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TPC reconstruction results for low-p_T tracks

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Abstract

A response to the Detector Advisory Committee's comment *"The DAC asked to present results about the MPD efficiency for transverse momenta below p_T = 0.2 GeV/c."* is presented.

1 Answer to the comment

The results presented below have been obtained for the UrQMD simulated event sample of central (0-3 fm) Au+Au collisions at 9A GeV, produced at the nominal interaction point Z-position, i.e. without a beam crossing point spread due to the beam diamond effect in order to have a better defined detector acceptance. The detector response was simulated either with a simplified approach based on the Gaussian smearing of the TPC points or with a realistic TPC simulation package and a cluster / hit finder procedure.

Figure 1 illustrates TPC acceptance for low-p_T tracks ($p_T < 0.2$ GeV/c) as a function of the particle pseudorapidity at the production point. One can see that the full acceptance (the maximum number of detector measurements equal to 53) is achieved for particles with $|\eta|$ <1.0.

One can see in Fig. 2 that the full acceptance in the TPC is achieved for primary particles with $p_T \simeq 95$ MeV/c at the production point.

Track reconstruction efficiency dependences on p_T and η are presented in Fig. 3 for high-multiplicity and in Fig. 4 for low-multiplicity events. One can see some decrease of efficiency for p_T below 0.2 GeV/c for the case of the realistic simulation. It can be explained by the reconstruction procedure where the track seeding for the Kalman filter is done in the innermost padrows with the highest hit density and the highest probability for the charge clusters to be distorted by neighbouring tracks.

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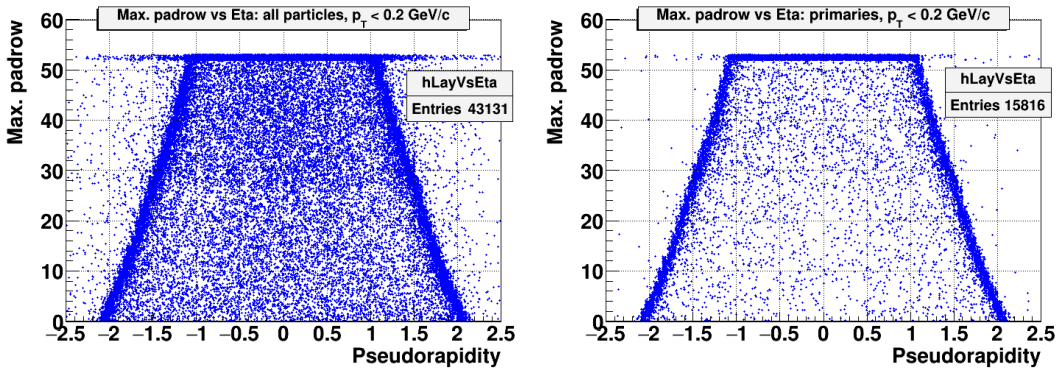

Figure 1: Maximum padrow number in the TPC reached by charged particles with $p_T < 0.2$ GeV/c as a function of their pseudorapidity at the production point: left) all particles, right) primary particles. One can see some outliers because of the scattering in inner volumes of the TPC.

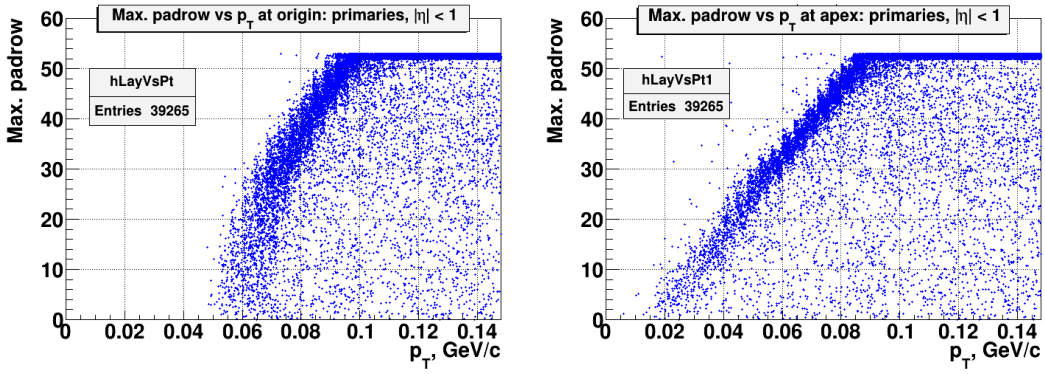

Figure 2: Maximum padrow number in the TPC reached by primary charged particles with $|\eta| < 1.0$ as a function of their p_T: left) at the production point, right) at the maximum radius reached in the TPC.

To check the aforementioned assumption, the seeding procedure was done at some distance from the innermost padrow. In addiiton, it was discovered that the track parameter evaluation for track seeds was done using approximate expressions which were not accurate enough for high-curvature (low-p_T) tracks.

After correcting the mathematics and starting track seeding at somewhat larger padrow numbers than originally, we could improve efficiency values (Fig. 5).

2 Summary

Some reconstruction efficiency loss for low-p_T tracks (below 0.2 GeV/c) for realistically simulated event samples was studied and explained. As a result, a solution was found to recover the reconstruction performance. Fine tuning of the corresponding procedure is ongoing.

