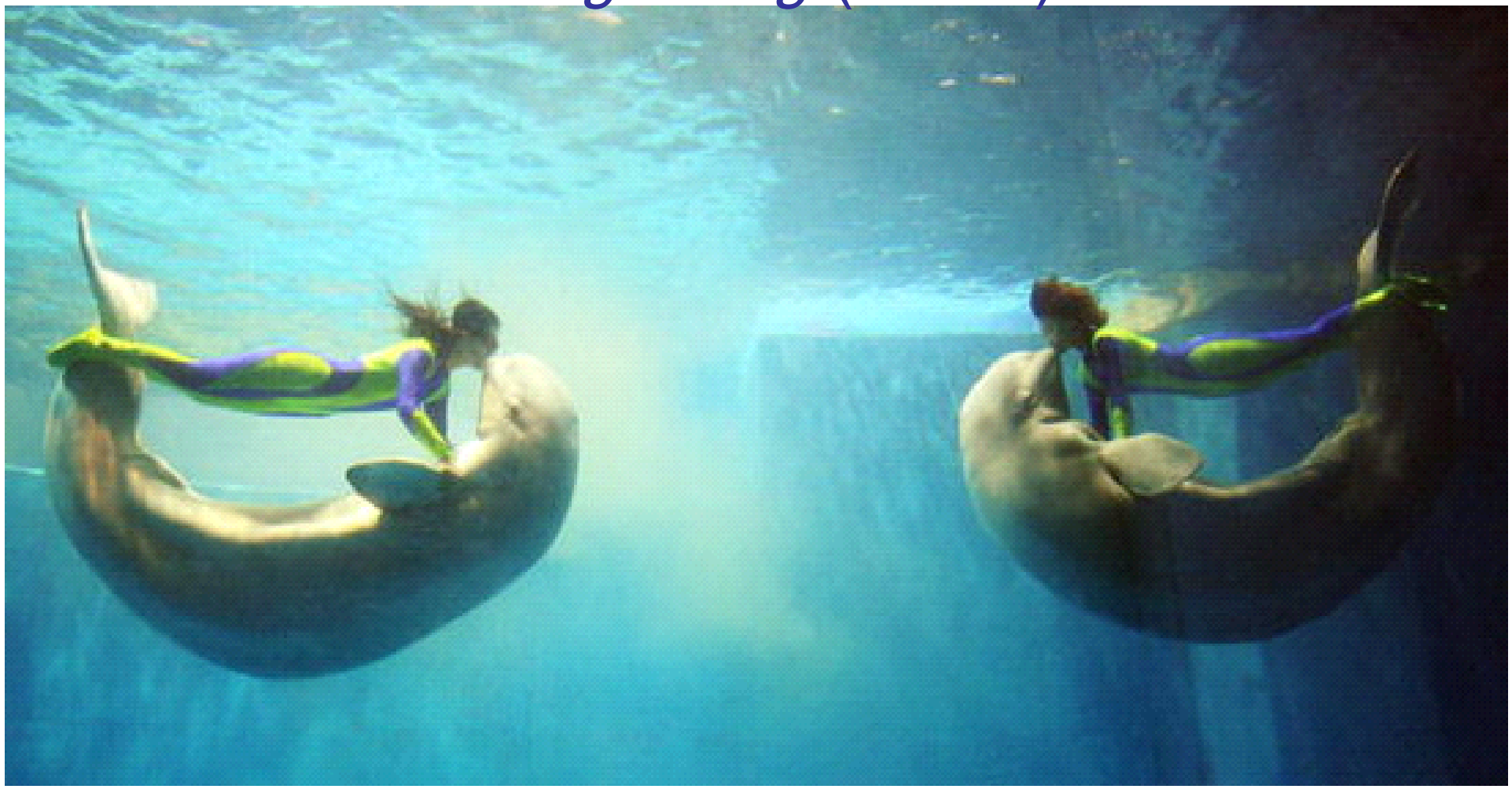
Search for local parity violation with 39 GeV data

