Status report CBM

KHuK Annual Meeting 2020

P. Gasik (GSI/FAIR)
for the CBM Collaboration

CBM physics and observables

QCD matter properties at large μ_B

- Critical point and phase transition
- Hadron yields, collective flow, dileptons, correlations, fluctuations
- (Multi-)strange hyperons (K, Λ, Σ, Ξ, Ω)

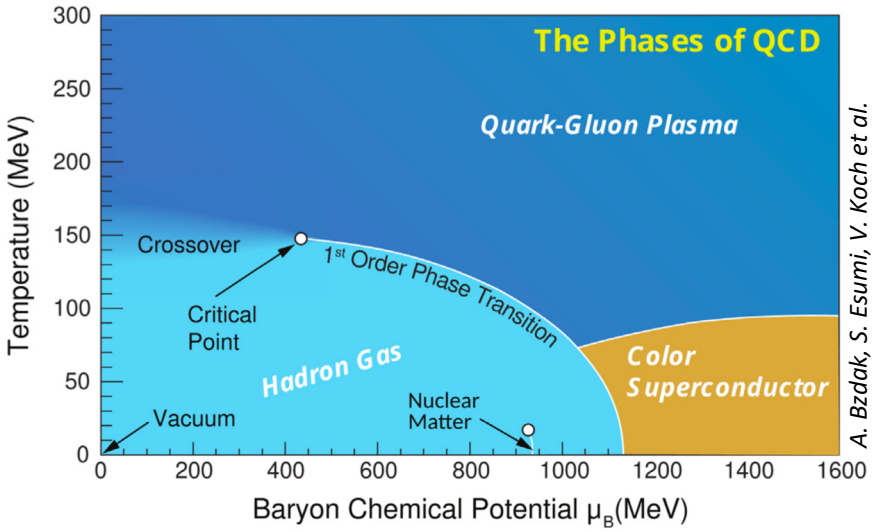
Chiral symmetry at large μ_B

- In-medium modifications of light vector mesons
- Chiral ρ-a_1 mixing via intermediate mass dileptons

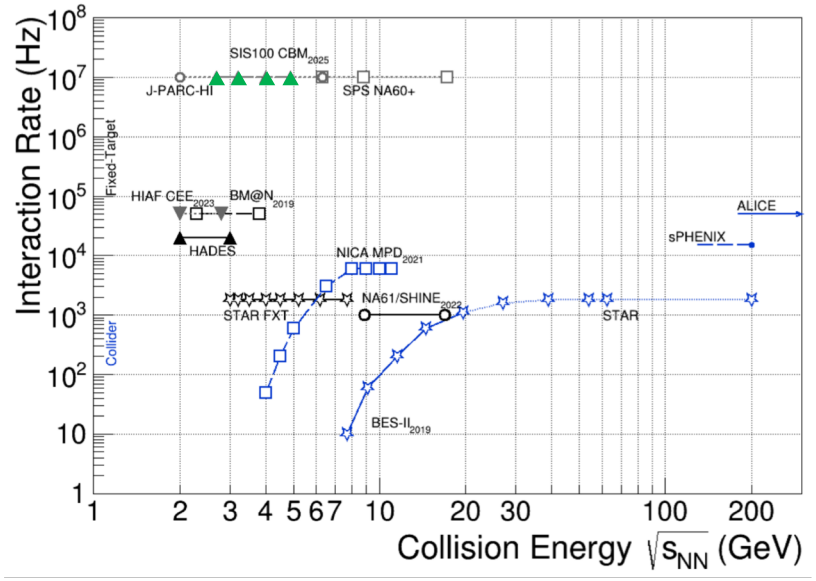
Hypernuclei

Charm production and propagation at threshold energies

- Excitation function in p+A collisions (J/ψ, D^0 , $D^{+/-}$)
- Charmonium suppression in cold nuclear matter



A. Bzdak, S. Esumi, V. Koch et al. Phys. Rep. 853 (2020) 1



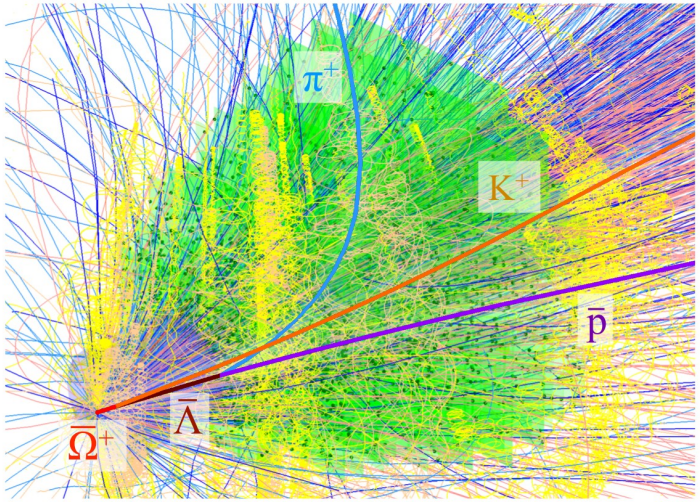
T. Galatyuk, Nucl.Phys. A982 (2019) 163
CBM, EPJA 53 (2017) 60

High statistics needs high reaction rates!

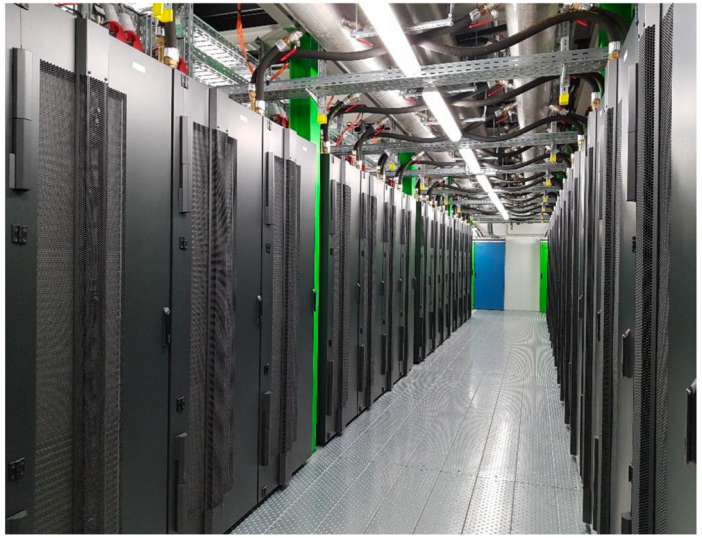
Physics goals realization (rate challenge)

