Status and Performance of the CBM Time-of-Flight system

Ingo Deppner[1] and Norbert Herrmann[1] for the CBM-Collaboration

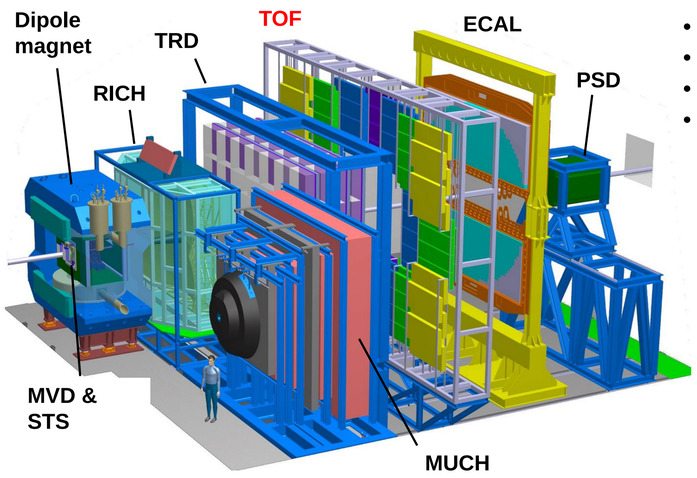
[1] *Physikalisches Institut Uni Heidelberg, Heidelberg, Germany*

CBM at FAIR

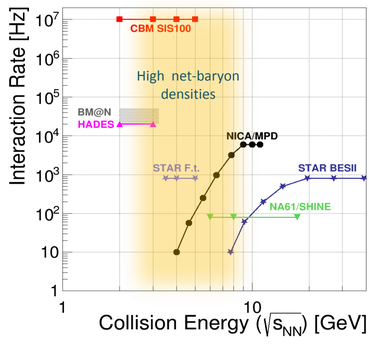
Compressed Baryonic Matter experiment

- Exploring the QCD phase diagram at large baryon densities
- Charged hadron PID for HI-collisions at kinetic beam energies T_{beam} = 2 – 11 AGeV (for the heaviest system)
- High granularity and rate capability for interaction rate R ≤ 10 MHz
- Multi-gap Resistive Plate Chamber (MRPC) system with about 120000 timing channels and a system time resolution of σ ≤ 80 ps
- Usage in STAR BESII campaign as part of the FAIR phase 0 program as eTOF system with acceptance range 1.0 ≤ η ≤ 1.5

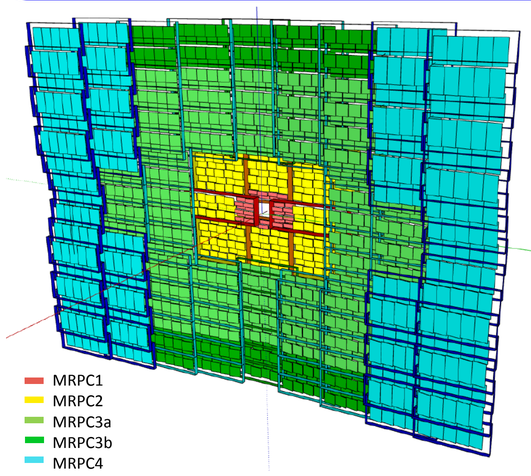
The Compressed Baryonic Matter (CBM) experiment



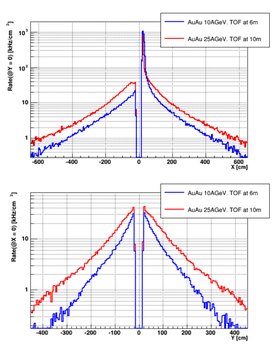
- Tracking acceptance: 2° < θ_{Lab} < 25°
- Free streaming DAQ
- Software based event selection
- R_{int} = 10 MHz (Au + Au)



