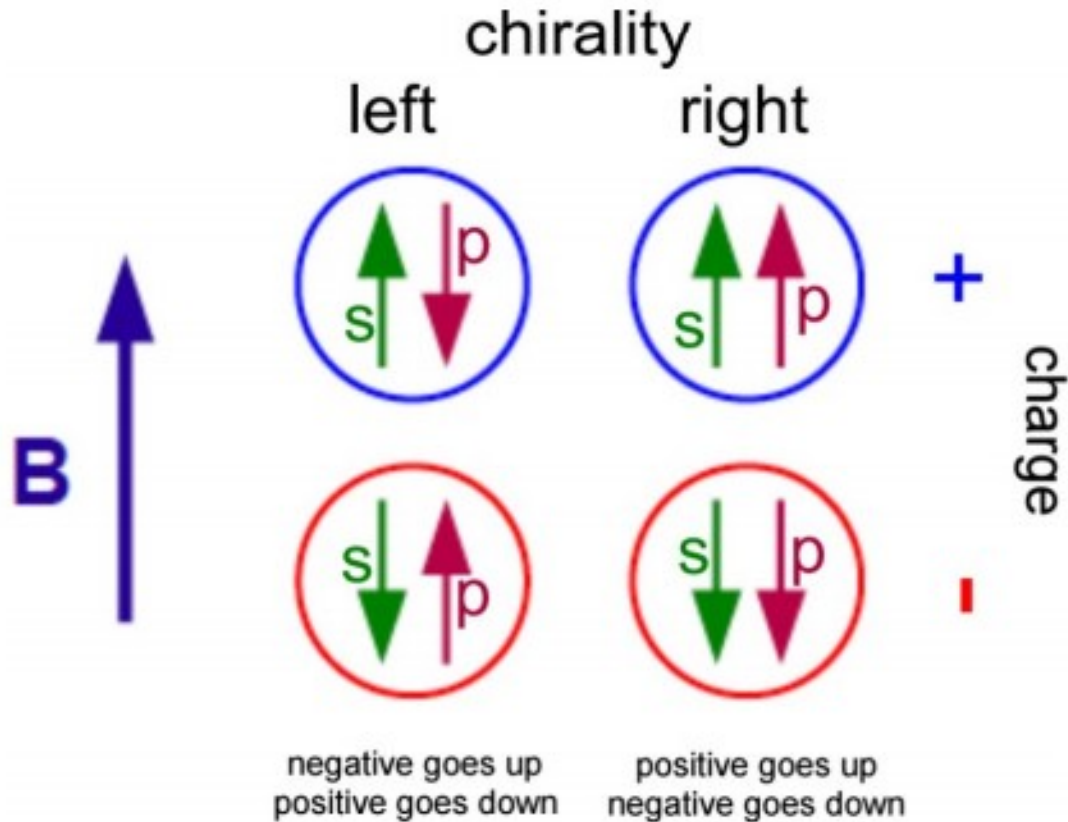# γ_{224} Correlations in Au+Au Collisions at 27 and 39 GeV

