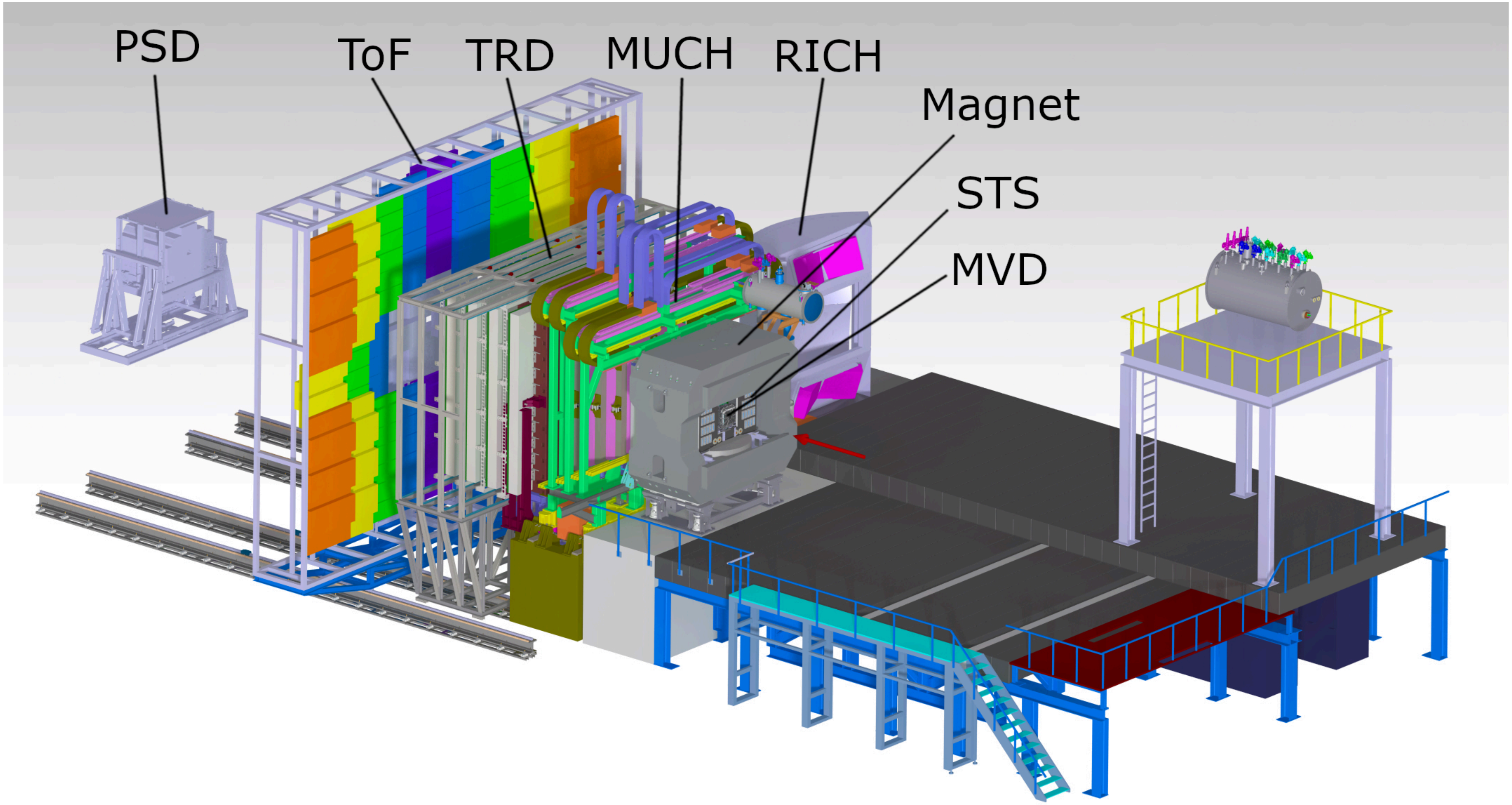
CBM status, follow up and science highlights