- High event rates, up to 10^7 Hz Au+Au collisions
- Fast, radiation hard detectors & front-end electronics
- Free-streaming readout and 4D (space + time) event reconstruction
- PID: hadrons and leptons, displaced (~50 µm) vertex reconstruction for charm measurements
- High speed data acquisition and performance computing farm for online event selection

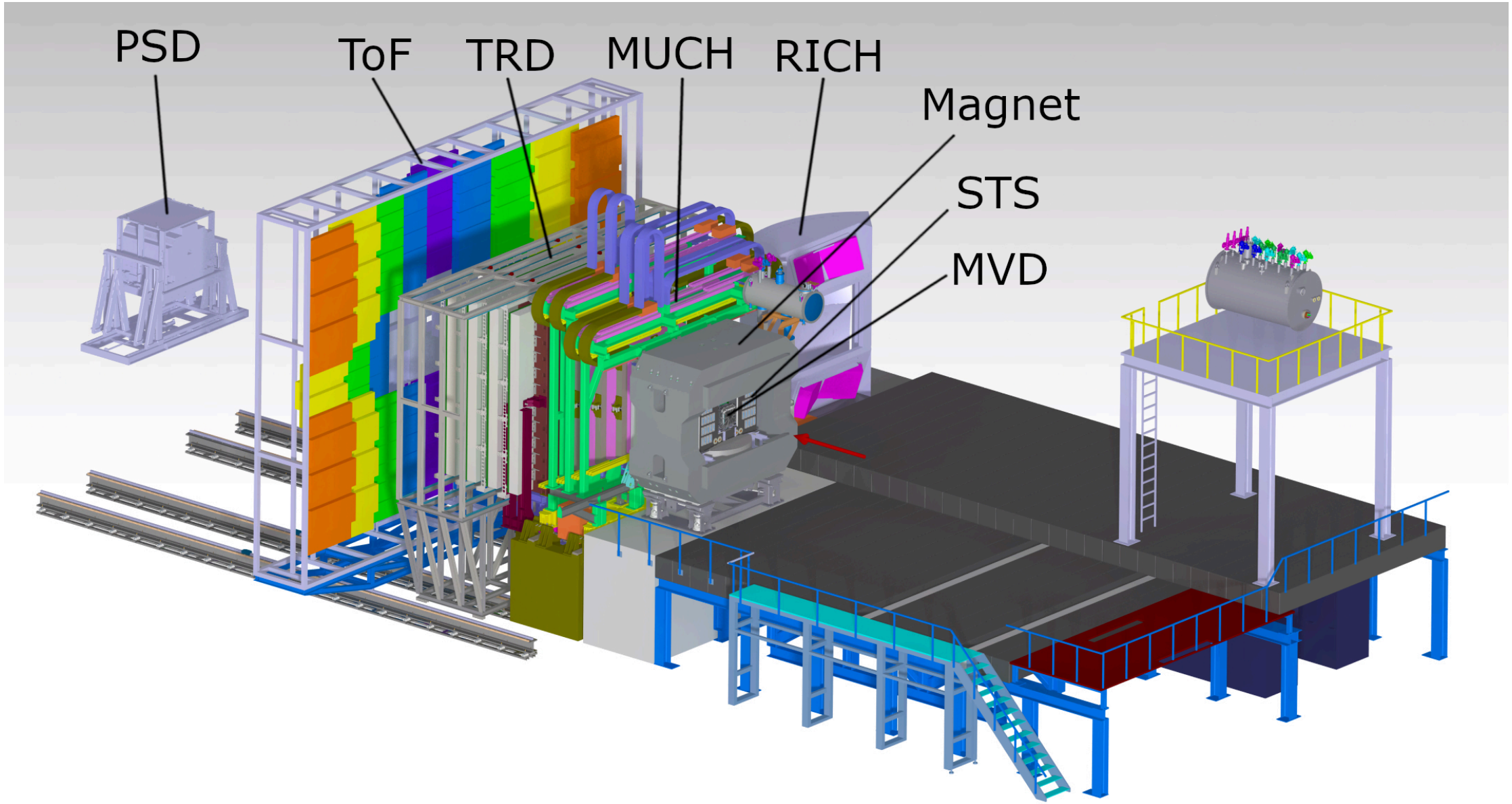
CBM simulation, central Au+Au @ 10*A* GeV/*c*



