Study of the interaction trigger and beam ion fragmentation for Au+Au collisions in BM@N experiment

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INTRODUCTION

Investigation of the properties of hot and dense nuclear matter formed in Au + Au collisions is the main focus of the BM@N [1-2] fixed target experiment. The trigger detector system consists of beam counters detecting each beam particle incident on the target, target area detectors – scintillation barrel and silicon multichannel detectors measuring multiplicity of secondary charged particles and forward detectors – Cherenkov detector of beam ion fragments and hadron calorimeter. The fast interaction trigger is obtained from the target area and forward detectors and it is used for effective selection of collision events in the BM@N target. Selection of the collision ion centrality is important option of the fast interaction trigger.

The detector and interaction trigger performance for Au + Au collisions at energy of 4 A GeV was studied by Monte-Carlo simulation with a code DCM-QGSM [3] + GEANT4 [4].

TARGET AREA DETECTOR PERFORMANCE

The BM@N target detector system consists of four detectors: barrel detector (BD), inner detector (FD), outer detector (HCal) and silicon vertex detector (SiD).

The BD detectors are arranged in three layers of drift tubes with wire readout: 1st layer, 2nd layer and 3rd layer. The drift tubes are made of quartz with inner diameter of 20 mm.

The FD has three single drift layers, inner with wire readout, single drift layer and outer with wire readout. The drift tubes are made of quartz with inner diameter of 20 mm.

The HCal is made of two layers of lead bricks of size 1.5 m × 1.5 m with thickness of 3.2 mm and 3.4 mm, respectively. The sensors are silicon strip detectors with wire readout.

The SiD consists of two forward layers (SiD1 and SiD2) of drift tubes with wire readout.

The total kinetic energy of neutrons as a function of the impact parameter is shown in Figure 1. The neutron energy loss in the target (SiD1) is shown in Figure 2.

The study of the trigger and selected events of the interaction trigger for Au+Au collisions can be realized.

Central and semi-central collisions – BD + SiD + HCal;

The first option (Min. Bias) is realized by setting a high threshold on FD pulse height close to Au- ion peak with a low threshold on HCal response.

The second option is selection events on the centrality of Au + Au collisions and it is realized by setting the corresponding thresholds on number of fired channels in the BD and SiD, and threshold on HCal pulse height.

Interaction trigger concept

Taking into account the considered results of MC simulation the following concept of the interaction trigger for Au+Au collisions can be realized.

Efficiency of triggering Au+Au collisions

In future BM@N run the new HCal [5] will replace the ZDC at the end of the beam line at a distance of 9 m from the target. The HCal has a hole in the beam area, and consists of two types of modules for inner and outer regions (upper picture) with transverse size 150×150 mm² and 200×200 mm², respectively.

In the future run, the MC simulations were used to explore the possibility to include the signals from the HCal in the trigger. Two zones were considered as potentially important for forming trigger signals, the first one, dominated by the hits from charged fragments, the second – from neutrons (bottom right picture).

The distribution of total kinetic energy of neutrons, which produces hits in the selected “neutron zone”, shows strong dependence on the impact parameter (bottom left picture), indicating that a combined signal from calorimeter modules in this zone can be used for selecting centrality of the collisions.

References