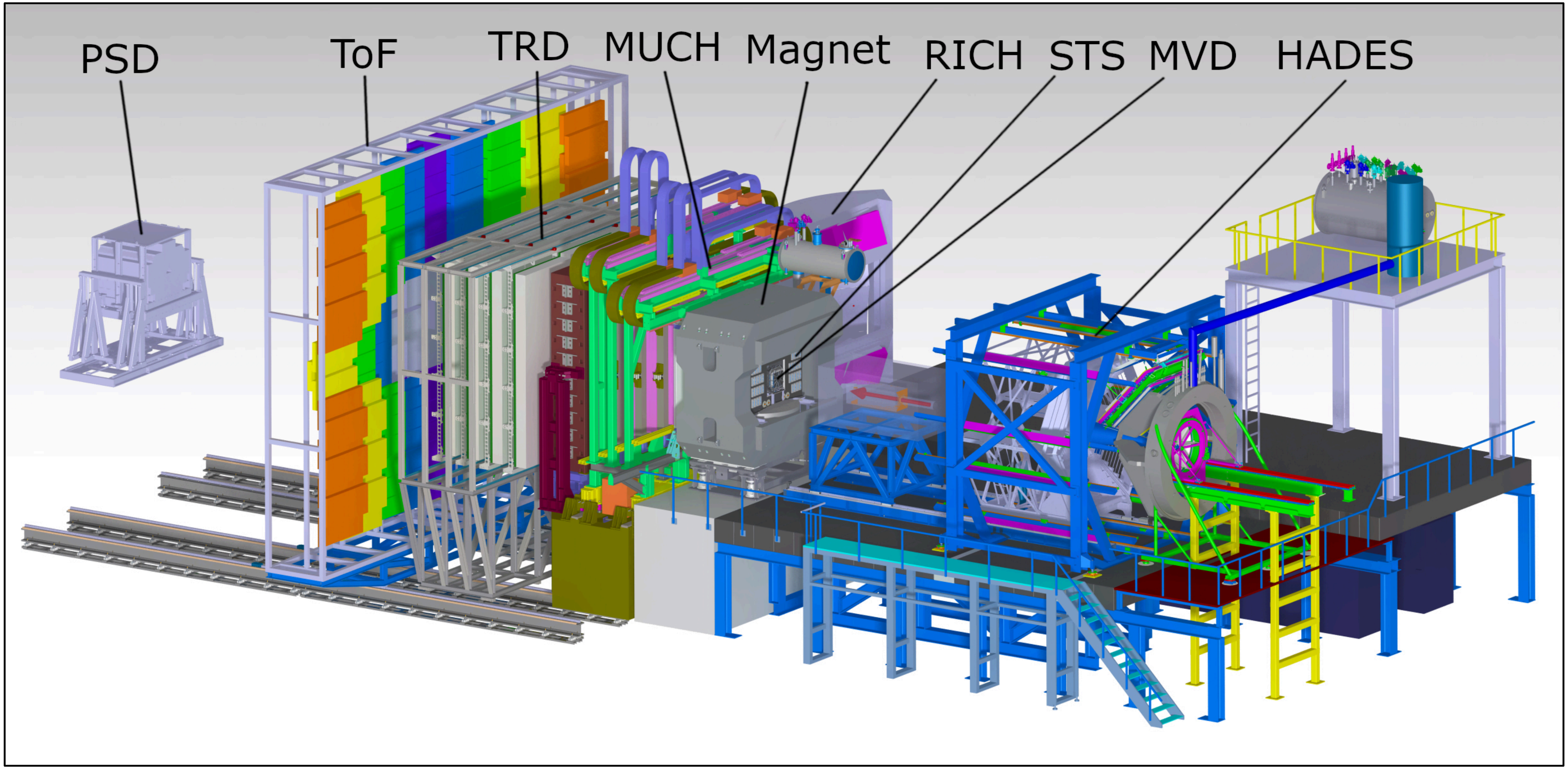
Joint FAIR ECE 13 and ECSG 04 meeting

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

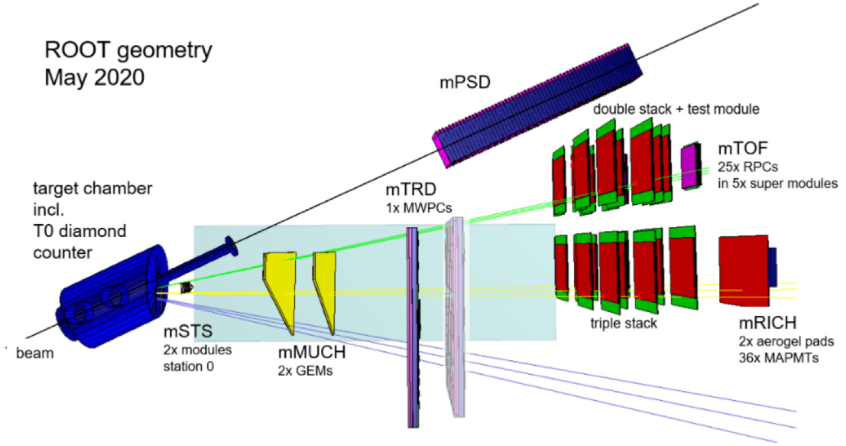
CBM experiment

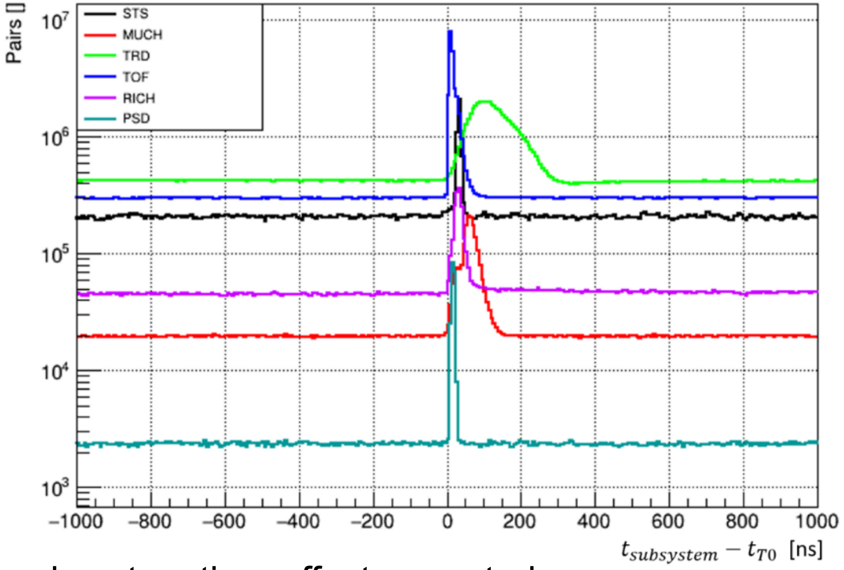


C.B.M. pillar

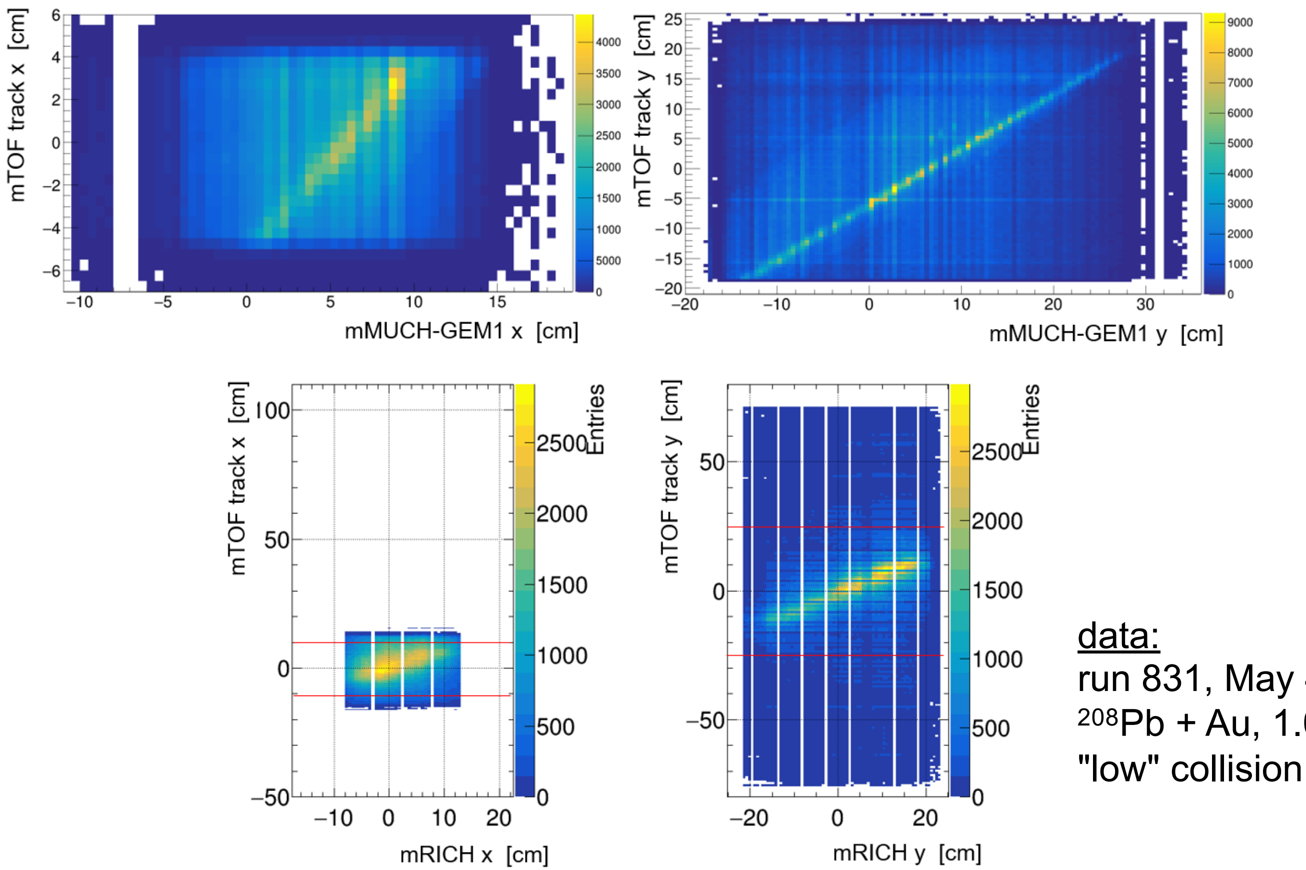


mCBM commissioning with beam, first results from May 2020





subsystem time offset corrected,
no time calibration

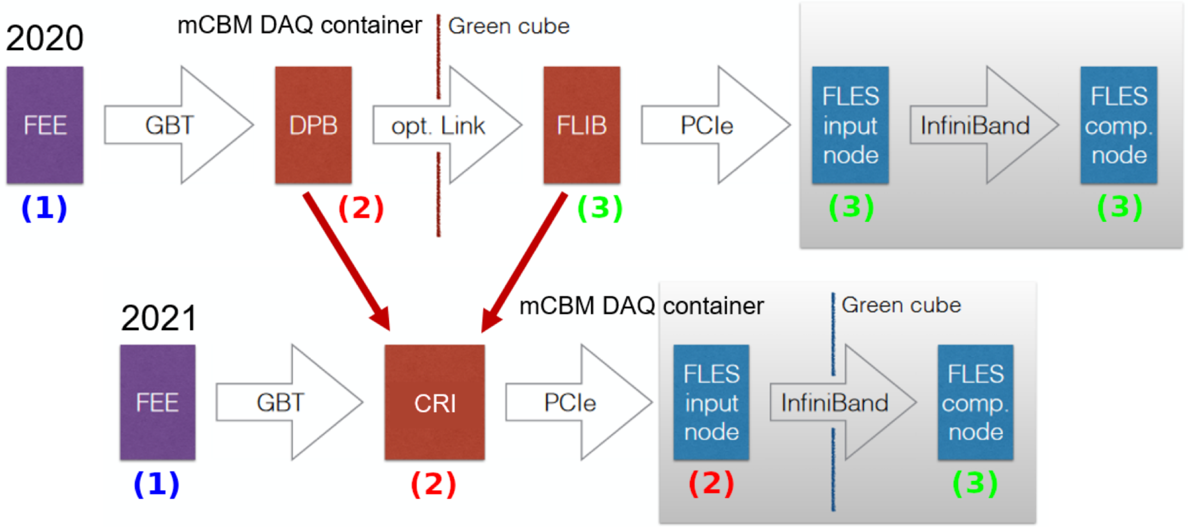


preliminary - May 2020 data

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

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

C.B.M. status – Score Card

	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 construction progress
- Slope should change in 2021 with the start of series production
- Need to monitor progress closely

CBM CAVE, INFRASTRUCTURE, INSTALLATION PLANS

CBM Building (L0608A)

- Shell construction is progressing
  - unavoidable delay due to COVID et al.
  - need to be addressed in cave infrastructure plans
  - re-baselining in Q1.2021
- Award of Technical Building Installation (TBI) packages until Q1/2021
  - later wrt. original plans
  - CBM installation in parallel to TBI – coordinate with FSB
- Beam dump shelling completed, installation of iron core pending
- Beam transfer tunnel being constructed with the same pace
- Ground floor prepared for the installation of the rail system

Construction MoU

CBM Construction MoU:

- No further comments from the RRB
- Signing has started (GSI/FAIR) in August 2020
- ~60 signatories at the CBM institutes and at the Funding Agencies are being identified;
- Sending of documents started
- Many thanks to the ECE/ECSG for its constructive role

