

# Measurements of charge-dependent correlations in Xe-Xe collisions with ALICE

A. Danu for the ALICE Collaboration  
Institute of Space Science (RO)  
E-mail: [Andrea.Danu@cern.ch](mailto:Andrea.Danu@cern.ch)

## Chiral Magnetic Effect (CME)

- Strong magnetic field ( $B \sim 10^{15}$  T) [1] coupled with QCD domains with P and CP symmetries locally broken [2] → charge separation along the magnetic field and perpendicular to the reaction plane → the **Chiral Magnetic Effect (CME)** [3]
- Studies usually performed using 2- and 3-particle correlators [4, 5]

$$\delta_{ab} = \langle \cos(\varphi_a - \varphi_b) \rangle \approx \langle a_{1,a} a_{1,b} \rangle + B_{\text{in-plane}} + B_{\text{out-of-plane}}$$

$$\gamma_{ab} = \langle \cos(\varphi_a + \varphi_b - 2\Psi_2) \rangle \approx -\langle a_{1,a} a_{1,b} \rangle + B_{\text{in-plane}} - B_{\text{out-of-plane}}$$

- Correlators contain background effects (e.g., local charge conservation + elliptic flow [6]) as well as potential CME signal

### Could Xe-Xe collisions help to constrain the background?

- Perform MC Glauber [7] simulations with magnetic field

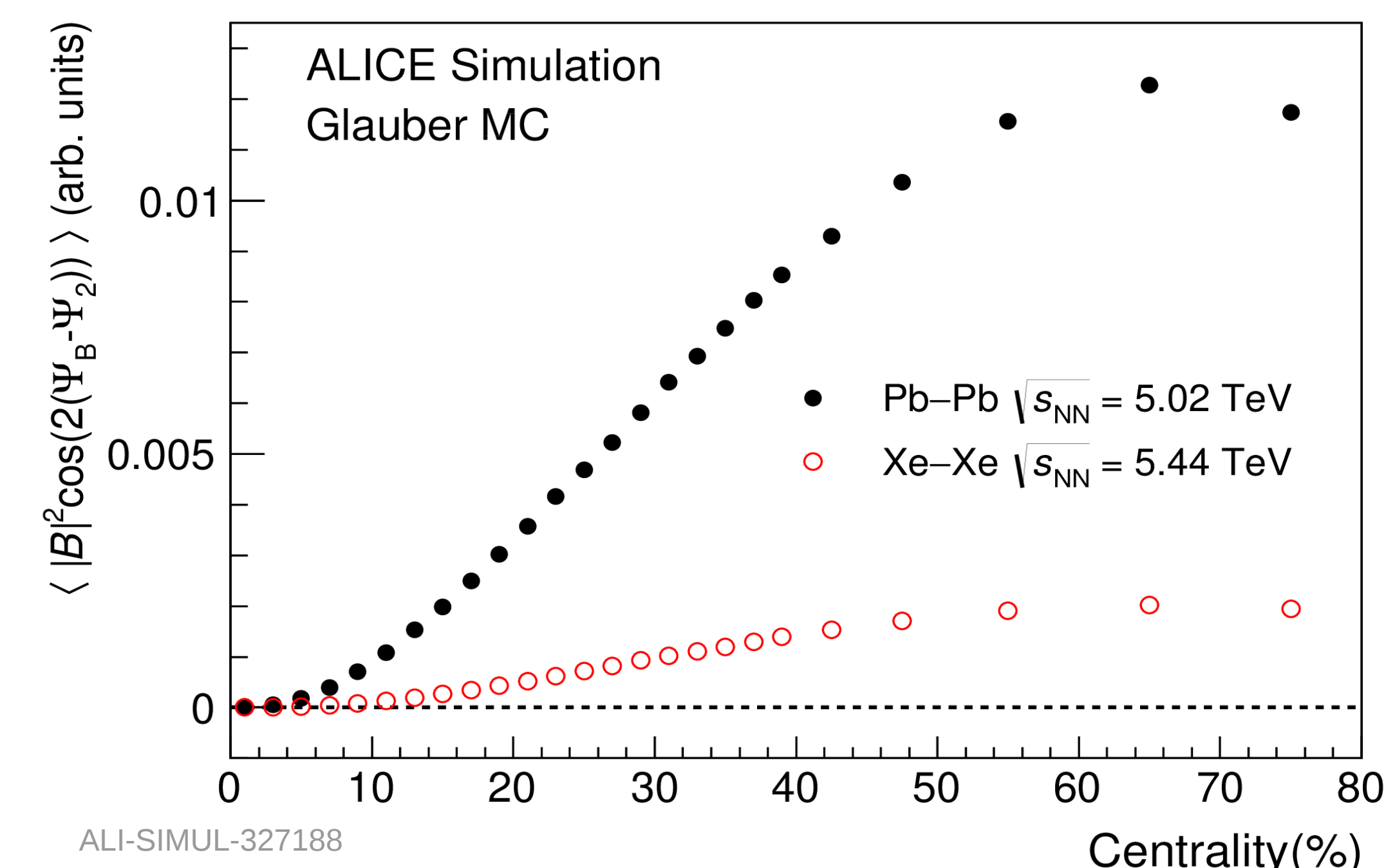
- Parameters tuned to ALICE results [8]