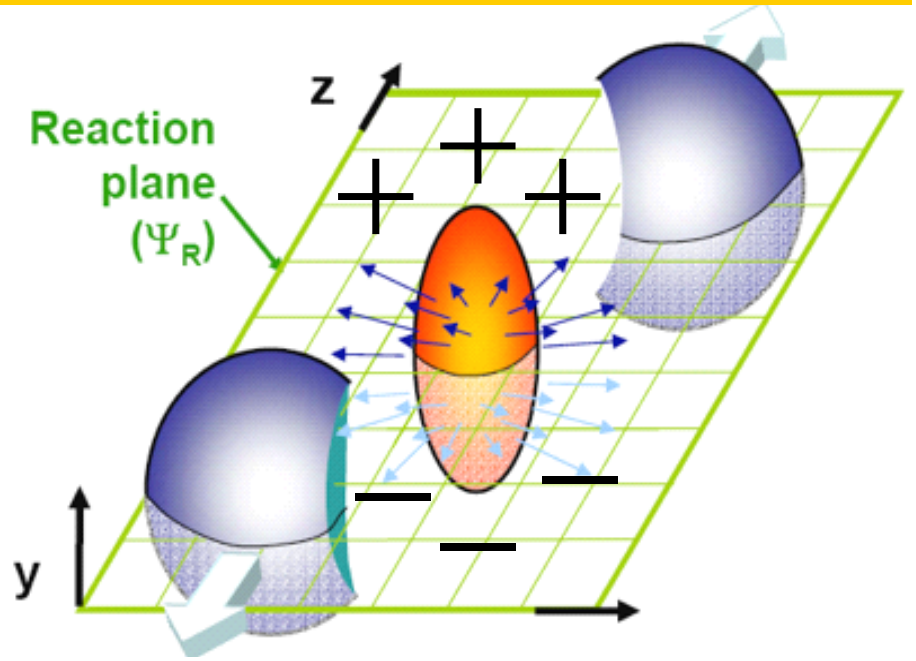
Gang Wang (UCLA)



Charge separation in strong interactions

$$\frac{dN_{\pm}}{d\phi} \propto 1 + 2a_{\pm} \cdot \sin\left(\phi^{\pm} - \Psi_{RP}\right)$$

A direct measurement of the *P*-odd quantity *"a"* should yield *zero.*



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

S. Voloshin, PRC 70 (2004) 057901

Non-flow/non-parity effects: largely cancel out

Directed flow: vanishes if measured in a symmetric rapidity range

P-even quantity: still sensitive to charge separation

Dataset and cuts

$$\langle \cos(\varphi_1 + \varphi_2 - 2\psi_{RP}) \rangle = \frac{\langle \cos(\varphi_1 + \varphi_2 - 2\psi_{EP}) \rangle}{EP \text{ resolution}}$$

The efficiency of ZDC-SMD is low at 39 GeV collisions, so we use the EP from TPC.