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,

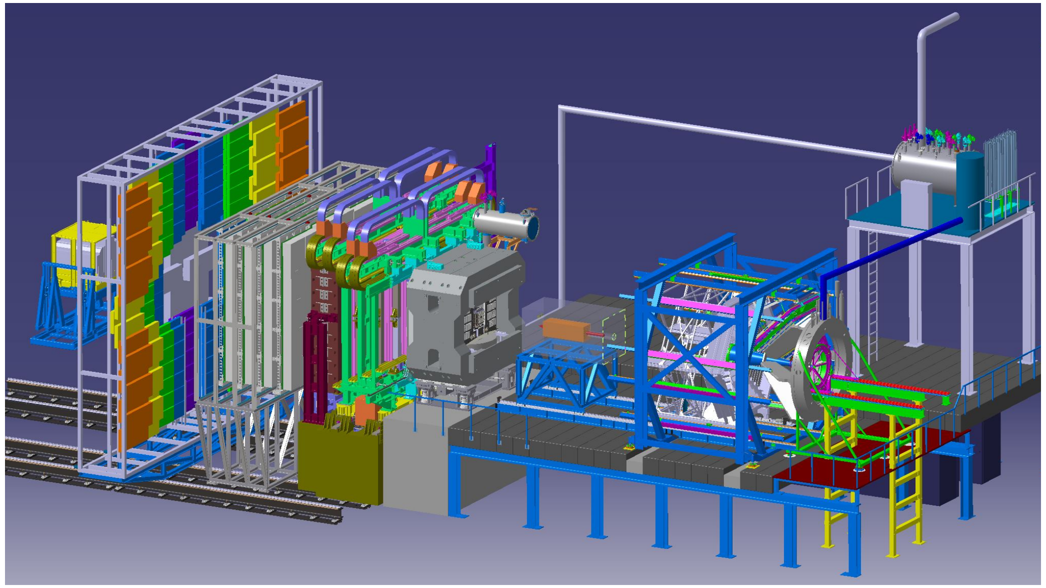
and

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

together with the corresponding funding agencies

Installation planning – key objective 2021

- **CBM cave**: construction is progressing and soon will be ready
- In parallel to the finalization of the detector design and series production **we must** plan installation activities
- Sub-system installation plans - to be discussed in the upcoming months with the TC team

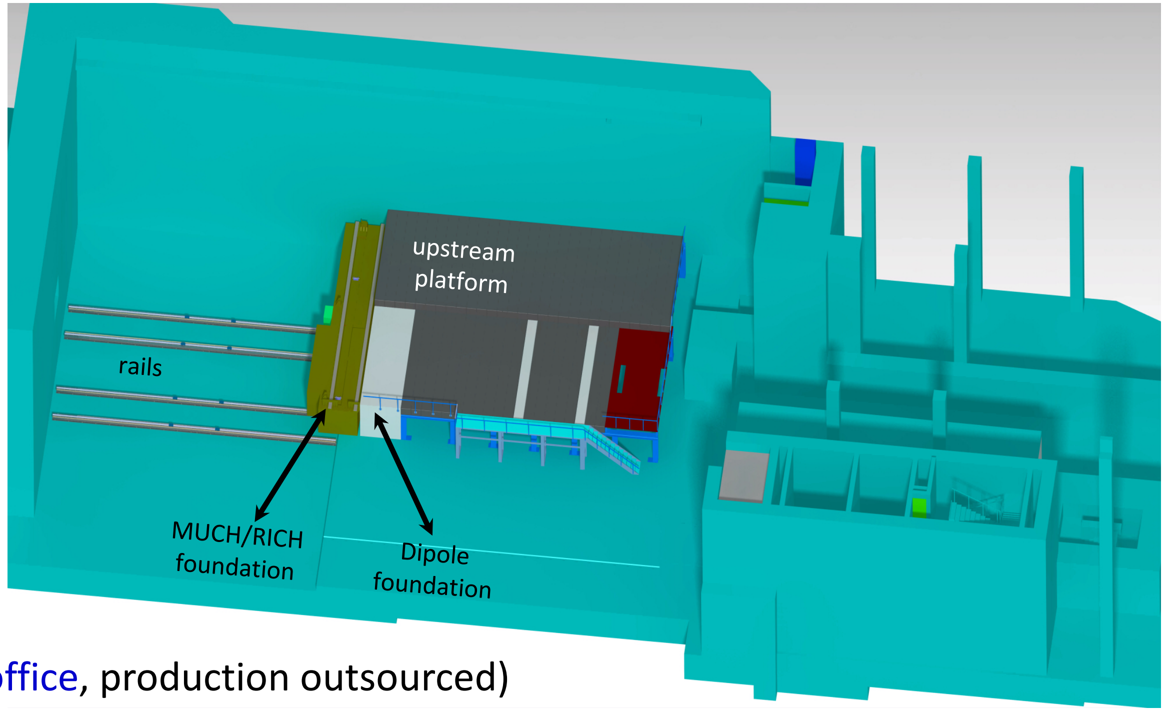


- Base for the CBM installation planning, coordinated with FAIR Site Management
- Installation procedures
- Documentation

Cave infrastructure

Preparatory work required

- Building shell completed
- Crane and elevator ready
- Electricity (power) available
- E10 survey, blue line ready



Installation work

- Magnet foundation (FSB*)
- Rail system (tendering shall start soon)
- Upstream platform (design ongoing, Czech in-kind)
- MUCH/RICH foundation (design by GSI Mechanical Design office, production outsourced)
- Basic services and detector supports/mechanics (to be planned)

To do:

- Update the timelines wrt. the new baseline (Q1.2021)
- Work out planning details of the installation work
- Structural analysis for steel constructions – consulting engineering company to be contracted (see help from FSB, SMG*)
- Close cooperation with FSB, SMG

