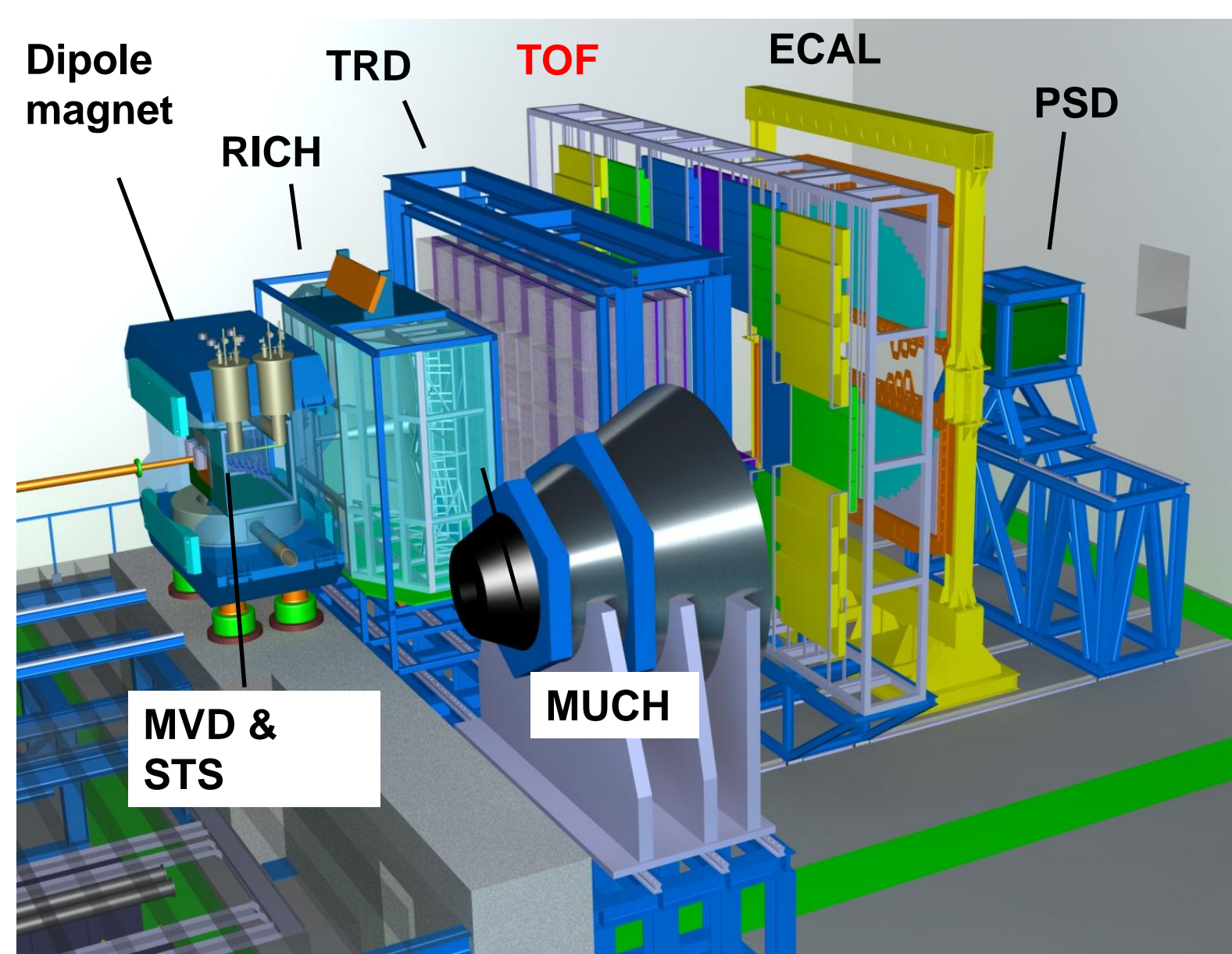
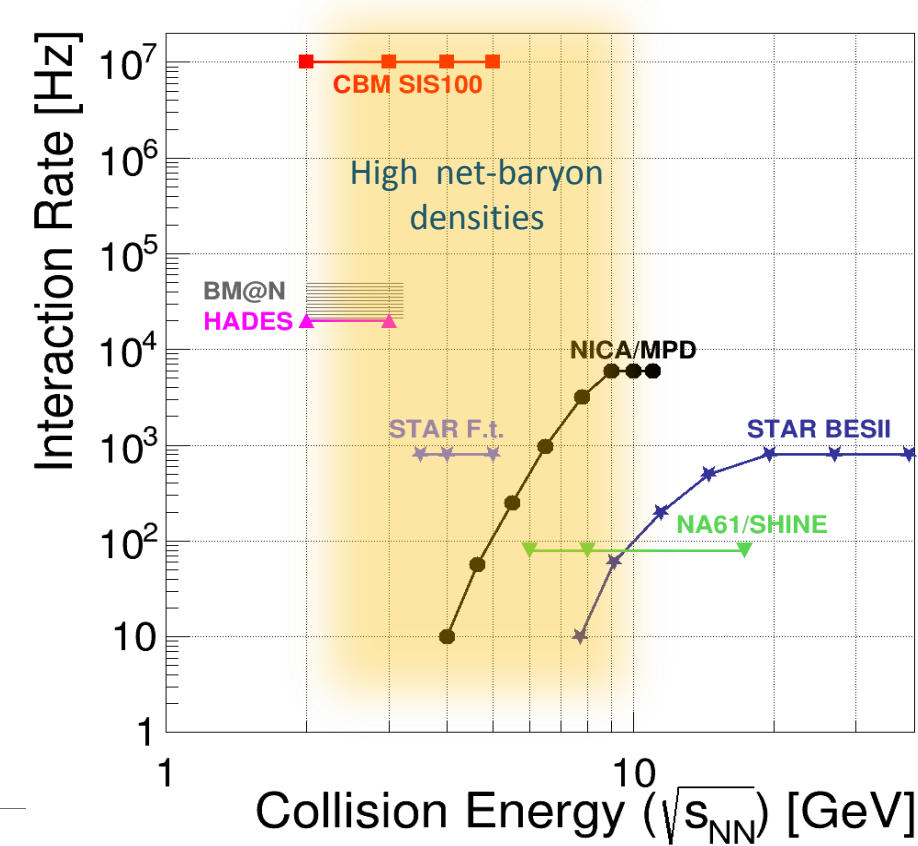


Abstract: The CBM experiment aims at exploring the QCD phase diagram at large baryon densities in the beam energy range from 2 A GeV to 11 (35) A GeV at the SIS100 (SIS300) accelerator of FAIR/GSI. For charged particle identification that is required by many observables that are sensitive to the phase structure like collective flow, phase space population of rare hyperons, fluctuations of conserved quantities, ... a high performance Time-of-Flight (TOF) wall with a granularity of about 120.000 channels and a system timing resolution of better than 80 ps is being built. Part of the wall (~ 10.000 channels) will be installed in the forward hemisphere ($1.5 < \eta < 1.0$) of the STAR experiment at RHIC/ BNL during the beam energy scan (BES II) campaign planned for 2019/2020.

