

# PROTON–ANTIPROTON PRODUCTION ASYMMETRY IN HEAVY-ION AND $pp$ COLLISIONS AT LHC, SIMULATION IN ALIROOT FRAMEWORK\*

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One of the phenomena to be studied on the LHC is the proton–antiproton asymmetry in heavy-ion and  $pp$  collisions. We will be able to study proton stopping and their spectra in plane perpendicular to the beam axis. Measurement of this observable will be possible with the ALICE detector at energies up to 14 TeV in  $pp$  and 5.5 ATeV in Pb–Pb collisions. Predictions of the value of proton–antiproton yields asymmetry can be made.

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## 1. Introduction

The ALICE (A Large Ion Collider Experiment) detector is dedicated to heavy-ion collisions but it can as well compare heavy-ion data with those from  $pp$  and  $pA$  collisions. As the detector is not ready yet, we, physicists, want to be ready for the first data from the detector. Data generated in the simulation are analyzed in AliRoot framework; each event is encoded to an Event Summary Data (or ESD). These files can be then analyzed for more specific physical channels.

## 2. Proton–antiproton asymmetry

Proton–antiproton asymmetry is one of the observables to be measured in the ALICE experiment. Asymmetry is defined as follows:

$$A = 2 \times \frac{N_P - N_{\bar{P}}}{N_P + N_{\bar{P}}}.$$

Study of baryon/anti-baryon asymmetry in high energy collisions yields information about the carrier of the baryon number. Baryon number can be transported by valence quarks or gluonic fields, as suggested by the different

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theoretical approaches [1, 2]. The main experimental challenge will be to distinguish between them. In the midrapidity region ( $y \in \langle -1, 1 \rangle$ ), theoretical predictions of the asymmetry differ by only 10%. The asymmetry is predicted to be dependent on the multiplicity [3], this dependence was confirmed also by H1 measurement. According to [1] the asymmetry should vanish exponentially for large rapidity gap between the projectile proton and produced baryon and in the midrapidity for high energy  $p$ - $p$  and  $A$ - $A$  collisions. Measurement of nonzero asymmetry at midrapidity requires a different mechanism of the baryon number transport. If the baryon number is transported by gluons, the probability to stop it is independent of the rapidity gap. This leads to a higher observed asymmetry at midrapidity. Experimentally accessible is information on  $\bar{p}/p$  ratio and asymmetry  $A$  and their dependence on  $P_T$  and  $y$ . The  $P_T$  dependence at  $\sqrt{s} = 200$  AGeV vanishes [4] and the same is predicted for LHC energies. Rapidity distribution of  $\bar{p}/p$  ratios and  $A$  is also rather flat but it contains the important information which can distinguish between the two theoretical predictions. In order to measure precisely this quantity, we have to understand in detail the influence of the detector response and correct properly the measurement. In the first phase of analysis, kinematic characteristics of  $A$  and  $\bar{p}/p$  ratio were studied using the output of Pythia event generator. This histogram (Fig. 1 (left)) represents asymmetry values from 100000  $pp$  collision at 14 TeV in CMS generated with Pythia 6.205 and analyzed in ROOT 5.14/00. On the right of Fig. 1, there are the asymmetry values for 900 GeV in CMS.

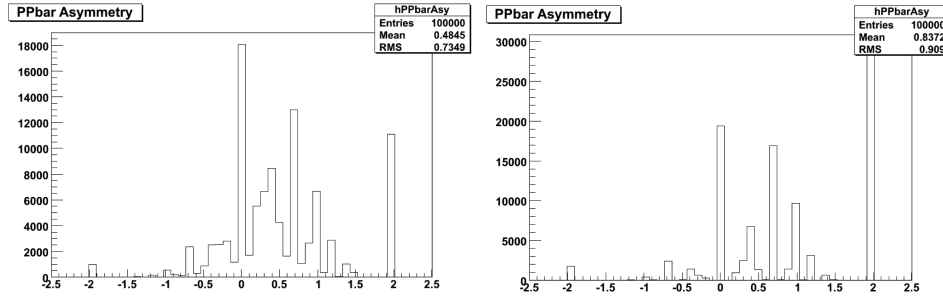


Fig. 1. Asymmetry at 14 TeV (left) and 900 GeV (right) for 100000 events.

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