CME signal & background study of 200 GeV Cu+Cu collision

Fufang Wen
University of California, Los Angeles
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event-shape engineering

$\frac{dN}{d\phi} \propto 1 + 2v_{1,\alpha}\cos(\Delta\phi) + 2v_{2,\alpha}\cos(2\Delta\phi) + 2a_{1,\alpha}\sin(\Delta\phi) + \ldots$

where $\Delta\phi = \phi - \Psi_{RP}$,

α(+ or -) denotes the charge sign of particle

v_1: directed flow v_2: elliptic flow

a_1: quantifies the charge separation due to CME

$$\gamma = \left\langle \left\langle \cos\left(\phi_\alpha + \phi_\beta - 2\Psi_{RP}\right) \right\rangle_P \right\rangle_E$$
$$= \left[\left\langle v_{1,\alpha} v_{1,\beta} \right\rangle + B_{in}\right] - \left[\left\langle a_{1,\alpha} a_{1,\beta} \right\rangle + B_{out}\right]$$

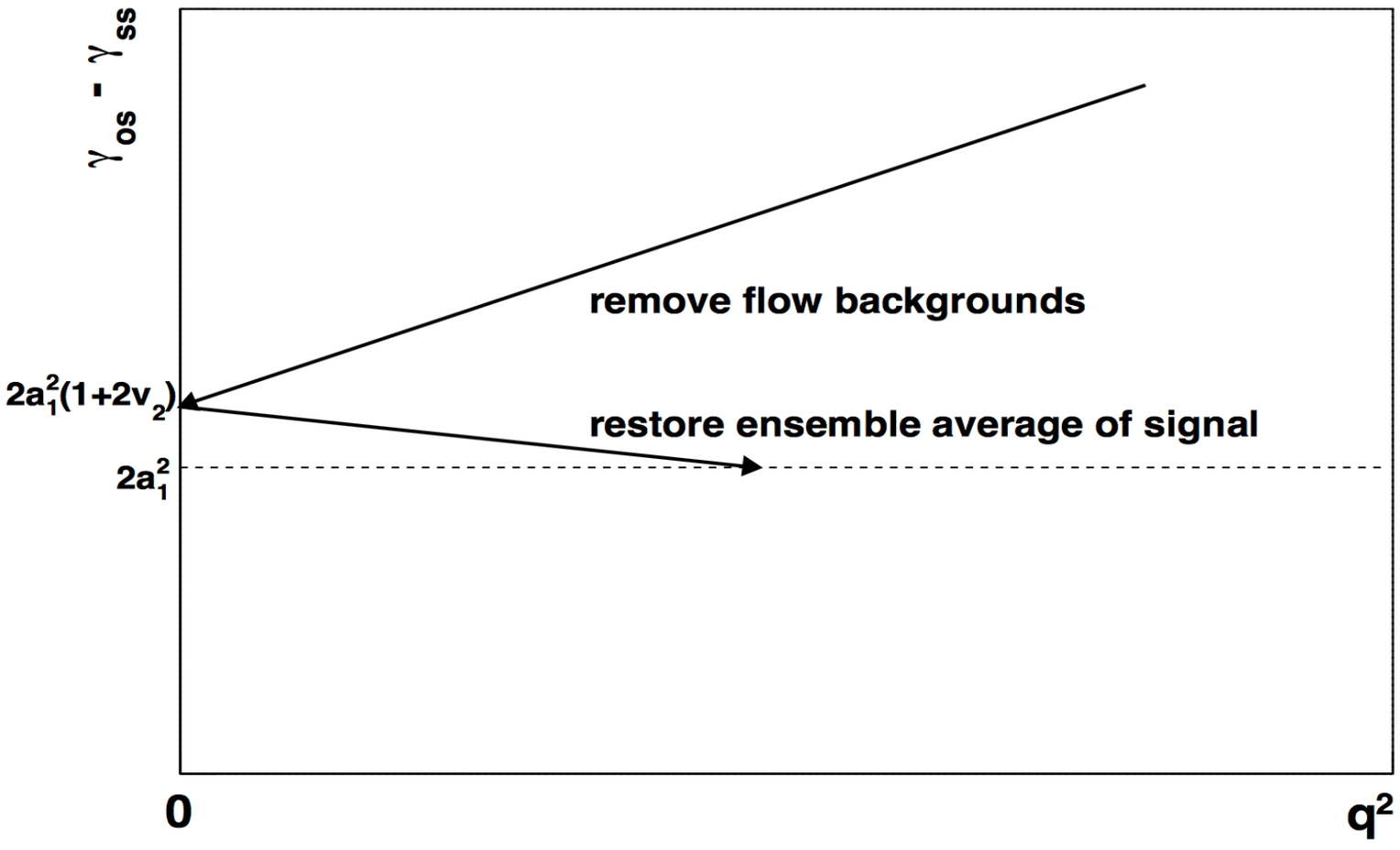
(B_{in}-B_{out}) :flow-related background

q^2 is a good handle to select spherical event (zero v_2) so the background can be removed

$$\vec{q}^{\,A} = \left(q_x^A, q_y^A\right) \quad where \quad q_x^A = \frac{1}{\sqrt{N}} \sum_i^N \cos(2\phi_i^A)$$
$$q_y^A = \frac{1}{\sqrt{N}} \sum_i^N \cos(2\phi_i^A)$$

event-shape engineering

A schematic diagram of how to reveal the ensemble average CME signal via event-shape engineering