Green IT Cube @ GSI



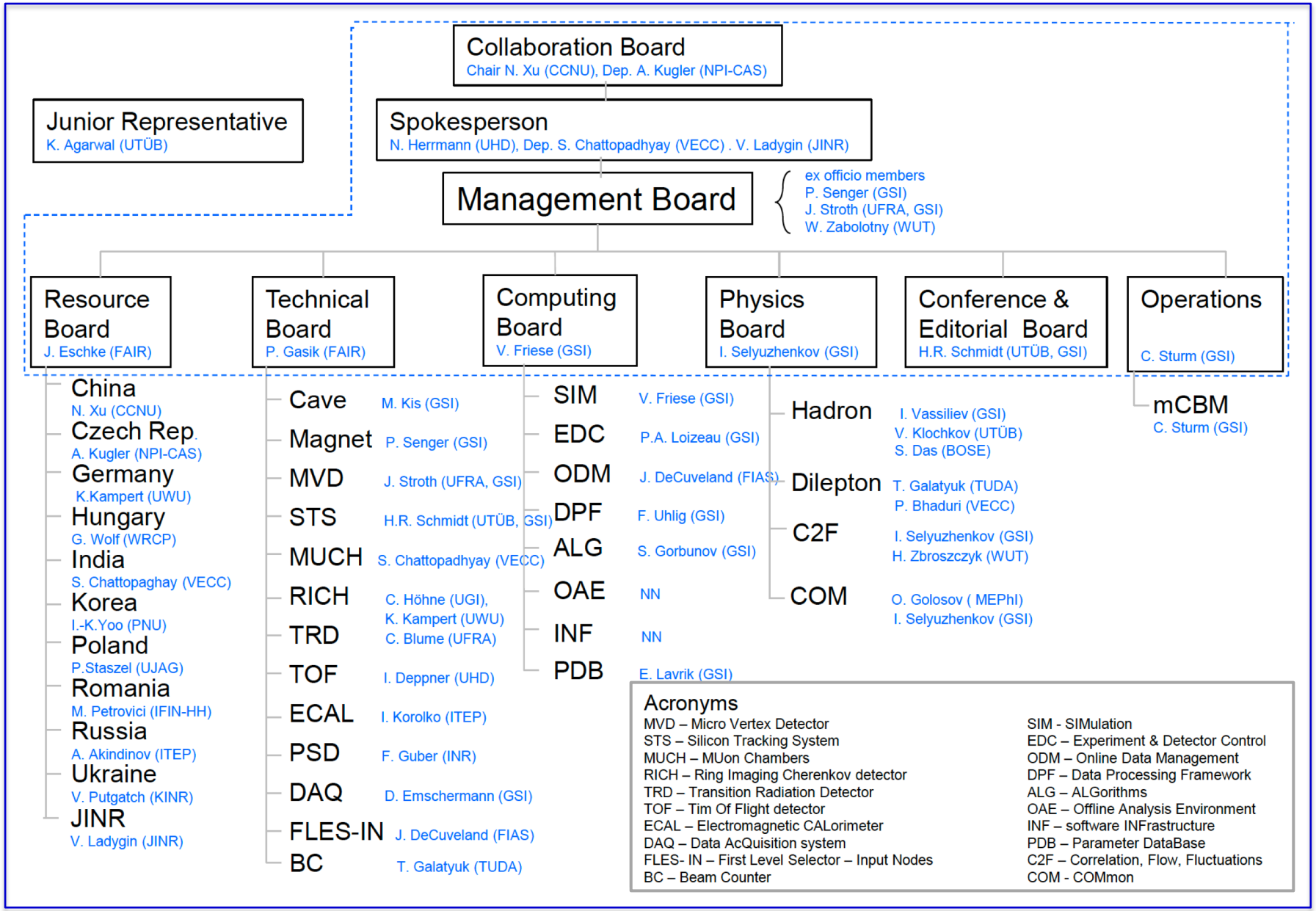
CBM experiment



CBM Building (L0608A)

- Shell construction is progressing
- Award of Technical Building Installation (TBI) packages until Q1/2021
- Beam dump shelling completed, installation of iron core will follow
- Beam transfer tunnel being constructed with the same pace
- Ground floor prepared for the installation of the rail system
- **CBM cave**: construction is progressing and soon will be ready

CBM collaboration structure

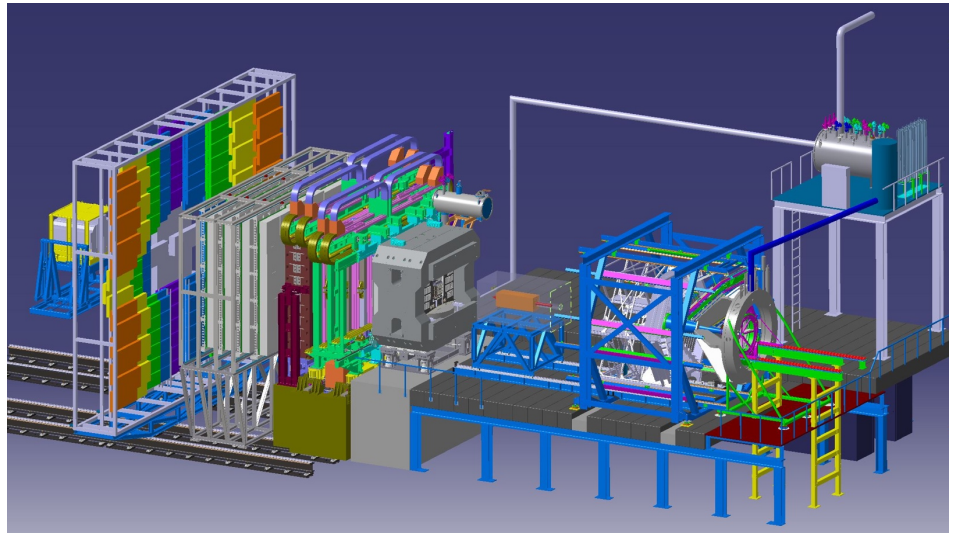


Full + Associated Members

- 66 institutes (incl. 16 in Germany)
- 493 members

Cave: common infrastructure, installation

- Cave 3D model (incl. services) for installation & integration planning
- Cave common infrastructure: installation starts ~Q2.2022
  - Rail system: call for tender start within next few weeks
  - Upstream platform: detailed design starts now, aim for installation in Q3.2022
- Technische Gebäude Ausrüstung: Q1-Q3.2023
- CBM installation detailed planning starts now!
  - User space (control room, IT room, racks, services) – 2023/24
  - Detector support and service installation: start Q1.2023
  - Detector installation and commissioning: Q3.2023
- CBM ready for beam (start global commissioning): H1.2025

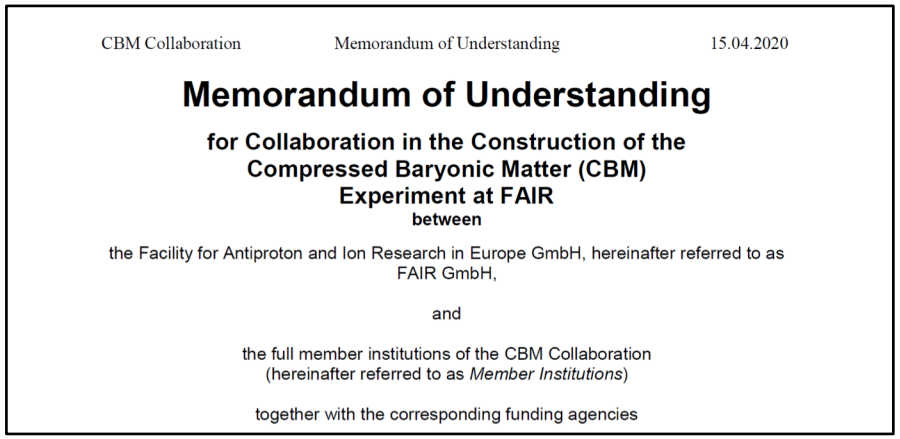


Construction MoU (incl. common funds) essential for common infrastructure!