- Calculate magnetic field at origin using spectator protons with the proper time  $\tau = 0.1$  fm [9]

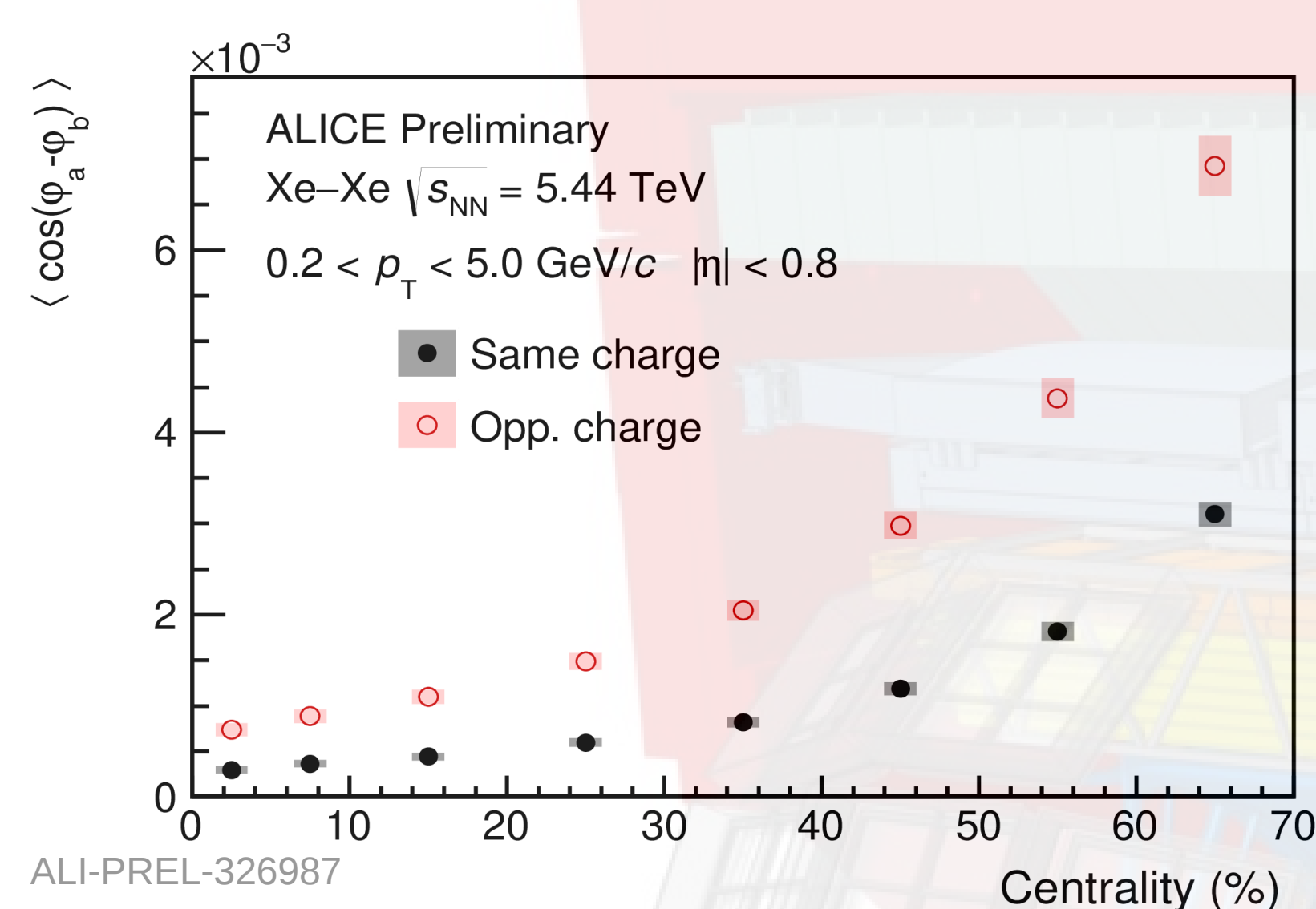
- $\langle |B|^2 \cos(2(\Psi_B - \Psi_2)) \rangle$  quantifies the expected CME contribution