* FSB – FAIR Site & Building, SMG – Site Management

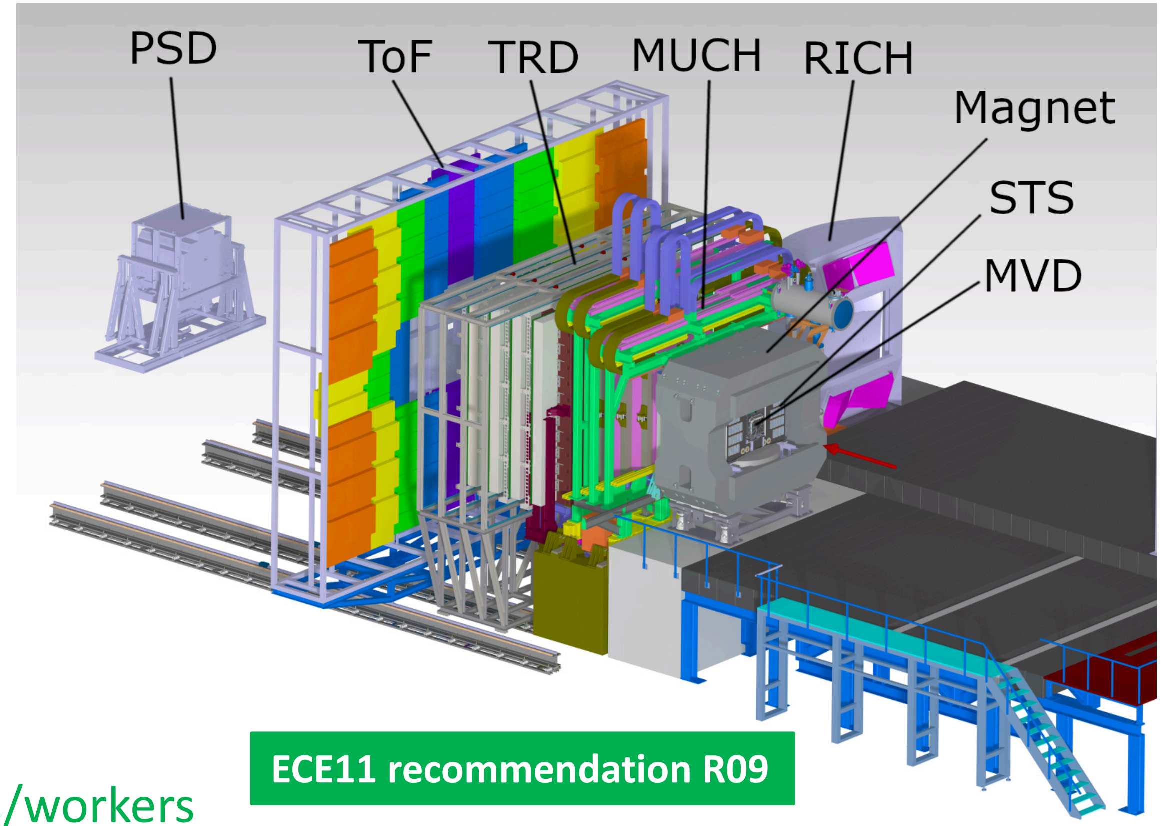
CBM experiment

Preparatory work

- Building ready, CBM infrastructure ready, TBI ongoing

Installation work

- Magnet, Detectors (incl. support structures) + **services**



To do:

- **Detailed plans to be worked out in the upcoming months**
  - CBM installation workshops, dedicated group meetings
  - Lean construction, emergency shutdown, tooling
  - Discussions with other large experiments
    (1st meeting with the ALICE TC team took place in Sep. 2020)

ECE11 recommendation R09

- Realistic estimate of extra and third party resources/workers
  Service installation: professional planner help needed, coordinate planning with FSB/SMG and execution with TBI

Timeline:

- **CBM sub-system milestones M10 (Ready for installation) remain unchanged**
- **Any potential shift in the SIS100 M11 (Ready for beam) will be used as an additional contingency for global commissioning**

News from CBM Technical Coordination

- Team: TC, Cave Coordinator, DAQ Coordinator, Project Engineer, mechanical engineer, 2x technician

✓ Team reinforcement with additional mechanical engineer in fall 2020

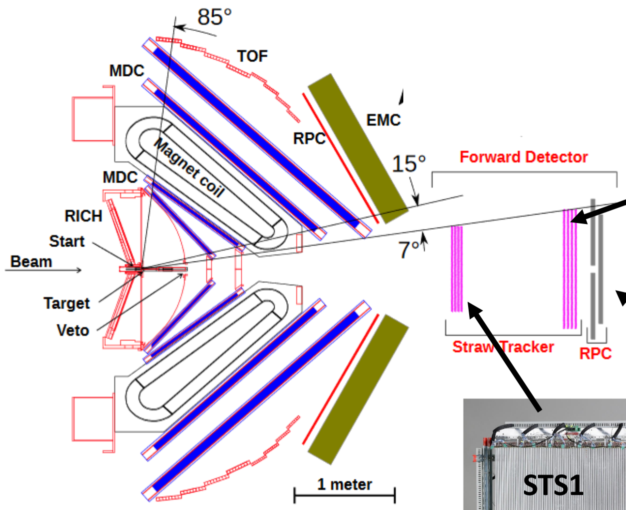
❑ Safety officer on the wish list

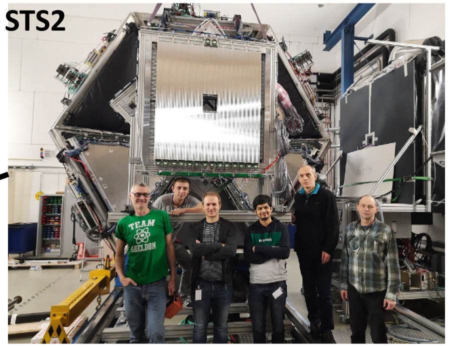
- Close cooperation with all coordinators
  - **CBM geometry management (for GEANT and CAD compatibility)**
  - **Beampipe studies and construction coordination**
  - Change request procedures
- Beam Monitor and Start Detectors (PL: T. Galatyuk)
  - Endorsed as an independent project, will be included in reporting
- Organizational aspects
  - Frequent progress reports, regular milestone tracker
  - EDMS system for storing all technical documentation, review materials, etc.
  - **Reviews in the upcoming months (CDR, EDR, PRR): sub-system inter-communication, finalize decisions, work out open questioons together**
  - Topical workshops: gas systems (last CBM week); next in line: installation, cooling, LV/HV, detector safety, etc.