CBM construction MoU

- Defines the (In-Kind) contributions of the CBM member institutes to the construction of the CBM experiment
- Establishes the CBM Common Fund for the financing of the CBM common infrastructure

  (Common infrastructure cost assessment evaluated by ECSG and ECE)
- CBM C-MoU agreed by CBM member institutes and all Funding Agencies in the FAIR RRBs



CBM Collaboration Memorandum of Understanding 15.04.2020

Memorandum of Understanding

for Collaboration in the Construction of the Compressed Baryonic Matter (CBM) Experiment at FAIR

between

the Facility for Antiproton and Ion Research in Europe GmbH, hereinafter referred to as FAIR GmbH,

and

the full member institutions of the CBM Collaboration (hereinafter referred to as *Member Institutions*)

together with the corresponding funding agencies

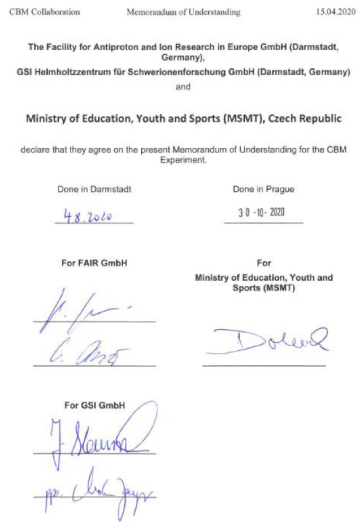
- Signing has started (GSI/FAIR) in August 2020
- ~60 signatories at the CBM institutes and at the Funding Agencies
- First signatories: GSI/FAIR GmbH
- First external signatory: Czech deputy minister

Cost Assessment

Compressed Baryonic Matter Experiment

Common Infrastructure of the CBM Experiment at FAIR

October 2019



CBM Collaboration Memorandum of Understanding 15.04.2020

The Facility for Antiproton and Ion Research in Europe GmbH (Darmstadt, Germany),
GSI Helmholtzzentrum für Schwerionenforschung GmbH (Darmstadt, Germany)
and
Ministry of Education, Youth and Sports (MSMT), Czech Republic

declare that they agree on the present Memorandum of Understanding for the CBM Experiment.

Done in Darmstadt 4.8.2020 — Done in Prague 30-10-2020

For FAIR GmbH — For Ministry of Education, Youth and Sports (MSMT)

For GSI GmbH

PAVEL DOLEČEK
Deputy Minister for Higher Education, Science and Research
Ministry of Education, Youth and Sports

Prague, 30th October 2020
Ref. No.: MSMT-41073/2020-2
Attachment

Dear Prof Giubellino

The Ministry of Education, Youth and Sports of the Czech Republic, being the funding agency of the Czech participation in the Facility for Antiproton and Ion Research, fully supports the activities developed by the Nuclear Physics Institute of the Czech Academy of Sciences, which is a Member institution of the CBM collaboration.

As a sign of the above-mentioned, I am sending you signed Memorandum of Understanding.

I wish you many successes during the CBM construction and experiments.

Yours sincerely

CBM status

	Component/ Sub-System	TDR	Cost [k€ 2005]	Funding	Construction	Construction completed	Test/ Commissioning
Day-1	Micro Vertex Detector (MVD)		914			04/2025	
	Silicon Tracking System (STS)		9504			08/2024	
	Ring Image Cherenkov Detector (RICH)		3697			01/2024	
	Muon Detector (MUCH)		6138			03/2024	
	Transition Radiation Detector (TRD)		2615			11/2024	
	Time of Flight System (TOF)		5857			11/2024	
	Projectile Spectator Detector (PSD)		944			11/2023	
	Dipol Magnet		3758			10/2022	
	Online Systems (DAQ and FLES)		1825			12/2023	
	Infrastructure		2192			12/2023	
		87% *value weighted*	37444	87% *secured*	15.3% *value weighted*		
Phase-0 (SIS18) & Day-1 (SIS100)	HADES upgrade		2453			03/2023	
Change since report 2020-I		unchanged		unchanged	2.5%		
Reporting Data Date: 01.09.2020							

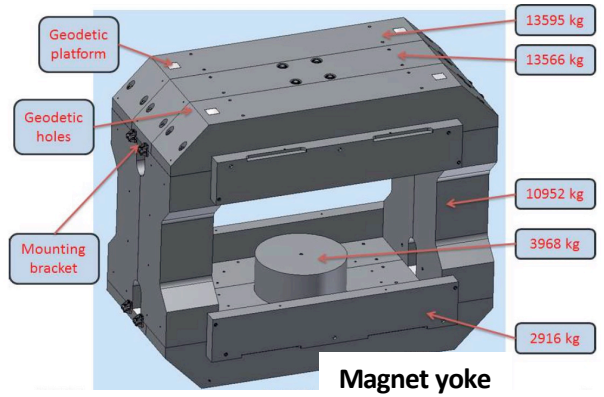
- CBM enters the final stage of the detector development, design finalization and transition to **series production**
- Well on track for preparing Day-1 setup in 2025
- Many reviews (>50) in the next 6 months

Conceptual Design Review
Engineering Design Review
Production Readiness Review

Highlights from the detector projects

Magnet (P. Senger, GSI)

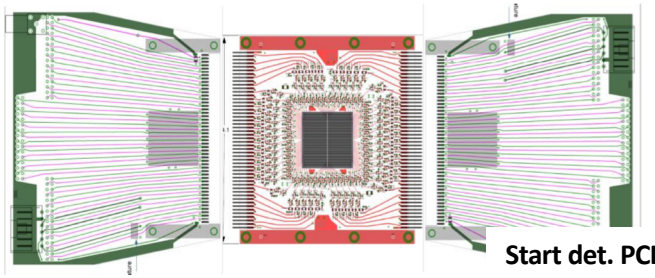
- Progress in design of coils, branch box, transfer line, cryostat.
- Yoke and Power Supply Production Readiness Review in December 2020
- Hall at BINP prepared for Factory Acceptance Tests