- Expected smaller CME contribution in Xe-Xe than in Pb-Pb collisions**

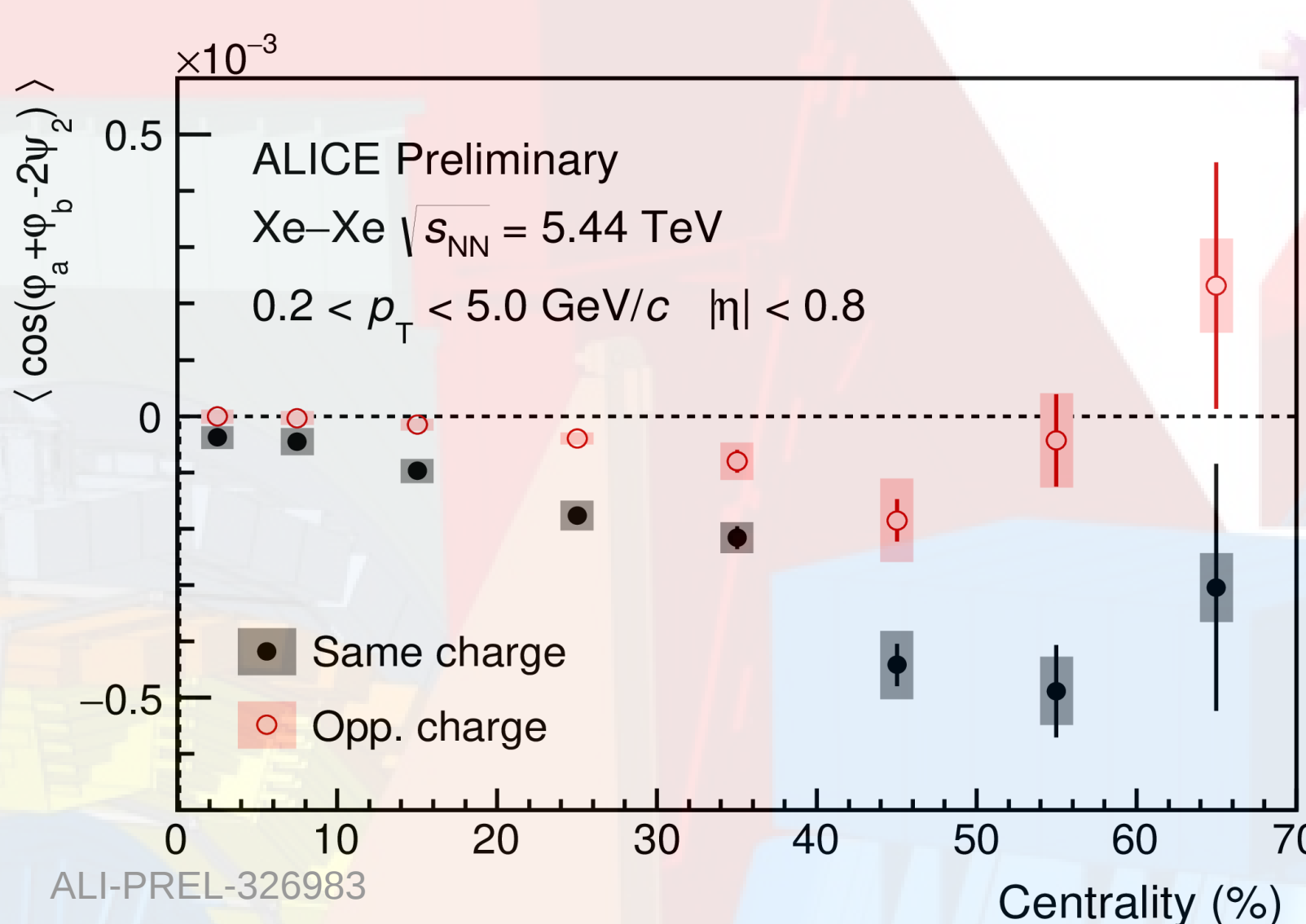
$$eB_s^\pm(\tau, \eta, \mathbf{x}_\perp) = \pm Z\alpha_{EM} \sinh(Y_0 \mp \eta) \int d^2\mathbf{x}'_\perp \rho_\pm(\mathbf{x}'_\perp) [1 - \theta_\mp(\mathbf{x}'_\perp)] \times \frac{(\mathbf{x}'_\perp - \mathbf{x}_\perp) \times \mathbf{e}_z}{[(\mathbf{x}'_\perp - \mathbf{x}_\perp)^2 + \tau^2 \sinh(Y_0 \mp \eta)^2]^{3/2}}$$



