

# The CBM Time-of-Flight system

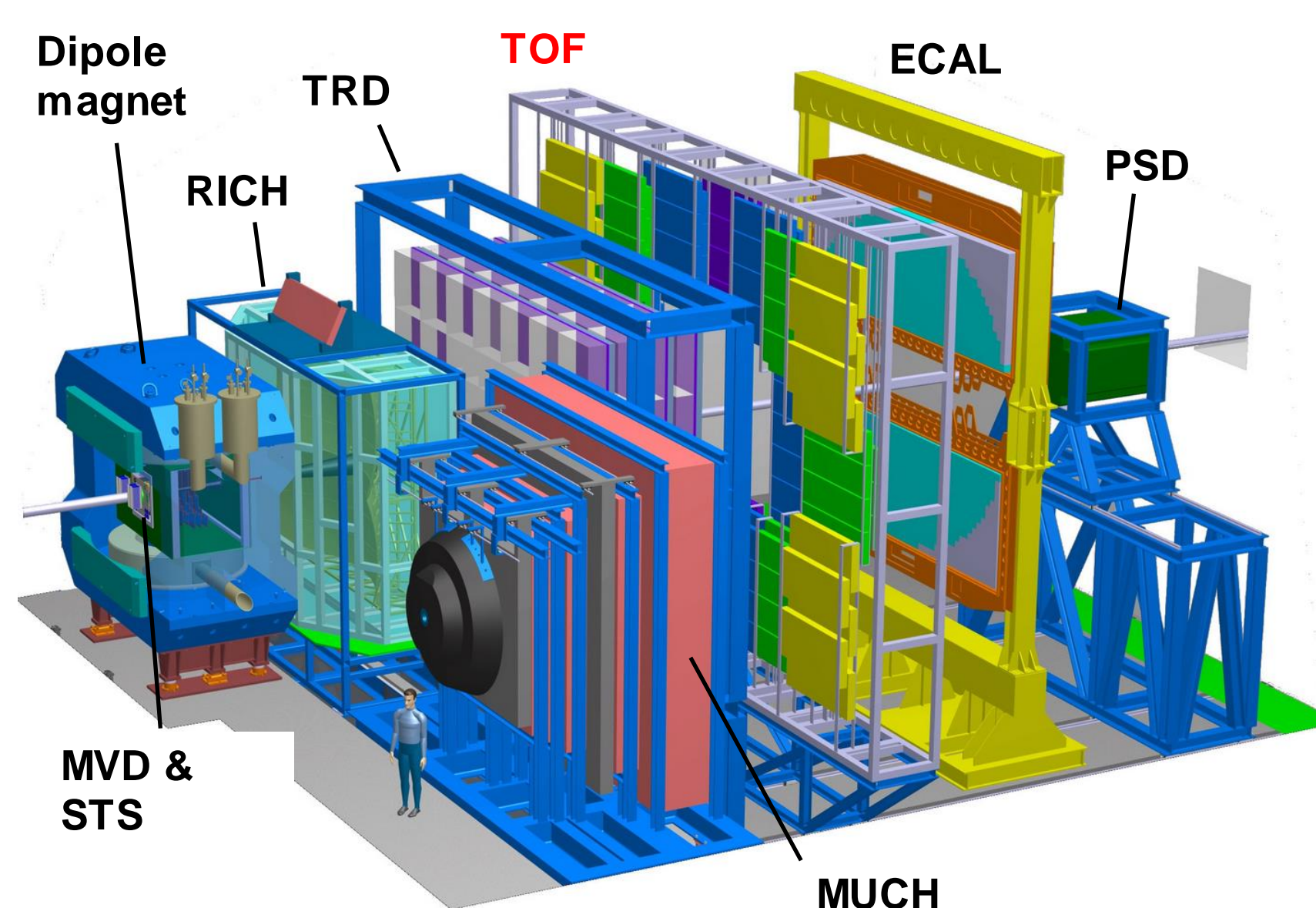
Ingo Deppner<sup>1</sup> and Norbert Herrmann<sup>1</sup> for the CBM-Collaboration