The Compress Baryonic Matter (CBM) experiment

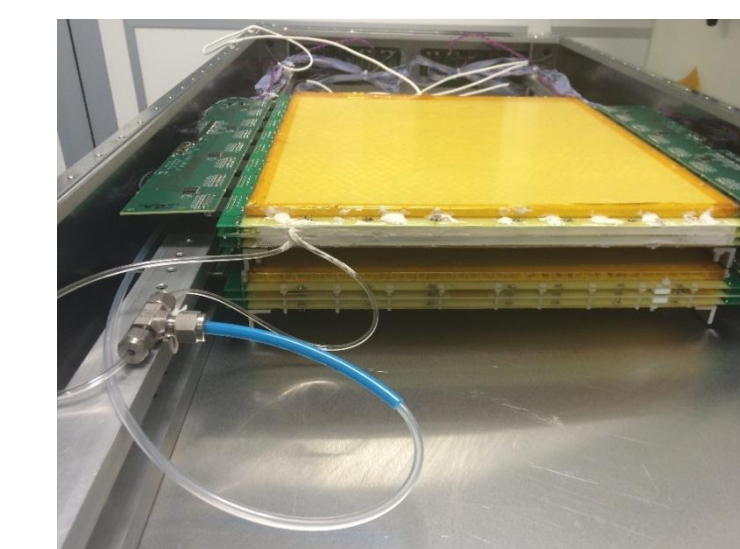
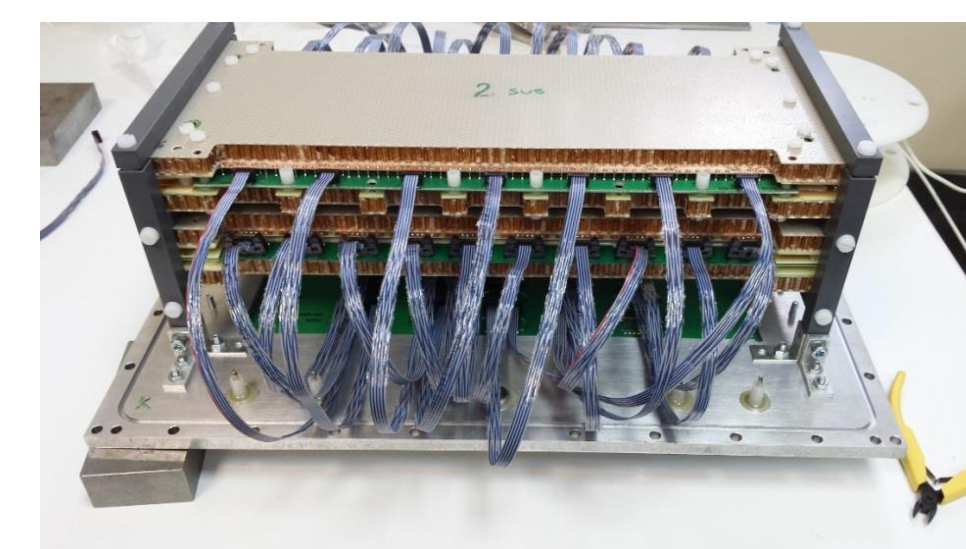


- Tracking acceptance: $2^\circ < \theta_{\text{Lab}} < 25^\circ$
- Free streaming DAQ
- Software based event selection