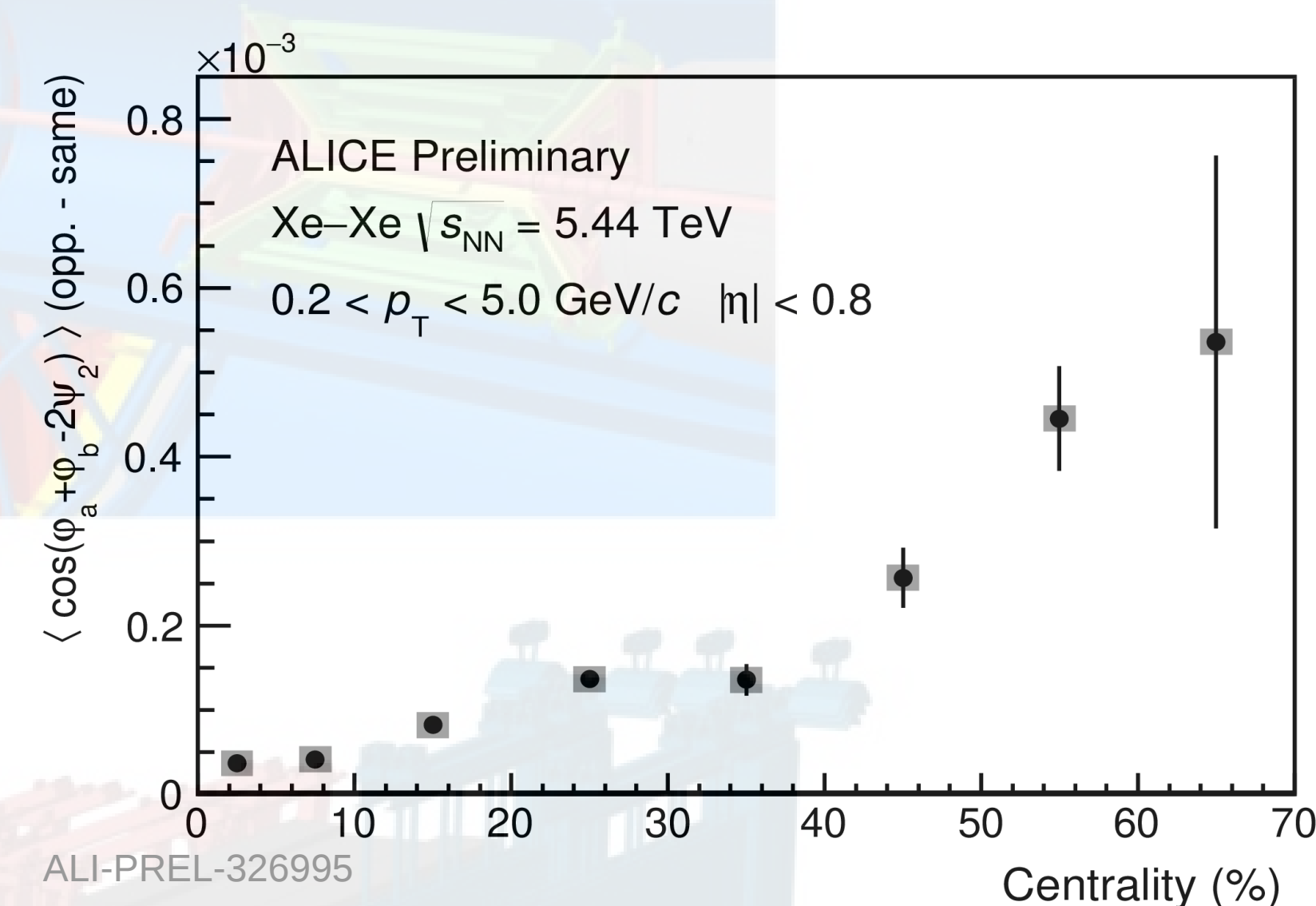
## CME studies in Xe-Xe collisions



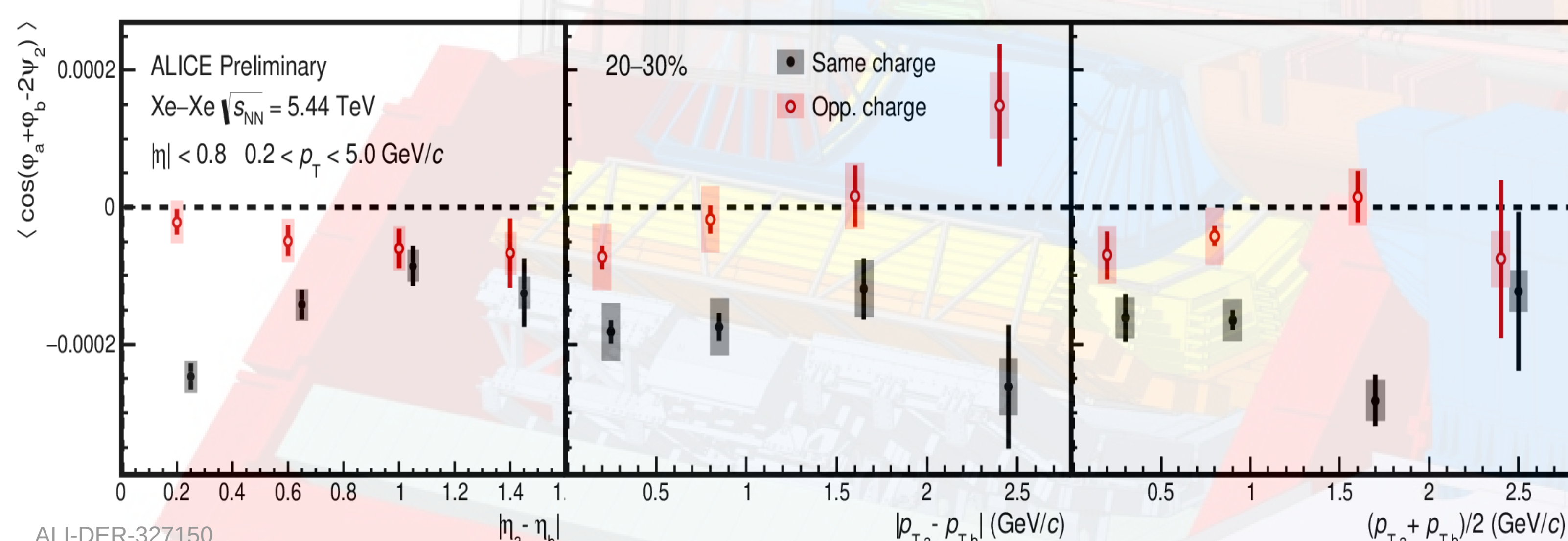
$\delta_{ab}$ : stronger correlation for opposite charge pairs compared to same charge → larger contribution from background effects



$\gamma_{ab}$ : stronger correlation for opposite charge pairs compared to same charge → charge separation

