Study of background effects for jet analyses with Run 3 data in ALICE

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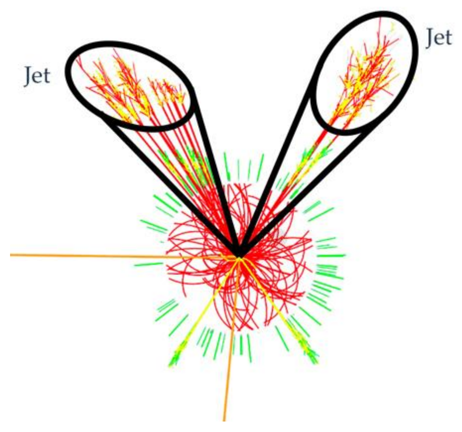
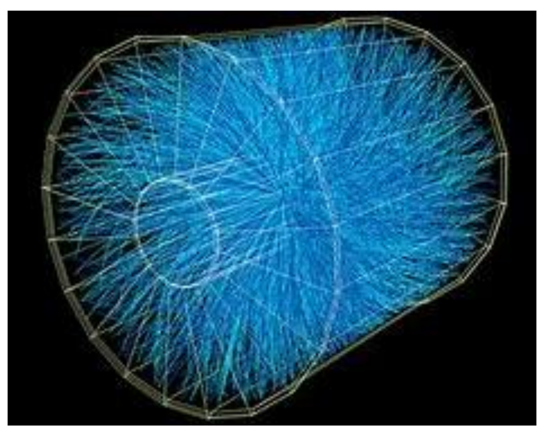
1 - Motivation

- In heavy-ion collisions, jets serve as a probe of the hot QCD medium.
- The jet signal is highly susceptible to interference from