mPSD data monitoring at mCBM experiment

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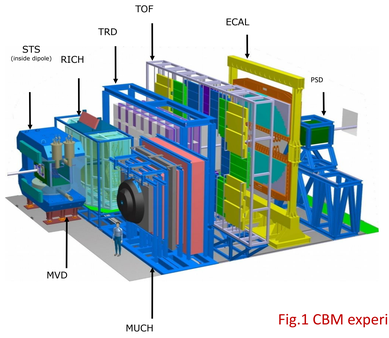
CBM experiment

The Compressed Baryonic Matter experiment (CBM) at FAIR accelerator facility is designed to measure nucleus-nucleus collisions at an unprecedented interaction rate of up to 10 MHz which will allow study of extremely rare probes with high precision. To achieve this high rate capability, CBM will be equipped with fast and radiation-hard detectors, which are readout via a triggerless-streaming data acquisition system, which will transport data with a bandwidth of up to 1 TB/s to a large scale computer farm, allowing for event reconstruction and first level event selection.



- Tracking acceptance: $2.5^o < \theta_{Lab} < 25^o$
- Peak R_{int} is 10 MHz for Au+Au
- Fast & radiation hard detectors
- Free-streaming DAQ
- 4D tracking (space, time)
- Online event reconstruction and selection
- Data rate: 1 TB/sec

Fig.1 CBM experiment

PSD module structure

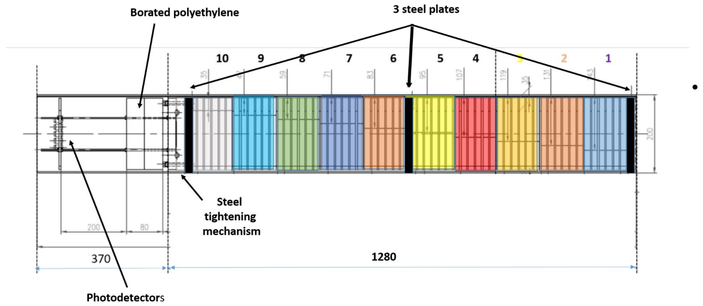


Fig.3 Module structure

- Longitudinal structure: Pb/Scint tiles layers: (Pb(16mm), Scint(4mm) grouped in 10 sections.

- Light collection – by WLS fibers from 6 sequentially placed scintillator tiles in one section to one optical connector at the end of module.
- Light readout: 10 MPPCs per module.
- Readout electronics: sampling ADC.

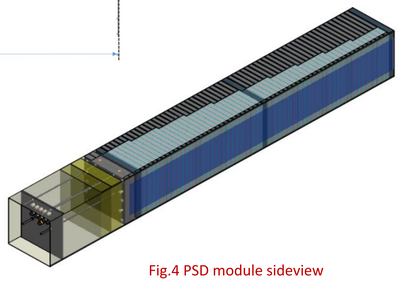


Fig.4 PSD module sideview

mCBM readout at high beam intensity

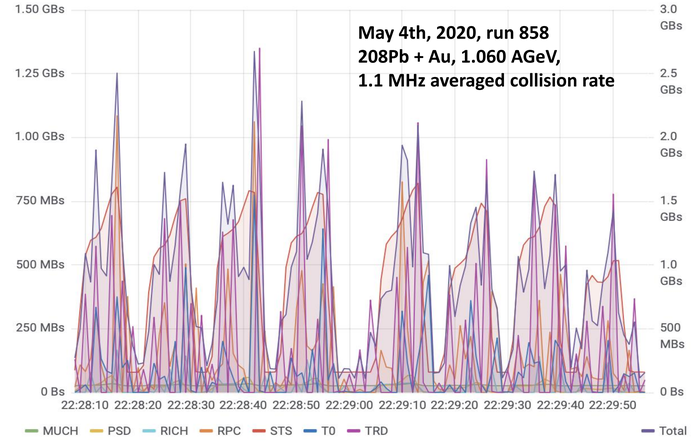


Fig.6 Total data rate (scale on the right) and break down to subsystem data rates (scale on the left)

mCBM as prototype for full CBM setup

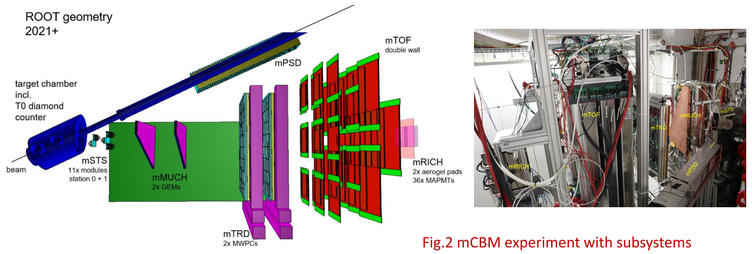


Fig.2 mCBM experiment with subsystems

Test and Optimize:

- Operation of the detector prototypes in a high-rate collision environment
- Free-streaming DAQ incl. the data transport to a high-performance computer farm
- Online track and event reconstruction
- Event selection algorithms & Offline data analysis
- Detector Control Systems

mPSD online monitor

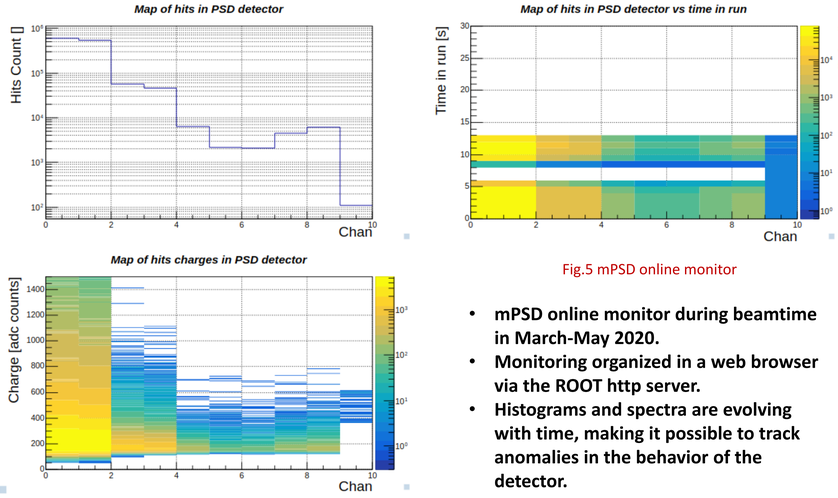


Fig.5 mPSD online monitor

- mPSD online monitor during beamtime in March-May 2020.
- Monitoring organized in a web browser via the ROOT http server.
- Histograms and spectra are evolving with time, making it possible to track anomalies in the behavior of the detector.

Time synchronisation

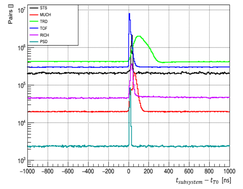


Fig.7 Time correlation of all subsystems

The intersystem time offsets were determined with respect to the T0 detector. Stable peaks in the distributions indicate that all subsystems are collecting data synchronously, which means meeting the requirements of a triggerless-streaming DAQ system.

Conslusions

- mPSD online data monitoring software was developed and successfully tested during beam time.
- The readout chain concept and firmware have proven themselves to be operational at high CBM-like interaction rates.
- Data monitoring module is fully scalable for the full PSD.
- Time synchronization was checked with all other mCBM subsystems.

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