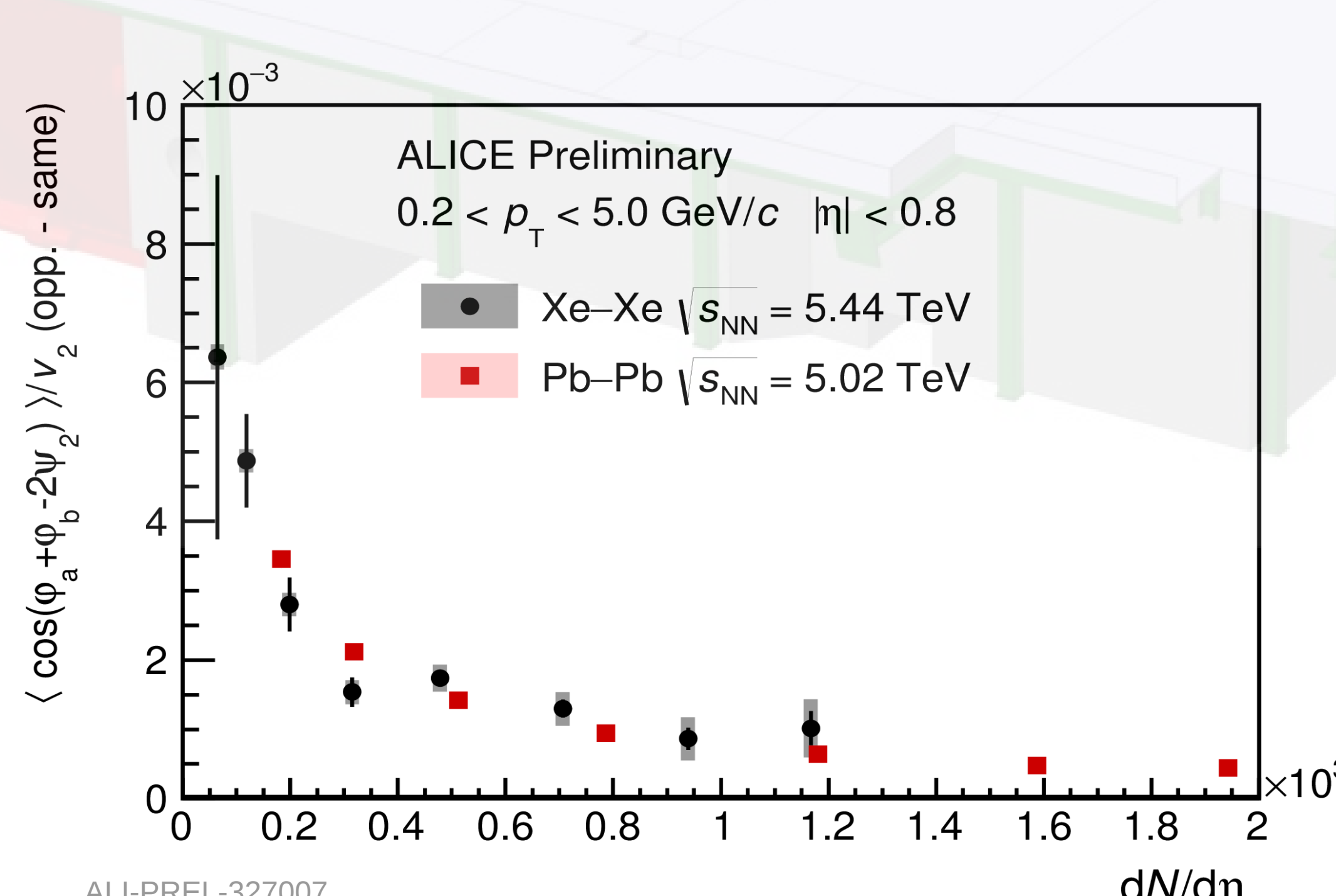