Magnet yoke

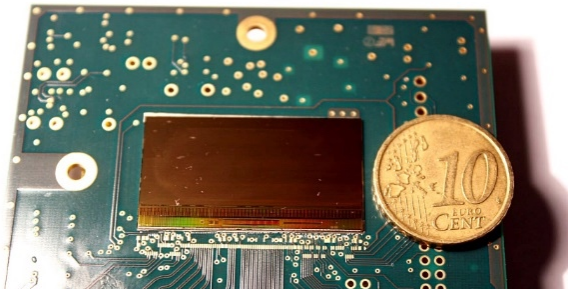
Beam monitor and start detectors (T. Galatyuk, TU Darmstadt)

- Endorsed as an independent project
- Start detector Concept for Day-1 based on pcCVD high purity diamond sensors
- A concept of the beam abort system being worked out


Start det. PCB

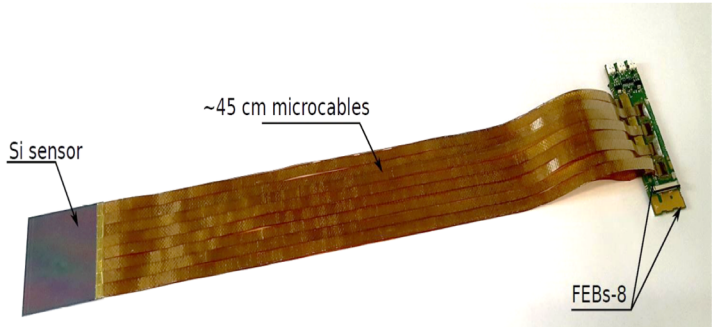
MVD (J. Stroth, U Frankfurt, GSI)

- MIMOSIS-1: first full size sensor prototype available! First tests successful, systematic studies ongoing
- TDR ready for collaboration review in December 2020
- MIMOSIS-2 submission in Q2.2021


MIMOSIS-1 (evaluation PCB)

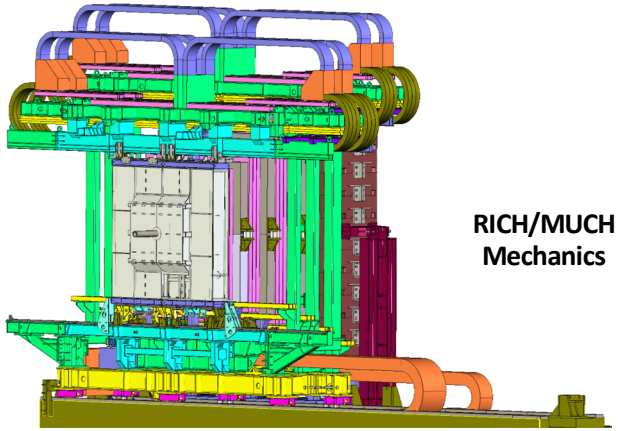
STS (H.R. Schmidt, U Tübingen, GSI)

- All sensors delivered, QA finalisation
- Module and Ladder assembly EDR next week!
- New ASICS available (STS-XYter2.2)
- Preproduction of 3 full-size ladders starts in Q1.2021
- PRR prior to mass production in 09.2021

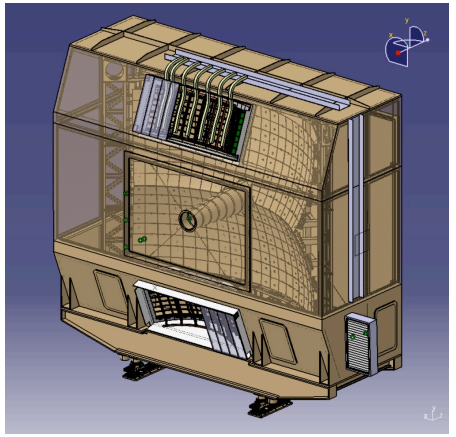


Assembled STS module

Highlights from the detector projects



RICH/MUCH Mechanics

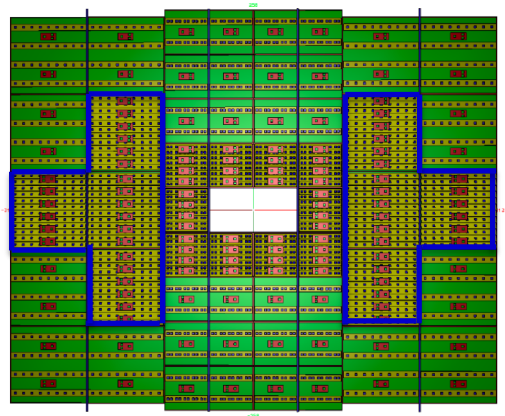


MUCH (S. Chattopadhyay, VECC)

- Mechanics CDR accepted, PRR in 06/21
- 2nd station GEM chamber - assembly in progress for mCBM ‘21
- RPC station - assembly in progress for mCBM ‘21

RICH (K.-H. Kampert, C. Höhne, U Wuppertal, U Gießen)

- Mechanics CDR accepted, PRR in 06/21
- Camera design CDR completed; pre-production (demonstrator incl. cooling) launch in 2021
- Mirrors EDR/PRR in Q1.2021 followed by start of mirror production



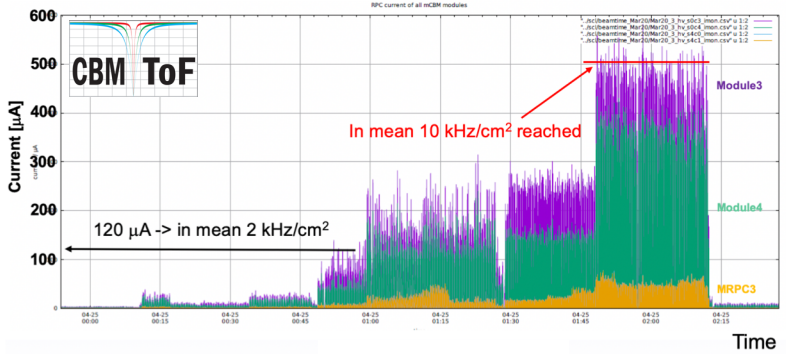
TRD wall layout
Module type “5”

TRD (C. Blume, U Frankfurt)

