

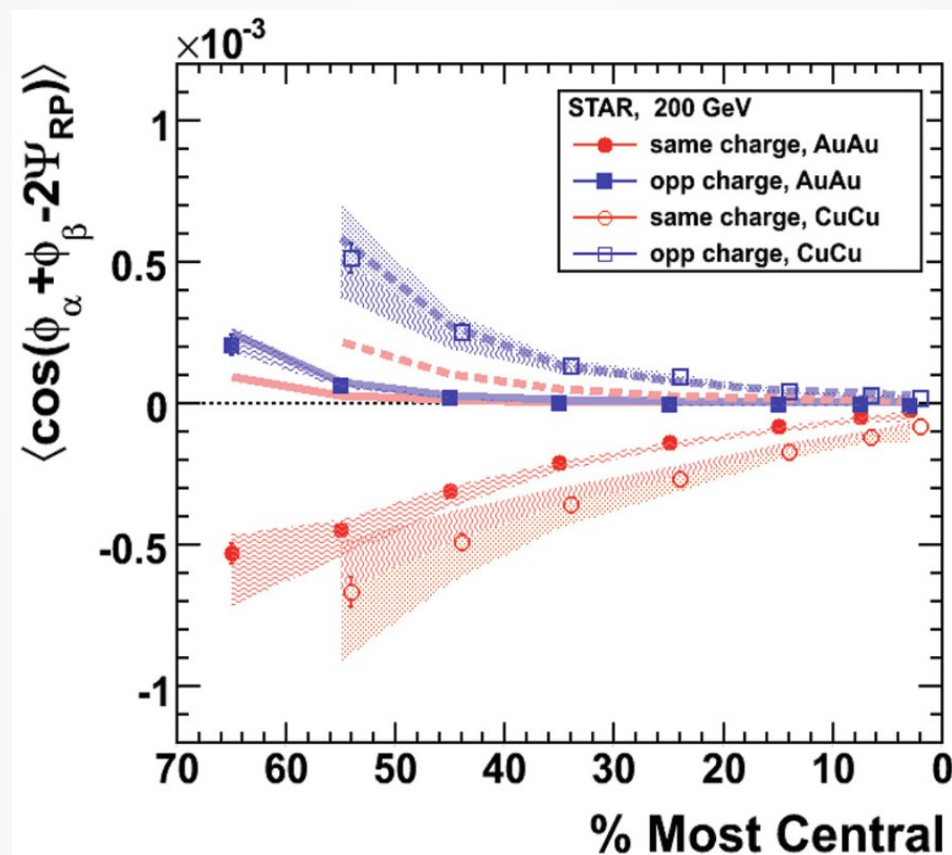
Charge conservation and azimuthal correlators in nuclear collisions