39 GeV 8M events after cuts

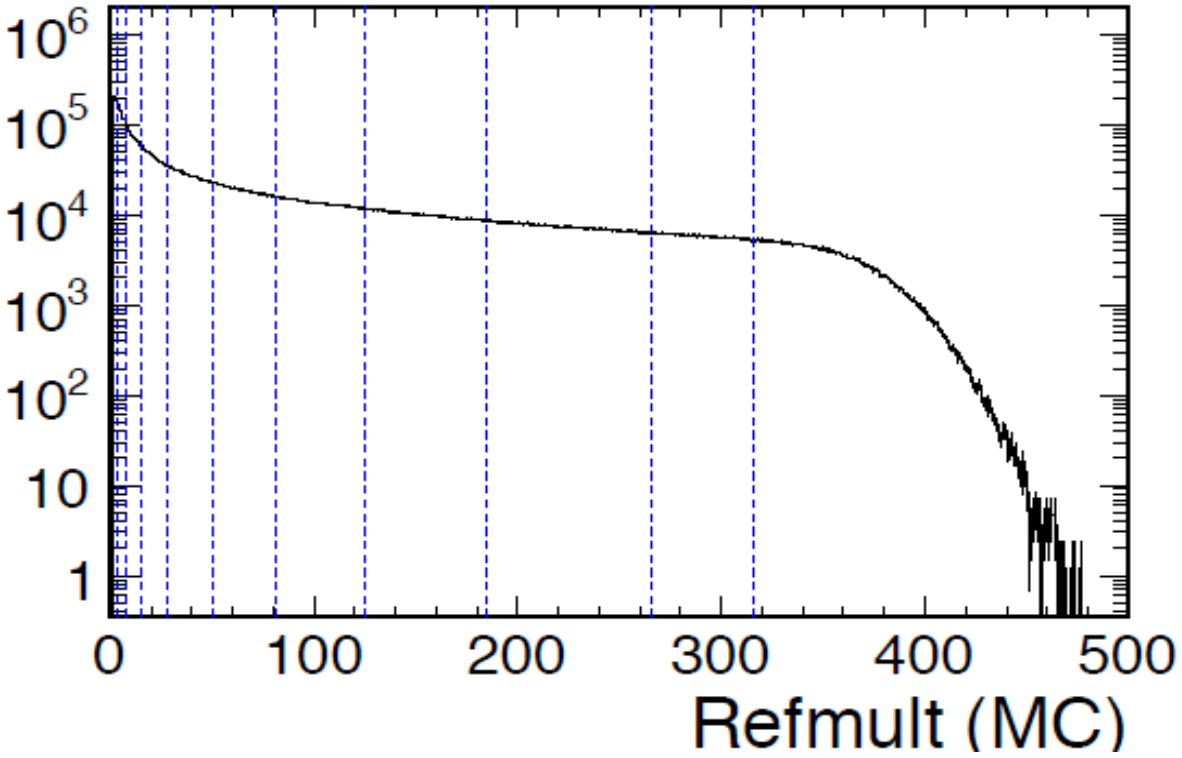
sqrt(Vx*Vx+Vy*Vy) < 2 cm
|vertexZ| < 40 cm

Track cuts: daughter nhitfits >= 15, nhitfits/nmax > 0.52
DCA < 2cm
|eta| < 1
0.15 < pT < 2 GeV/c

Centrality definition

I use the centrality definition from Hiroshi M., and also his weight function for peripheral events: $f(x) = 1 - \exp(-p_0 * x^{p_1})$