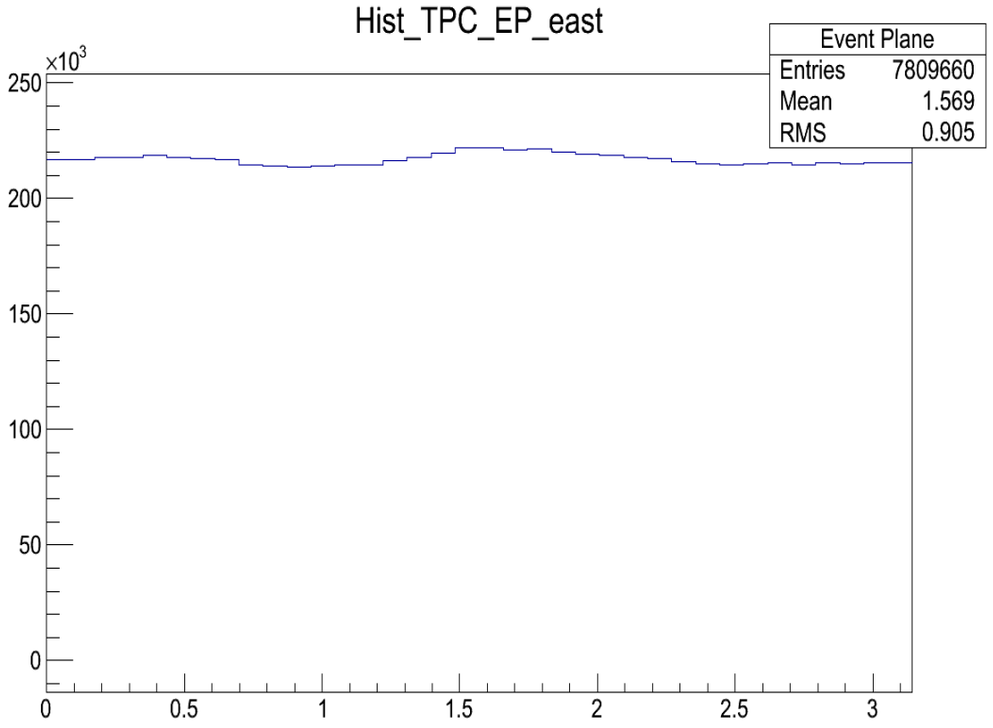


- ensemble average can be restored from apparent signal by:$\Delta\gamma = \Delta\gamma(q^2 = 0)/(1 + 2v_2)$