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Motivation

- 2009, STAR experiment: strong P/CP violation via Chiral Magnetic Effect

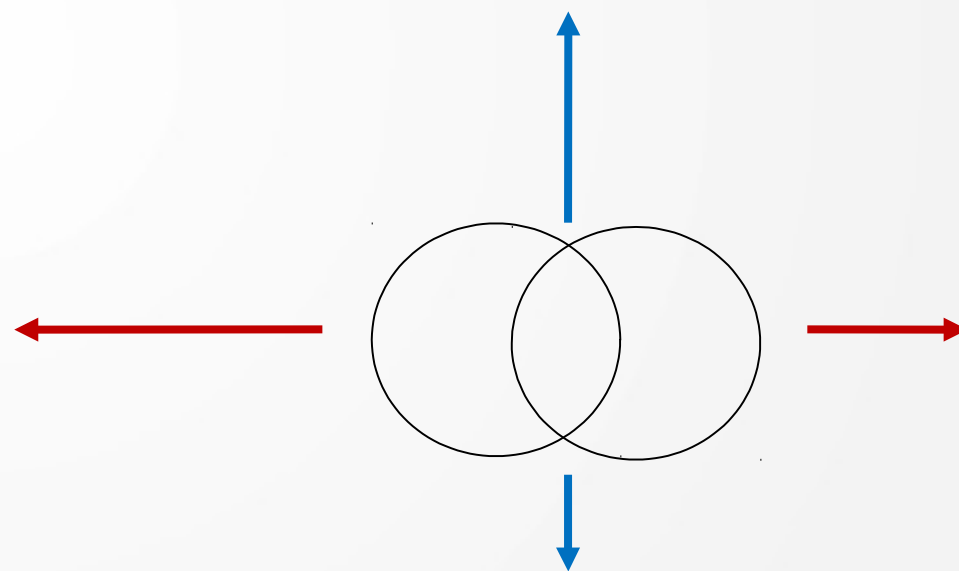
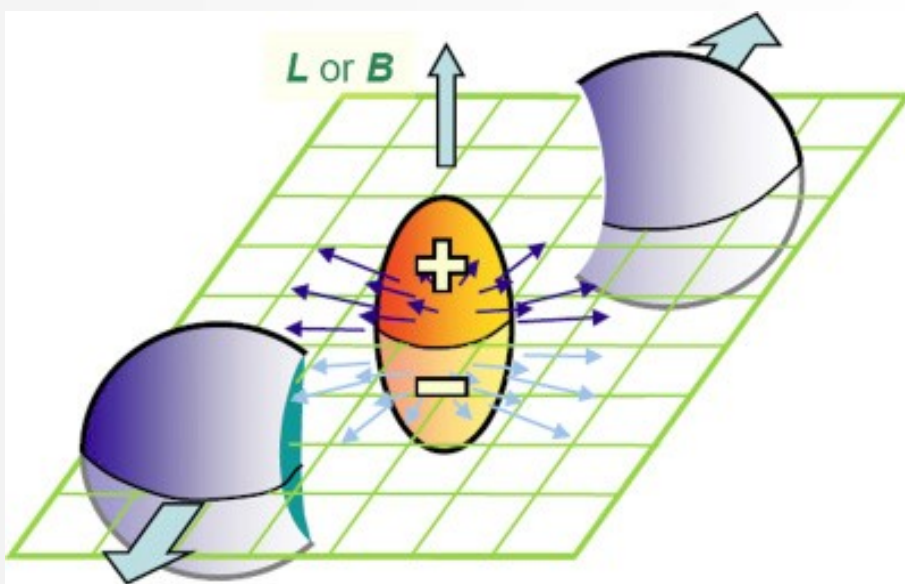


STAR Collaboration: PRL 103 (2009)

Chiral Magnetic Effect

- Charge separation with respect to the reaction plane
- Fourier decomposition of particle distribution with respect to φ :

$$\frac{dN_{\alpha}}{d\phi} = 1 + 2v_1 \cos(\phi - \psi_{RP}) + 2v_2 \cos(2(\phi - \psi_{RP})) + \dots + 2a_{\alpha} \sin(\phi - \psi_{RP}) + \dots$$



Schematic picture of a non-central collision: v_1 a a_{\pm}

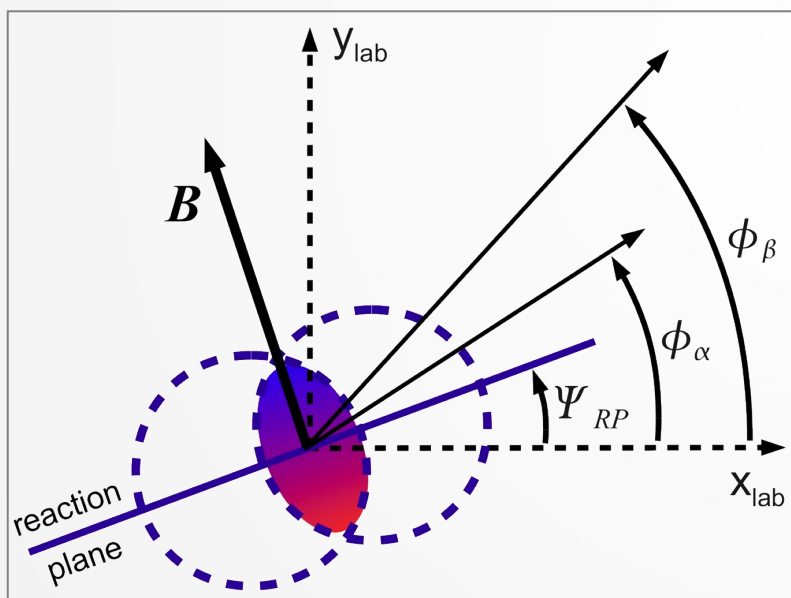
Chiral Magnetic Effect

- Azimuthal correlator:

(Voloshin: Phys. Rev. C 70, 057901 (2004))

$$\gamma_{\alpha\beta} \equiv \langle \cos(\phi_\alpha + \phi_\beta - 2\psi_{RP}) \rangle$$

$$\gamma_{\alpha\beta} = \langle \cos(\phi_\alpha - \psi_{RP}) \cos(\phi_\beta - \psi_{RP}) \rangle - \langle \sin(\phi_\alpha - \psi_{RP}) \sin(\phi_\beta - \psi_{RP}) \rangle$$