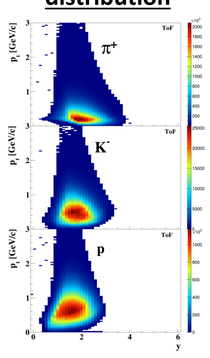
The CBM Time-of-Flight wall



Anticipated rate



Phase space distribution



CBM TOF module M4_001

CBM-ToF Requirements

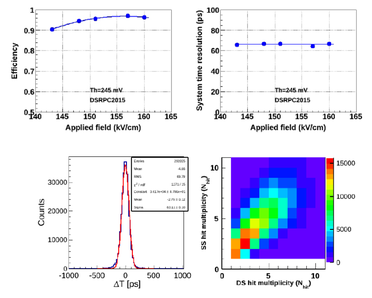
- Full system time resolution σ_T ~ 80 ps
- Efficiency > 95 %
- Rate capability ≤ 30 kHz/cm²
- Polar angular range 2.5° – 25°
- Active area of 120 m²
- Occupancy < 5 %
- Low power electronics
- (~120.000 channels)
- Free streaming data acquisition

CBM MRPC prototypes and test performance

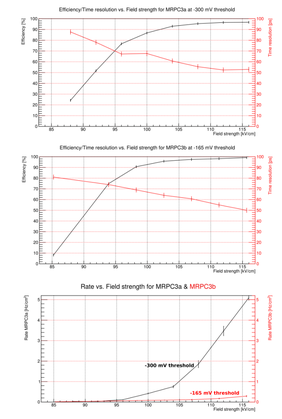
Counter properties

- Active area 300 – 864 cm²
- Granularities 10 – 27 cm²
- Low resistive glass
- Rate capability > 30 kHz/cm²
- Time resolution about 50 ps
- Efficiencies above 95 %
- Cluster size about 1.4 - 2

CERN SPS setup



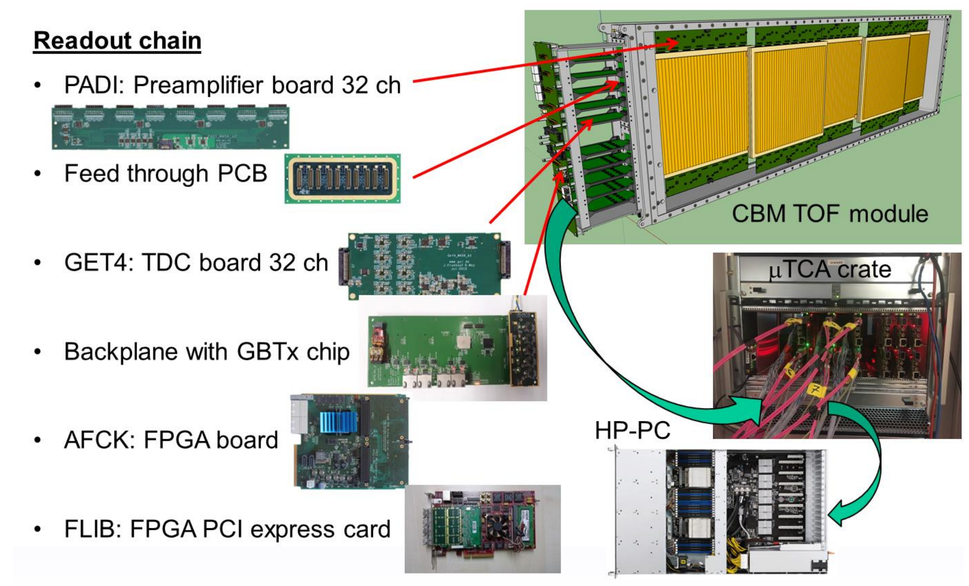
Cosmic stand setup



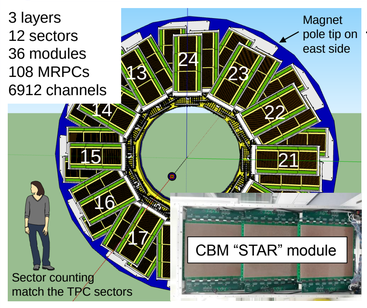
Electronic readout chain

Readout chain

- PADI: Preamplifier board 32 ch
- Feed through PCB
- GET4: TDC board 32 ch
- Backplane with GBTx chip
- AFCK: FPGA board
- FLIB: FPGA PCI express card