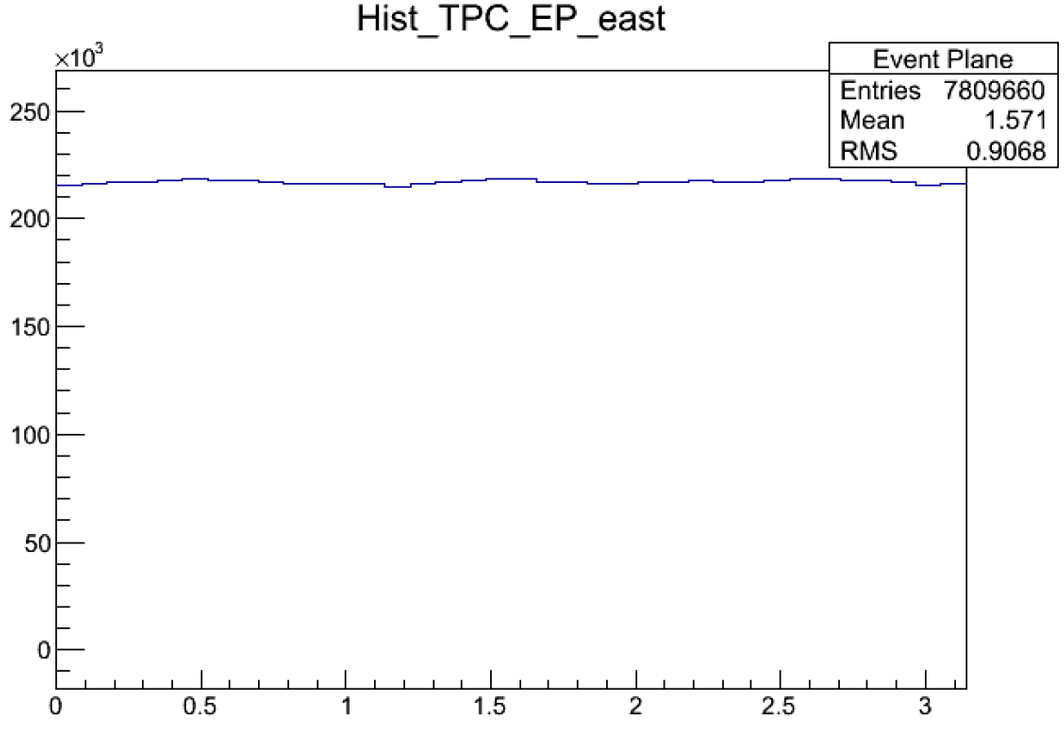
EP distribution in 200GeV Cu+Cu

- Shifting method is applied to flatten event plane distribution

Before

