Measurement of $R_2(\Delta\eta, \Delta\varphi)$ and $P_2(\Delta\eta, \Delta\varphi)$ correlation functions in pp collisions at $\sqrt{s}$ = 13 TeV with ALICE

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Correlation observable

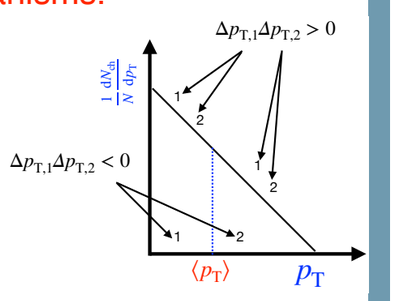
- **Two-particle differential number correlation [1,3,4]:**

$$R_2(\Delta\eta, \Delta\varphi) = \frac{\rho_2(\Delta\eta, \Delta\varphi)}{\rho_1 \times \rho_1(\Delta\eta, \Delta\varphi)} - 1$$

✓ Sensitive to particle production mechanisms.

- **Two-particle differential transverse momentum correlation [1,3,4]:**

$$P_2(\Delta\eta, \Delta\varphi) = \frac{\langle \Delta p_{T,1} \Delta p_{T,2} \rangle (\Delta\eta, \Delta\varphi)}{\langle p_T \rangle^2}$$



where $\Delta p_{T,i} = p_{T,i} - \langle p_T \rangle$

✓ Sensitive to transverse momentum fluctuations.

Why did we use R_2 & P_2 ?

✓ Dimensionless quantity ✓ Robust observable[4]

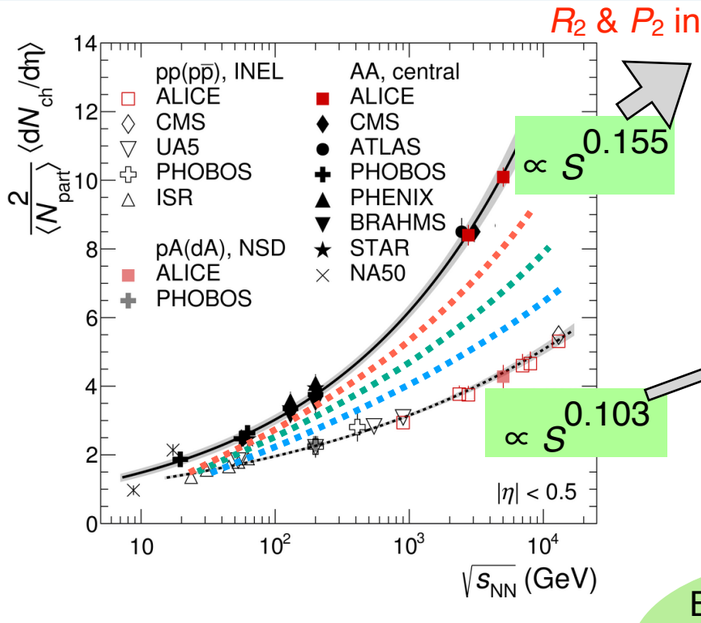
Our Focus:

1. Charge-Independent (CI): $O^{CI} = \frac{1}{2}(O^{+-} + O^{-+} + O^{++} + O^{--})$
2. Charge-Dependent (CD): $O^{CD} = \frac{1}{2}(O^{+-} + O^{-+} - O^{++} - O^{--})$

where $O \equiv \{R_2, P_2\}$

R_2 and P_2 correlation functions in Pb--Pb

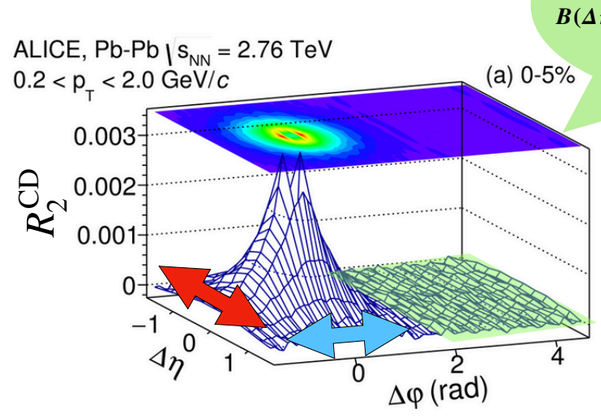
R_2 & P_2 in p--Pb & Pb--Pb[3,4]