- $R_{\text{int}} = 10 \text{ MHz (Au + Au)}$



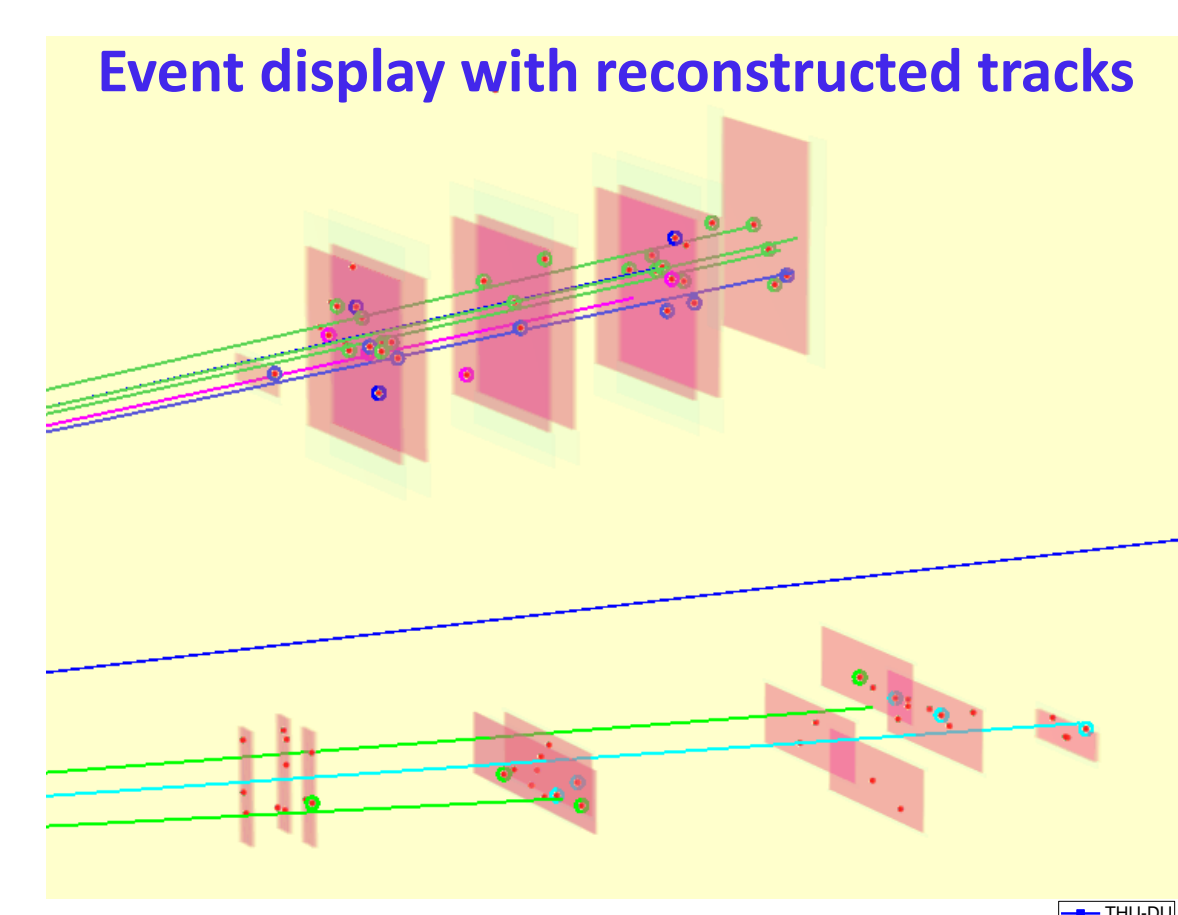
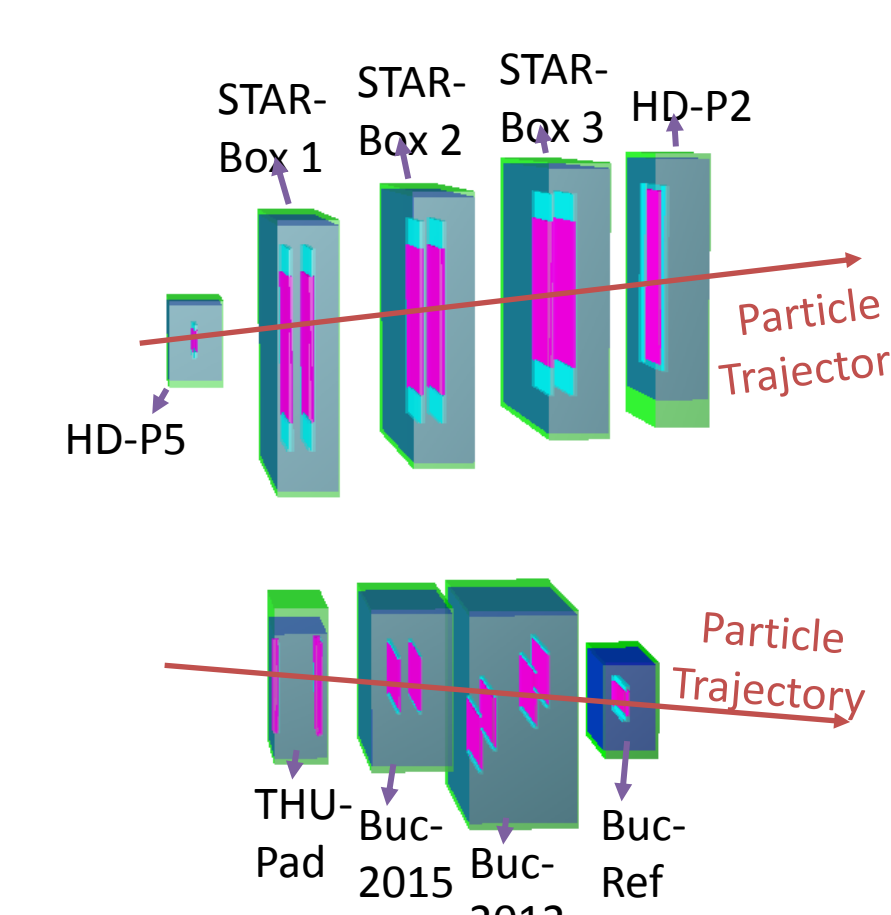
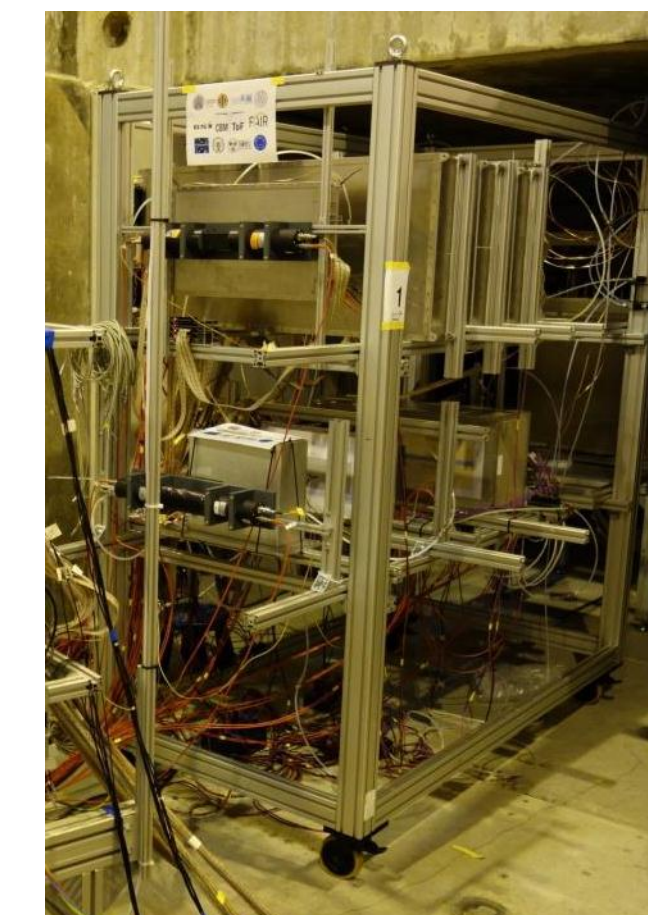
CBM MRPC prototypes and test beam performance