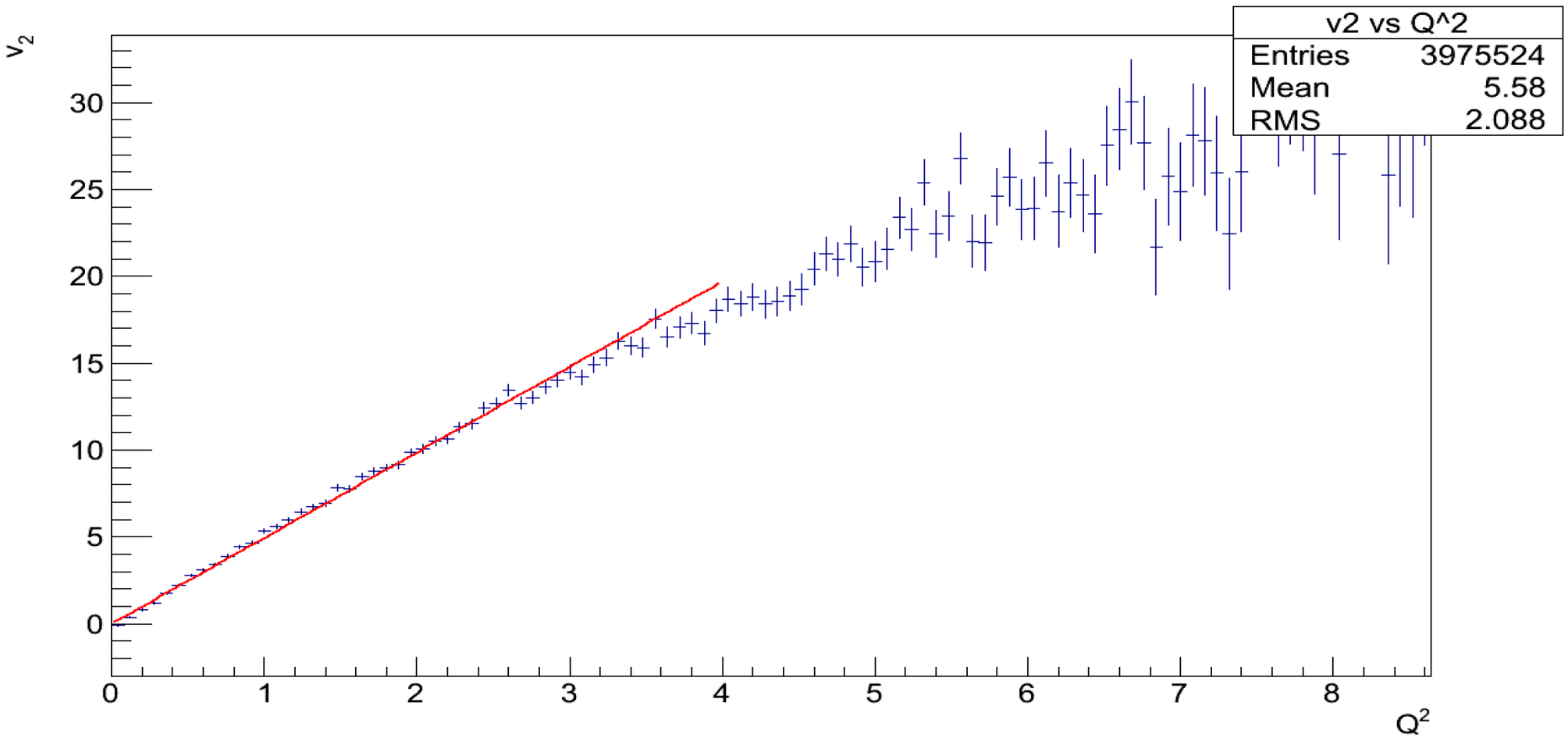


after



v_2 vs q^2 in 200GeV Cu+Cu

- 30%-40% most central

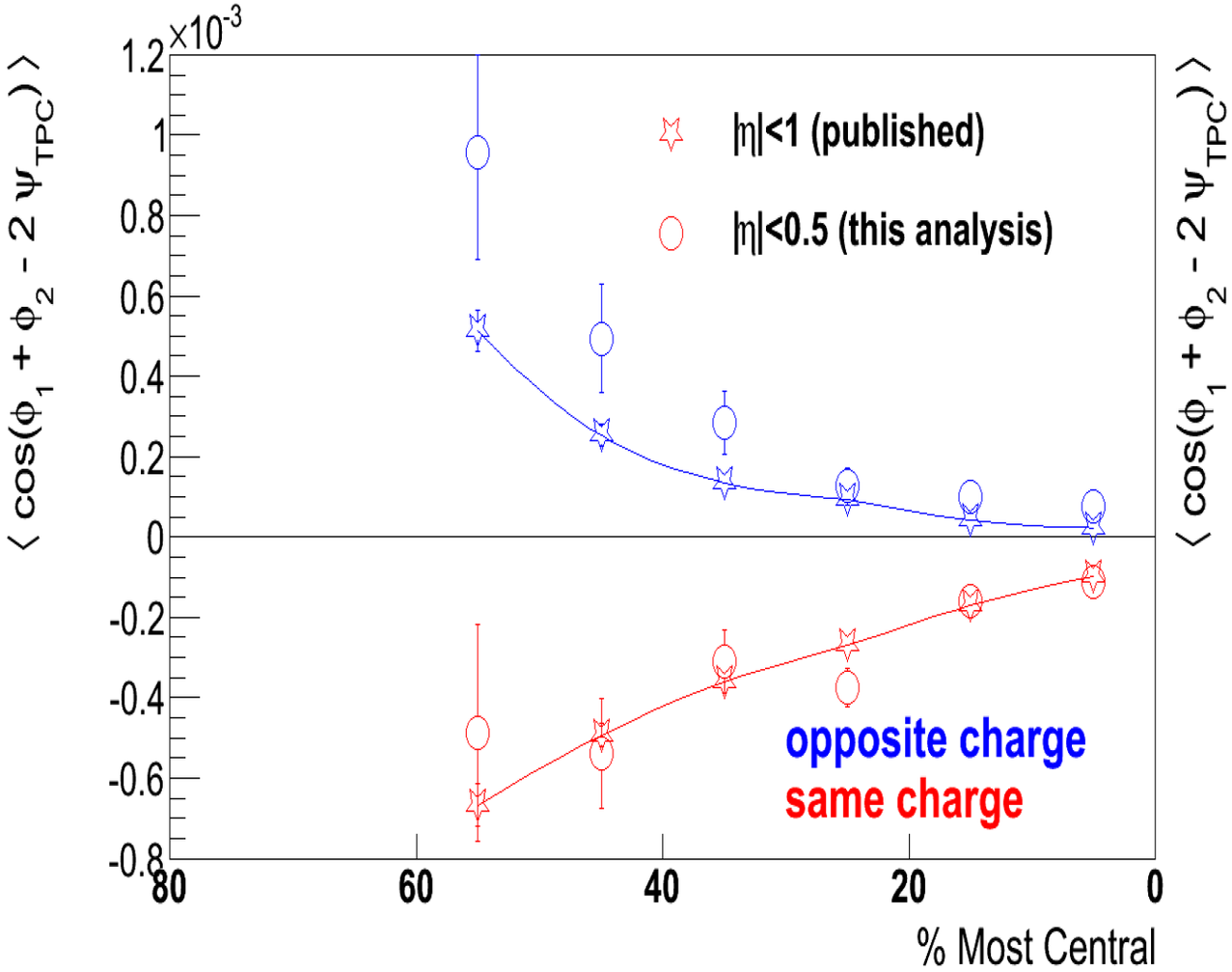


Fit with the function [0]*x^[1]: [1]=0.9977±0.0055