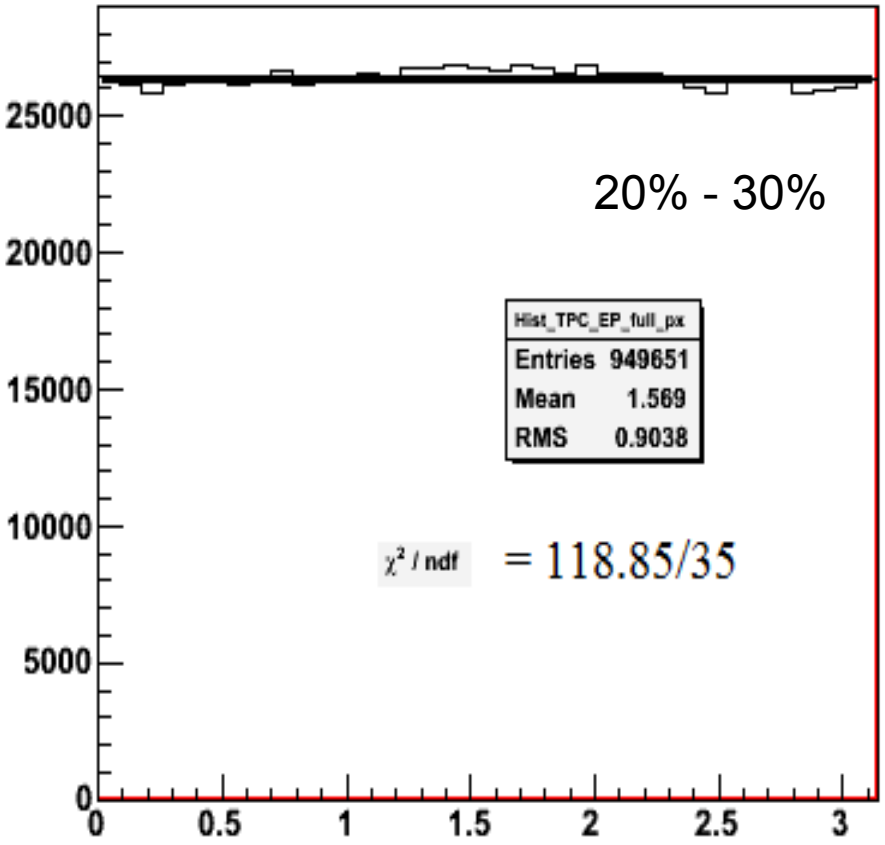
p_0=0.92±0.03, p_1=0.43±0.01

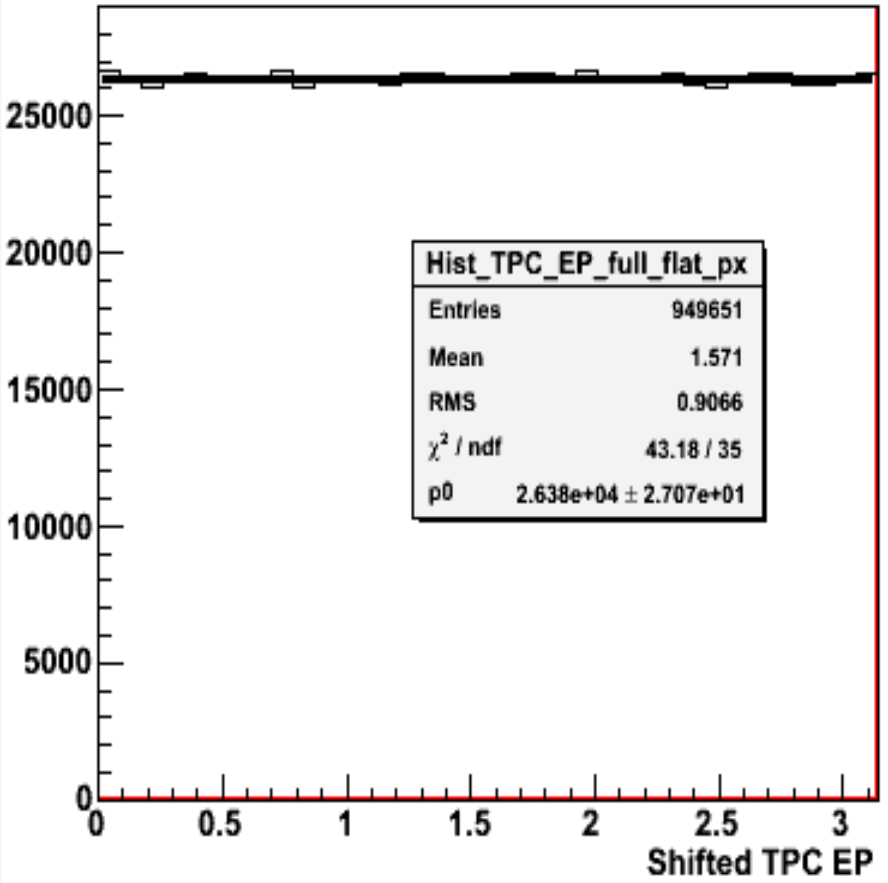


centrality	Refmult
0-5	>316
5-10	>265
10-20	>185
20-30	>125
30-40	>81
40-50	>50
50-60	>28
60-70	>15
70-80	>7

TPC phi angle

The EP from TPC is pretty flat, after applying the phi weight.