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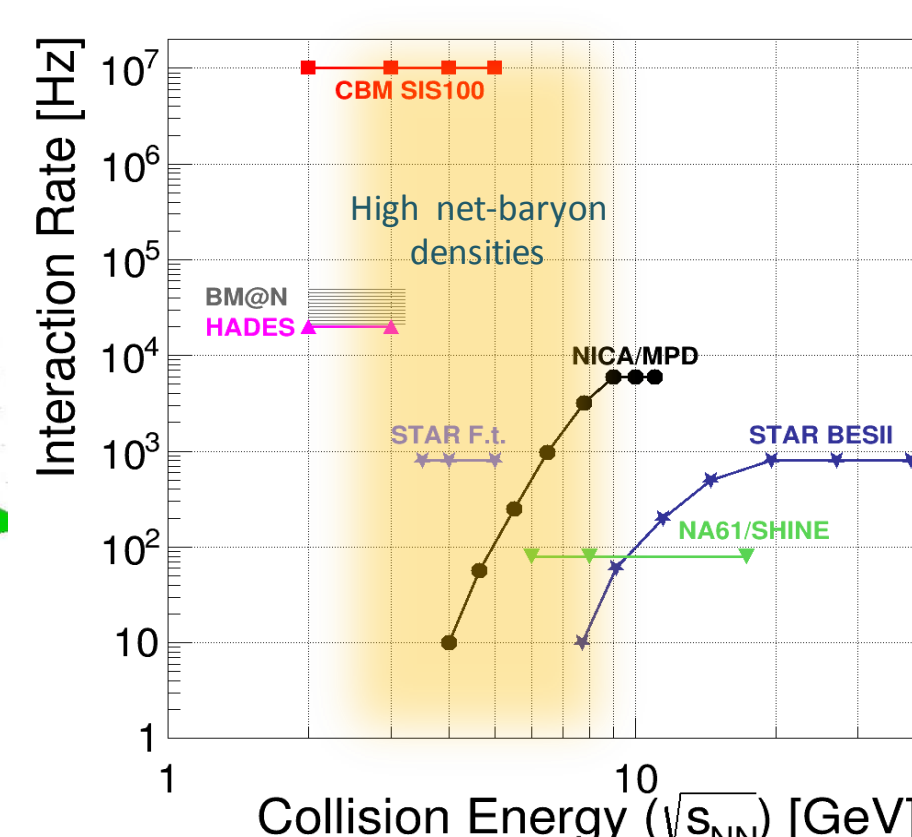
Compressed Baryonic Matter experiment at FAIR

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

## The Compressed Baryonic Matter (CBM) experiment



Tracking acceptance:  $2^\circ < \theta_{\text{Lab}} < 25^\circ$   
Free streaming DAQ  
Software based event selection  
 $R_{\text{int}} = 10$  MHz (Au + Au)