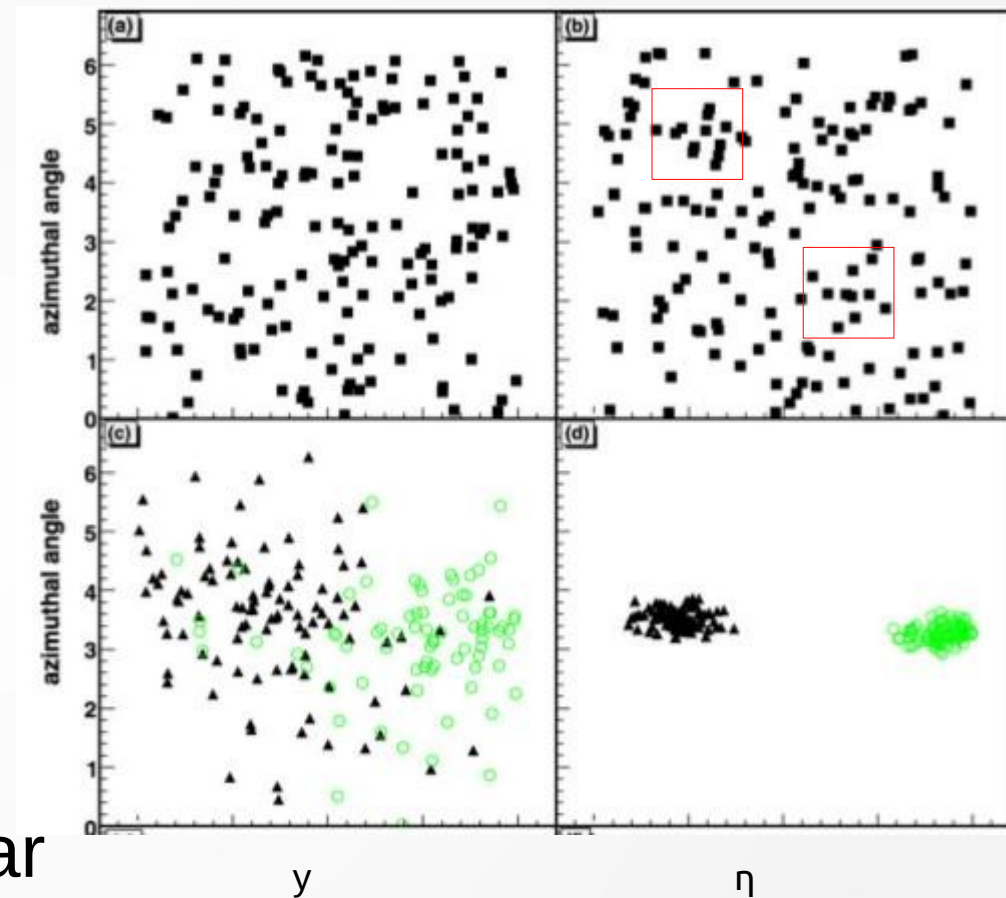
$$\gamma_{\alpha\beta} \propto -\langle a_\alpha a_\beta \rangle$$

Azimuthal correlator

- Contributions other than P/CP violation:
transverse momentum conservation, charge, baryon number, strangeness conservation
- Charge production late in the collision
- Collective motion, diffusion
- Charge-balanced particles emitted within a close range