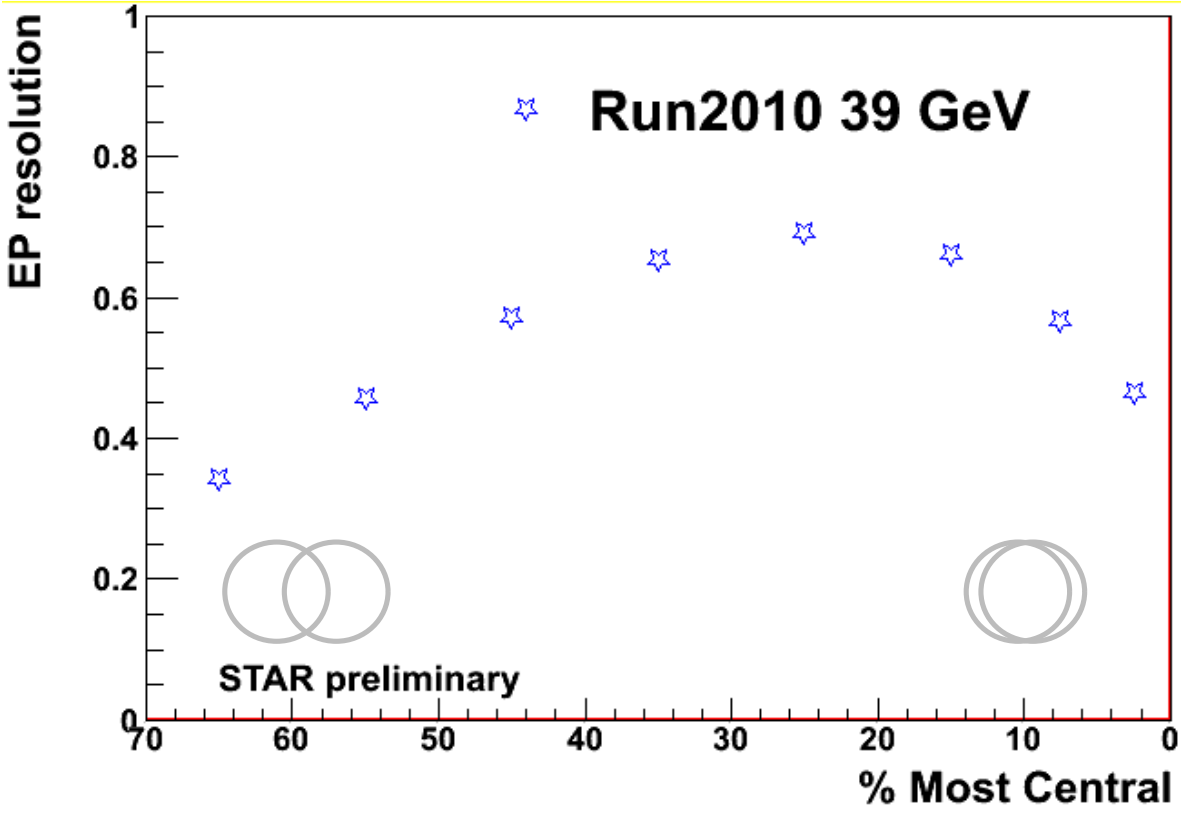


To flatten the distribution, see "E877 Collaboration, Phys. Rev. C 56, 3254 (1997)" for details.

I applied the shifting method to force the EP from TPC to be even more flat.