## CBM MRPC prototypes and test performance

### Counter properties

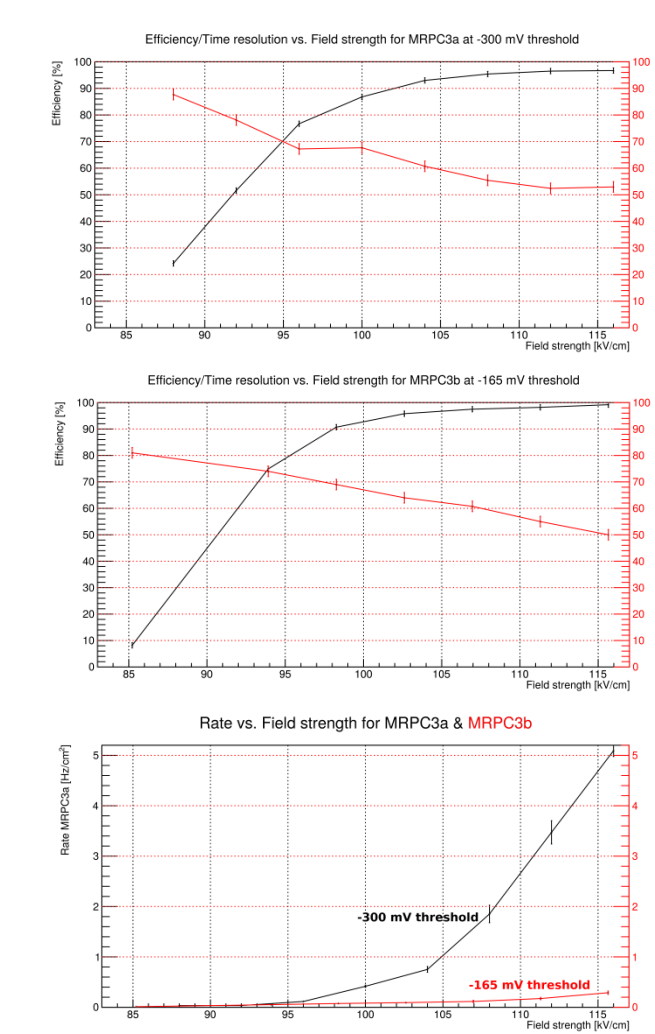
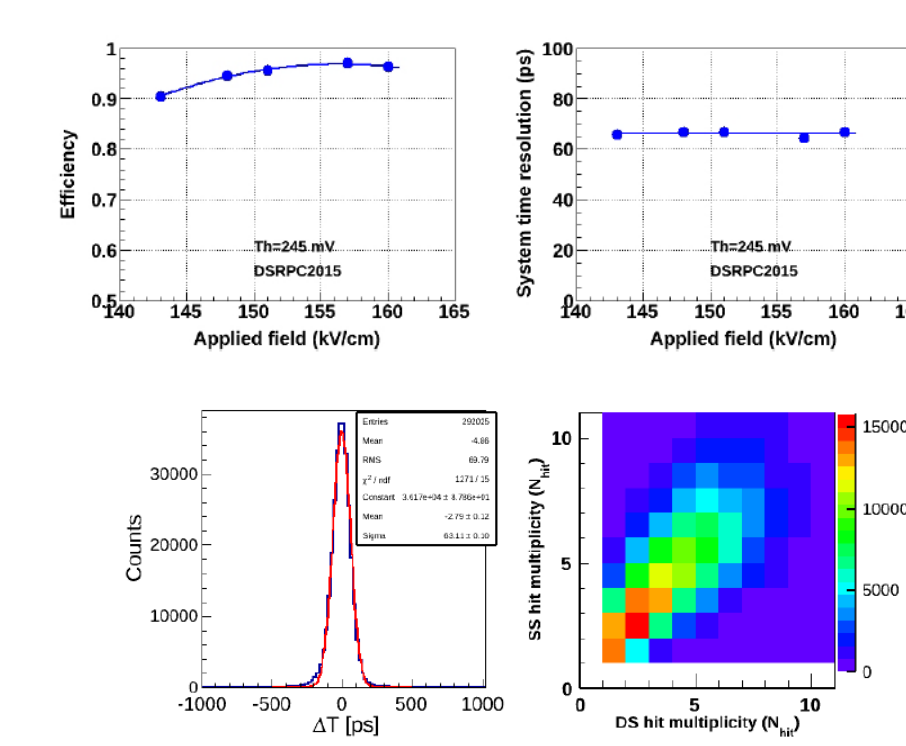
- Active area 300 – 864 cm<sup>2</sup>
- Granularities 10 – 27 cm<sup>2</sup>
- Low resistive glass
- Rate capability > 30 kHz/cm<sup>2</sup>
- Time resolution about 50 ps
- Efficiencies above 95 %
- Cluster size about 1.4 - 2