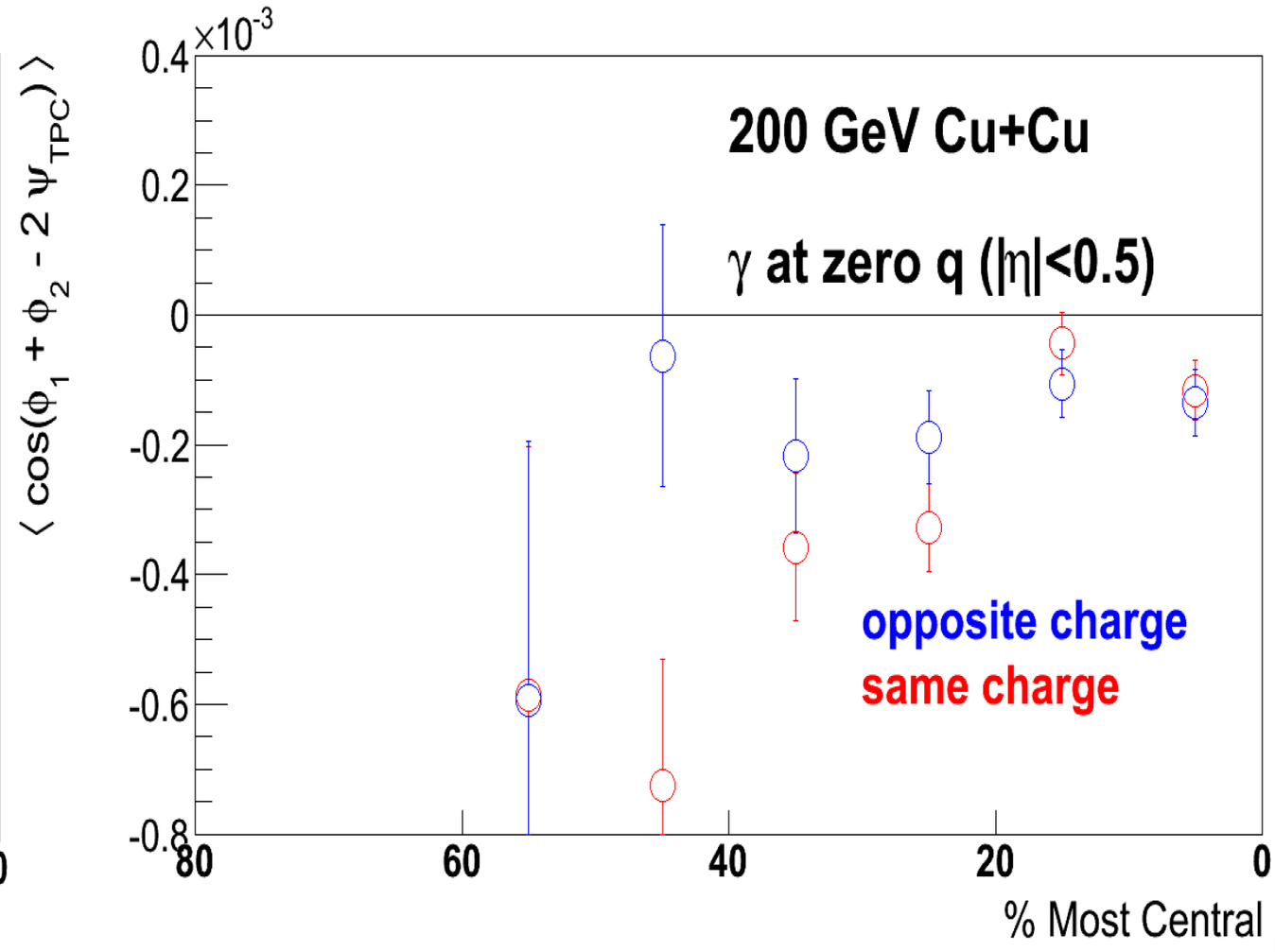
- It demonstrates the almost linear relationship of v_2 and q^2.
- Same for other centralities.