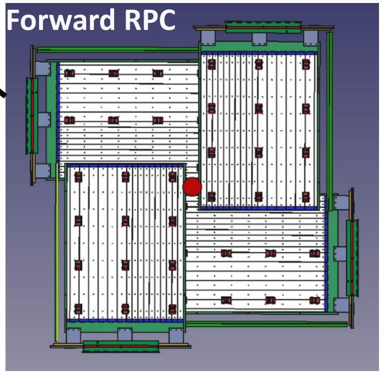
HADES STATUS

HADES Upgrades towards S518 experiment

❑ Forward Detector to Track Charged Hadrons at $\theta < 7°$







- STS1 – installation in November 2020
- STS2 – installed, ready for beam
- Forward RPC – installation in Q1 2021

Participating institutes: FZ Jülich, JU Kraków, IPNO Orsay, LIP Portugal

❑ T0 System Based on LGAD Technology

Eur. Phys. J. A (2020) 56:183
https://doi.org/10.1140/epja/s10050-020-00186-w
THE EUROPEAN PHYSICAL JOURNAL A

Special Article - New Tools and Techniques

Low Gain Avalanche Detectors for the HADES reaction time (T_0) detector upgrade

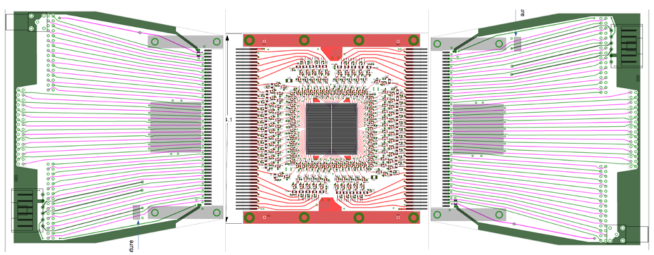
J. Pietraszko[1,a], T. Galatyuk[1,2], V. Kedych[2], M. Kis[1], W. Koenig[1], M. Koziel[3], W. Krüger[2], R. Lalik[4], S. Linev[1], J. Michel[3], S. Moneta[5], A. Rost[2], A. Schemm[6], C. J. Schmidt[1], K. Sumara[4], M. Träger[1], M. Traxler[1], Ch. Wendisch[1]

Collaboration with Fondazione Bruno Kessler (FBK, Trento, Italy), INFN Torino, Italy

T0 Detector Key Requirements:

- Time precision below 50 ps
- Rate capability of 100 MHz / cm²
- Vacuum operation
- Sensor size 2cm x 2cm

FEE for LGAD (96 channels)



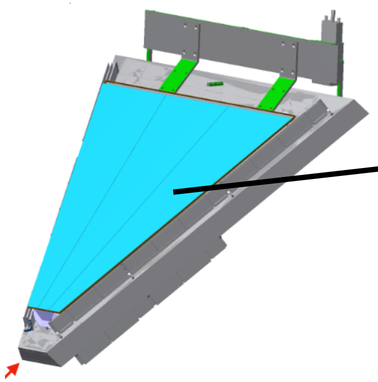
- **Project Status:**
- Readout system readiness in Q4 2020
- Sensor production at FBK started, delivery in 06/07 2021

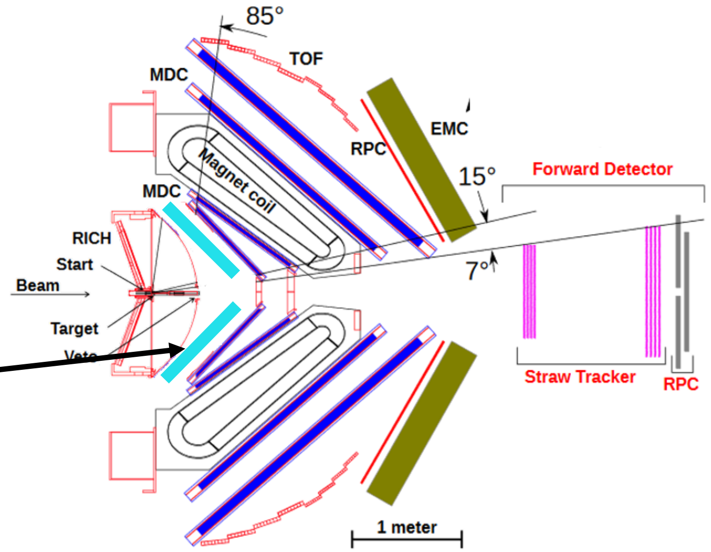
- **Participating institutes: GSI, TU Darmstadt, GUF**

HADES Upgrades towards S518 experiment

- InnerTOF Trigger System for Elementary Reactions
- Trigger selectivity improvement by a factor of 2 expected

Single sector of InnerTOF system
- Three plastic scintillators
- Thickness of 7mm



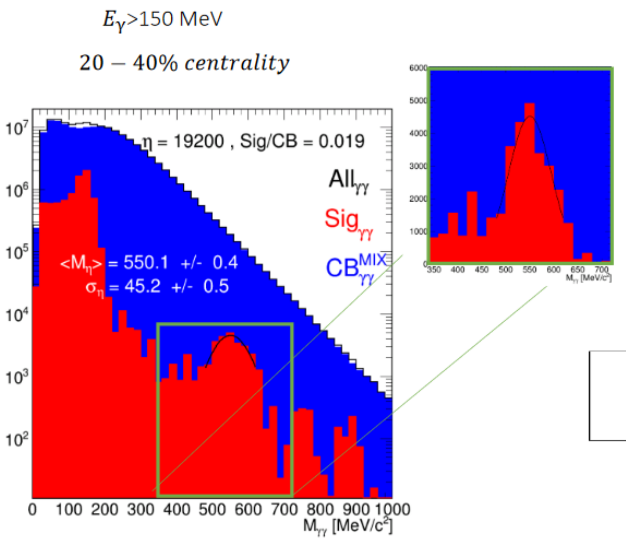


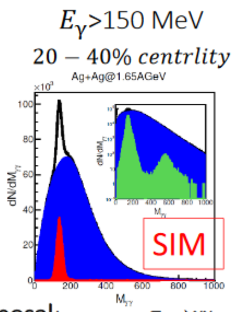
- Two sectors ready in Feb 2020
- Full system ready for beam in Q3 2021

- Increase of the ECAL Detector Coverage
- 5th ECAL sector installed

Preliminary

η in AgAg at 1.58AGeV





Proposal:

	$\pi_0\to\gamma\gamma$	$\eta\to\gamma\gamma$
S/B	0.3	0.007
$S/\sqrt{S+B}$	378	5.5
σ [MeV (%)]	16 (11)	43 (8.3)