By Antonett Nunez-delPrado | UCLA
Advisers: Huan Huang and Gang Wang
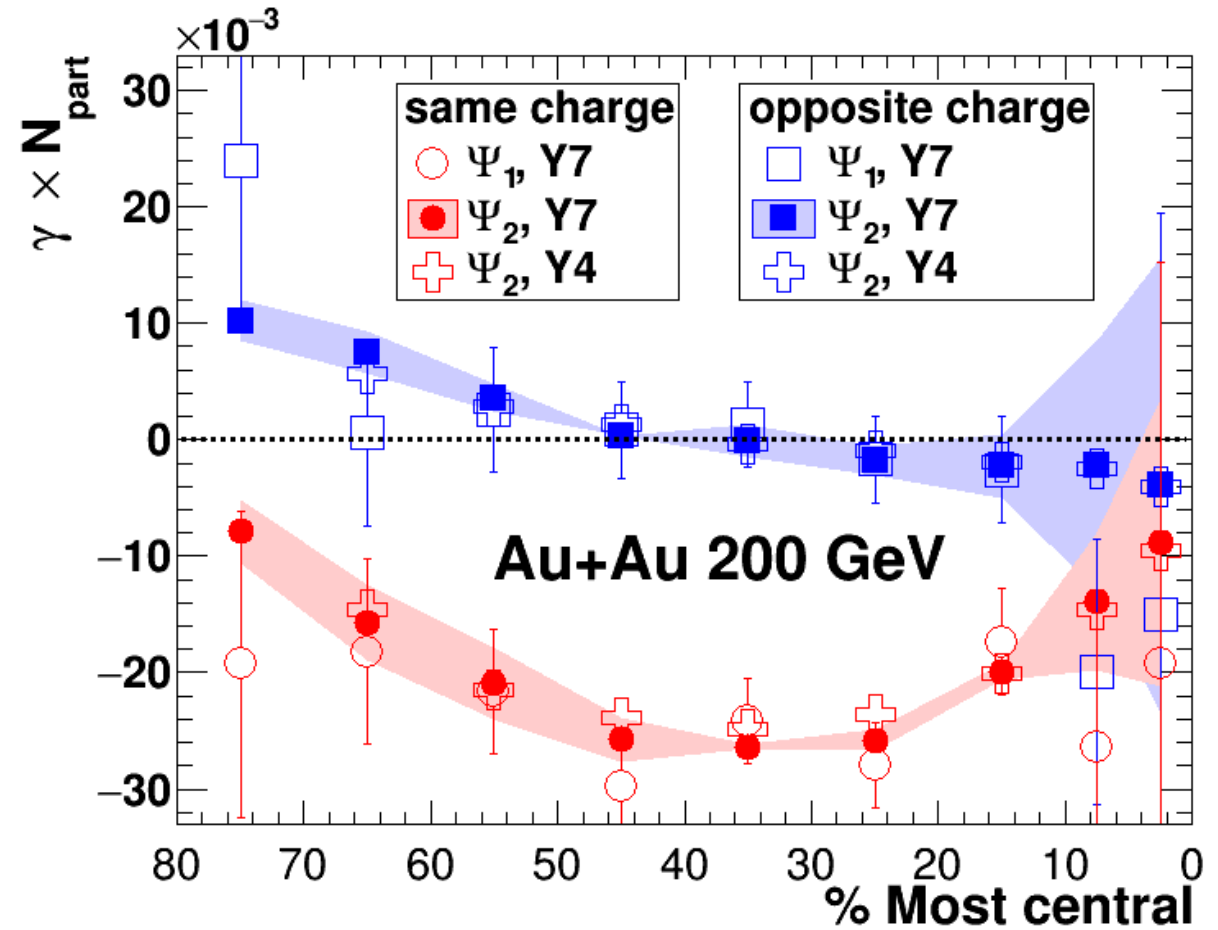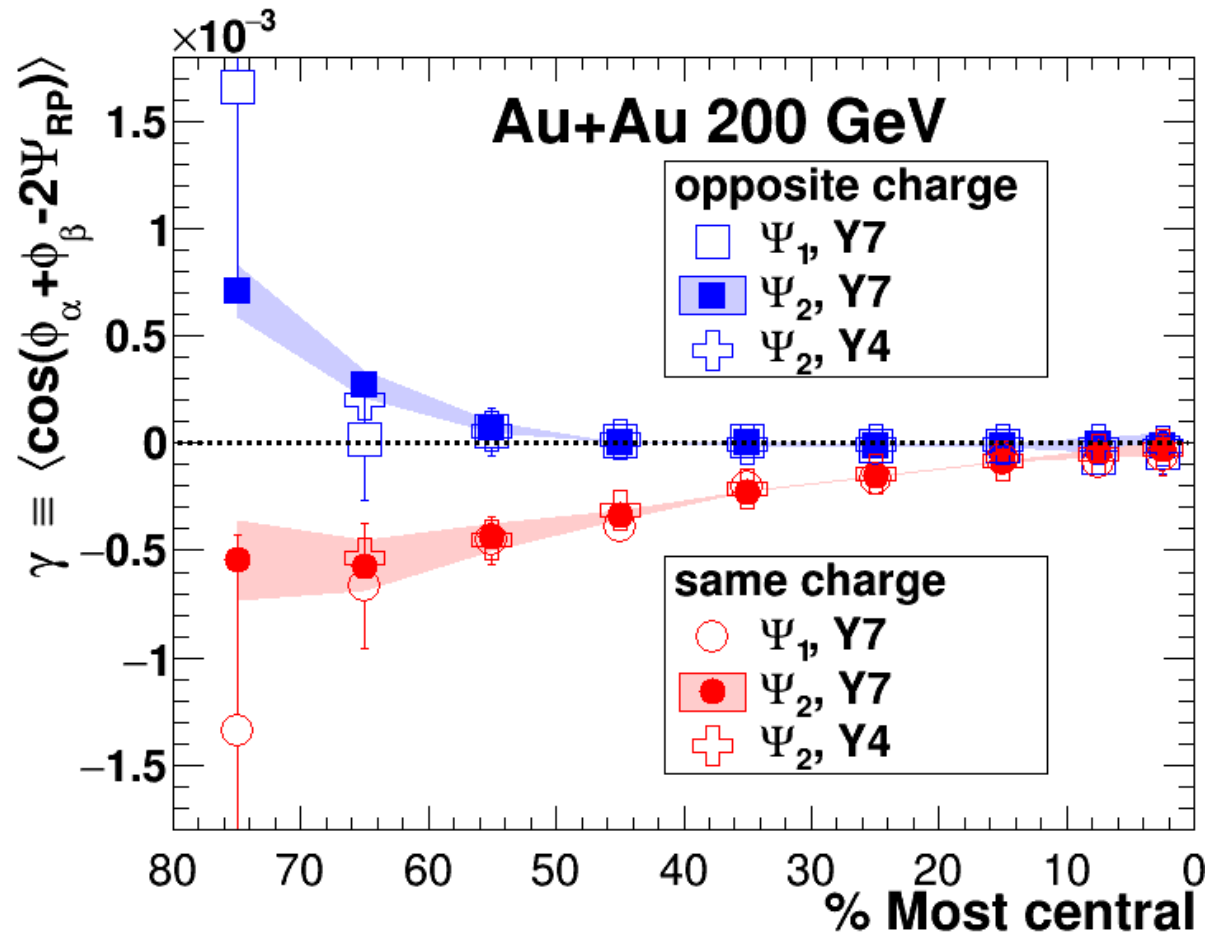
Chiral Magnetic Effect

