The Forwards-Backwards Asymmetry of Charged Particles in pPb collisions at √s_{NN}=5.02 TeV

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Introduction: Proton-nucleus (pA) and deuteron-nucleus (dA) collisions serve as baseline measurements for the study of nucleus-nucleus (AA) collisions. Understanding the signatures of QCD matter created in heavy-ion collisions relies on an understanding of benchmark processes from dA or pA collisions, where final-state medium effects are expected to be largely suppressed, such as the modification of particle production functions in the bound nucleons will contribute to the observed differences in pp and AA collisions, and so the study of pA collisions allow one to disentangle initial- and final-state effects in AA collisions and better characterize the deconfined matter created in these collisions. Additionally, the study of pA collisions is useful for constraining the nuclear parton distribution functions and the gluon saturation at low parton fractional momenta (x), as predicted by color-glass condensate models.

Systematical uncertainties: Several of the uncertainties of the measurement of the individual spectra largely cancel when the \( Y_{asym} \) ratio is formed. Such are the uncertainties related to the trigger efficiency, momentum resolution effects, the particle composition in the generator, or the trigger combination. The remaining uncertainties are evaluated to be 2-3% for the 0.3<|η|<0.8 measurement, while for the 1.3<|η|<1.8 measurement they are 2-10% depending on the \( p_T \).

Results: All results presented here are from Ref. [4]. Figure 6 shows \( Y_{asym} \) as a function of \( p_T \) for \( 0.3<|η|<0.8 \), 0.8<|η|<1.3, and 1.3<|η|<1.8. In all three ranges, the value of \( Y_{asym} \) rises up to a \( p_T \) of 3 GeV/c, and then falls to unity at a \( p_T \) of 5 GeV/c. Particles with high \( p_T \) are recorded by track triggers with various \( p_T \) thresholds. These triggers perform an “online” track reconstruction using the whole CMS Tracker. The \( p_T \) thresholds applied in these triggers are \( p_T = 12, 20 \), and 30 GeV/c. The data from the minimum bias and the track triggers are then combined by normalizing the track triggers data to that of the minimum bias data using the ratio of the number of events with high \( p_T \) tracks in regions where the triggers are fully efficient. In the fully efficient regions the trigger with the highest statistical significance is used in the trigger combination. The \( p_T \) distribution of leading tracks from the various triggers are shown in Fig. 5. The track-triggered data reproduce the shape of the minimum bias distribution.

Extension of the statistical reach: In order to extend the \( p_T \) reach of the measured spectrum, data from several triggers are used in combination. The minimum bias trigger requires the presence of at least 1 charged particle in the CMS pixel tracker with \( p_T > 20 \) GeV/c. Particles with high \( p_T \) are recorded by track triggers with various \( p_T \) thresholds. These triggers perform an “online” track reconstruction using the whole CMS Tracker. The \( p_T \) thresholds applied in these triggers are \( p_T = 12, 20 \), and 30 GeV/c. The data from the minimum bias and the track triggers are then combined by normalizing the track triggers data to that of the minimum bias data using the ratio of the number of events with high \( p_T \) tracks in regions where the triggers are fully efficient. In the fully efficient regions the trigger with the highest statistical significance is used in the trigger combination. The \( p_T \) distribution of leading tracks from the various triggers are shown in Fig. 5. The track-triggered data reproduce the shape of the minimum bias distribution.

References:
[4] CMS Collaboration, CMS-PAS-HIN-12-017