Method

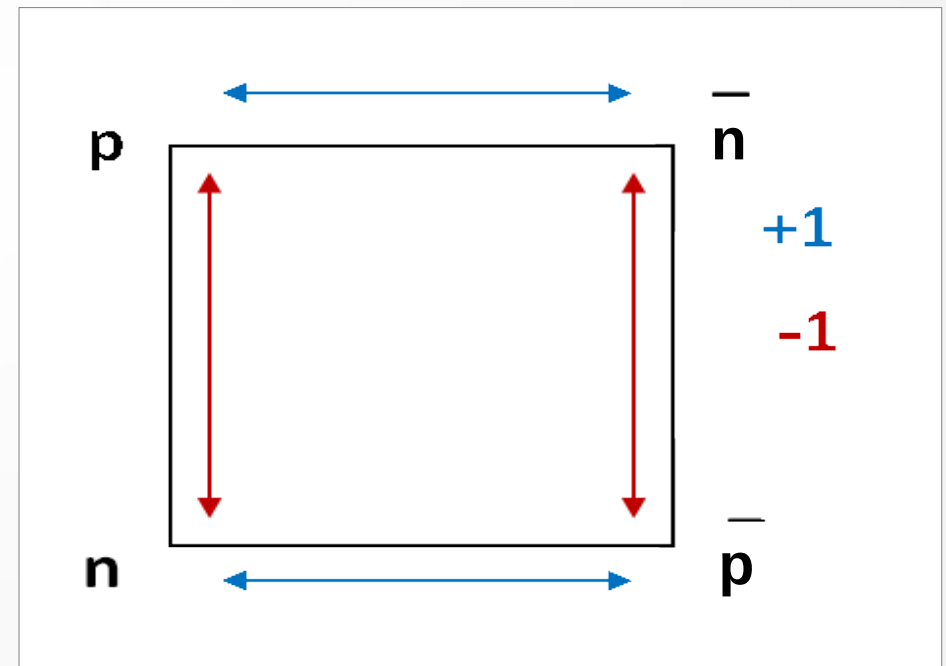
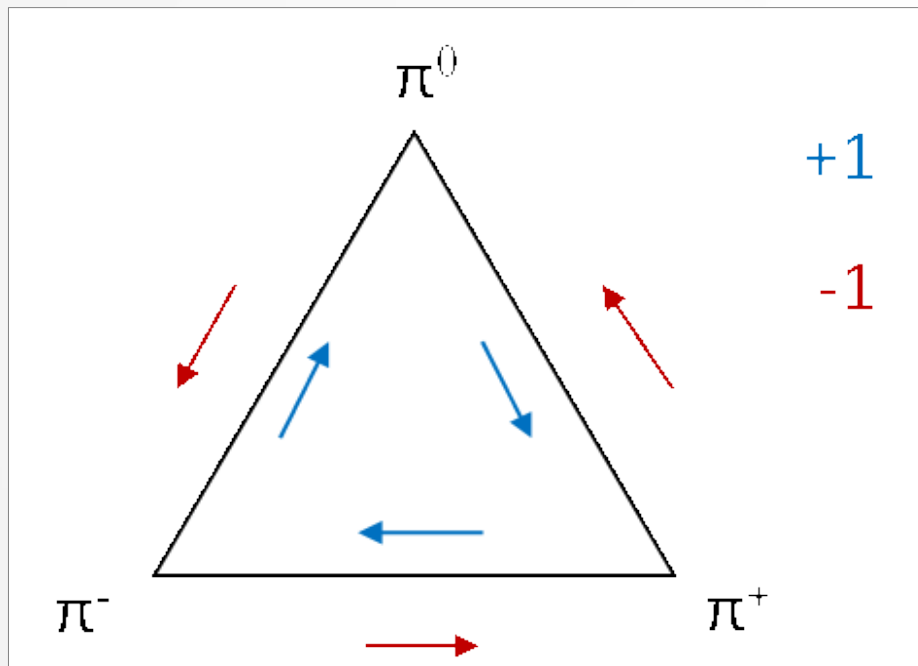
- DRAGON: blast-wave model
- Global p_t conservation
- Local charge, B and S conservation:
 - Clusters (uncorrelated particles)
 - Droplets (equal or similar emission velocities)



(fig.: B. Tomášik, Comput. Phys. Commun. 180, 1642 (2009))