chirality

left   right

B

negative goes up
positive goes down

positive goes up
negative goes down

charge

+

–

> Arises from a strong magnetic field and a finite chirality; produces an induced electric current.

> Can help to explore 3 fundamental concepts:

    i.   The strong magnetic field created in heavy ion collisions.

    ii.   Vacuum transition

    iii.   Chiral Symmetry Restoration
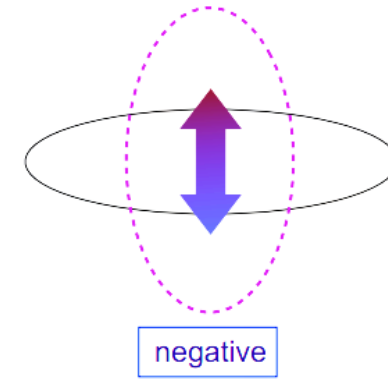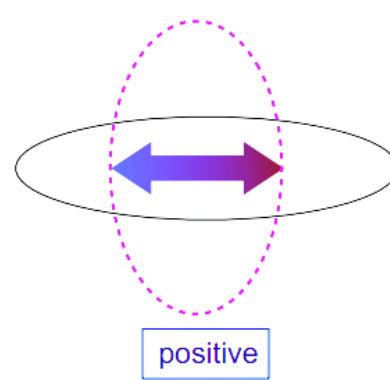
γ_{112} Correlator

$$\gamma_{112} = \left\langle \cos(\phi_\alpha + \phi_\beta - 2\psi_{RP}) \right\rangle$$

$$= \left[\left\langle v_{1,\alpha} v_{1,\beta} \right\rangle + B_{in} \right] - \left[\left\langle a_\alpha a_\beta \right\rangle + B_{out} \right]$$

Au+Au 200 GeV

opposite charge
- Ψ_1, Y7
- Ψ_2, Y7
- Ψ_2, Y4

same charge
- Ψ_1, Y7
- Ψ_2, Y7
- Ψ_2, Y4

γ_{224} Correlator

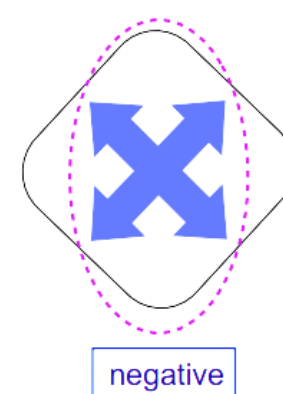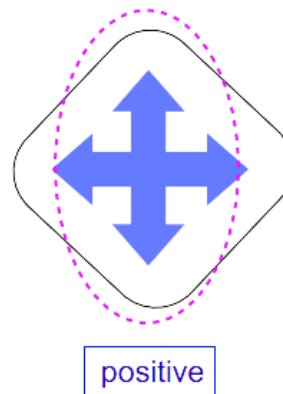$$\gamma_{112} = \langle\cos(\phi_a + \phi_b - 2\Psi_2)\rangle = \langle\cos(\phi_a - \Psi_2)\cos(\phi_b - \Psi_2)\rangle - \langle\sin(\phi_a - \Psi_2)\sin(\phi_b - \Psi_2)\rangle$$

