HBOM method for Event-Background Fluctuations in Pb-Pb Collisions at the LHC*

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With the measurement of jets and their modification in heavy-ion collisions the quark-gluon plasma can be investigated tomographically. However, the determination of the jet momentum in Pb–Pb-collisions is complicated by the background of the underlying event and its fluctuations. The fluctuations of the jet momentum scale can be described by the distribution of residuals (δp_T) after background subtraction of the momentum in a cone placed randomly in φ and η in real Pb–Pb events. The standard deviation $\sigma(\delta p_{\mathrm{T}})$ of the resulting distribution is used to classify these fluctuations [1].

The measured fluctuations depend on the correlations within the heavy-ion event as well as on the detected particle number. The correlations in the event are a-priori unknown, which is the motivation for a data-driven correction of detector effects on the width of the fluctuations. This is done here with the so called Hit Backspace Once More (HBOM) method [2] for the 10% most central heavy ion events measured in Pb-Pb collisions at 2.76 TeV with ALICE. It is a model independent method to back-extrapolate the data to no detector effect (truth) [3].

The method works as follows. First the $\sigma(\delta p_{\mathrm{T}})$ is determined for the measured events as usual. Then the efficiency is applied again to all particles in the event by a Monte Carlo method that only accepts a particle, if a random number is lower than the p_T and φ dependent detection efficiency. Doing this once for all particles is called one detector hit. After the detector hit the $\sigma(\delta p_{\mathrm{T}})$ is determined again. This is done up to five times. The fit to 0–4 detector hits is back-extrapolated to -1 detector hits which corresponds to the efficiency-corrected value of the standard deviation [3].

The method has been validated in simulations that emulate the generic features of heavy-ion collisions such as the multiplicity, the p_T spectrum, and flow (v_2, v_3). In Fig. 1 the back-extrapolation is shown. Since the *truth* value is known in the simulation the number of fit points and its functional form can be optimized. With the best configuration, a corrected $\sigma(\delta p_{\mathrm{T}}) = (9.43 \pm 0.02(stat) \pm 0.05(syst))$ GeV/c is achieved and the *truth* value $\sigma(\delta p_{\mathrm{T}}) = (9.458 \pm 0.005)$ GeV/c is reproduced [3].

After the validation, the method has been applied to measurements of 2010 and 2011 Pb–Pb collisions as shown in Fig. 2 and a value of $\sigma(\delta p_{\mathrm{T}}) = (11.85 \pm 0.14)$ GeV/c is obtained consistently in both Pb–Pb data sets. A comparison with the simulated value is not meaningful because the simulation does not consider all correlations [3].

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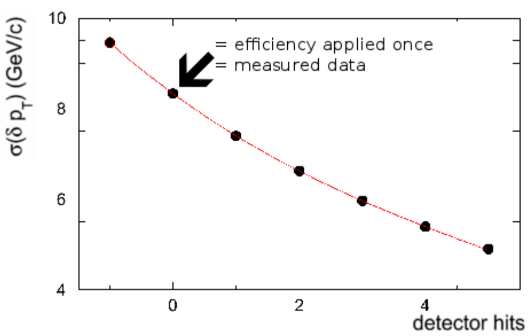

Figure 1: HBOM back-extrapolation for $\sigma(\delta p_{\mathrm{T}})$ in simulated Pb–Pb events. The point at zero detector hits corresponds to the measured spectrum [3].

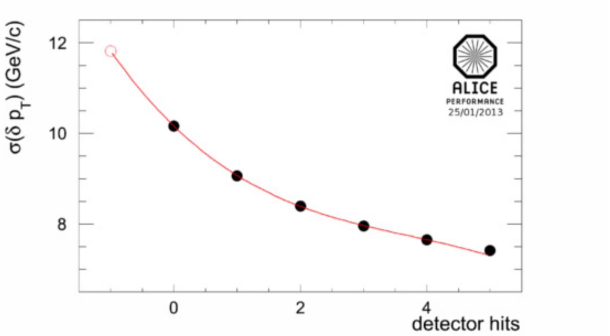

Figure 2: HBOM back-extrapolation for $\sigma(\delta p_{\mathrm{T}})$ in Pb–Pb collisions from 2010. The red point at minus one shows the corrected value [3].

References

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