- Outer modules PRR completed, first of series production (5 modules type “5”) in H1.2021
- Inner modules TDR Addendum ready for submission in 04.2021
- SPADIC 2.3 ASIC test submission in Dec. 2020

TOF (I. Deppner, U Heidelberg)

- New ASIC PADI XI successfully tested – PRR in 01.2021
- Unprecedented time resolution of 35 ps reached (prelim.)
- Particle fluxes > 10 kHz/cm^2 reached
- Ageing studies ongoing in Bucharest (ISRAM facility);



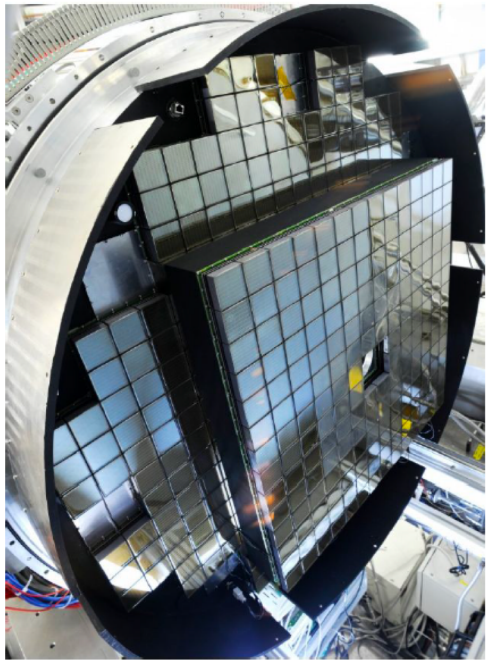
TOF high-rate test

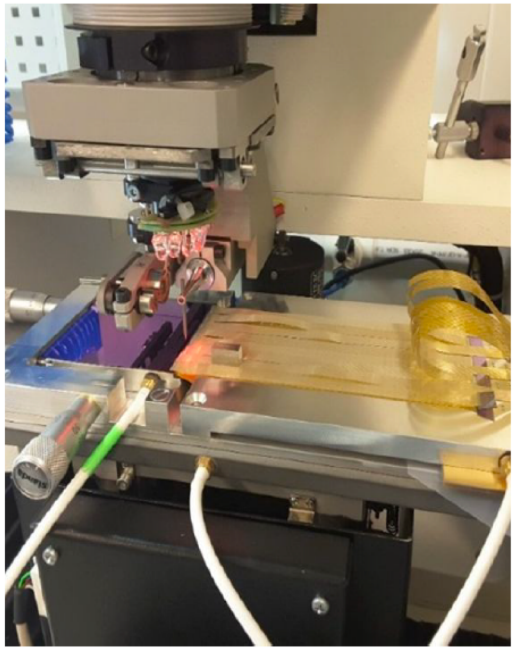
PSD (F. Guber, INR Moscow)

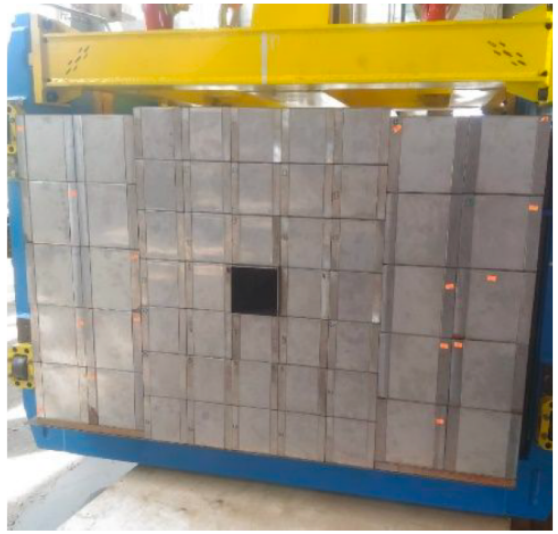
- All modules produced
- Upper support structure arrived at FAIR in 09.2020