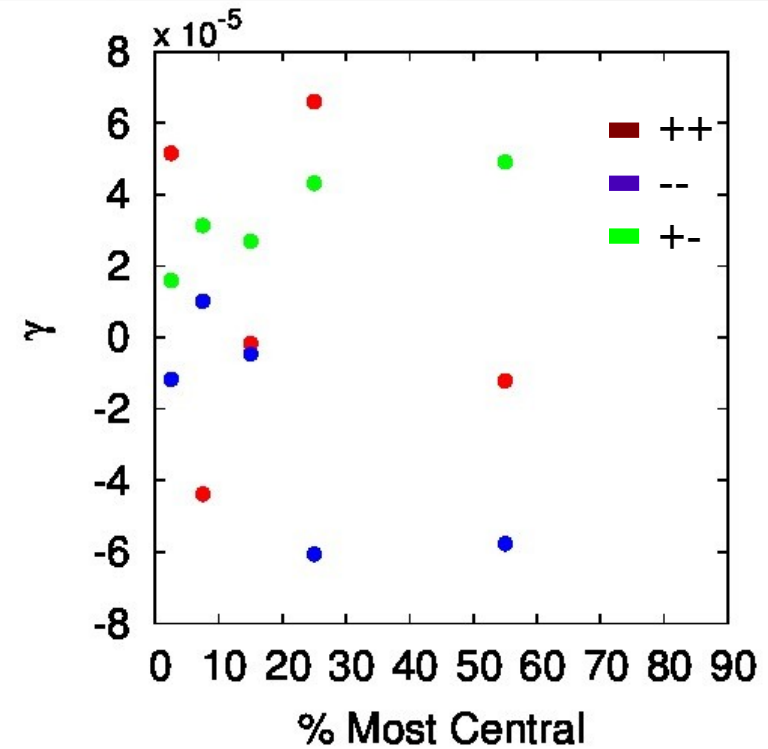
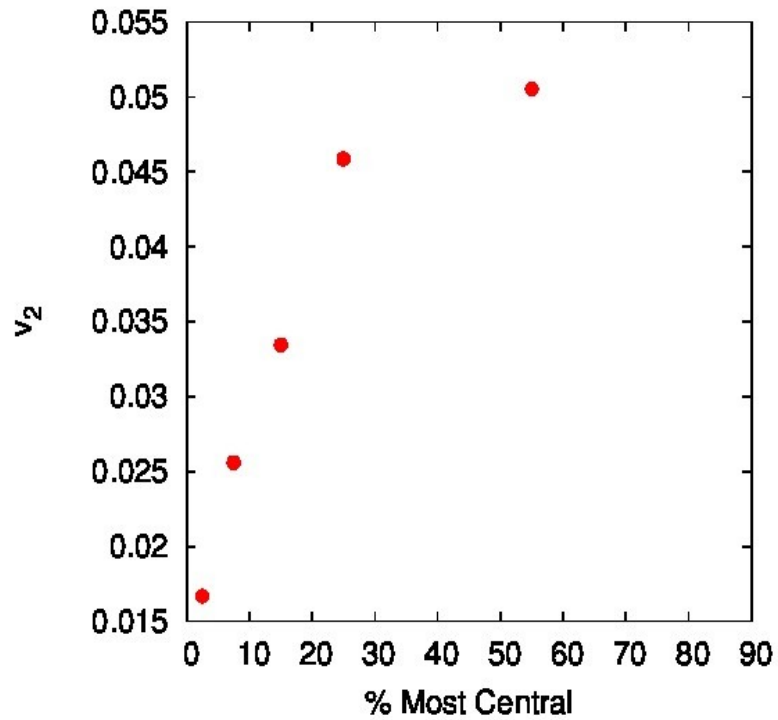
Method

- Transverse momentum conservation: shifting p_t of every particle
- Q, B, S conservation: „neutralisation“ algorithm

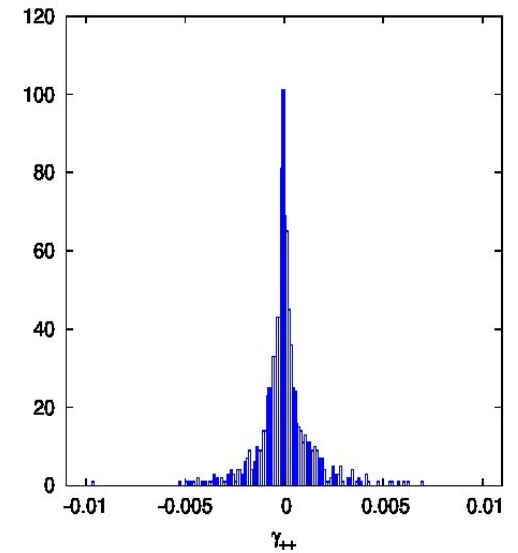
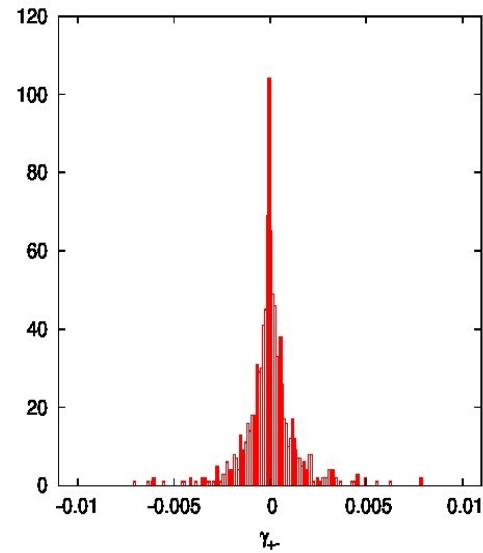
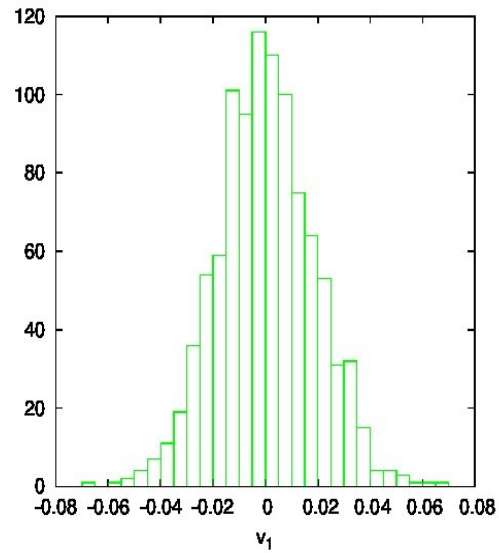


