Flash Talk on:

Methods & Procedures for a Blind Analysis of Isobar Data from STAR Collaboration

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Link to my poster video: [https://drive.google.com/file/d/1gdg7Yx0WLzeLie8Nf_2COaWhD7KgEvzm/view?usp=sharing](https://drive.google.com/file/d/1gdg7Yx0WLzeLie8Nf_2COaWhD7KgEvzm/view?usp=sharing)
A decisive experimental test of the Chiral Magnetic Effect (CME) will lead to three major discoveries in heavy ion collisions:

1. Formation of deconfined medium where chiral symmetry of Quantum Chromodynamics is restored

2. Creation of strongest known electromagnetic field in nature

3. Strong local Parity Violation
Model calculations predict:

- Vacuum B-field: \(~10-18\%\) difference
- Backgrounds: within 4\% (for \(\Delta \gamma_{112}/v_2\))

Isobar collisions \(^{44}_{96}Ru + ^{44}_{96}Ru\) and \(^{40}_{96}Zr + ^{40}_{96}Zr\) present an opportunity to make decisive experimental test of Chiral Magnetic Effect by varying the initial magnetic field while keeping background same.


Preparation & Data collection

- Fill-by-fill switching, alternated frequently.
- Collect data during 30-minute “runs” of the data acquisition system.
- 20 hour fills to maintain nearly constant collision rates.

Minimize the Systematics:
- Similar run conditions for both species
- Eliminate Pre-determined bias:
  - Perform blind analysis of data

Blind analyses (5 groups):
- $\Delta \gamma, \Delta \delta$ and $\kappa$
- $\Delta \gamma, \Delta \delta, \Delta \gamma(\Delta \eta)$
- $\Delta \gamma$ in PP/SP, $\Delta \gamma(M_{inv})$
- $\Delta \gamma$ in PP/SP
- $R(\Delta S)$ Correlator.

No-Blind analysis (1 group):
- Signed Balance Function.

A large, collective effort

Physics Working Group (All the Analyzers)

A Blinding Committee

God Parent Committee

Step-I
Mock data challenge
Test data structure (27 GeV files)

Step-II
Isobar-Mixed Analysis
QA, physics & code freezing (One run is Ru+Zr)

Step-III
Isobar-Blind Analysis
Run-by-run QA, full analysis (One run is Ru/Zr)

Step-IV
Isobar-Unblind Analysis
Full analysis (Ru and Zr separated)

**STEP-I**

- Using the 27 GeV data taken in the same year.

**STEP-II**

- One “run” is mixed with Ru&Zr events.
- Freeze the cuts, methods & codes.

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How do we define the stable run period before we have the data?

An automated Run-by-Run QA Algorithm!

1. Quantity list (example)
   - 1. <definiteness>
   - 2. <definiteness>
   - 3. <definiteness>
   - 4. <definiteness>

Global Run QA Check

- STEP-1: Precheck the jumps without any bad run list cut
- STEP-2: 1st round bad runs check (10% Run)
- STEP-3: Recheck the 1st round bad runs and check the jumps (5% weighted error & 5% different as default)
- STEP-4: Recheck every region gotten in the prior step to avoid artifacts
- STEP-5: Do the strict bad runs check (5% Run as default)

Then we freeze all the code for this analysis!
STEP-III

❖ One “run” is either Ru or Zr, but the species are still unknown
❖ Outlier runs due to bad detector conditions are removed by frozen automated algorithm.
❖ Also, do analysis of physics observables with frozen codes.

STEP-IV

❖ Ideally, no additional analysis work is required for the publication.
❖ Many different methods and observables will be measured.

\[
\gamma_{112} = \left( \cos \left( \phi_1^a + \phi_2^a - 2 \psi_2^{SPD} \right) \right) \\
\gamma_{123} = \left[ \cos \left( \phi_1^a + 2 \phi_2^a - 3 \psi_3^{SPD} \right) \right]
\]

Isobar bind analysis is ongoing by STAR

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We are here!

Thank you for your attention!