CBM MRPC prototypes (MRPC2 and MRPC3a)

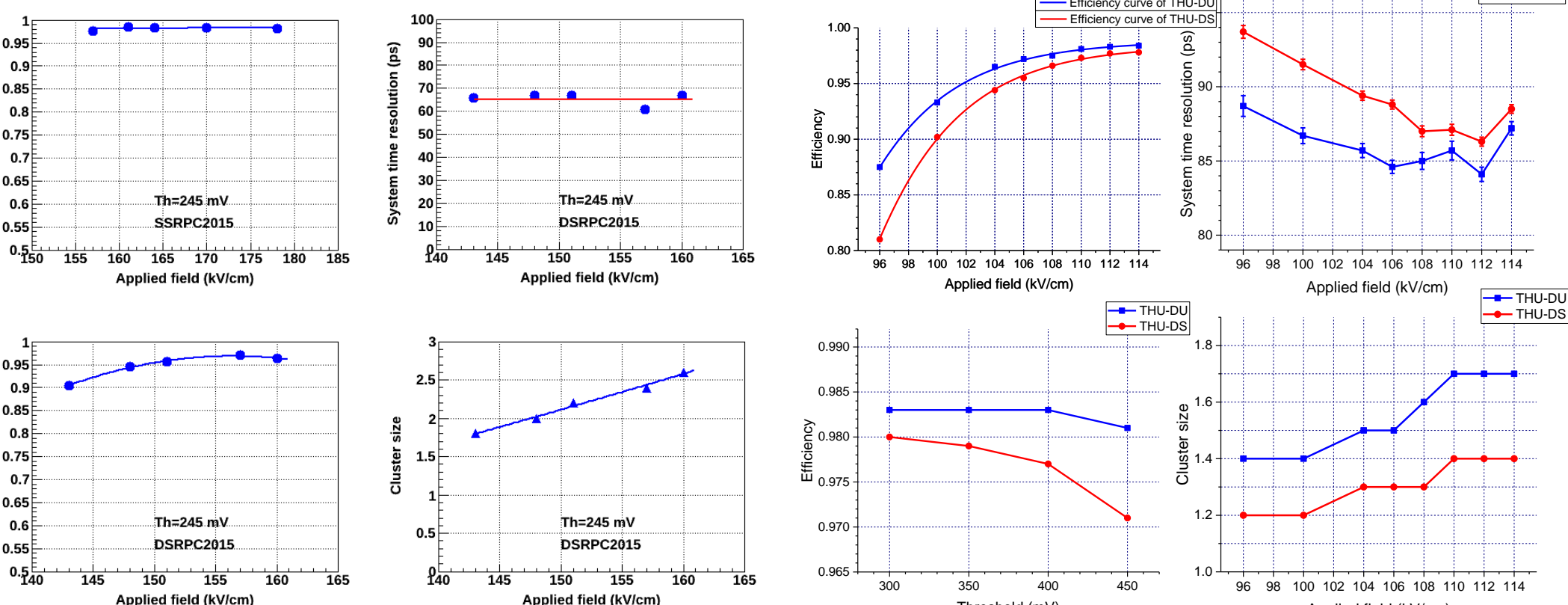
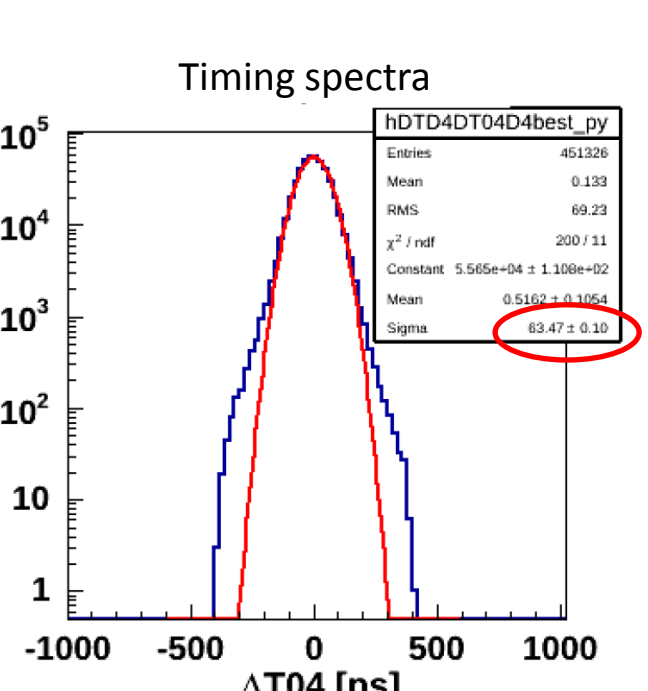