- 5 sector version ready for operation in Q4 2020
- The last sector, 6th expected in Q4 2021/Q1 2022

CBM SUB-SYSTEMS STATUS

DIPOLE MAGNET

SC magnet project progress

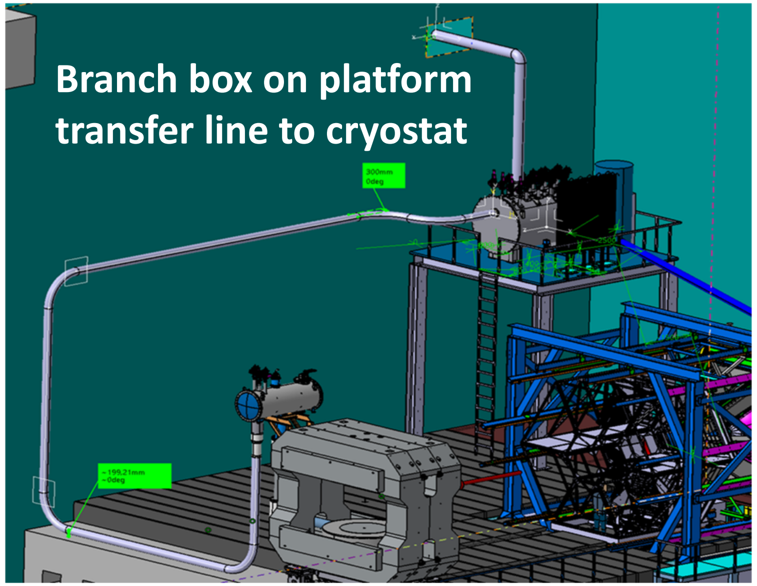
Main achievements

Magnet

- **Progress in design of coils, branch box, transfer line, cryostat.**
- Coil support strut between cold stainless steel plate and warm vacuum vessel: structural analysis of single ring made of Glass Fiber Reinforced Plastic (GFRP) shows good performance.

Infrastructure

- **Hall at BINP prepared for Factory Acceptance Tests**
- Platform for branch box designed
- Transfer line from branch box to cryostat defined



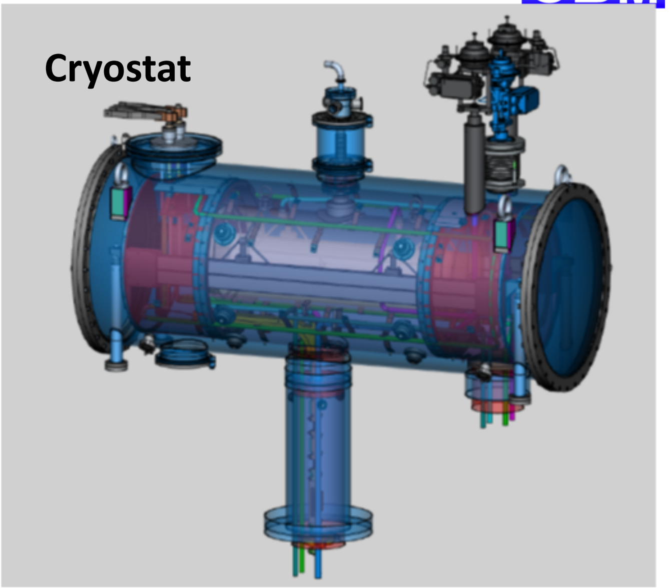
SC magnet project progress

Essential steps in next months

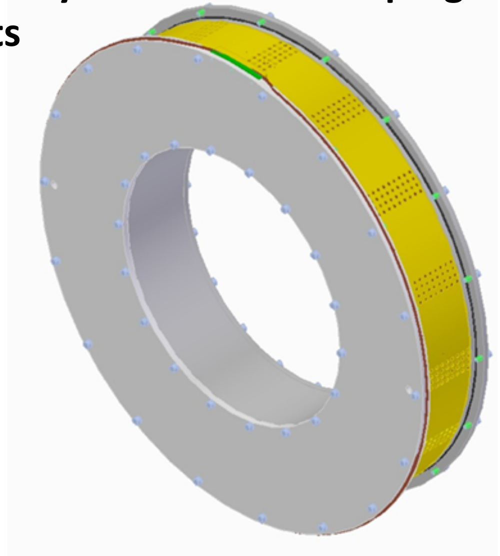
- Final optimization of branch box and cryostat ongoing in collaboration of BINP with GSI experts.
- **Impregnation tests with curved dummy coil and improved epoxy resin planned at BINP for November 2020.**
- **Subcontractor will start yoke production in 2021.**

Open issues/risks

- **Final Design Review delayed**, partly due to lockdown. New date mid of 2021.



Dummy coil model for impregnation tests



BEAM MONITOR AND START DETECTORS

Project

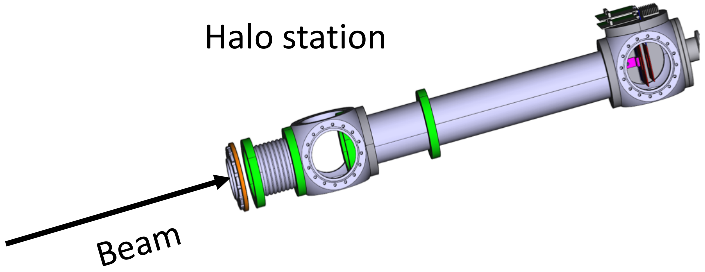
Main achievements

Detector Concept for Day-1

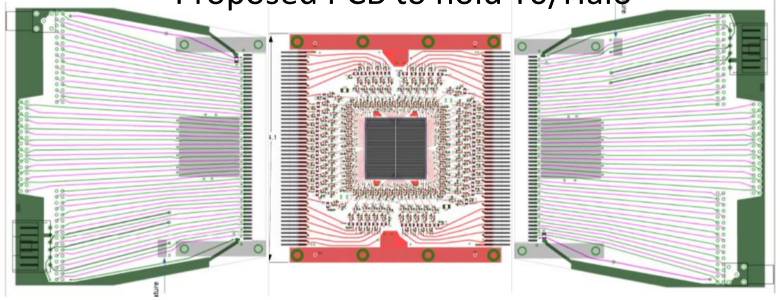
- Two separate stations (T0 and Halo) proposed
- Mounting position ~1 m upstream of the CBM target
- Mechanics based on standard vacuum components
- Rate capability of T0 up to 10 MHz