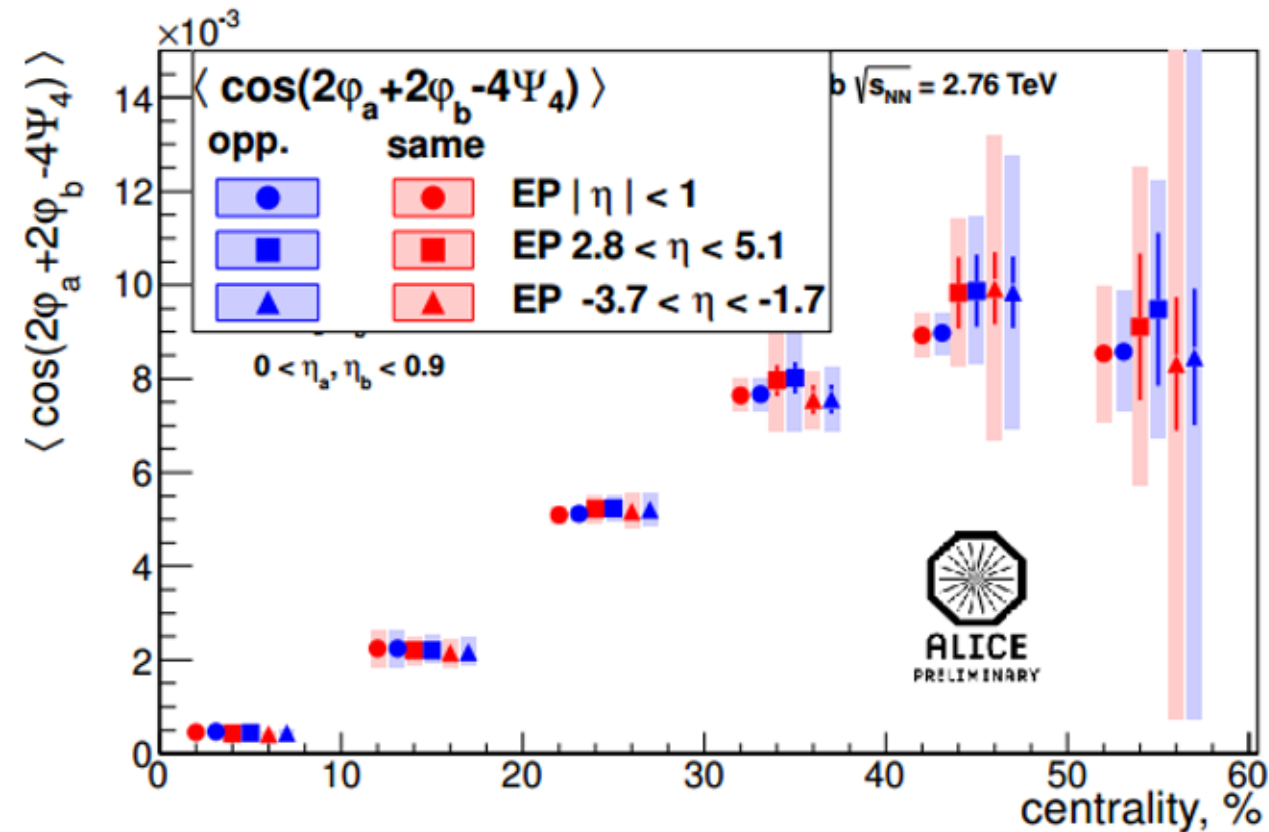Directed flow fluctuations relative to the elliptic flow plane

positive

negative

$$\gamma_{224} = \langle\cos(2\phi_a + 2\phi_b - 4\Psi_4)\rangle = \langle\cos(2\phi_a - 2\Psi_4)\cos(2\phi_b - 2\Psi_4)\rangle - \langle\sin(2\phi_a - 2\Psi_4)\sin(2\phi_b - 2\Psi_4)\rangle$$

