Preliminary Test Results of Real size GEM modules in nucleus-nucleus collisions at mCBM campaign 2022

A. Agarwal[1,2,3],* C. Ghosh[1,2,3], E. Nandy[1,2,3], J. Saini[1,3], A. K. Dubey[1,2,3], V. Singhal[1,3], V. Negi[1], C. Sturm[3], P. A. Loizeau[3], D. Emschermann[3], and S. Chattopadhyay[1,2,3]
[1] *VECC, Kolkata, India*
[2] *HBNI, Mumbai, India and*
[3] *CBM Collaboration, GSI, Darmstadt , Germany*

1. Introduction

The future Compressed Baryonic matter (CBM) experiment will study phase space diagram of strongly interacting matter at finite baryochemical potential. Before the ac- tual experiment however, the mCBM experiment ("mini CBM") has been setup as a precursor and demonstrator at SIS18 as a part of FAIR Phase-0.It facilitates prototype tests of all CBM sub systems. In this regard, two large size triple GEM detectors developed at VECC have been installed and commissioned there. For the mCBM campaign of 2022, data were taken with upgraded GEM modules and CRI based DAQ for the first time along with dedicated high intensity runs. In this report, we present the preliminary test results of heavy ion collisions data taken with Uranium beam on Gold Target (2.5 mm) at T= 1.0 AGeV during March-April and later with Gold beam on Nickel (4 mm) and Gold Target (2.5 mm) at T = 1.23 AGeV in June 2022. We have mainly focused on the high intensity scan data of U-Au in this document, with the aim of understanding the rate handling capability of our detectors.

Run Number	Intensity (Ions/10s)	Total Voltage (GEM 1,GEM 2) (V)
2254	1.0 X 10^7	4800,4400
2256	5.0 X 10^7	4800,4400
2257	1.0 X 10^8	4800,4400
2258	5.0 X 10^8	4800,4400
2262	1.0 X 10^9	4800,4400

Table 1: Runs for intensity scan

*Electronic address: a.agarwal@vecc.gov.in

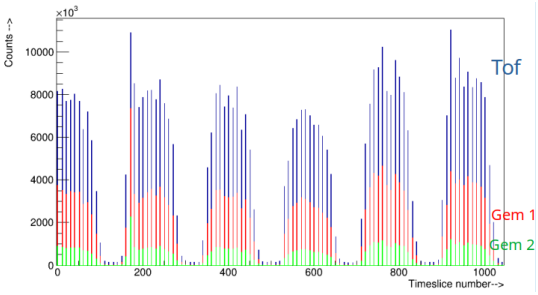

FIG. 1: Spill structure of GEM 1, GEM 2 and Time of flight (TOF) detector for U-Au collisions at intensity of 5.0 X 10^8 ions per spill (Preliminary)

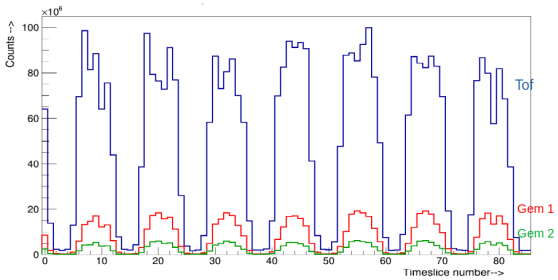

FIG. 2: Spill structure of GEM 1, GEM 2 and Time of flight (TOF) detector for Au-Ni collisions at intensity of 2.0 X 10^8 ions per spill (Preliminary)

2. Data analysis

Several data runs were performed at mCBM during March - June,2022. Table 1 shows a list of selected high intensity runs. Figure 1 and 2 show the spill structure (signal counts vs. timeslice) from U-Au run and Au-Ni runs respectively. The runs were acquired with dif-

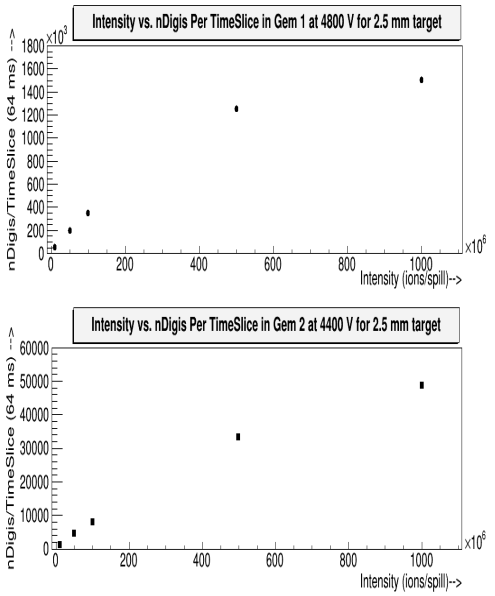

FIG. 3: Intensity response of GEM 1 (top) and GEM 2 (bottom) with intensity for U-Au at T = 1.0 AGeV(Preliminary)

ferent set of conditions like threshold, operating voltage, beam intensity etc. For the U-Au intensity scan, data runs with similar operating conditions were identified for the two GEM modules (termed GEM 1 and GEM 2). Several data cleanup operations were performed to remove the noisy channels. Apart from that several pads on the detector readout were masked to ensure common acceptance for all the runs. Subsequently, number of digital signal (digis) per Timeslice (64 ms) vs. counts plot were plotted and fitted with gaussian for all intensities for both modules. The mean, sigma and number of data points under the curve were extracted from these fits.

3. Results

Fig. 3 shows the response of the mean number of digis (with error-bars) vs. intensity. While the response is initially linear, non-linearities are observed at very high beam intensities for both modules. The same maybe inferred from fig. 4 and 5 which show a linear behaviour of digi correlations between GEM

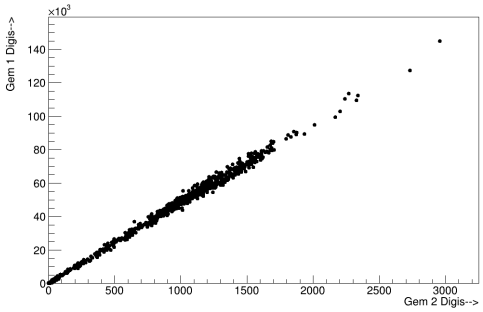

FIG. 4: GEM 1 vs. GEM 2 digi correlation for U-Au collisions at lowest intensity (10^7 ions per spill) (Preliminary)

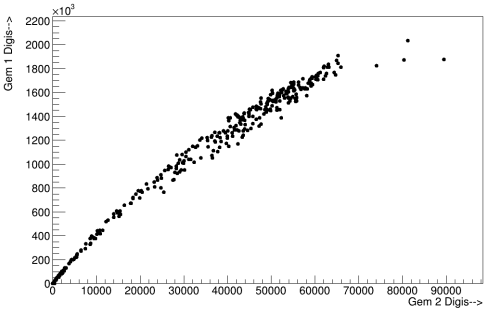

FIG. 5: GEM 1 vs. GEM 2 digi correlation for U-Au collisions at highest intensity (10^9 ions per spill) (Preliminary)

1 and GEM 2 at low intensities and non-linearity in the high intensity regions. A detailed investigation on the nature of this variation is under progress. The detailed experimental layout and detector geometries will be presented and discussed.

4. Acknowledgement

We acknowledge the efforts of members of CBM collaboration particularly Dr. Christian Sturm, Dr. Pierre A. Loizeau and D. Emschermann. They helped make mCBM experiment a success.