3 Acknowledgements

We are grateful to members of the Detector Advisory Committee for bringing our attention to the problem discussed above.

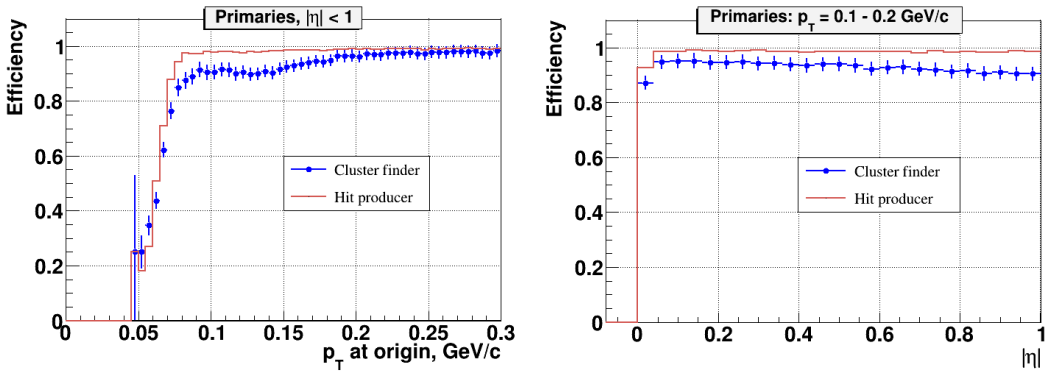

Figure 3: Left) primary track reconstruction efficiency as a function of track p_T for pseudorapidities $|\eta| < 1.0$; right) primary track reconstruction efficiency as a function of track pseudorapidity for p_T = 0.1 - 0.2 GeV/c. Solid lines and symbols present simulation results with a hit producer (Gaussian smearing of TPC points) and cluster finder (TPC realistic simulation), respectively. Some efficiency drop at η=0 is due to the TPC central membrane.

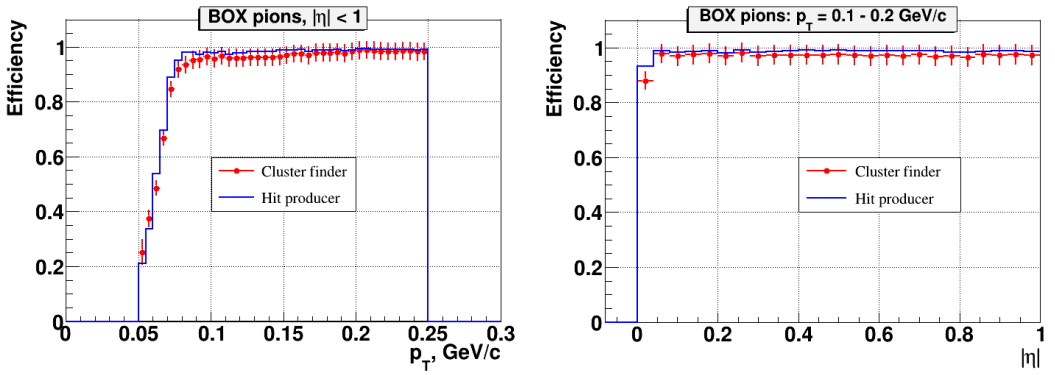

Figure 4: The same as in Fig. 3 for the BOX generated pions (5 π^+ and 5 π^- with p_T = 0.05 – 0.25 GeV/c and $|\eta| < 1.3$).

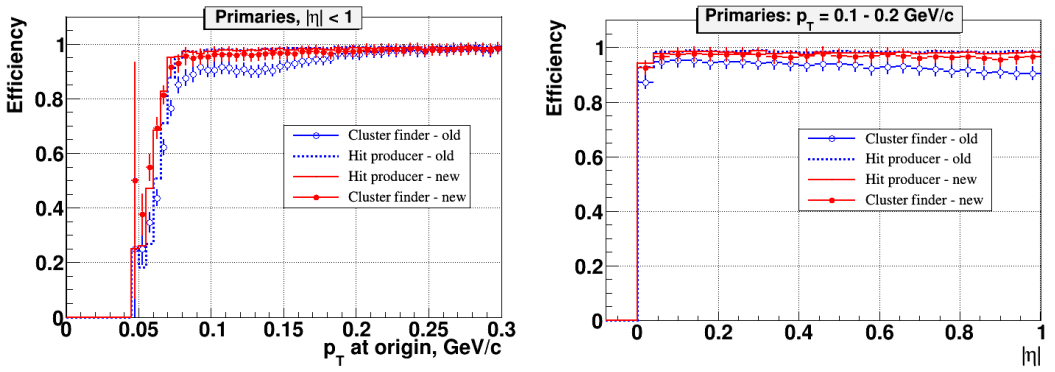

Figure 5: Left) primary track reconstruction efficiency as a function of track p_T for pseudorapidities $|\eta| < 1.0$; right) primary track reconstruction efficiency as a function of track pseudorapidity for p_T = 0.1 - 0.2 GeV/c. Lines and symbols present simulation results with a hit producer (Gaussian smearing of TPC points) and cluster finder (TPC realistic simulation), respectively. Dashed line and open symbols represent old results (Fig. 3), solid lines and filled symbols are for the new results.