Balance Function

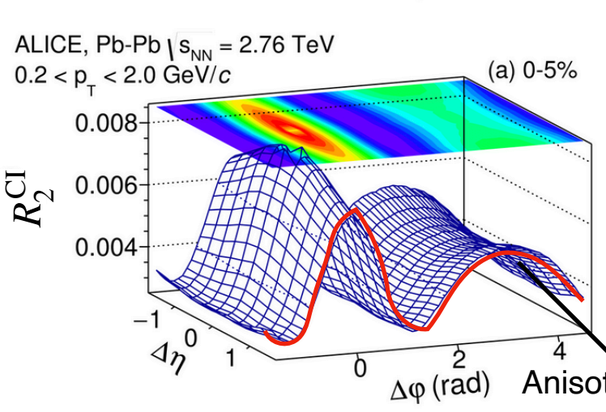
$$B(\Delta\eta, \Delta\varphi) \equiv \frac{dN_{ch}}{d\eta} R_2^{CD}(\Delta\eta, \Delta\varphi)$$

$R_2^{CD} = \frac{1}{2}(R_2^{+-} + R_2^{-+} - R_2^{++} - R_2^{--})$



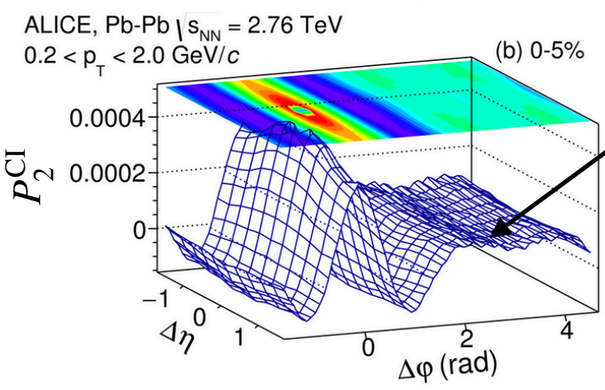
Charge Balance, Diffusivity
Radial flow

$R_2^{CI} = \frac{1}{2}(R_2^{+-} + R_2^{-+} + R_2^{++} + R_2^{--})$



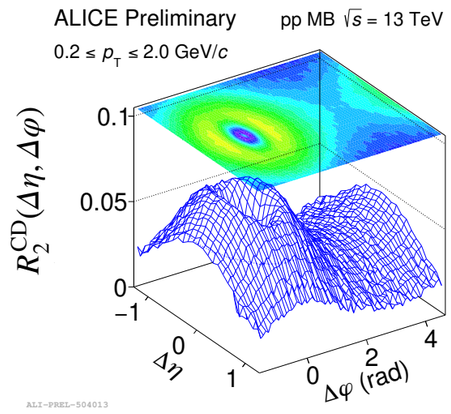
Anisotropic Flow: v_2, v_3 etc

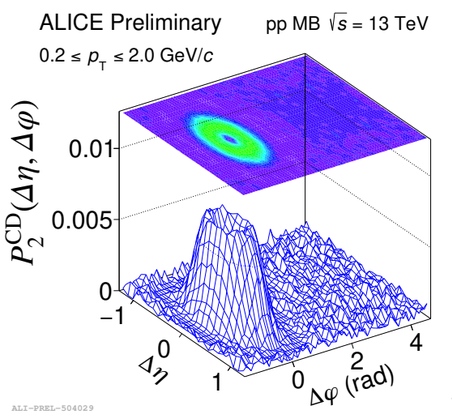
$P_2^{CI} = \frac{1}{2}(P_2^{+-} + P_2^{-+} + P_2^{++} + P_2^{--})$