- Active area 300 – 864 cm²
- Granularities 10 – 27 cm²
- **Low resistive glass**
- Rate capability > 30 kHz/cm²
- Time resolution about 50 ps
- Efficiencies above 95 %
- Cluster size about 1.4 - 2

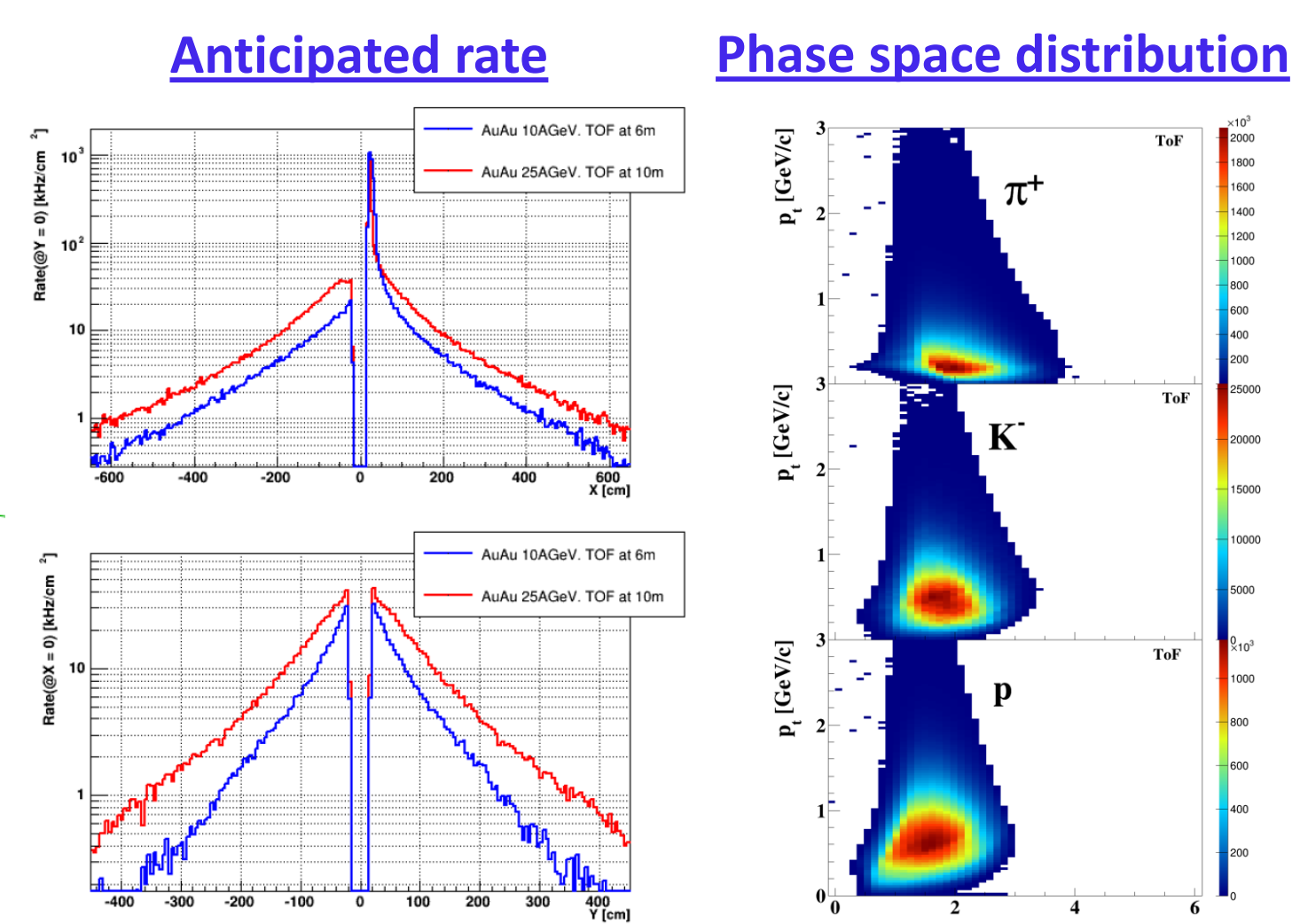
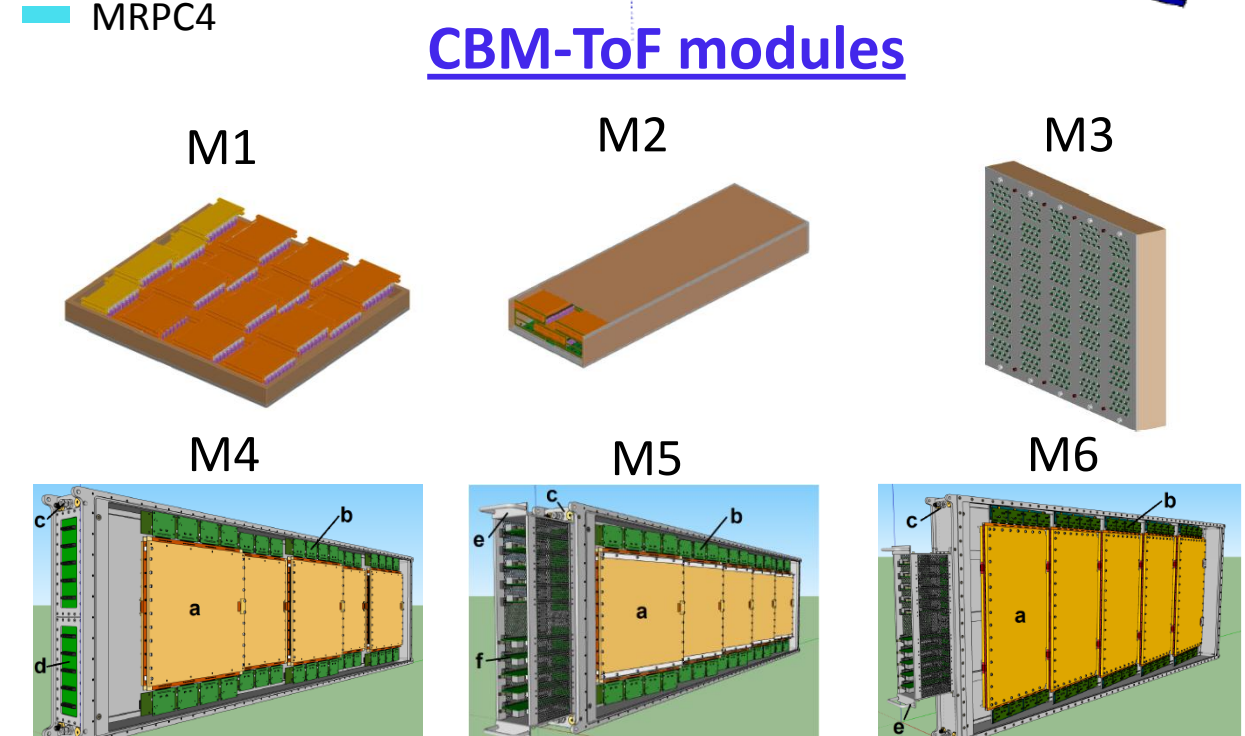
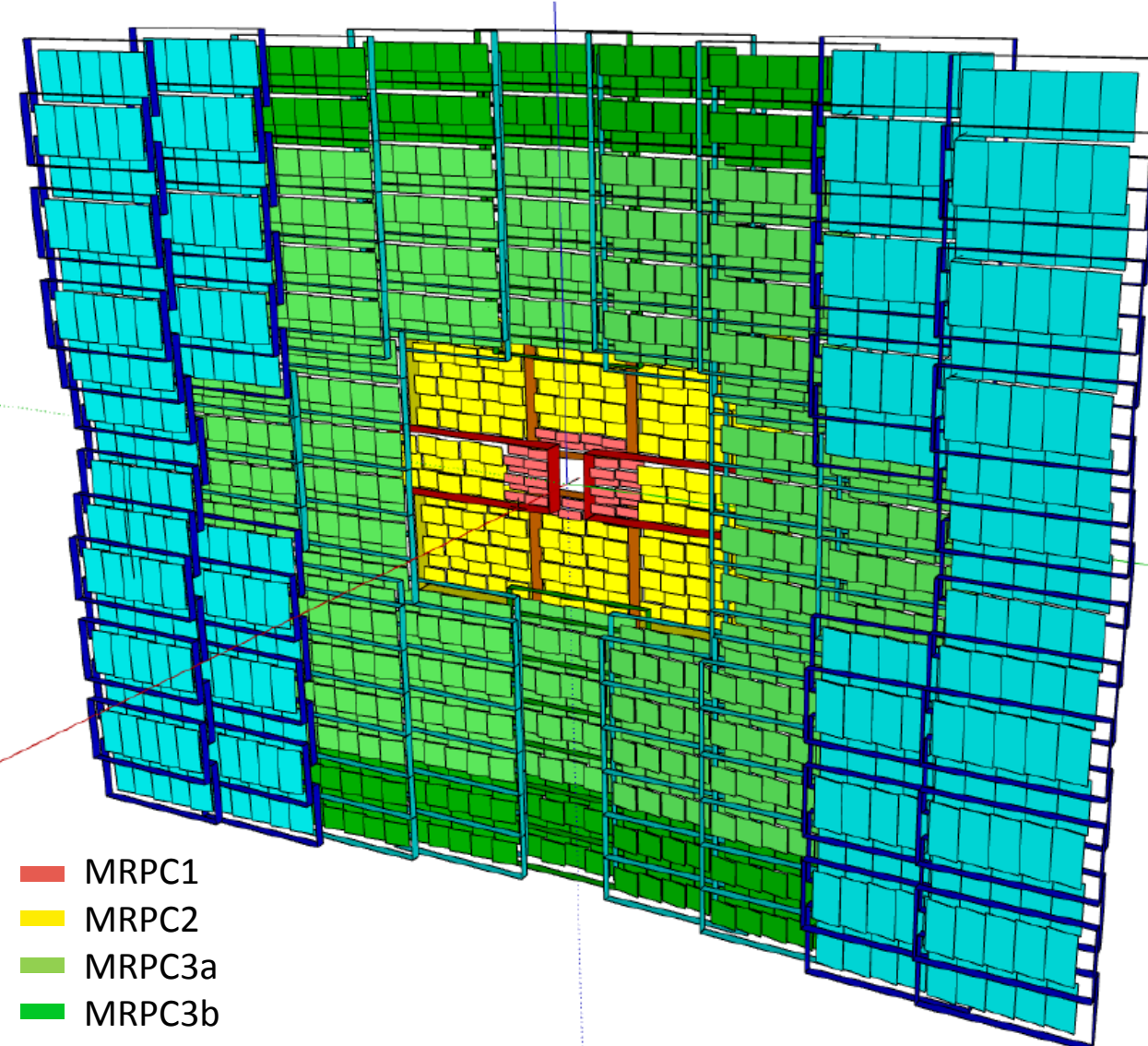
CERN beamtime Nov. 15 with Pb beam of 30A GeV on a Pb target