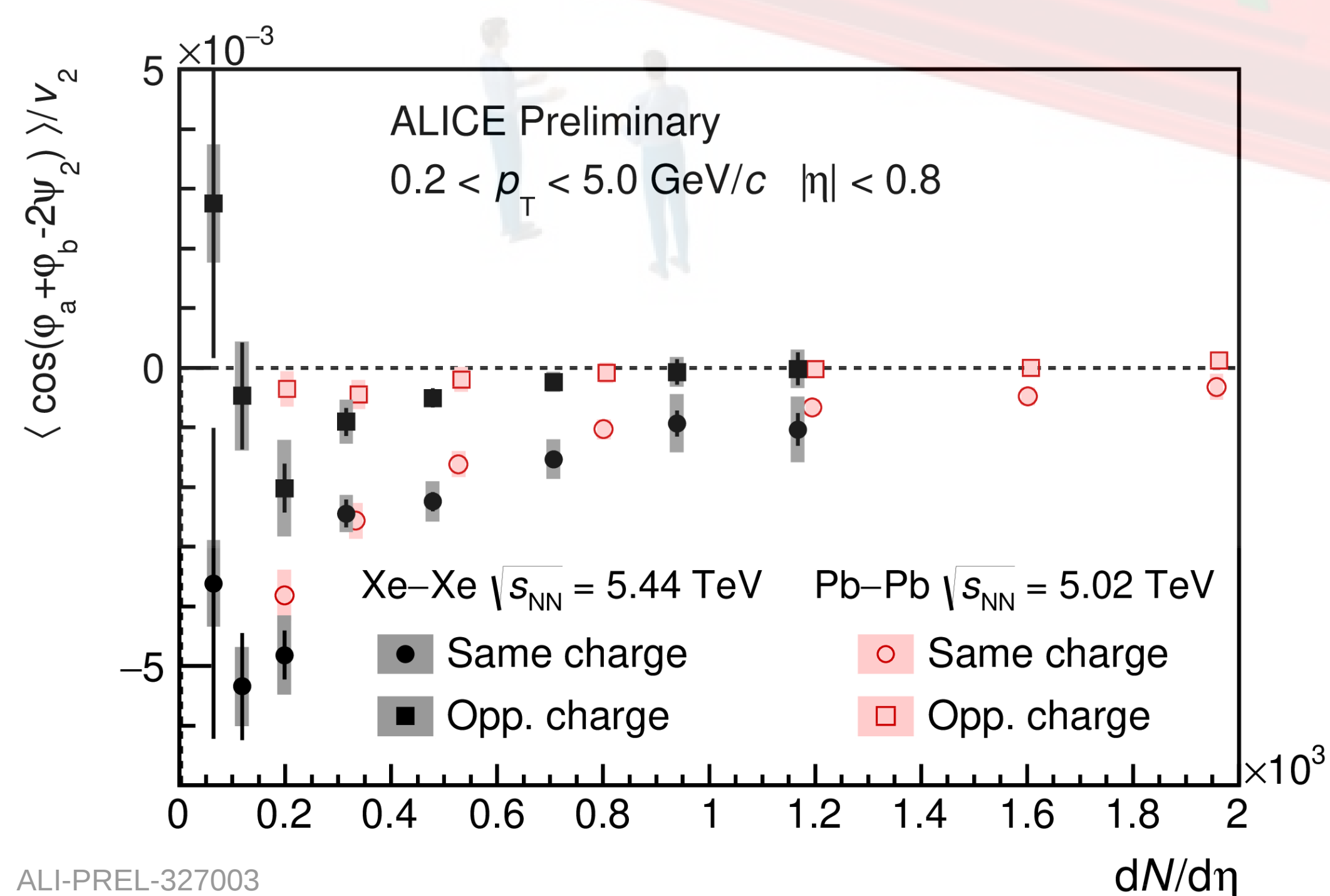