the uncorrelated high-multiplicity environment. Subtracting the pedestal background and its fluctuations are crucial in jet analyses.
- We characterize the background in heavy-ion collisions as well as the response of the ALICE detector in Run 3 to this background.





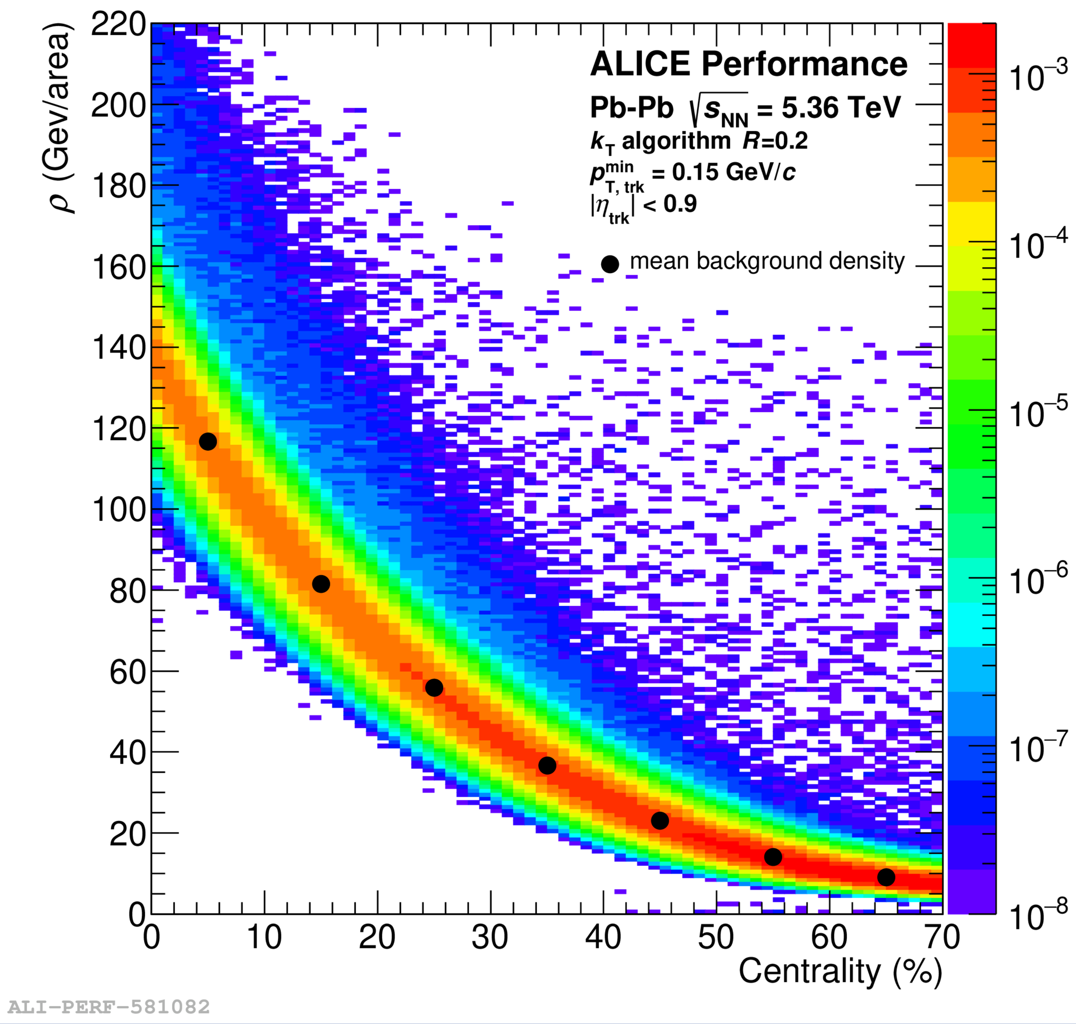
2 - Background transverse momentum density