Beam time results



The CBM Time-of-Flight wall

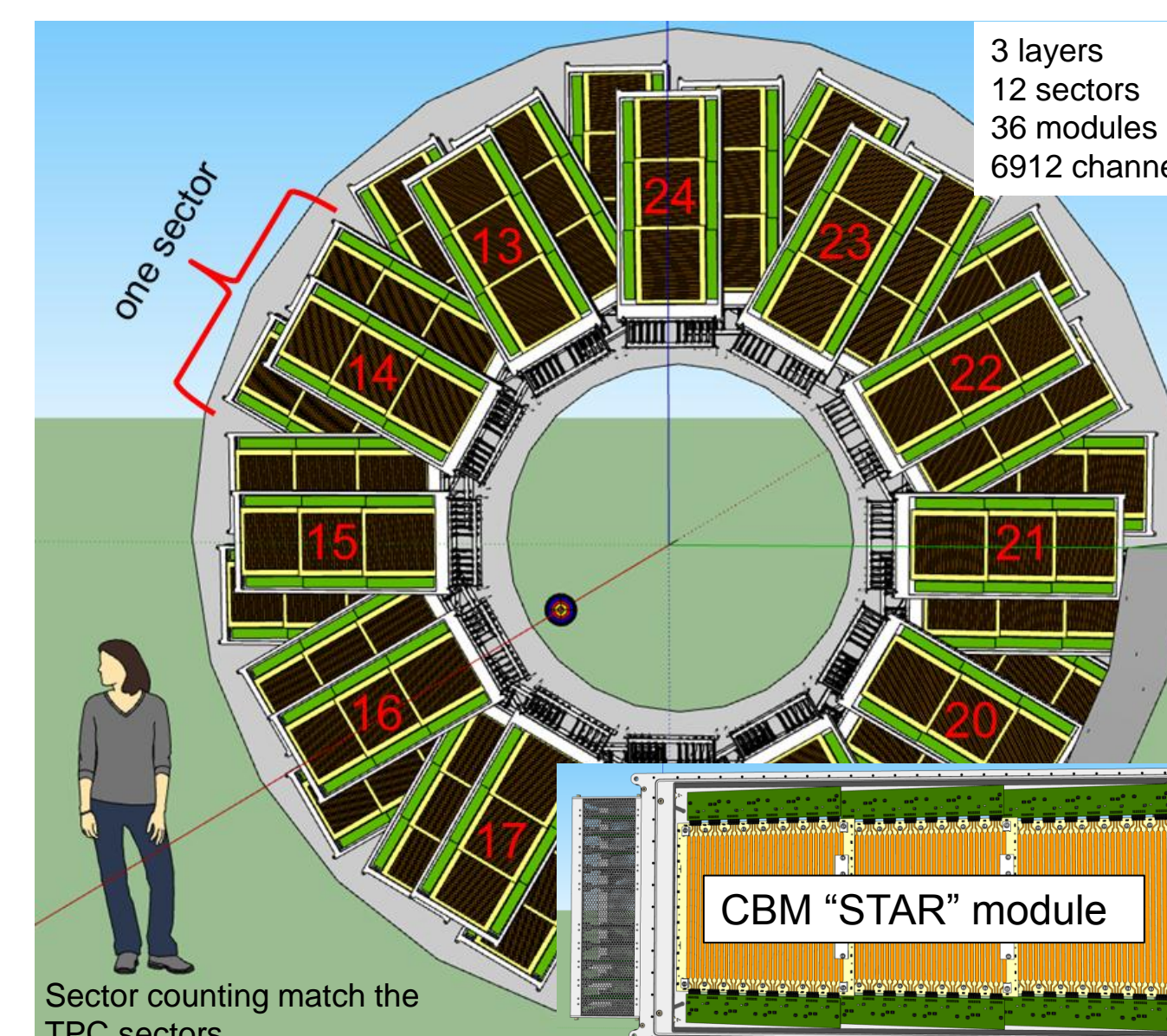


CBM-ToF Requirements

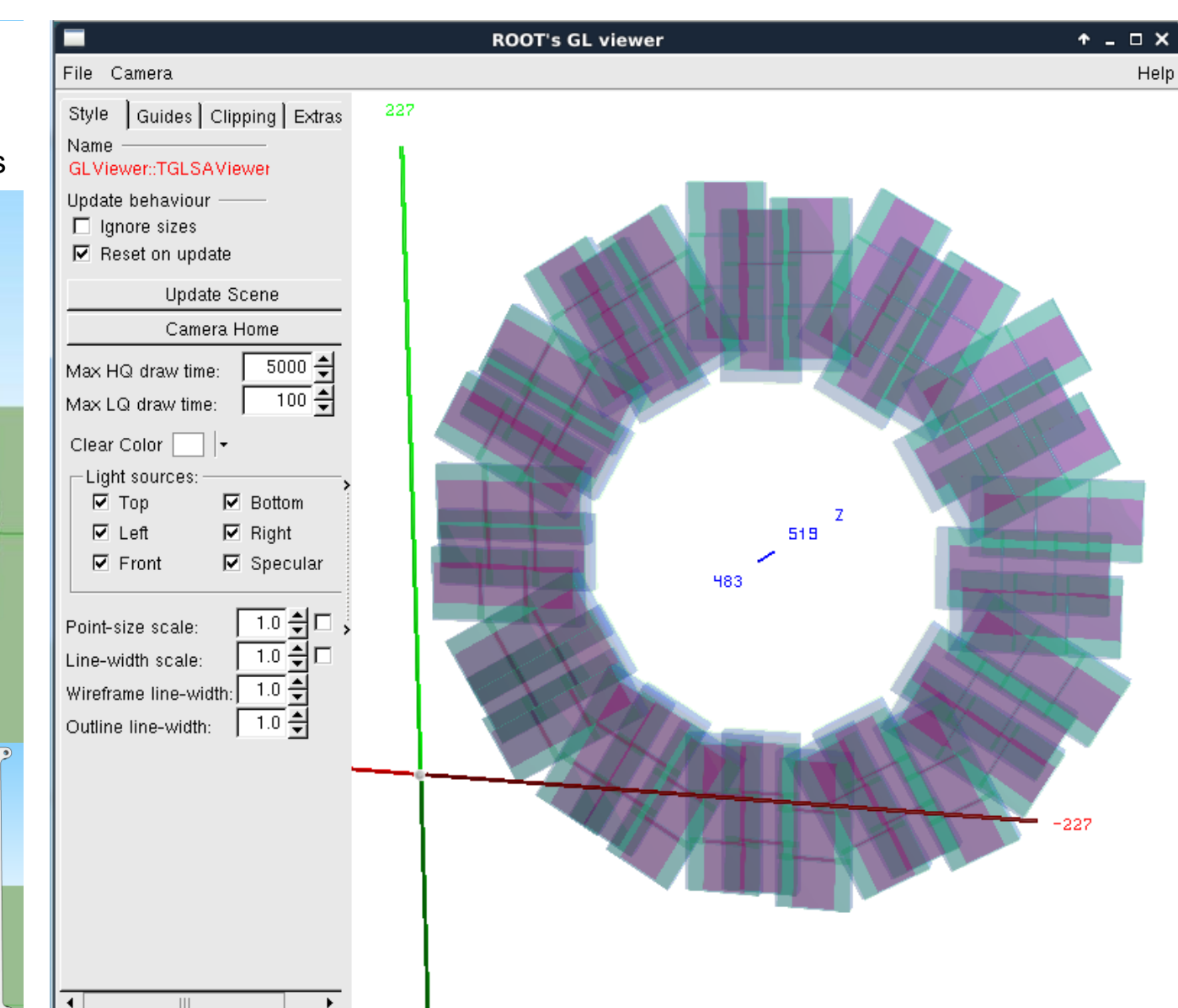
- Full system time resolution $\sigma_T \sim 80 \text{ ps}$
- Efficiency > 95 %
- Rate capability $\leq 30 \text{ kHz/cm}^2$
- Polar angular range $2.5^\circ - 25^\circ$
- Active area of 120 m²
- Occupancy < 5 %
- Low power electronics
- (~120.000 channels)
- Free streaming data acquisition