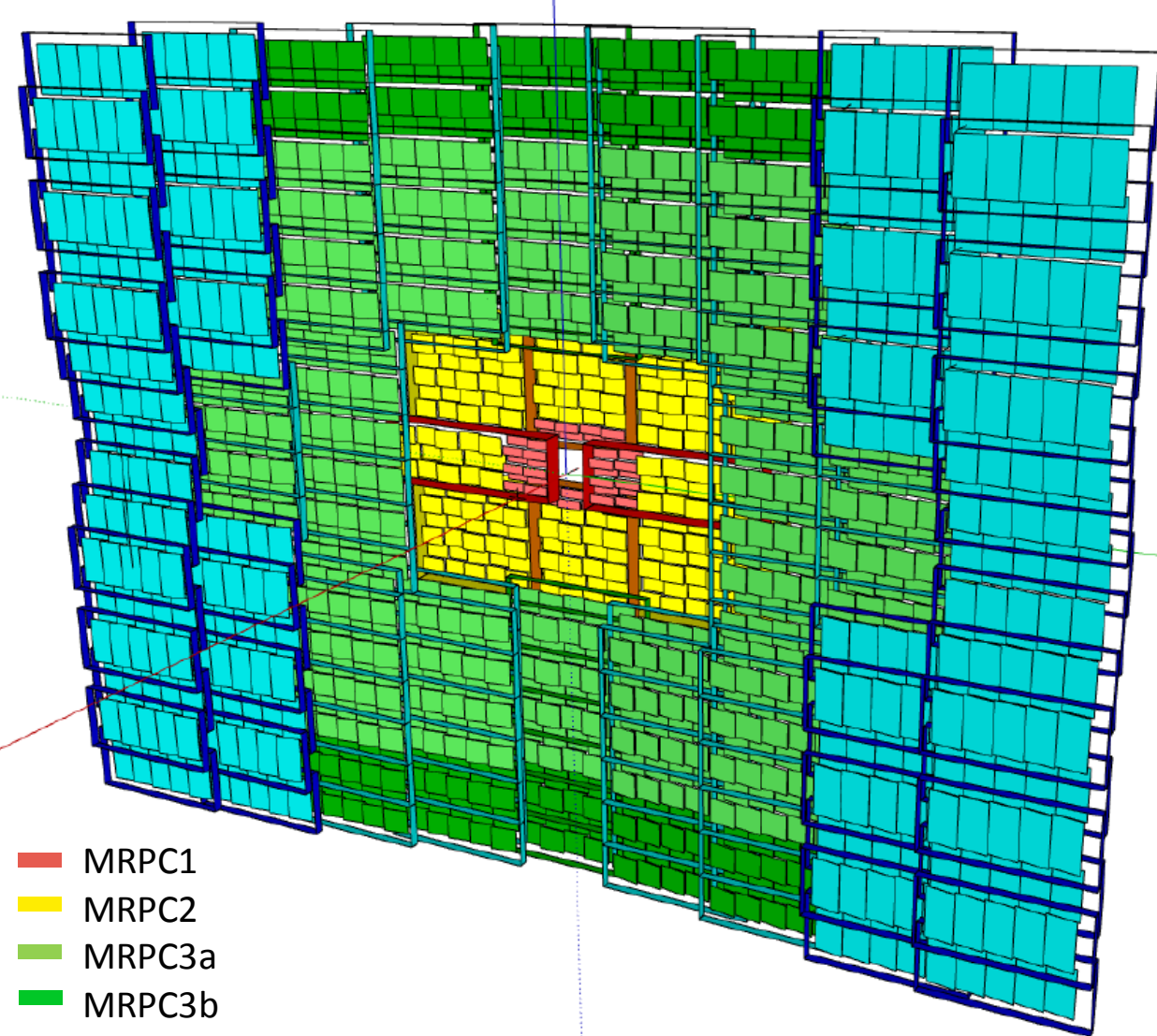
### CERN SPS setup



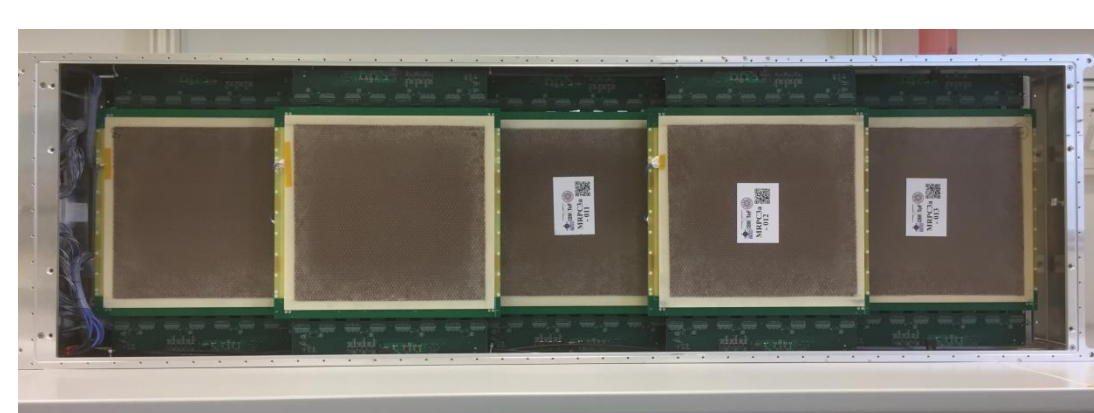
### Cosmic stand setup



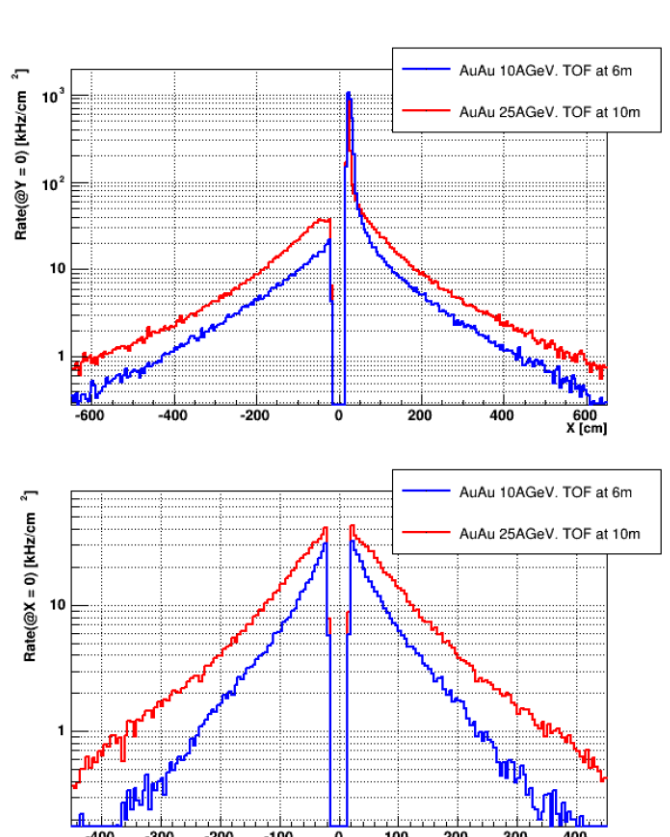
## The CBM Time-of-Flight wall



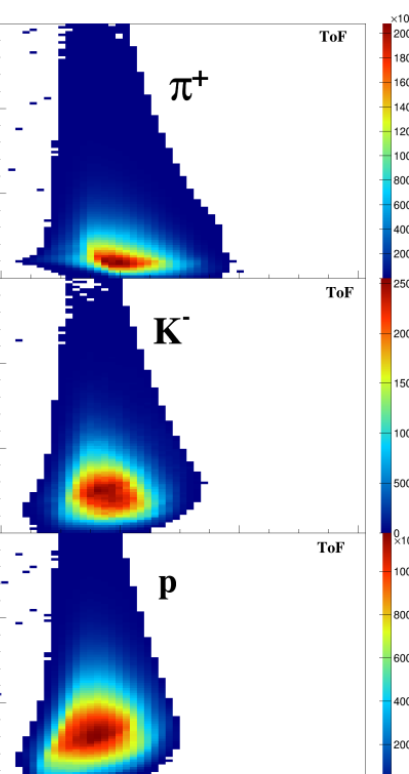