- The estimation of background density employs the sequential recombination algorithm, k_t. The background p_T density ρ is defined as:

$$\rho = median\{\frac{p_{T,k_t}}{A_{k_t}}\}$$

p_{T,k_t}: transverse momentum of all k_t cluster
A_{k_t}: area in (η, ϕ)-plane for all kt cluster

➢ A similar background density on the dependence of centrality in Run 3 has been characterized with Run 2.



Centrality	Mean background density $< \rho >$	
	Run 3	Run 2[4]
0-10%	116.6	146.4
10-20%	81.5	81.4
20-30%	55.8	
30-40%	36.6	32.3
40-50%	23.0	
50-60%	14.0	3.7
60-70%	9.0	
70-90%	-	

3 - Background subtraction for jet measurements

◻ Area-base method:

Corrects the jet momentum by estimating the background p_T density and assuming its uniform distribution across the jet area. The corrected jet p_T is:

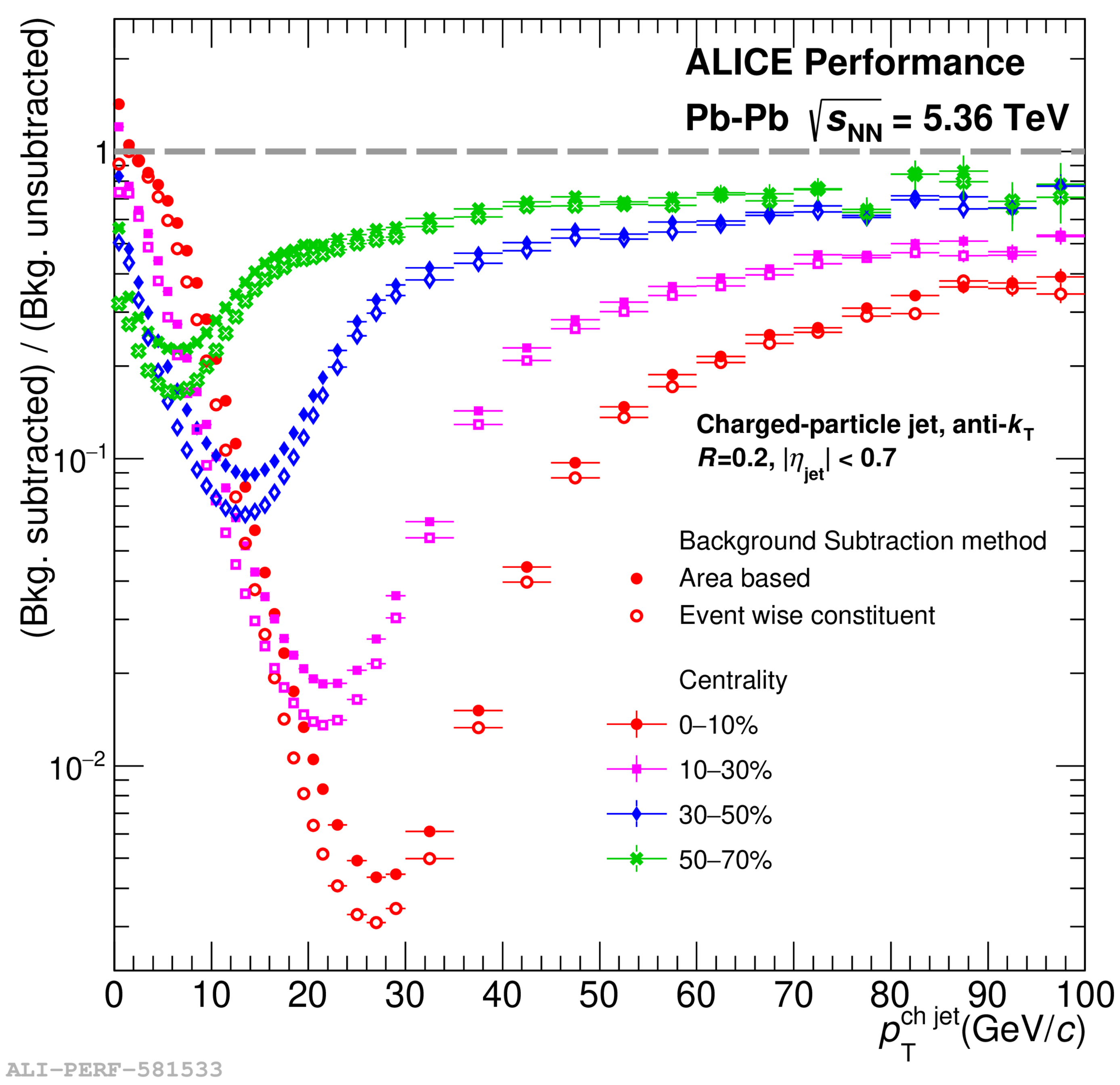
$$p_{T,jet}^{sub} = p_{T,jet}^{raw} - \rho A_{jet}$$

◻ Event-wise constituent method:

The procedure removes the average bkg. at the track level from the event. This reduces or entirely removes the soft background contributions from the tracks transverse momentum. Jet finding is then perform on the subtracted track list [6]. In this method the parameters are a little different from Run 2.

- Track reconstruction:
  - $p_T^{track} > 0.15$ GeV/c
  - $|\eta^{track}| < 0.9$
- Jet reconstruction:
  - anti-k_T algorithm
  - R = 0.2
  - $|\eta^{jet}| < 0.7$