CBM FAIR Phase 0 program – The eTOF upgrate @ STAR

eTOF wheel – conceptual design



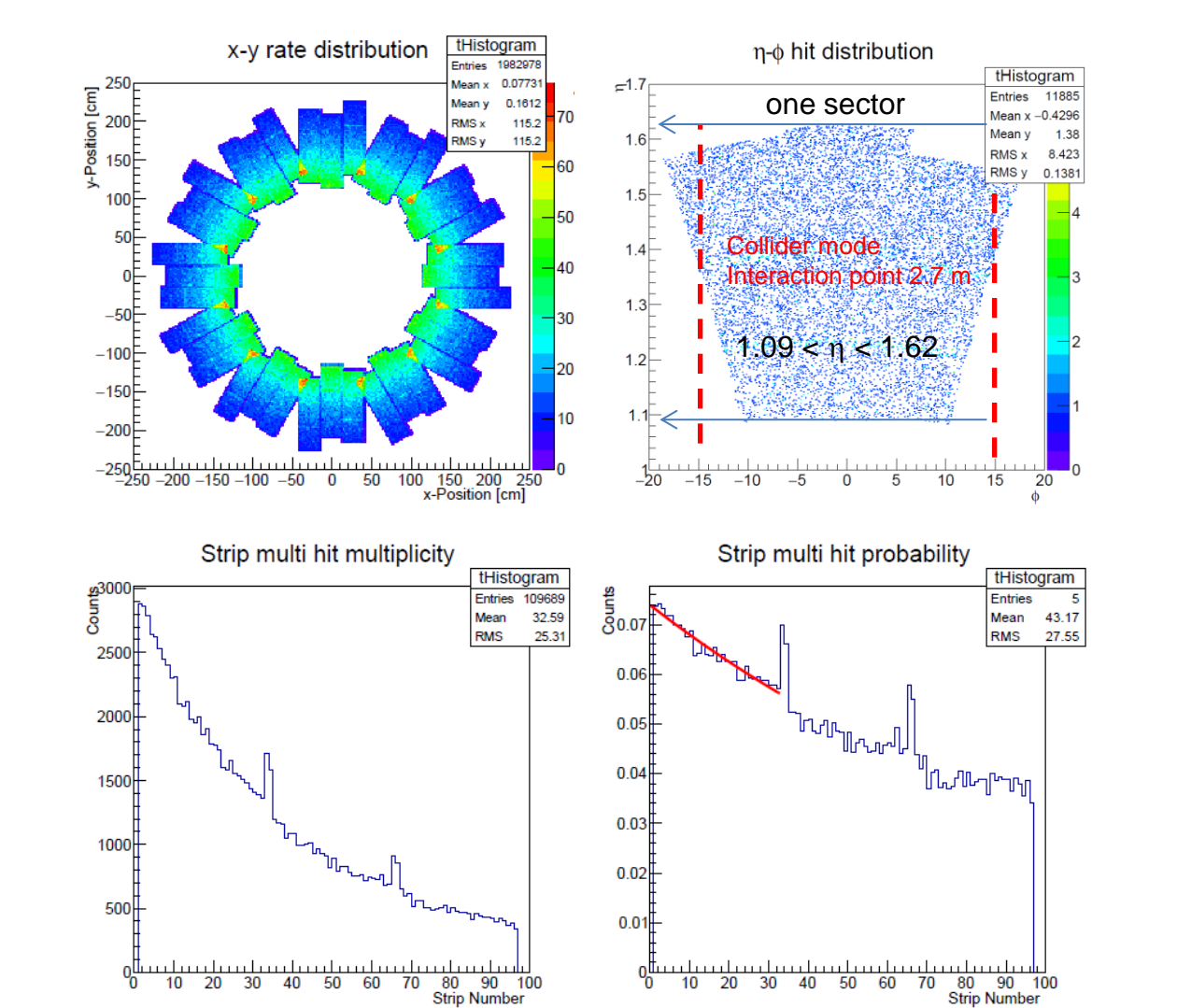
Geometry implementation in CBMROOT



Time line

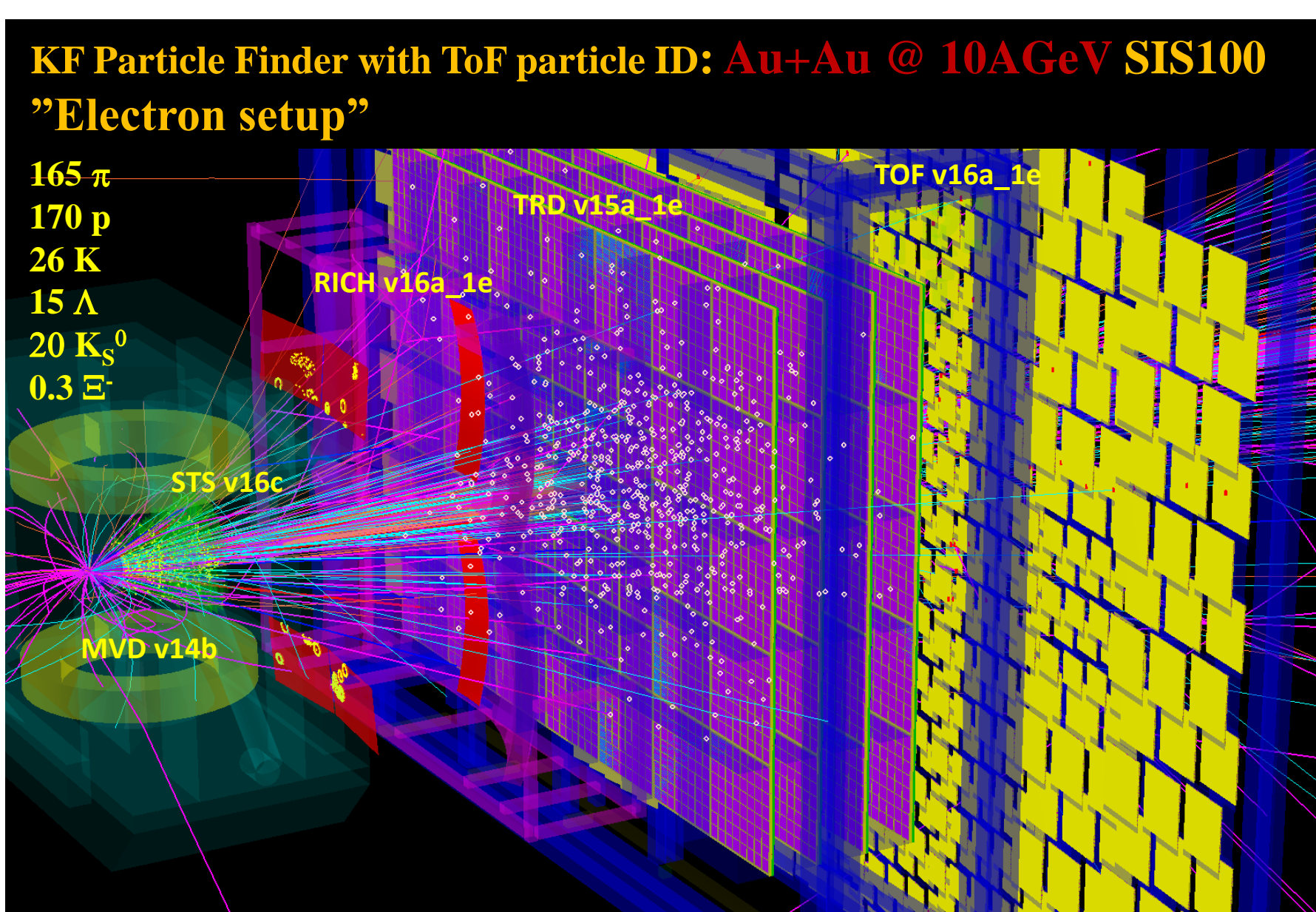
- December 2015: submit the physics proposal to GSI and BNL for approval
- October 2016: shipping a real size module to BNL and installing it on the east side pole of STAR
- Feb. 2017: 1st system integration test with one module by participating on the Run17 beam time in STAR
- June 2017 : submit the plan and schedule for the endcap TOF installation to STAR operations.
- Feb. 2018: 2nd system integration test with one module by participating on the Run18 beam time in STAR
- Summer 2018: shipping all 36 modules including infrastructure (gas system, LV-, HV-power supply) to BNL
- Fall 2018: Installation and commissioning
- Feb 2019: Start of the BES II campaign
- Summer 2020: Decommissioning and shipping of all modules including infrastructure to FAIR

Fixed target simulation (Au + AU @ 25A GeV)