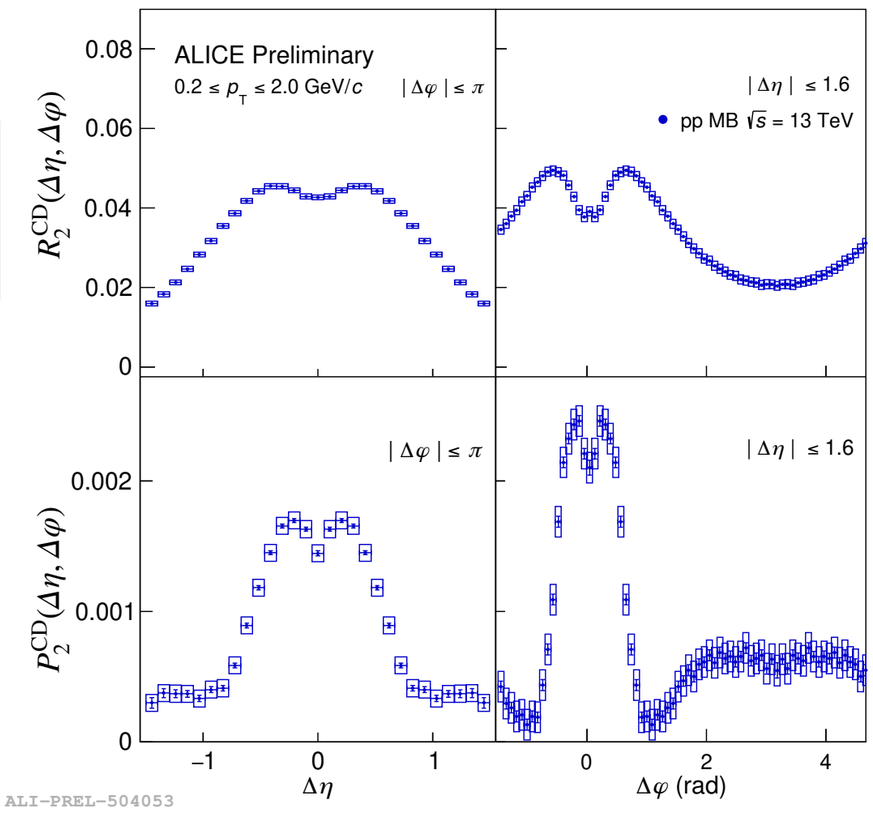


Related to Temperature Fluctuations: $P_2^{CI} \propto \frac{\Delta T}{T}$

R_2^{CD} and P_2^{CD} correlation functions in pp





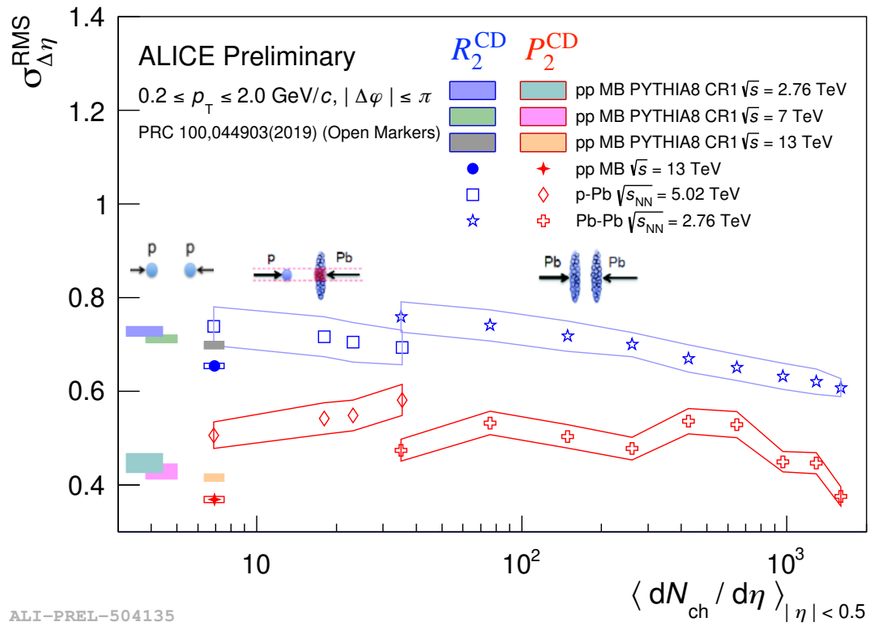


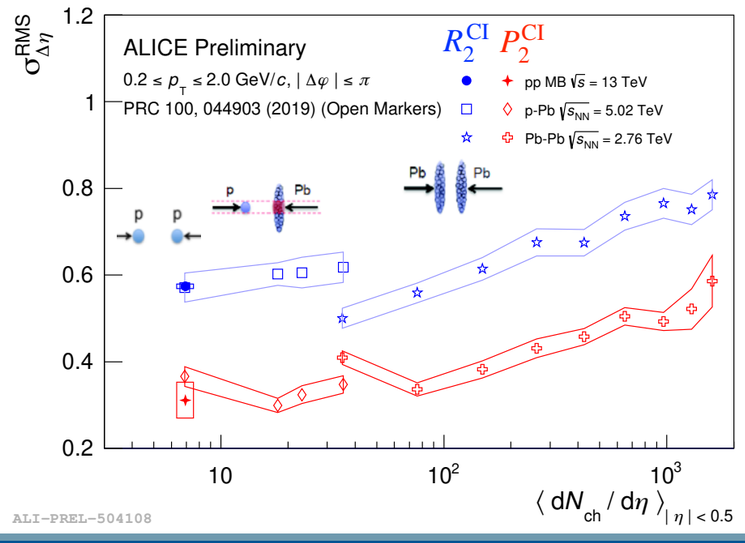
- Dip in R_2^{CD} and P_2^{CD} is expected to result largely from **HBT** effect.
- Difference in shape and width between R_2^{CD} and P_2^{CD}.
- P_2^{CD} is narrower than R_2^{CD} expected from **angular ordering**[1] of the p_T of jet constituents.

Width of the correlation functions

- The widths decrease monotonically as a function of $\langle dN_{ch}/d\eta \rangle$ in Pb--Pb data sets from peripheral to central collisions for both R_2^{CD}(strong) and P_2^{CD}(modest)

  → **Radial flow, diffusivity**
- For p--Pb case, the widths have noticeable reduction for R_2^{CD} whereas widths of P_2^{CD} have reverse trend.
- Widths of R_2^{CD} show $\sqrt{s}$ dependence.
- Widths of P_2^{CD} show $\langle p_T \rangle$ and $\sqrt{s}$ dependence.





- The widths increase monotonically as a function of $\langle dN_{ch}/d\eta \rangle$ in Pb--Pb data sets from peripheral to central collisions for both R_2^{CI} and P_2^{CI} except for P_2^{CI} in peripheral region

  → **Anisotropic flow**
- For p--Pb case, the widths have weak dependence as a function of $\langle dN_{ch}/d\eta \rangle$.
- Good agreement with pp results.

Summary

- ☑ Measurement of R_2 and P_2 for CI and CD combinations in pp collisions at $\sqrt{s}$ = 13 TeV is performed.
- ☑ P_2 is narrower than R_2 expected from **angular ordering** of the p_T of jet constituents.
- ☑ Widths for different systems show consistency.

References

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