CBM TOF module M4\_001



### Anticipated rate



### Phase space distribution



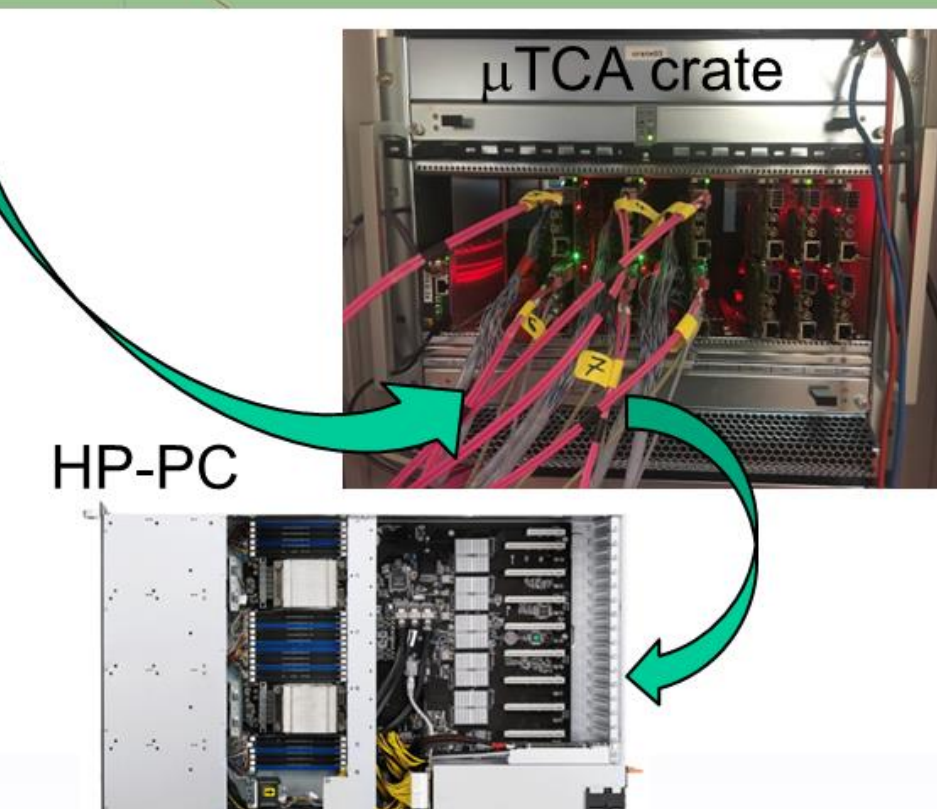
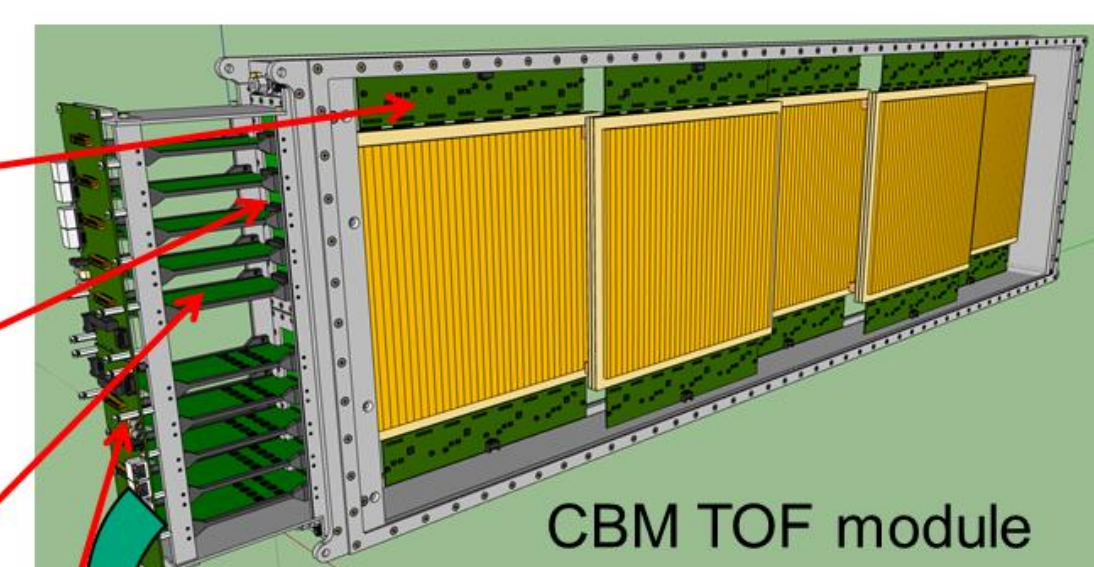
### CBM-ToF Requirements

- Full system time resolution  $\sigma_T \sim 80$  ps
- Efficiency > 95 %
- Rate capability  $\leq 30$  kHz/cm<sup>2</sup>
- Polar angular range  $2.5^\circ - 25^\circ$
- Active area of 120 m<sup>2</sup>
- Occupancy < 5 %
- Low power electronics
- (~120.000 channels)
- Free streaming data acquisition