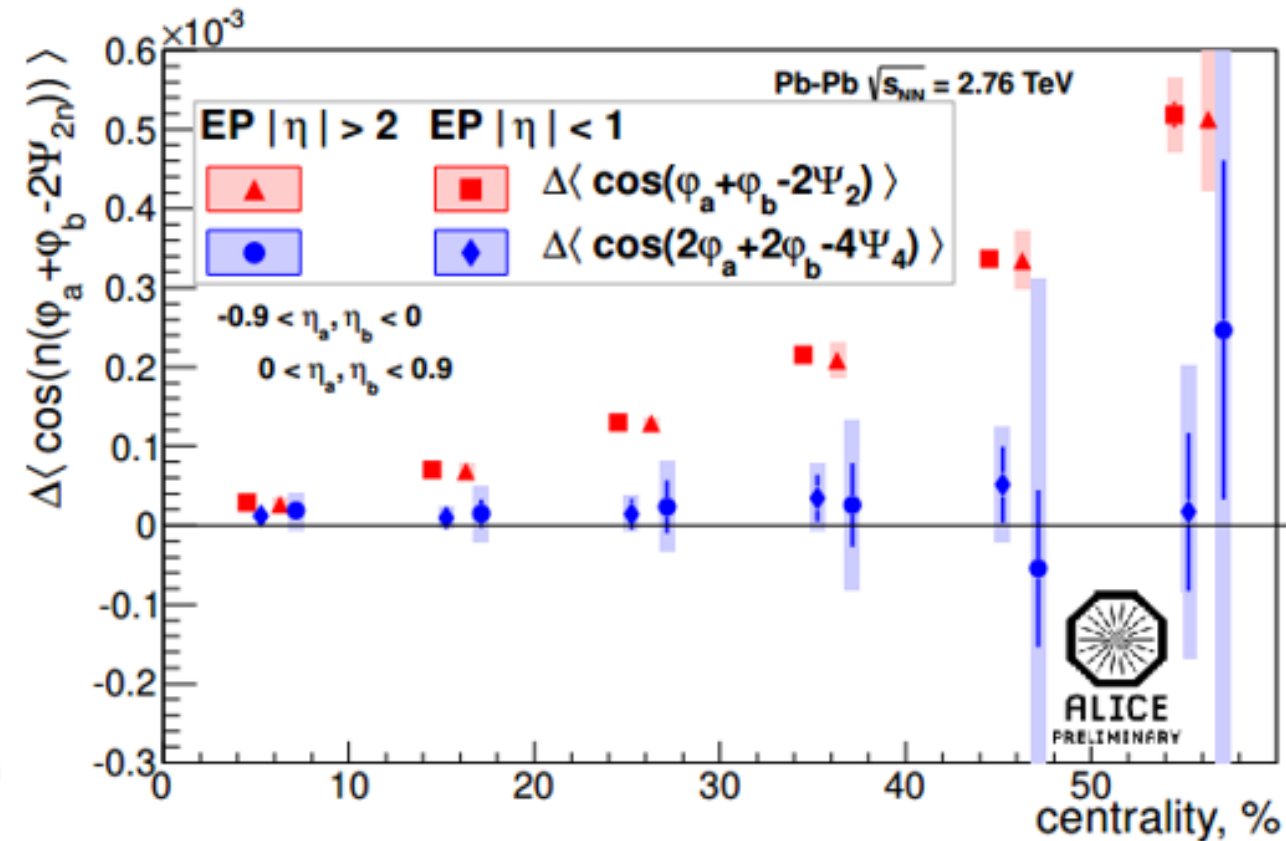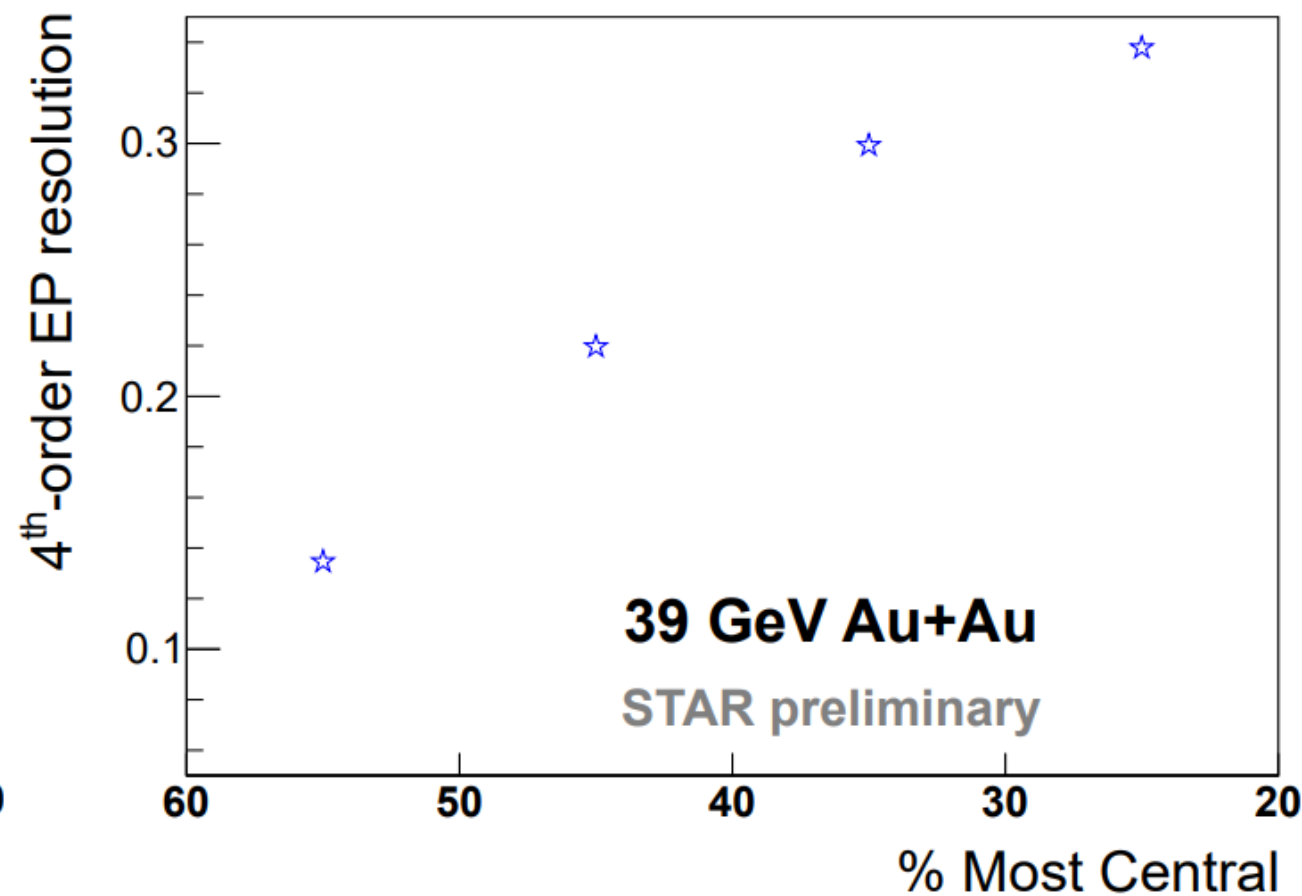