Charge and other quantum numbers neutralisation inside particle's isomultiplet

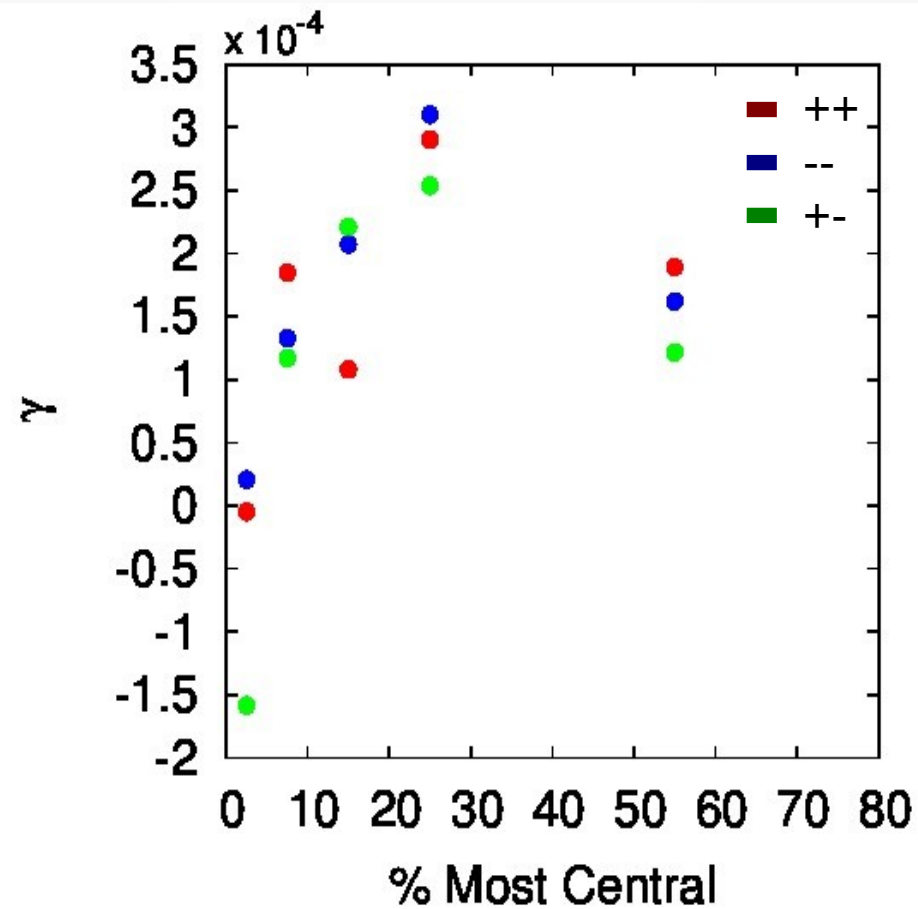
Simulation: clusters