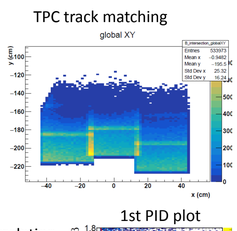


FAIR phase 0 program: eTOF at STAR/BNL

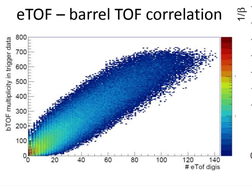


Installation of Sector 18 in Jan. 2018

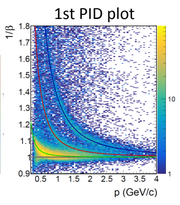
TPC track matching



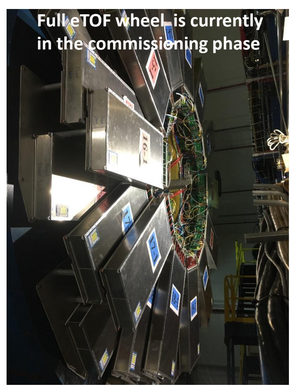
eTOF – barrel TOF correlation



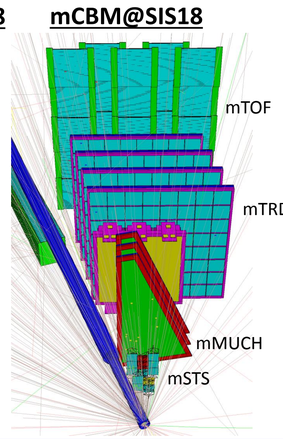
1st PID plot



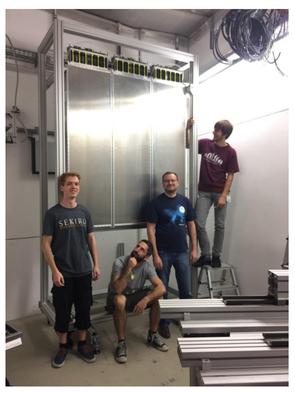
Full installation in Nov. 2018



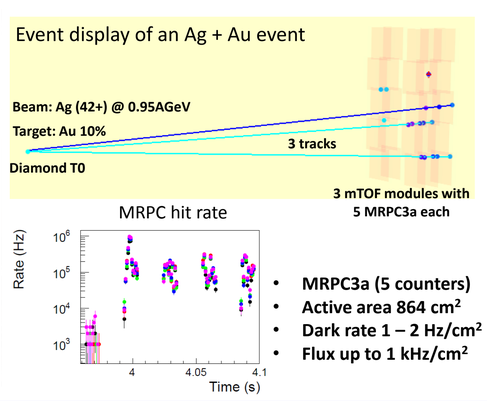
mCBM@SIS18



mTOF



1st "commissioning" beam-time in Dec. 18



- MRPC3a (5 counters)
- Active area 864 cm²
- Dark rate 1 – 2 Hz/cm²
- Flux up to 1 kHz/cm²

Summary: The CBM Time-of-Flight system is developed by 8 institutions from China, Germany, Romania and Russia. It comprises about 120000 channels and a rate capability up to 30 kHz/cm². The targeted system time resolution is 80 ps at an efficiency above 95%. Test beam experiments have demonstrated counter resolutions in the order of 50 ps. CBM-TOF will participate as part of the FAIR phase 0 program in the BESII campaign of STAR@RHIC and miniCBM@GSI. The CBM-TOF wall will be ready to take beam at FAIR in 2024.