PSD support SAT

FAIR phase 0

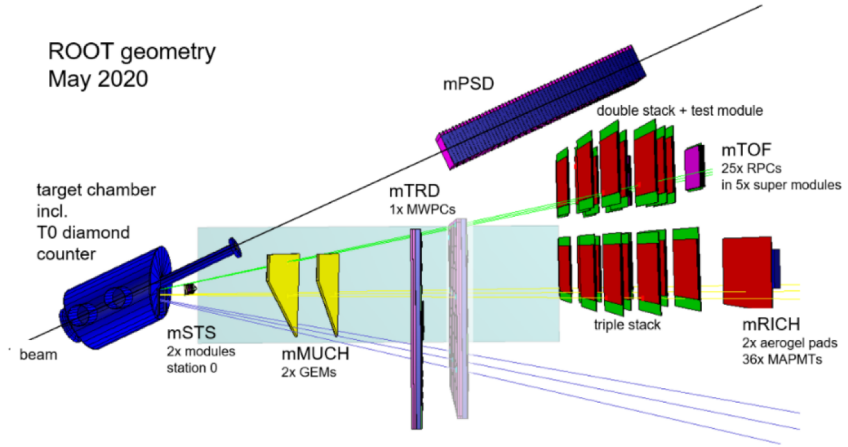


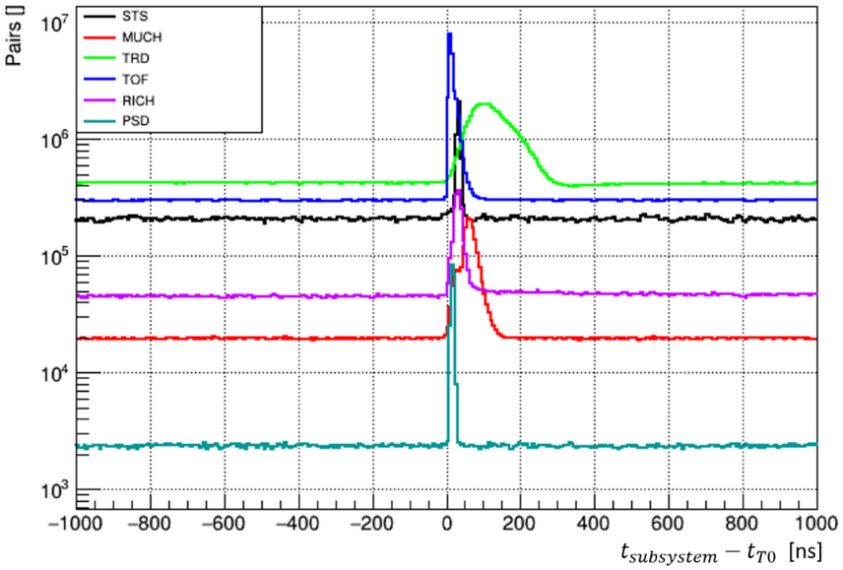




- eTOF @ STAR is installed, commissioned and running
- Use 430 out of 1100 CBM RICH multi-anode photo-multipliers in HADES → successful operation during 4w beam time in 03.2019
- 4 Silicon Tracking Stations in the BM@N in JINR
- Use PSD modules at BM@N and NA61/SHINE → Tests and performance studies at the NA61/SHINE experiment at CERN/SPS

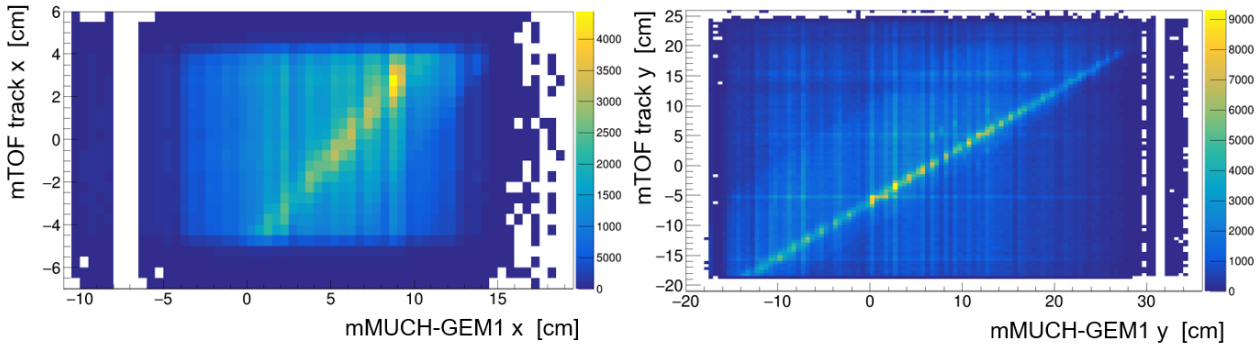
mCBM commissioning with beam, first results from May 2020

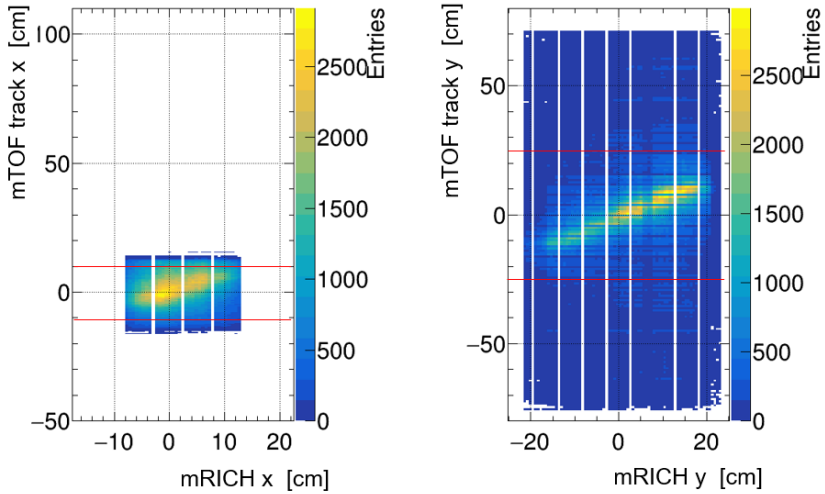




Subsystem time offset corrected,
no time calibration

preliminary - May 2020 data

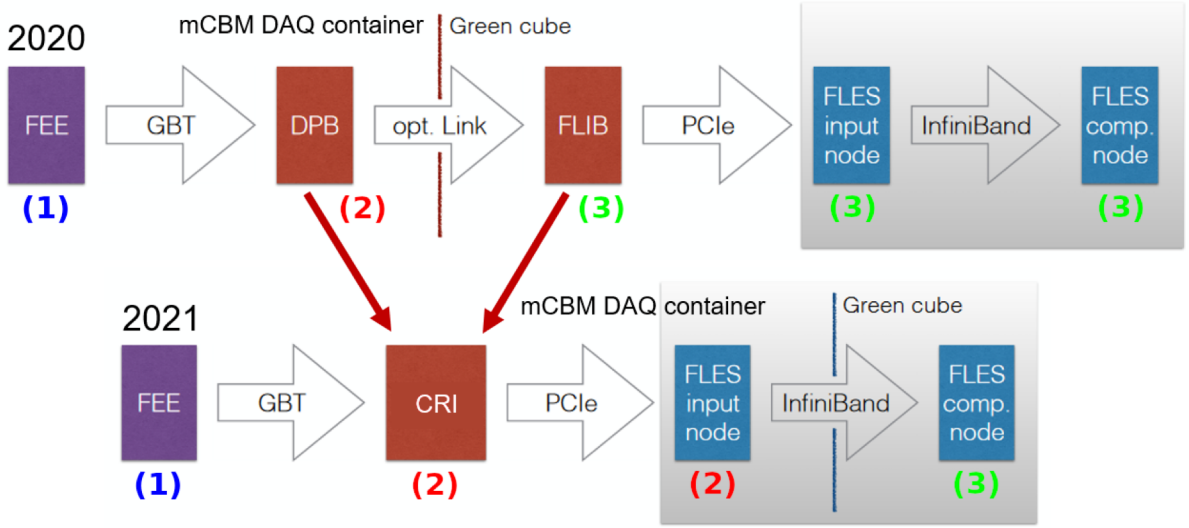




data:
run 831, May 4th, 2020
^{208}Pb + Au, 1.060 AGeV
"low" collision rate ≈ 20kHz