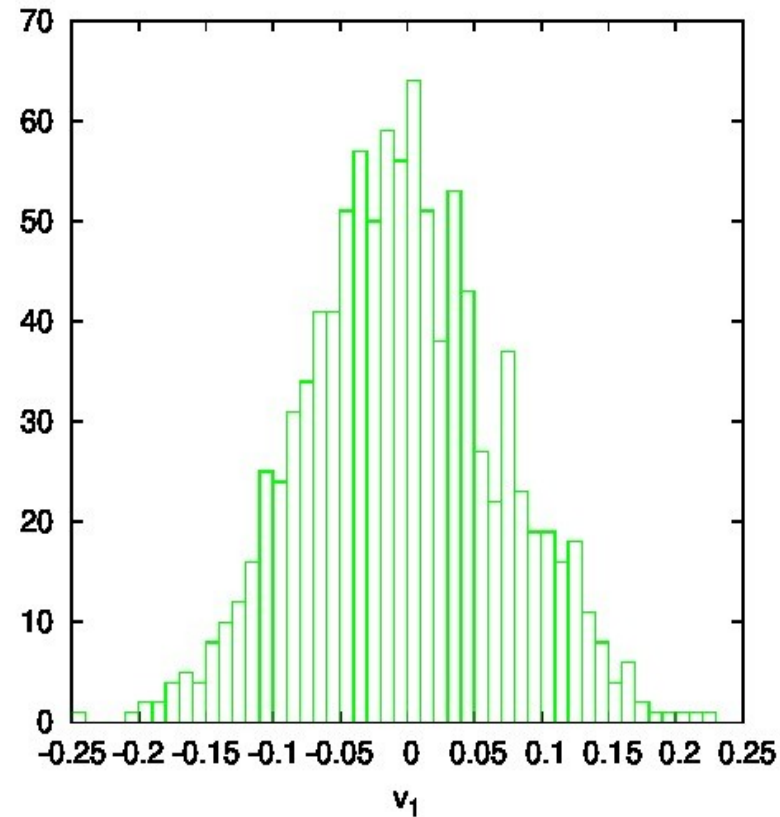
Simulation: clusters



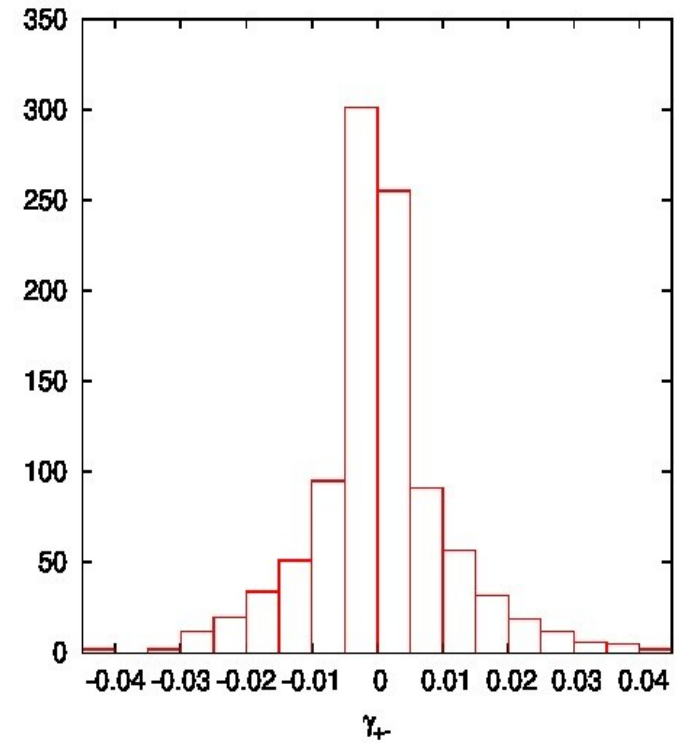
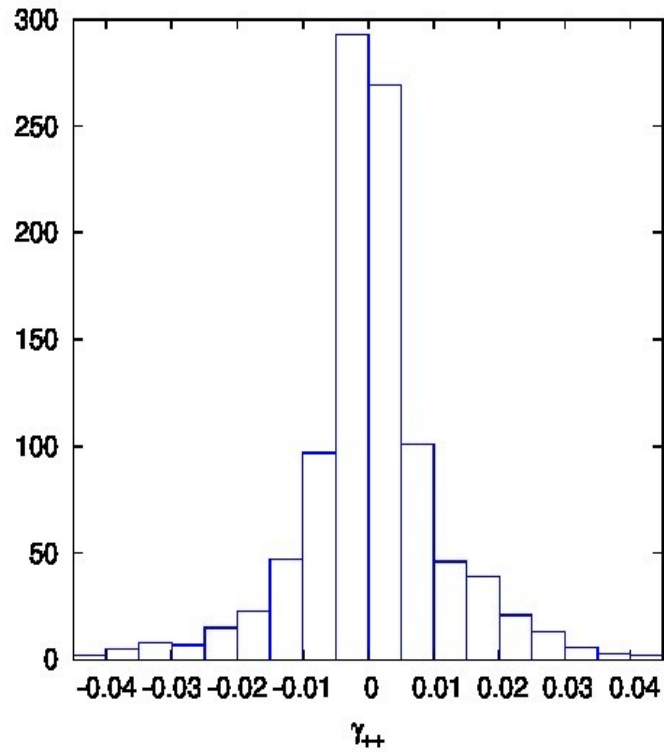
Simulation: droplets