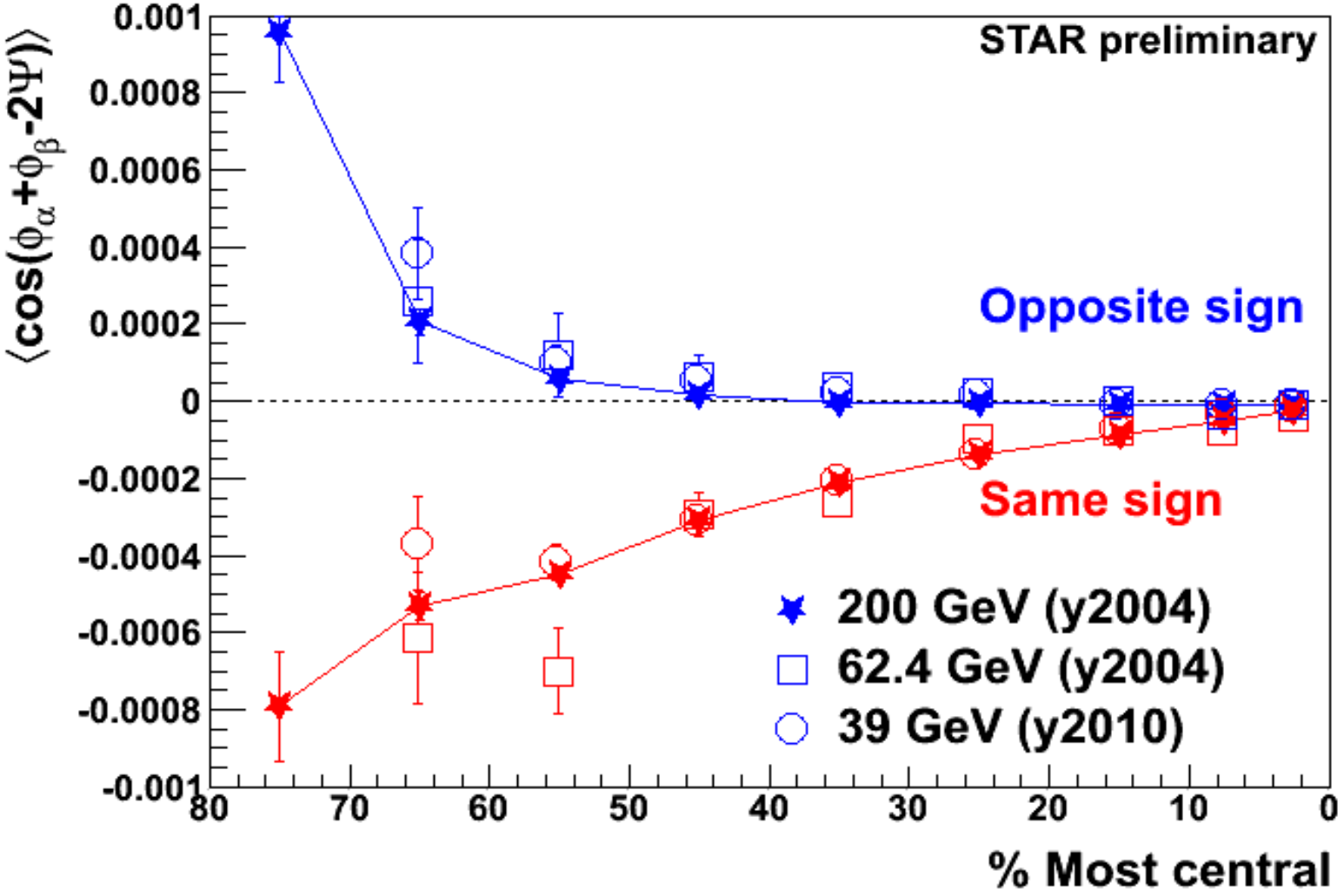
TPC event plane at 39 GeV

The 1st and 2nd particles removed from the event plane reconstruction to remove the auto-correlation.



