Monte Carlo studies on event-by-event mean p_{T} fluctuations and comparison with results from the ALICE experiment*

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For the study of event-by-event fluctuations in heavy-ion collisions the understanding of effects seen in pp collisions is of major importance. They serve as a baseline for the interpretation of observations in heavy-ion collisions.

In this analysis, non-statistical event-by-event fluctuations of the mean transverse momentum $M(p_{\mathrm{T}})$ of charged particles are studied as a function of the event multiplicity. A detailed comparison of results for pp collisions at $\sqrt{s}$ = 7 TeV, obtained with the ALICE detector [1] at the LHC, with different Monte Carlo event generators is performed in $0.15 < p_{\mathrm{T}} < 2$ GeV/c and $|\eta| < 0.8$.

Full simulations including the implementation of the detector setup are computing expensive. To be able to compare the data to a larger set of generators and tunes, a fast simulation method based on a simple p_{T}-dependent efficiency filter is developed. The filter is shown for both pp and Pb–Pb collisions in figure 1.

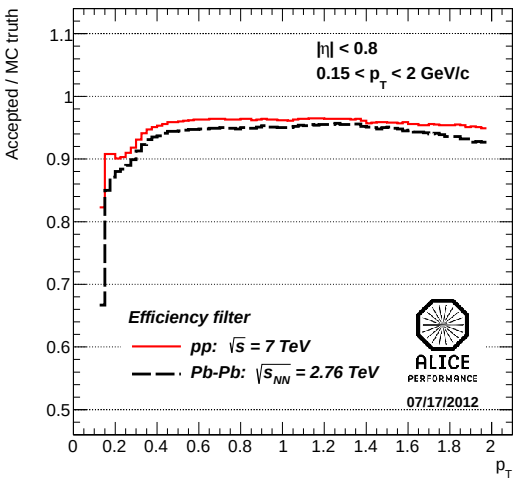

Figure 1: Efficiency filter as a function of p_{T} in pp collisions at $\sqrt{s}$ = 7 TeV (solid line) and Pb–Pb collisions at $\sqrt{s_{\mathrm{NN}}}$ = 2.76 TeV (dashed line).

As a measure of dynamical fluctuations the two-particle correlator $C = \langle \Delta p_{\mathrm{T},i}, \Delta p_{\mathrm{T},j} \rangle$ [2] is analysed, with

$$C = \frac{1}{N_{\mathrm{ev}}^{\mathrm{ps}}} \sum_{k=1}^{n_{\mathrm{ev}}} \sum_{i=1}^{N_k} \sum_{j=i+1}^{N_k} (p_{\mathrm{T},i} - M(p_{\mathrm{T}}))(p_{\mathrm{T},j} - M(p_{\mathrm{T}})),$$

where n_{ev} is the number of events, N_k the number of particles and N_k^{ps} the number of particle pairs in event k and $N_{\mathrm{ev}}^{\mathrm{ps}} = \sum_{k=1}^{n_{\mathrm{ev}}} N_k^{\mathrm{ps}}$. By construction, C equals zero in the presence of only statistical fluctuations. The correlator is calculated in bins of the event multiplicity N_{acc}, where N_{acc} is the number of tracks accepted by the analysis cuts.

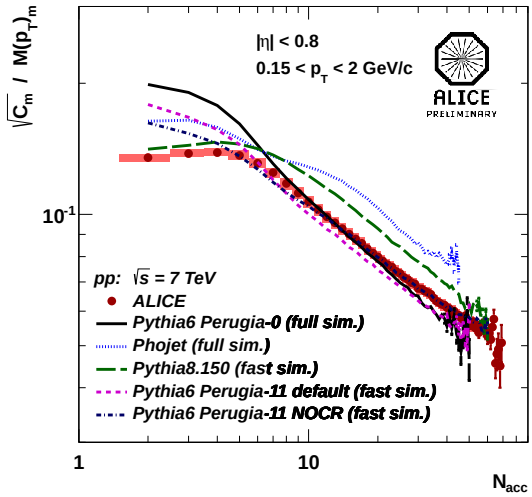

Figure 2: $\sqrt{C_m}/M(p_{\mathrm{T}})_m$ as a function of N_{acc} in pp collisions at $\sqrt{s}$ = 7 TeV and comparison to different Monte Carlo generators and tunes.

The results for pp collisions at $\sqrt{s}$ = 7 TeV are presented in figure 2 in terms of the relative fluctuations $\sqrt{C_m}/M(p_{\mathrm{T}})_m$, where m indicates the given multiplicity class. The Monte Carlo simulations PHOJET [3], PYTHIA6 (Perugia-0 and -11) [4] and PYTHIA8 are analysed. For Perugia-11, the default version is compared to one without color reconnections (NOCR), which is expected to show a steeper slope in figure 2. All PYTHIA6 tunes show a good description of the data, though, Perugia-11 slightly better than Perugia-0. The good agreement of Perugia-11 NOCR rules out color reconnections as the reason for the slope being different from a simple superposition expectation. PYTHIA8 also shows the correct slope, but overestimates the data by about 10–15%, while PHOJET shows only qualitative agreement.

References

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[3] R. Engel *et al* 1995 *Phys. Rev.* D **52** 1459
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