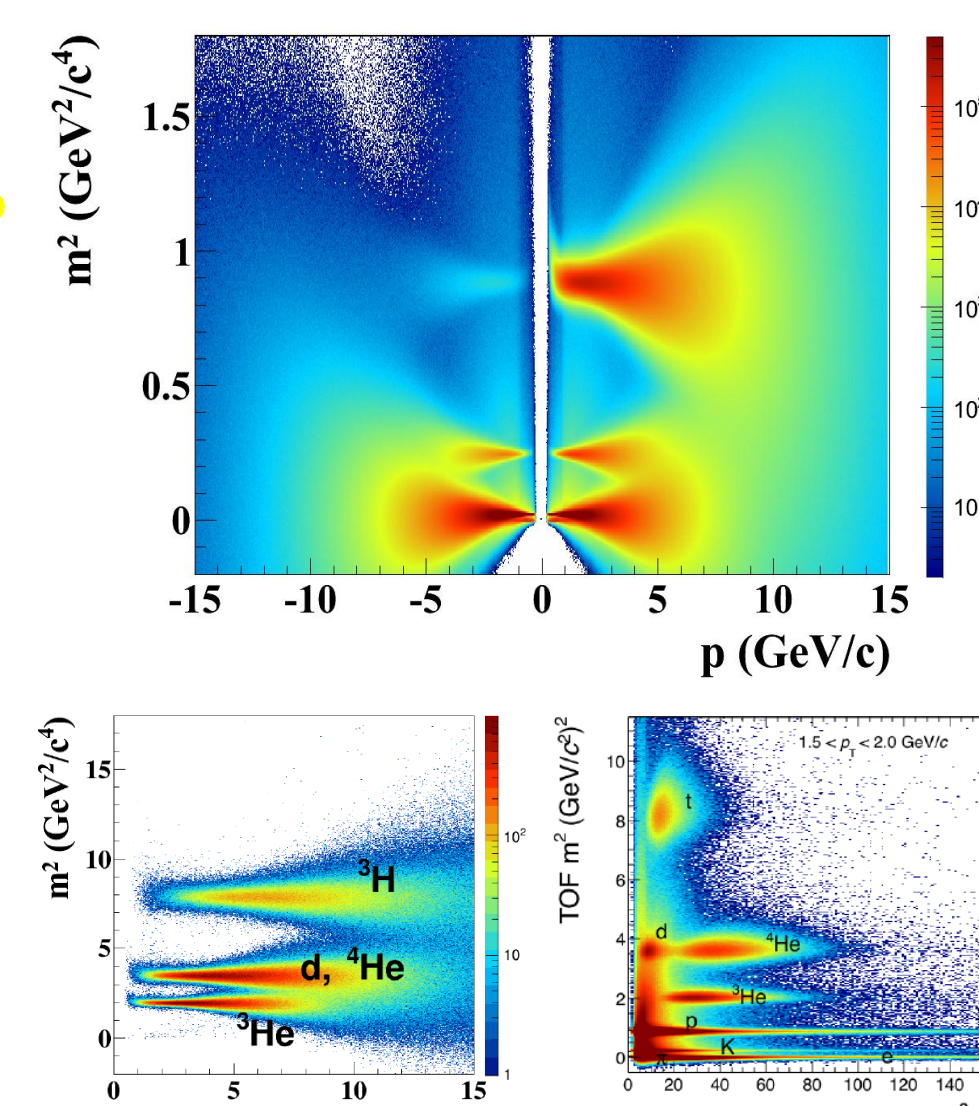


Beam energy	4A GeV	10A GeV	25A GeV
Max. rate of all particles [Hz/cm ²]	15	30	45
Max multi-hit prob. of all part. [%]	3.4	5.8	7.4
Max rate of prim. particles [Hz/cm ²]	12	20	25
Max multi-hit prob. of prim. part [%]	1.3	2.4	3.6

PID capability and an example of physics applications

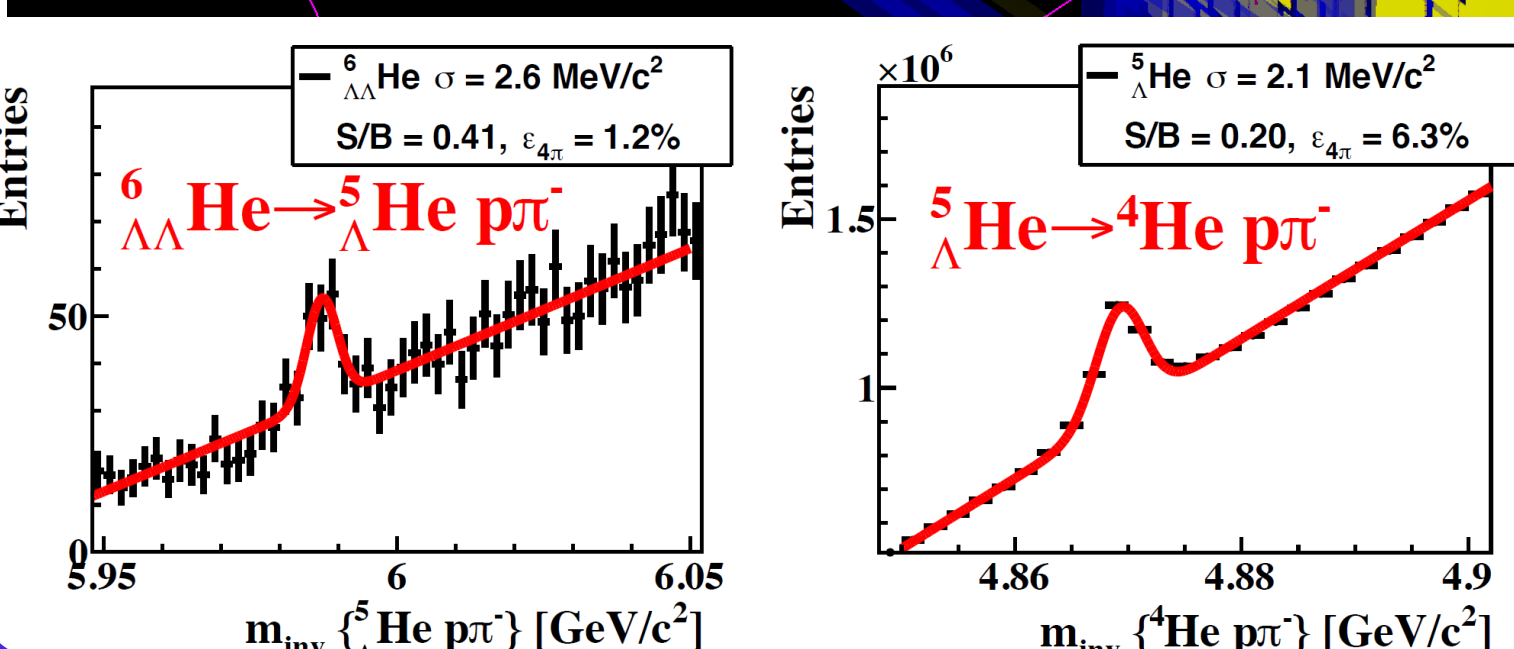


Particle Identification



Reconstruction of double Λ -hypernuclei

- 10A GeV Au + Au
- 10¹² central events
- High interaction rate is essential
- Large d background for ⁴He
- ⁴He can not be separated from d with TOF
- Additional dE/dx information is necessary



Summary: The CBM Time-of-Flight system is developed by 9 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. The CBM-TOF wall will be ready to take beam at FAIR in 2023.

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