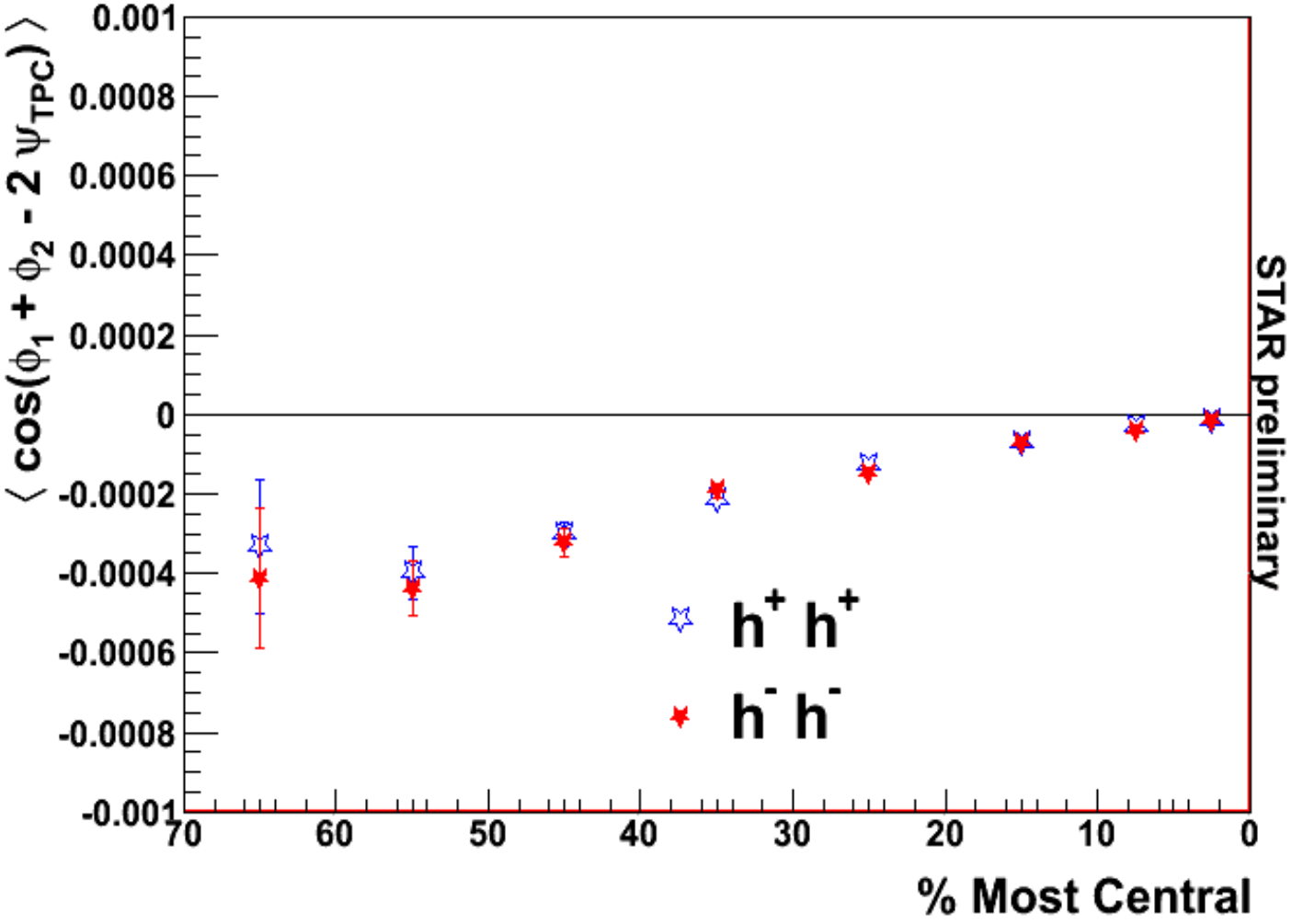
I also applied the shifting method to force the phi distributions of the first two particles to be flat, to reduce detector effects.

Results with different beam energies



The correlator for 39 GeV AuAu is similar to those for 200 GeV and 62.4 Gev.

Results with different combinations



The correlators for ++ and -- are consistent with each other.