301
 $Cu+Cu$: STAR, Phys. Rev. Lett. 108 (2012) 072301



Ω/ϕ Ratio

- In isobar and O+O collisions, Ω over ϕ enhancement is observed with respect to $p+p$ collisions. Enhancement increases from peripheral to central collisions.
- For collisions with **similar** N_{part} , enhancement in central O+O is **consistent** with 40-60% isobar.

$p+p$ 200 GeV $\Omega + \bar{\Omega}$: X. Zhu, QM2014;
 $p+p$ 200 GeV ϕ : STAR, Phys. Rev. C 79(2009) 064903



Summary and Outlook

- Precise measurement of $\phi, \Omega, \bar{\Omega}$ p_T spectra and $\Omega, \bar{\Omega}$ yields in isobar and O+O collisions at 200 GeV are achieved.
- N_{part} scaled Ω yield increases with the increasing N_{part} ; no significant system-size dependence is observed.
- In isobar and O+O collisions, Ω over ϕ enhancement is observed with respect to $p+p$ collisions. Enhancement increases from peripheral to central collisions.
- For collisions with **similar** N_{part} , Ω over ϕ enhancement in central O+O is **consistent** with 40-60% isobar; analysis with high-multiplicity triggered O+O events is ongoing.

Supported in part by the



Office of
Science



清华大学
Tsinghua University

The STAR
Collaboration

