Measurement of Two-particle Long-range Angular Correlations ALICE in *pp* collisions at $\sqrt{s} = 13$ TeV

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Two-particle Correlations







Ridge in Small Systems



 Long-range correlations in pseudo-rapidity with an azimuthal modulation in small systems show strikingly similar features to those in heavy ion collisions.





 Models incorporating initial or final state effects attempt to describe the angular correlations especially for high multiplicity events.



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ALICE Experiment





Subsystems used in this analysis

- ITS and TPC for Tracking
- V0 for multiplicity estimator up to 0-0.01% and Trigger

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Analysis Information # events : ~400 M in 0-0.1% Single track acceptance $|\eta| < 0.9, p_T > 0.2 \text{ GeV/}c$ Multiplicity class 0-0.1% Iong-range definition $1.5 < |\Delta \eta| < 1.8$



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$\Delta \phi$ Distribution





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- In very high multiplicity events, Ridge can be clearly observed in $\underline{1.5} < |\Delta \eta| < \underline{1.8}$ range.
- The $\Delta \varphi$ distribution has been measured and compared with CMS results, where the longrange is defined as $2.0 < |\Delta \eta| < 4.0$
- The ridge yield has been obtained by integrating near side peak



$\Delta \phi$ Distribution





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$$\frac{1}{N_{\text{trig}}} \frac{dN^{\text{pair}}}{d\Delta\varphi} = \int C(\Delta\eta, \Delta\varphi) d\Delta\eta$$
$$\frac{dY_{\text{assoc}}}{d\Delta p_{\text{T}}} = \int \frac{1}{N_{\text{trig}}} \frac{dN^{\text{pair}}}{d\Delta\varphi} d\Delta\varphi$$

$\Delta \phi$ Distribution





Yield Distribution



 The ridge yield has been measured as function of transverse momentum and compared with CMS results.

The measured yield is comparable with CMS

High *p*_T Track



- Good probes of hard-scattering interaction.
- Understanding the relation between hard event and ridge.
- Control the "hardness" of events by requiring leading track.
 - leading track : a track with highest $p_{\rm T}$ in a given event.



Ridge in Hard Events









Even with hard event selection, Ridge can be still seen clearly.



Yield Spectra with Hard Event Selection





• The identical ridge yield has been measured.

The formation of ridge is independent of hard-scattering process

Summary



- Two-particle angular correlations in long pseudorapidity range has been measured in very high multiplicity pp collisions at 13 TeV
- The measured associated yield with ALICE has comparable spectra with CMS results.
- The associated yield has been observed even in hard events, which may help to understand origin of the ridge whether it comes from final or initial state effect.

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Thanks for your attention!