$\gamma_{ab}(\text{opp-same})$ : can be used to study the CME  
• Indication of charge separation



- $\gamma_{ab}(|\eta_a - \eta_b|)$ : opposite charge pairs show a weak (if any) dependence while the same charge pairs show a strong dependence
- $\gamma_{ab}(|p_{T,a} - p_{T,b}|)$ : opposite charge pairs show a strong dependence while the same charge pairs show no dependence
- $\gamma_{ab}((p_{T,a} + p_{T,b})/2)$ : opposite charge pairs show a weak dependence while the same charge pairs show a strong correlation

## CME: Xe-Xe vs Pb-Pb collisions



$\gamma_{ab}$  in Xe-Xe collisions has similar values as in Pb-Pb collisions when divided by  $v_2$  [10], except peripheral collisions

$\gamma_{ab}(\text{opp-same})$  in Xe-Xe collisions has similar values as in Pb-Pb collisions within uncertainties  
→ Background dominates using results from magnetic field simulation

## Summary

- First measurement of charge-dependent correlations in Xe-Xe collisions performed in ALICE
- MC Glauber simulations with magnetic field suggest smaller CME contribution in Xe-Xe than in Pb-Pb collisions
- $\gamma_{ab}(\text{opp-same})$  similar values as in Pb-Pb collisions within uncertainties  
→ Large background contribution to  $\gamma_{ab}(\text{opp-same})$

## References

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