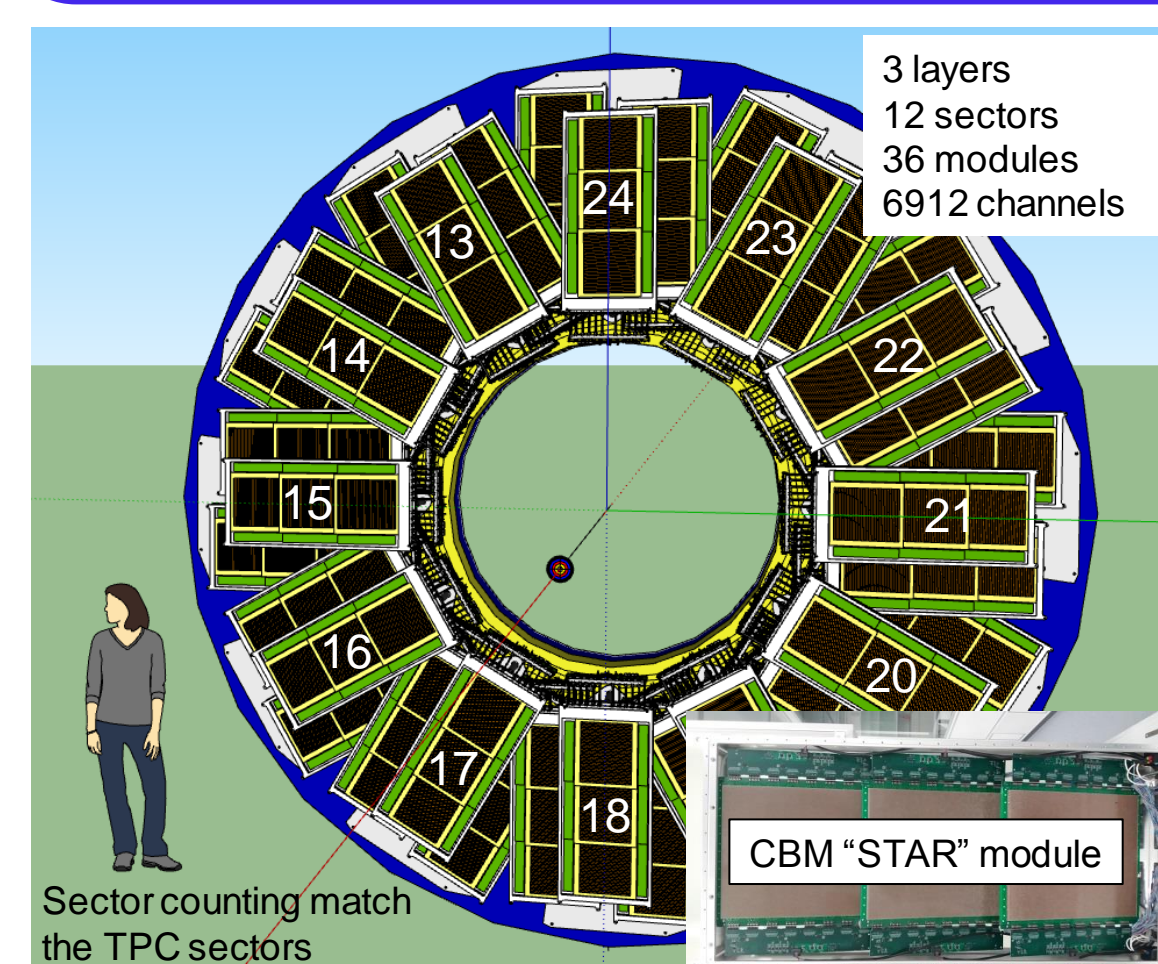
## Electronic readout chain

### 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



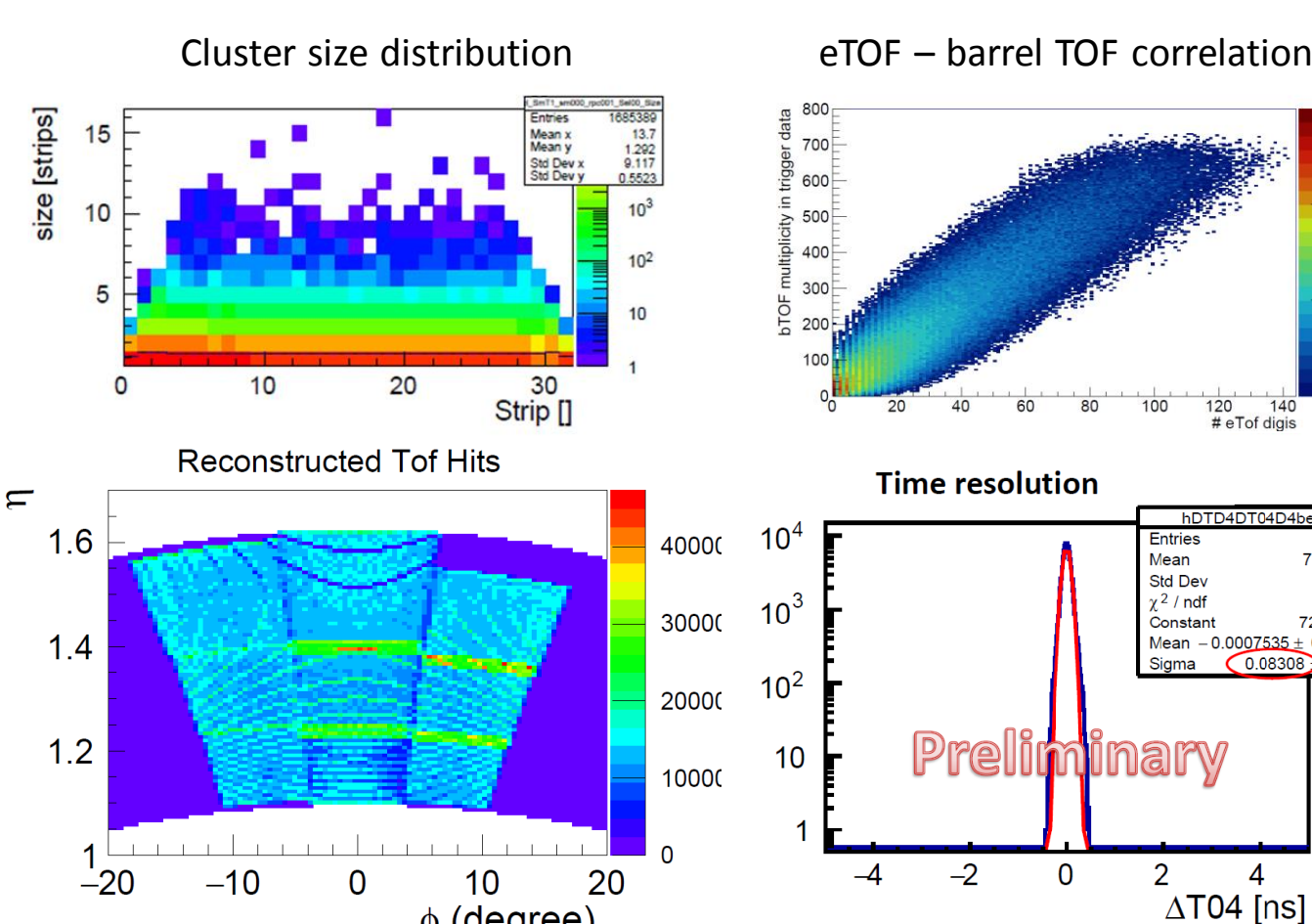
## FAIR phase 0 program: eTOF at STAR/BNL



### Installation of Sector 18 in Jan. 2018



### First results from RUN 2018



### Time line

- Jan. 2018: Installation of one sector
- Feb. 2018: 2<sup>nd</sup> system integration test with one sector by participating on the RUN 18 beam time in STAR
- Aug. 2018: Installation of eTOF infrastructure at BNL
- Oct. 2018: Shipping all 36 modules to BNL
- Nov. 2018: Installation and commissioning
- Feb. 2019: Start of the BES II campaign
- latest 2022: Decommissioning and shipping of all modules including infrastructure to FAIR

**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/cm<sup>2</sup>. 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 2023.