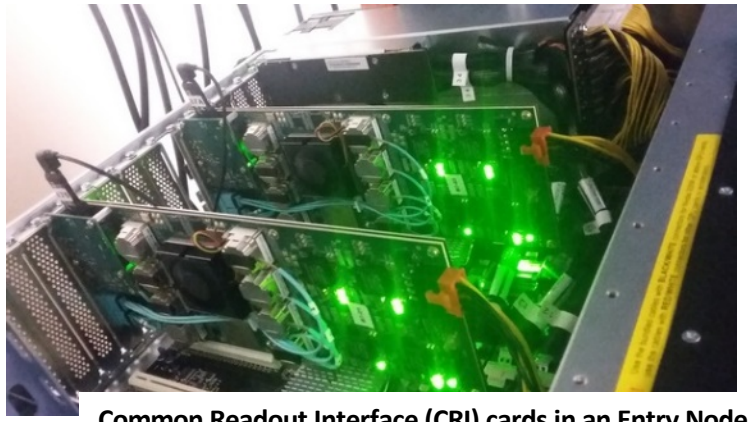
Observed time and spatial correlations between detector subsystems:
first steps towards verification of the triggerless-streaming DAQ system of CBM,
to be verified up to the CBM design limit of 10 MHz collision rate.

mCBM - towards the data campaign 2021



- **Migration to the final configuration of the CBM data transport chain**
- Completion of detector stations / subsystems
- Upgrade of cave infrastructure (cooling, vacuum, alignment)
- Further development of CBM online/offline software packages incl. controls / run control

beam time application for 2021/22 fully granted



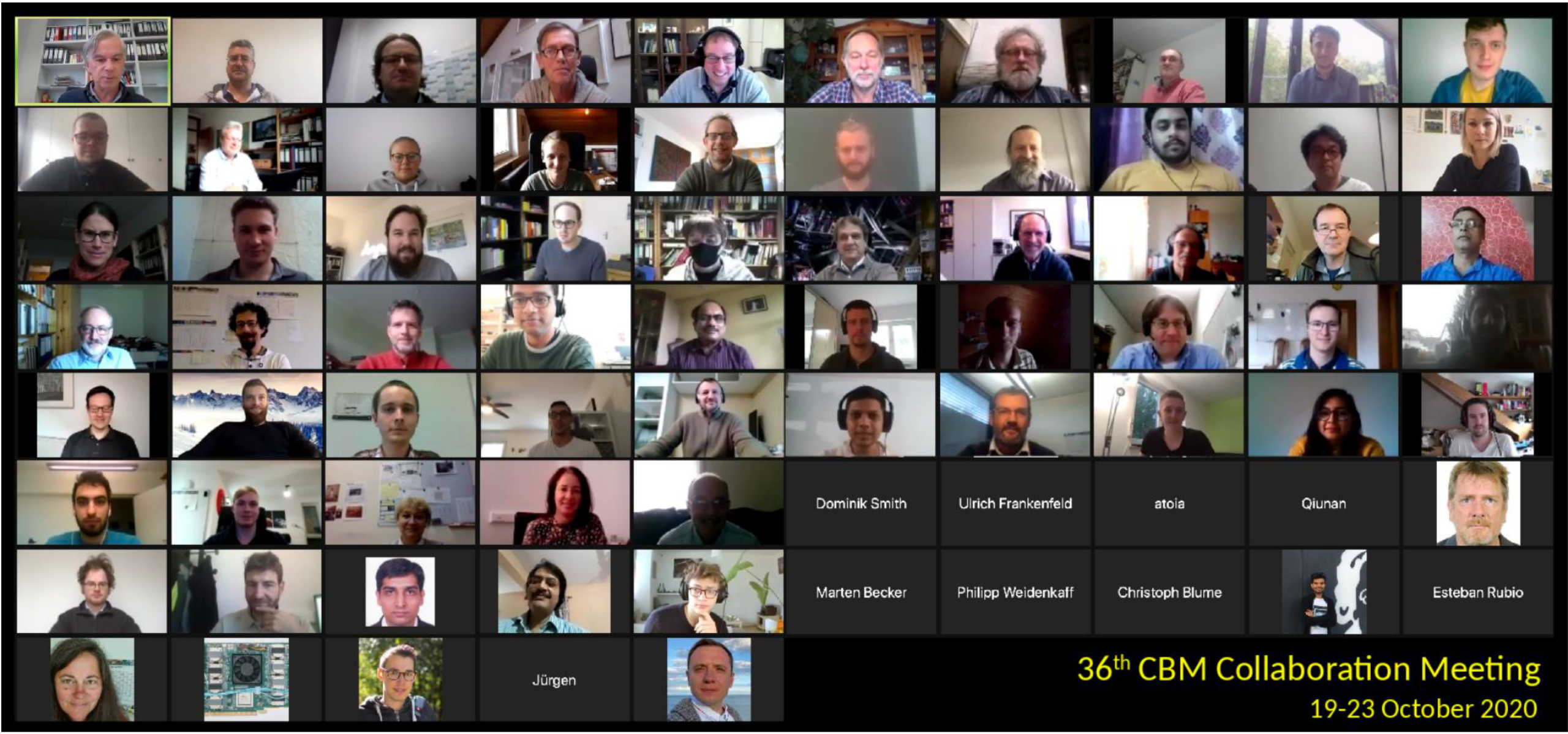
Common Readout Interface (CRI) cards in an Entry Node

Beam time schedule 2021

1. Commissioning of upgraded data transport and detector subsystems & high-rate detector tests
   ^{208}Pb beam, shifts (sec. user) within February 26th - March 14th , 2021

2. Commissioning of benchmark runs (Λ production) incl. online reconstruction & selection
   ^{78}Kr beam, (prim. user) May 2nd - 4th , 2021

Many thanks to the entire CBM collaboration for their commitment and progress!



Summary

- CBM enters crucial phase of production of its main detector components.
- Closely watch the critical component production, starting from their reviews to SATs
- This includes development of the CBM DAQ and Online Systems

- Installation planning – main focus for the upcoming months
- Securing common fund crucial for timely completion of the experiment infrastructure

- Updated FAIR project baseline expected in Q1.2021 (incl. COVID-19 induced delays)

- CBM milestones “ready for installation” remain unchanged
- The time difference between CBM and SIS100 readiness → global commissioning

Thank you!