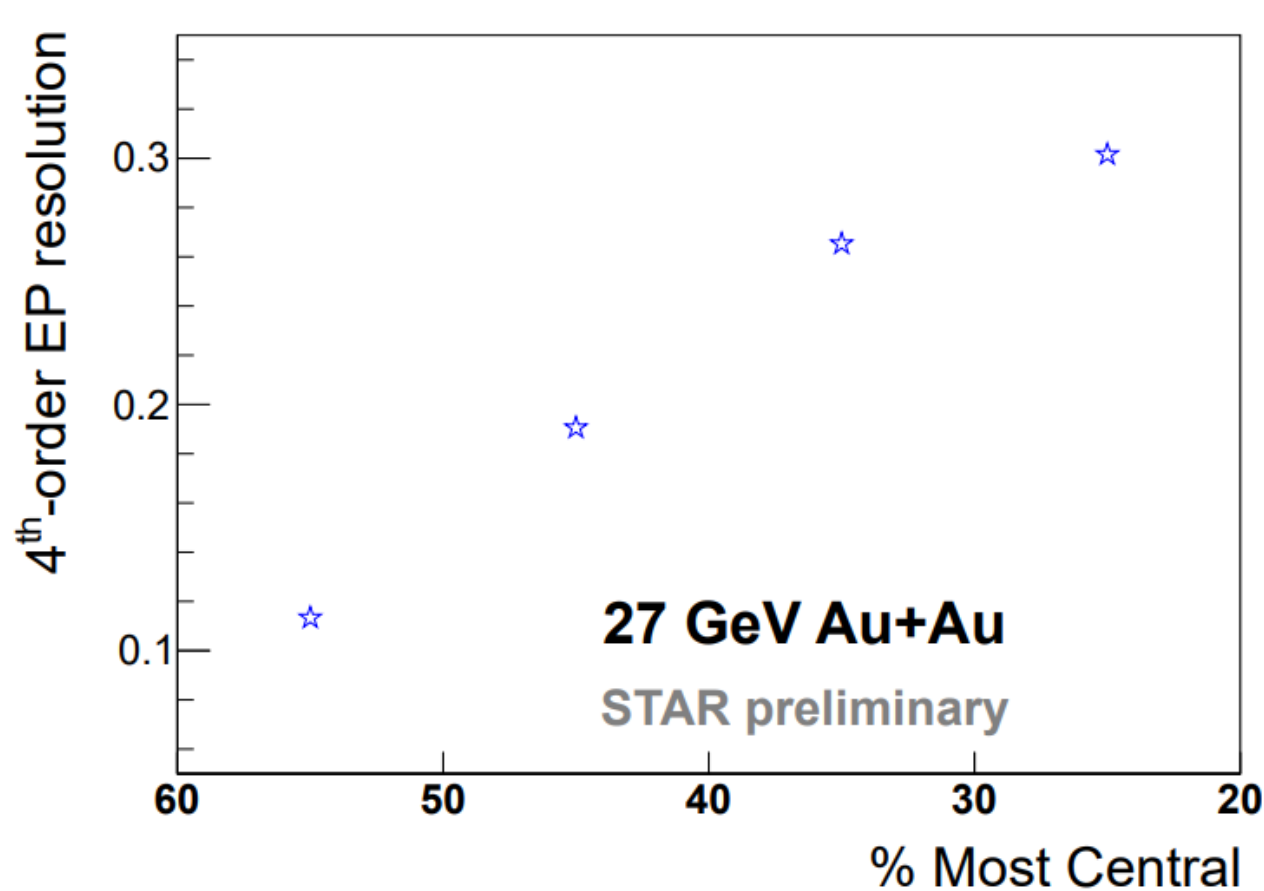Elliptic flow fluctuations relative to the quadrangular flow plane