CME signal & background study in 200GeV Cu+Cu

w/i flow background

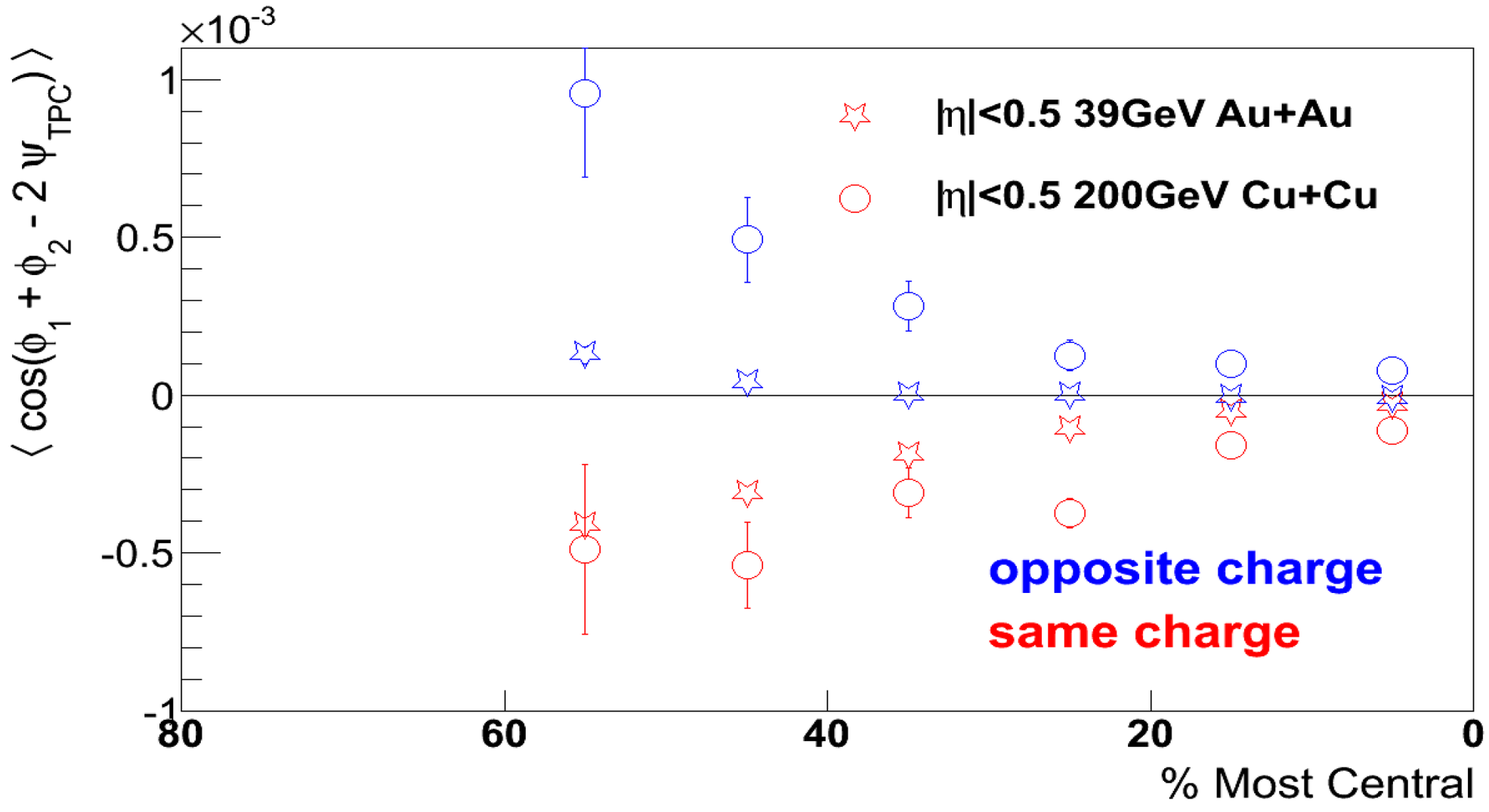


w/o flow background



- Difference between this analysis and published result mainly comes from different acceptance.

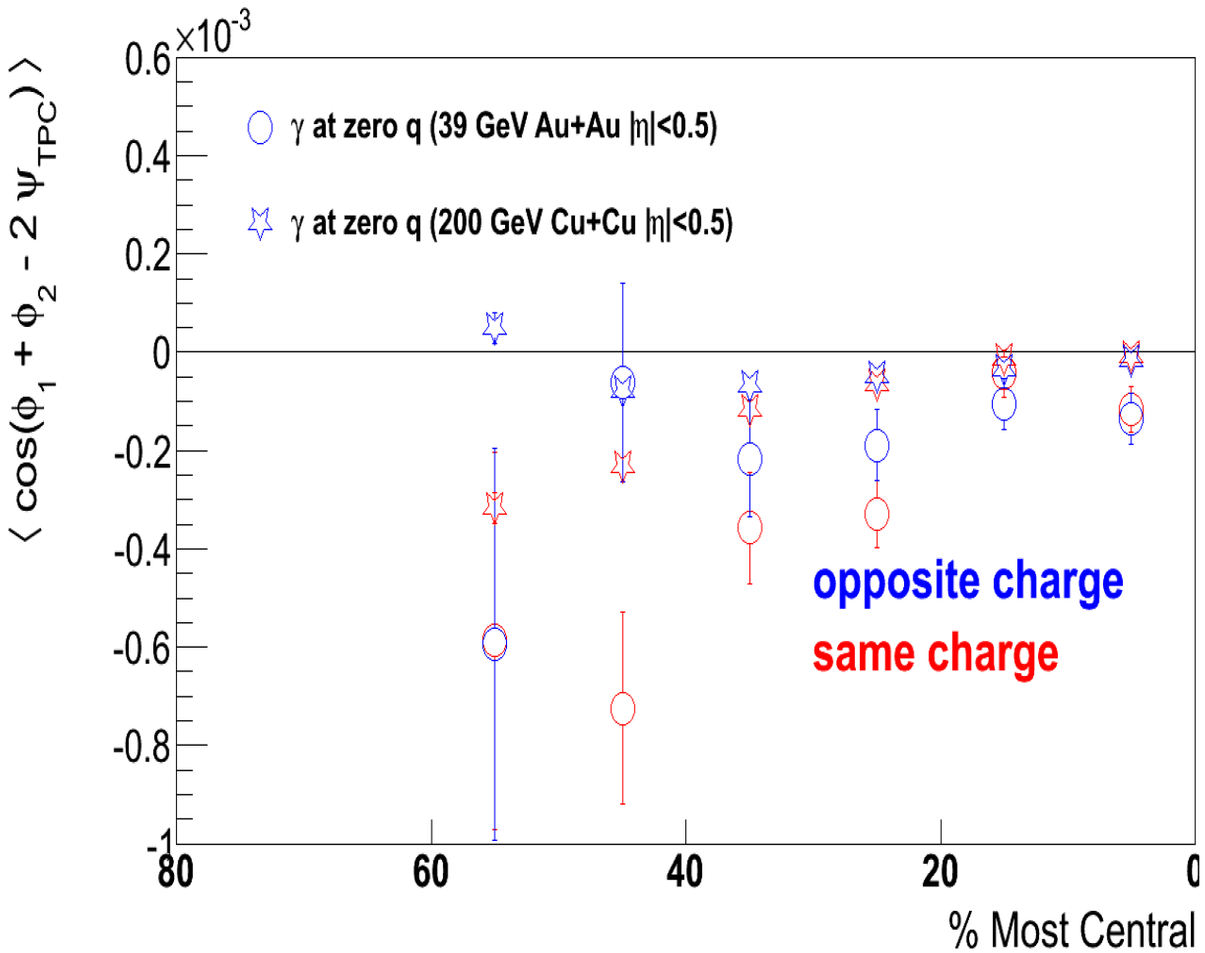
Results compared to 39GeV Au+Au without removal of background:

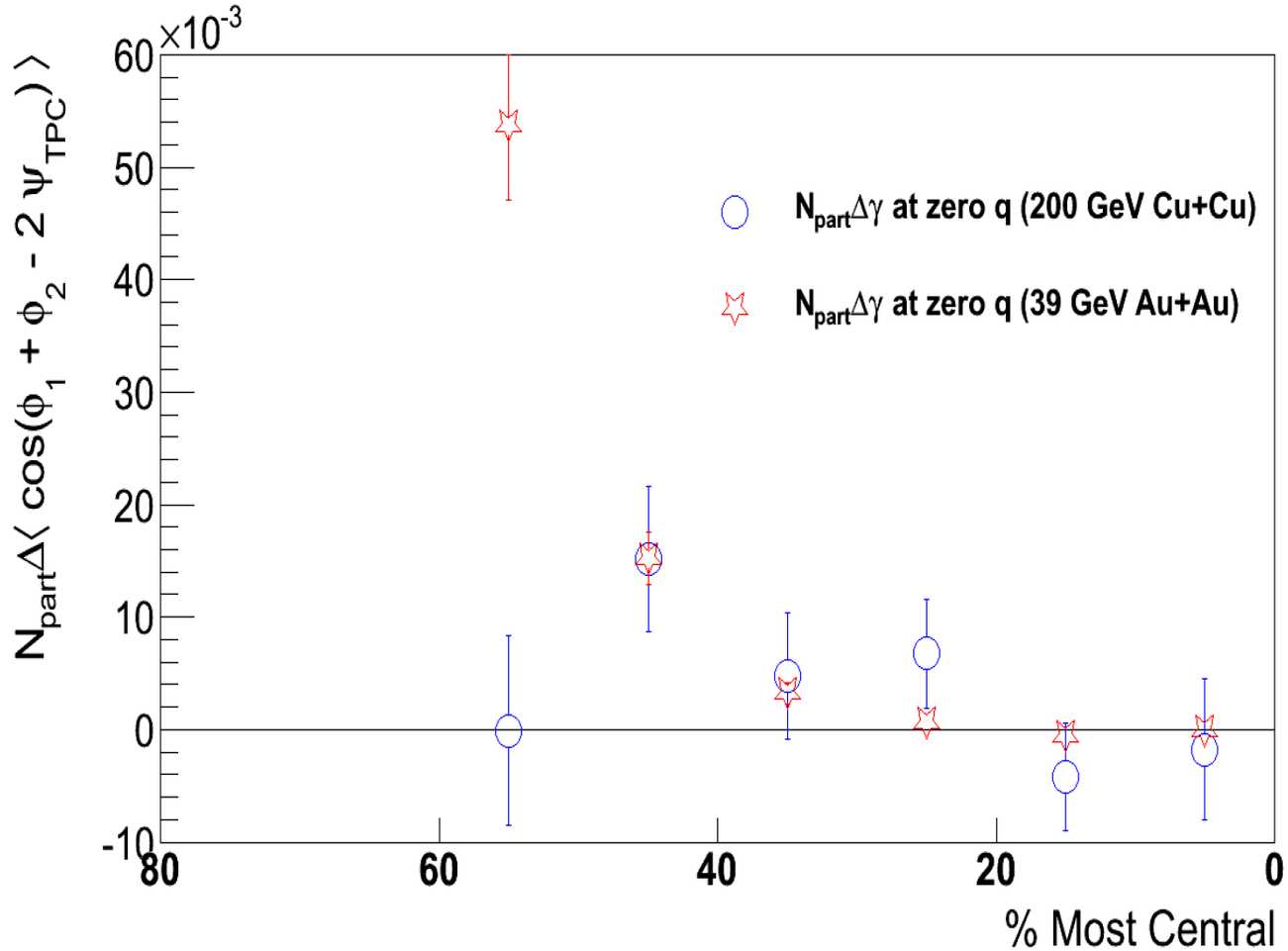


- Cu+Cu sig+bg is much larger than Au+Au

Results compared to 39GeV Au+Au

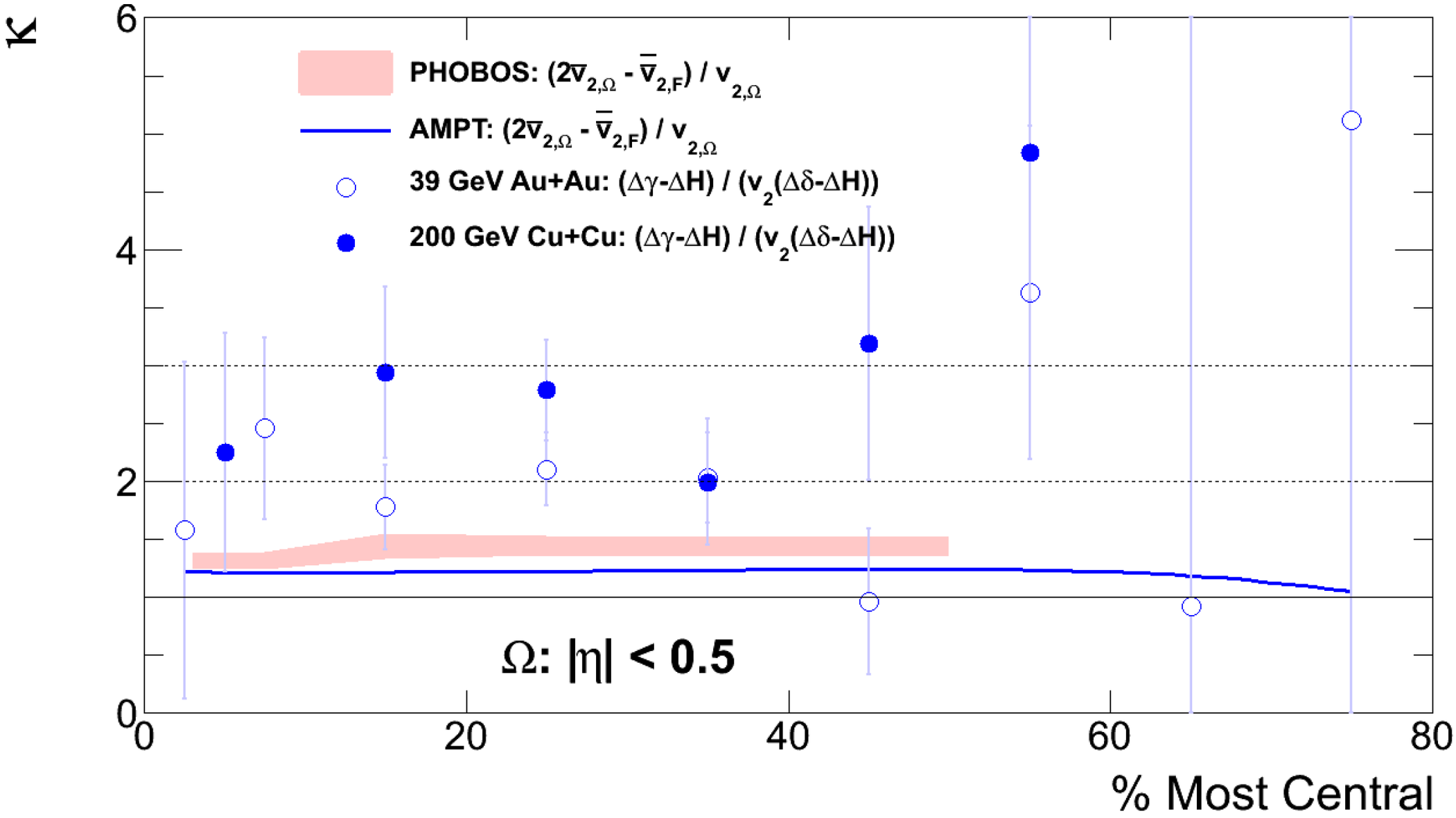
After removal of background:





- Real CME signals are similar for 20-50% centralities.
- Background contribution in Cu+Cu collision is larger than Au+Au.

κ comparison



- κ for Cu+Cu collision lies between 2~3
- Different collision has different value of κ