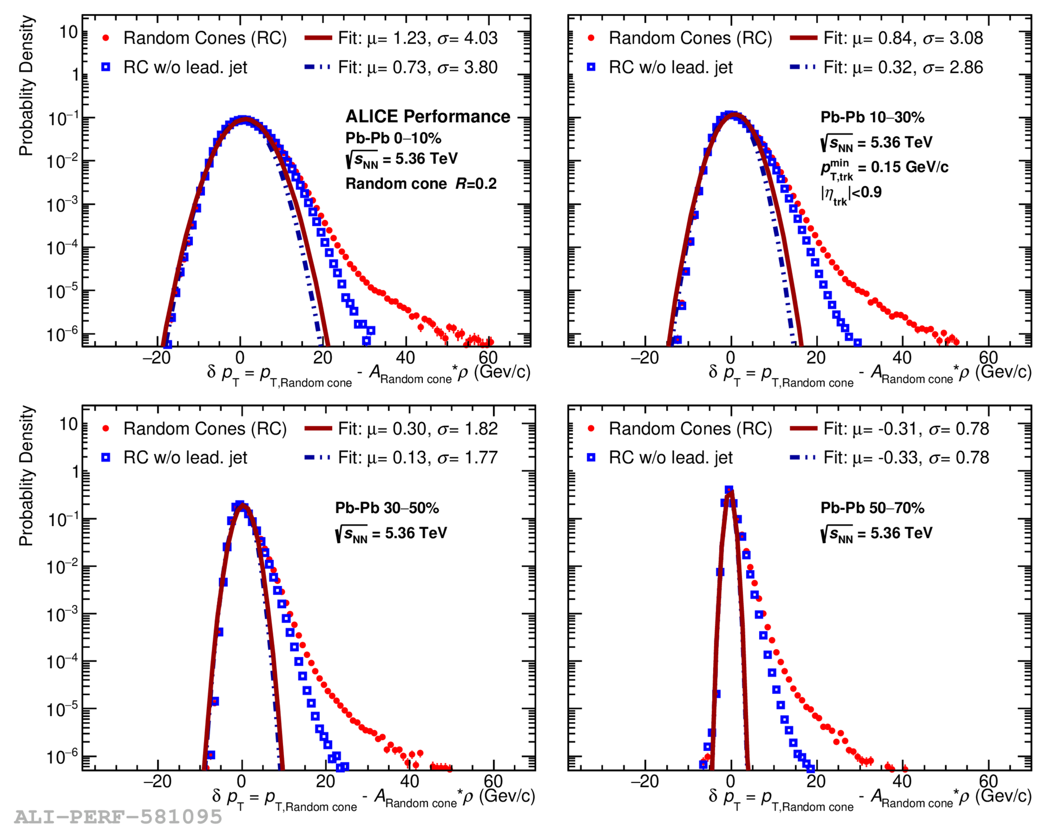
- The ratio of the jet spectra with and without background subtraction are shown below.



➢ The event-wise constituent method subtracts more background than the area-base method in all centrality bins.

4 - Background fluctuations

- Potential soft background fluctuations occur between different locations, so we aim to investigate the differences between local and average p_T density.

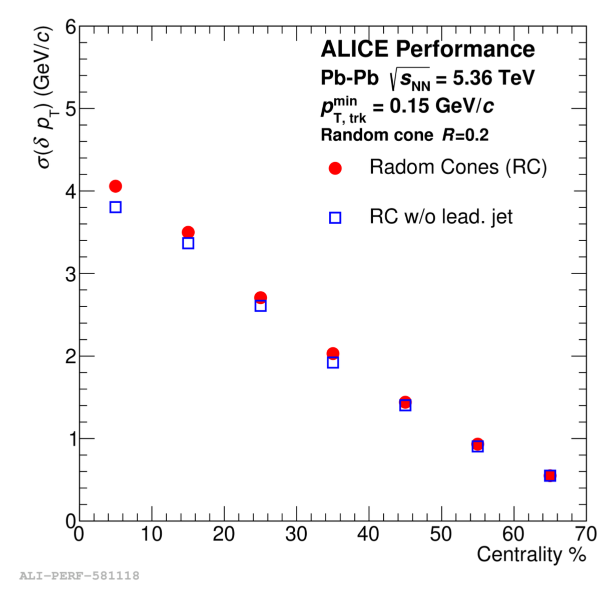


- **Random Cone method:**

$$\delta p_T = \sum_i p_{T,i} - A * \rho$$

$p_{T,i}$: transverse momentum of tracks in cone

- Random R=0.2 cones are reconstructed in each event with and without leading jet



➢ When avoiding the leading jet to suppress upward fluctuations, the tail to the right-hand-side is already reduced, which comes from real jets.

➢ The fluctuations effects will be corrected by an unfolding procedure using a Monto-Carlo simulation.

Summary and Outlook

- We have presented the first look at the background density and fluctuations in Pb-Pb collisions with the upgraded ALICE detector in Run 3.
- The response of background is similar between Run 2 and Run 3.

Outlook

- Further study the impact of background on jet analyses by embedding jets from Monte-Carlo simulations into real minimum-bias Pb-Pb Data .
- Measure the charged-particle jet spectrum in Pb-Pb collisions in Run 3, taking advantage of the substantially higher statistics.

References

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[6] P. Berta, M. Spousta, D.V. Miller and R. Leitner. JHEP 06(2014) 092

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