positive

negative

ALICE RESULTS

Resolution of 4th Harmonic Event Plane

$$EP \sim v_n * \sqrt{N}$$

27 GeV Au+Au

STAR preliminary

39 GeV Au+Au

STAR preliminary

STAR Results

$0.2 < pT < 2 \, GeV/c$

$|\eta| < 1$

$(\gamma_{224} \times N_{part})$ vs Centrality

27 GeV Au+Au

◇ same charge

○ opposite charge

STAR preliminary

$\gamma^{II} \equiv \langle \cos(2\phi_1 + 2\phi_2 - 4\,\psi_{TPC}) \rangle$

% Most Central

39 GeV Au+Au

◇ same charge

○ opposite charge

STAR preliminary

$\gamma^{II} \equiv \langle \cos(2\phi_1 + 2\phi_2 - 4\,\psi_{TPC}) \rangle$

% Most Central
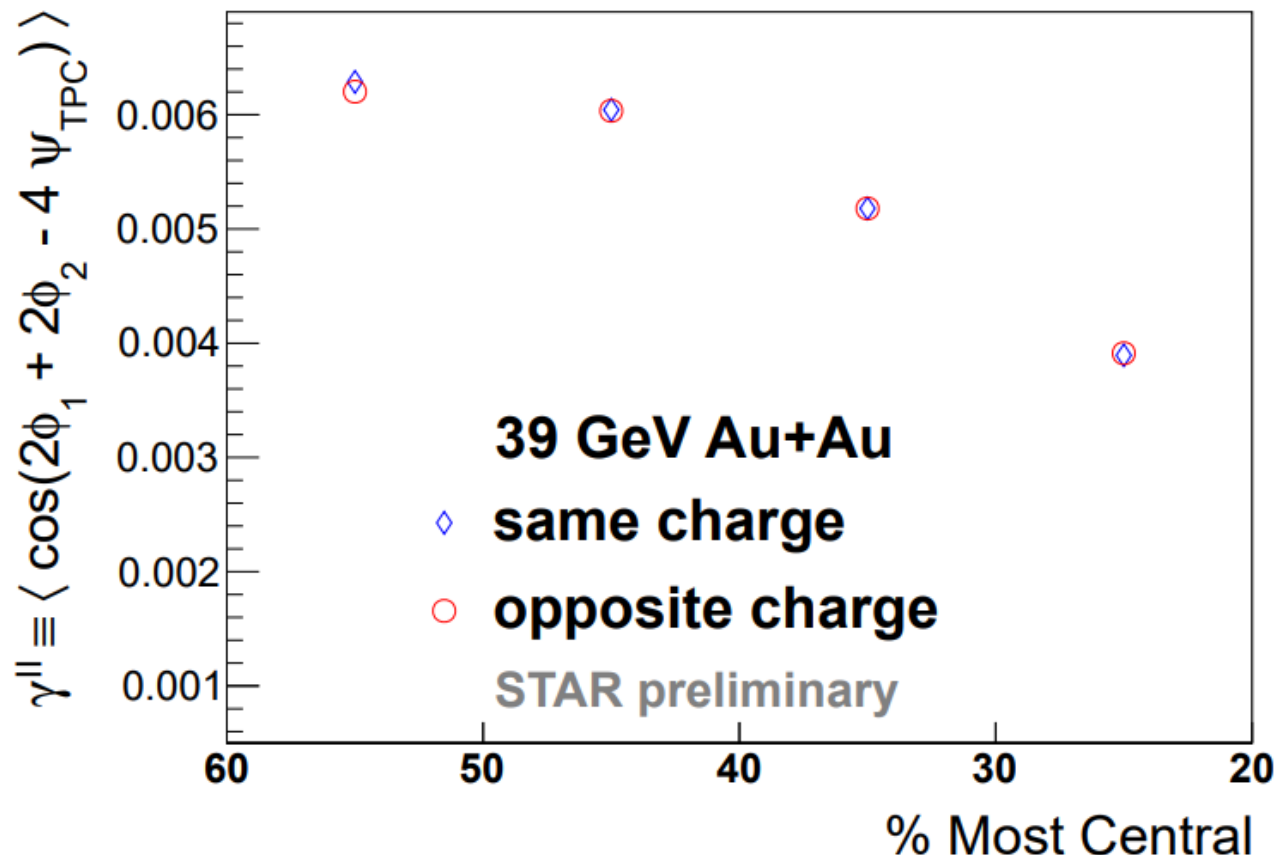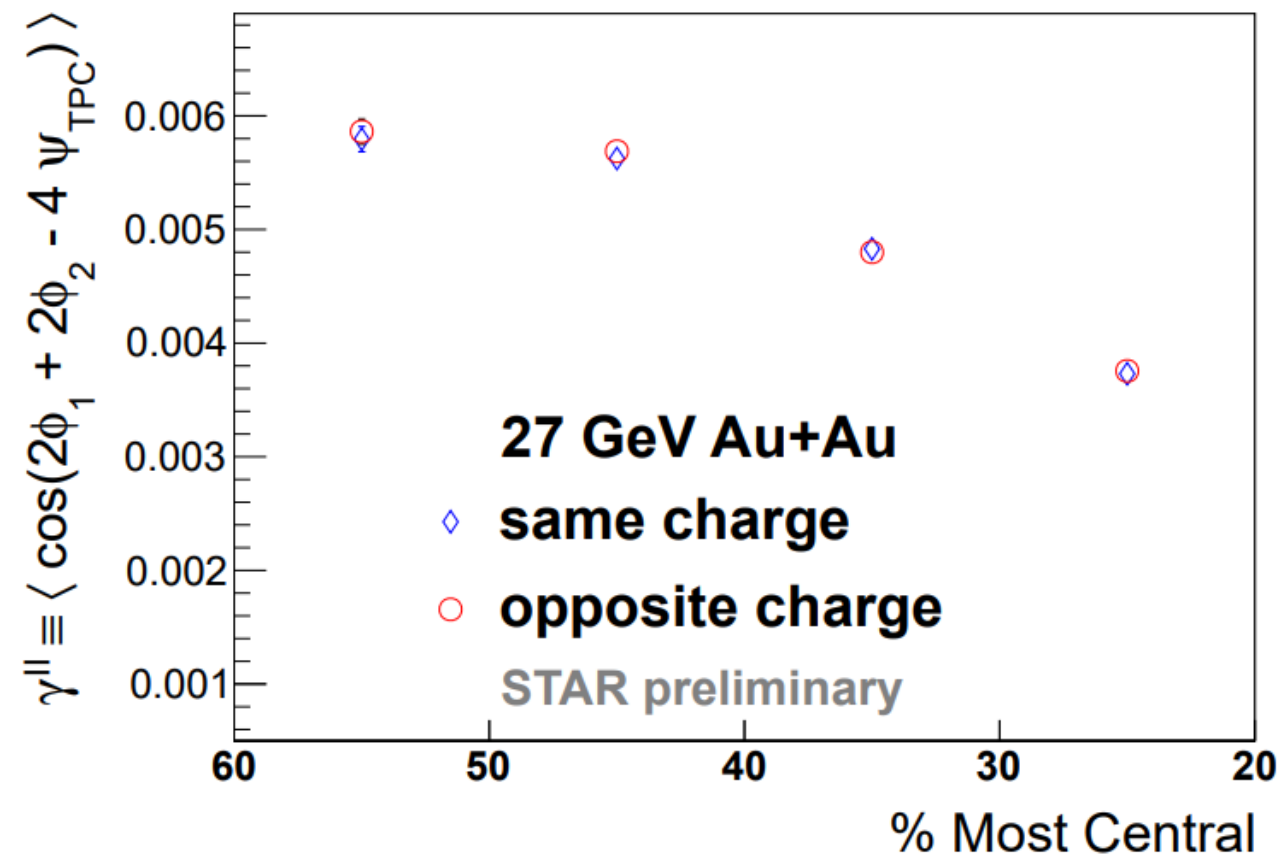
Kinematic Ranges
$0.2 < pT < 2 GeV/c$
$|\eta| < 1$

γ_{224} difference vs Centrality