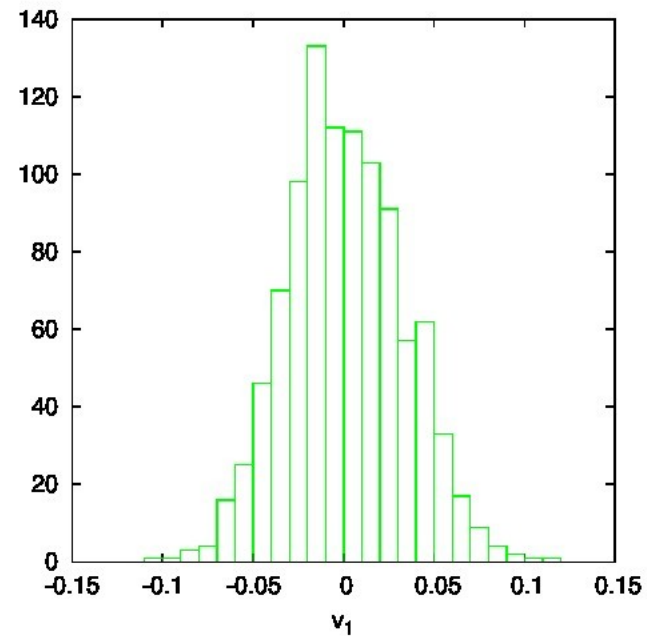
Simulation: droplets



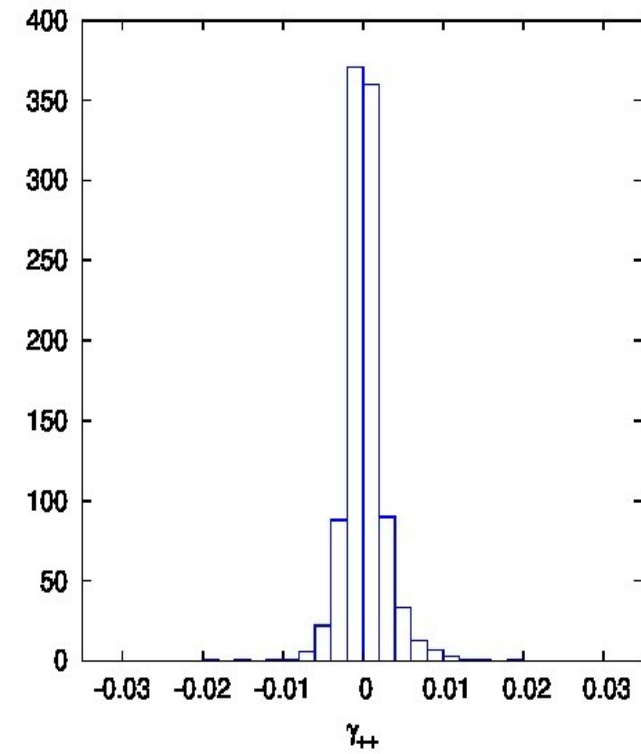
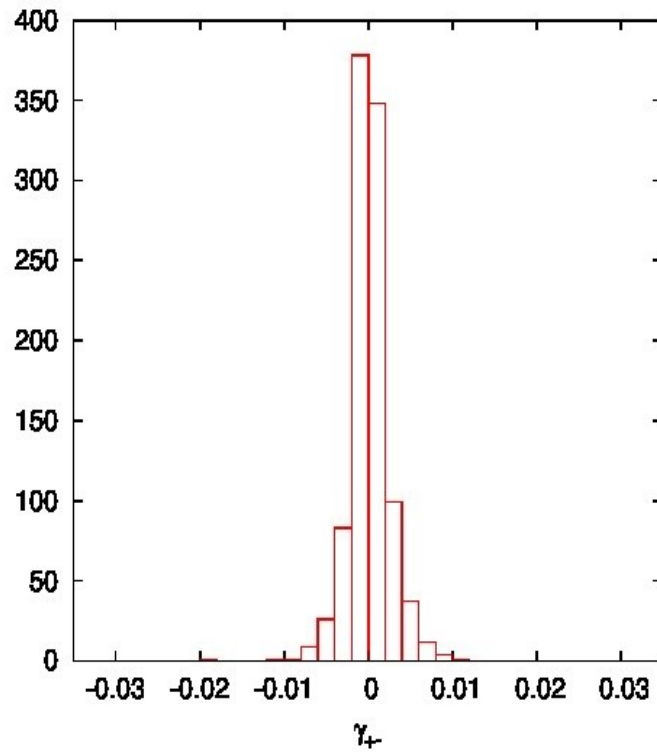
Simulation: droplets



Simulation: droplets



Simulation: droplets



Summary

- Cluster simulation: no significant values of azimuthal correlator γ
- Droplet simulation: values of γ are governed by large fluctuation of v_1