Performance study of CBM Muon Chamber detectors at the mCBM setup of SIS18 with Pb+Au collisions at 1.06 AGeV

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mCBM experiment
- mCBM is a part of FAIR phase 0 program
- A CBM full-system test-setup at the SIS18 facility of GSI/FAIR
- Real size prototypes or pre-series productions of all CBM detector systems

Major objectives
- To commission and optimize the complex interplay of the different detector systems with the triggerless streaming data acquisition
- Validate time based event reconstruction & track reconstruction at high particle density environment
- Control software packages

mMUCH data analysis
- Data analysed for Pb+Au collisions at 1.06 AGeV.
- Analyzed 2020 data (MUCH could not join 2021, but ongoing 2022 campaign)
Free streaming data transport in mCBM: time & spatial correlations

- Time and spatial correlations are extracted for mMUCH with other subsystems

- A clear time correlation is observed between MUCH-T0 and MUCH-TOF with narrow time correlation width

- Spatial correlations of reconstructed GEM-hits with projected mTOF tracks at GEM plane shows a clear correlation band in both X and Y

- Time and spatial correlation proves synchronicity of data streams
Spills & digi correlations of mMUCH with other sub-detectors at low & high intensity

Spills are clearly visible for all subsystems at low as well as at high intensity. The spill structure of the accelerator, followed by a short break, can be clearly identified.

Linearity in digi-correlations observed between GEM1 & GEM2 at low and high intensity.
MUCH performance & tracking using mCBM data

Linear response of GEM module wrt intensity – not saturating

Uniformity of time correlation width across different FEBs in GEM

mTOF tracking from mCBM data

- mTOF tracks multiplicity in Fig (a) & mTOF tracks extrapolated to origin (0,0,0) in Fig (b)
- mTOF tracks extrapolated at GEM plane & the X, Y residual of mTOF tracks with reconstructed GEM hits, have narrow residual widths, which suggests future use of GEM hits in tracking

- mTOF tracks are reconstructed from mTOF & T0 hits
- mTOF Track selection criteria: (i)Tracks within 5cm radial cut around origin (0,0,0) (ii) Associated hits with mTOF tracks >=4 & (iii) Time Correlated (3σ time window) mTOF tracks with GEM hits
Summary

• Two Real size trapezoidal GEM modules (mMUCH) designed for the first two layers of the CBM MUCH system have been installed within the mCBM experiment
• Successful test of the triggerless-streaming read out system under realistic conditions; time and spatial correlations demonstrate synchronocity of the subsystem data streams
• Clear spill structure observed for GEMs, at low as well as at high collision rates
• No saturation with rate observed for GEMs

Outlook

• GEM Efficiency determination using mTOF tracks will be performed
• Systematics of GEM efficiency with MUCH HV & threshold scan from next mCBM 2022 campaign will be performed

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Thank you