4 pcCVD high purity diamond sensors at GSI;

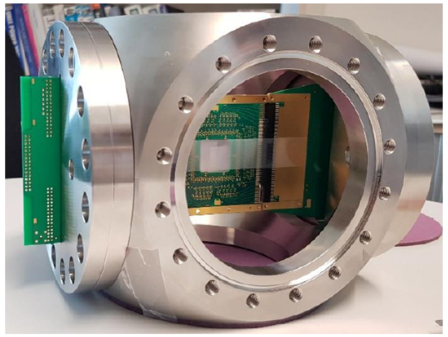
- polished, ready for metallization



Proposed PCB to hold T0/Halo



Proposed mounting scheme



Essential steps in next months

- Sensor metallization concept (granularity)
- PCB design for double sided pcCVD diamond sensors
- Prepare a Readout Concept
- **Write a Technical Note**
- **A concept of the beam abort system**

Open issues/risks

- Availability of pcCVD diamond material (currently not available at “Element 6”)

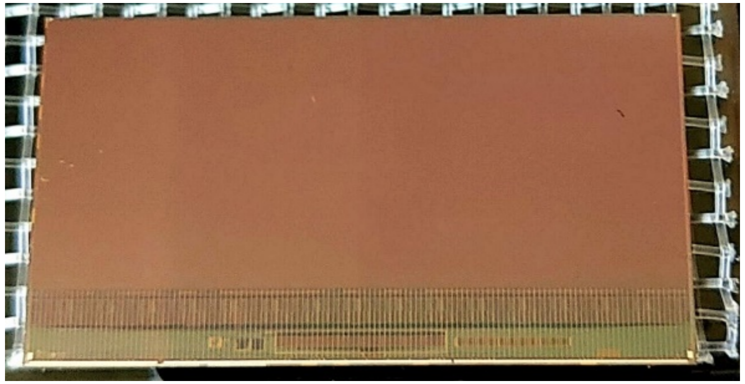
MVD – MICRO VERTEX DETECTOR

MVD project progress (SENSOR)

Main achievements

- MIMOSIS-0 test program concluded
- **MIMOSIS-1: first full size sensor**
  - Sensor in house (our partner IPHC Strasbourg)
  - First smoke tests successful, systematic tests (including irradiation) in preparation

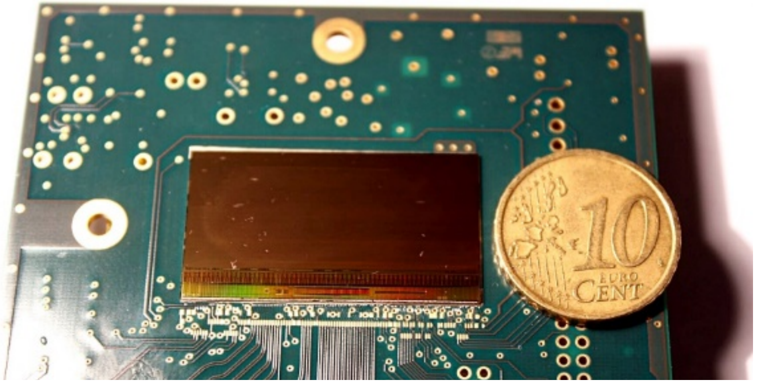
MIMOSIS-1



Essential steps in next months

- **MIMOSIS-1 systematic tests, irradiation of sensors**
- **MIMOSIS-2: apply results from MIMOSIS-1 on MIMOSIS-2 design, submission due Q2/2021**

MIMOSIS-1 evaluation board



Open issues/risks

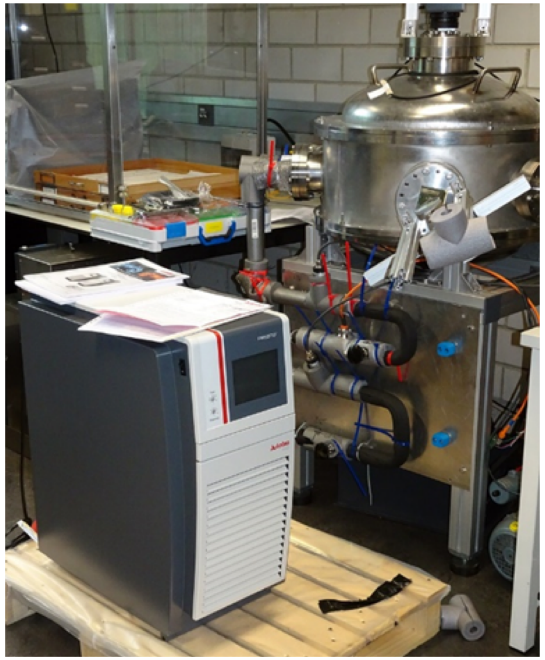
- Work load on existing manpower
- MIMOSIS-1 test imply additional actions → delay for MIMOSIS-2
- **Covid-19:**
  - Travel between GUF and IPHC, and access to irradiation facilities might be hampered
  - Access to laboratories (at IPHC) might be restricted
  - Delivery times for components (boards, cables etc.)

MVD project progress (INTEGRATION)

Main achievements

- **Mono-phase cooling w/ NOVEC-649 represents new baseline,** purchase and commissioning of a dedicated chiller (Julabo Presto A40)
- Re-establish contact to Fraunhofer IGB on TPG-coating with Parylen & EPOXY
- Publishing internal CBM notes on Digitizer & detector geometry (Geant & CAD)
- Conclude all technical chapters of the TDR

UFO test stand with the new chiller



Essential steps in next months

- Continue studies on integration yield w/ PRESTO-2, prepare PRESTO-3 prototype (MIMOSIS-1) and identify synergies with CREMLIN+
- Systematic studies with new coolant NOVEC-649
- **Finish TDR, Internal Review now scheduled Q4/2020**

In preparation

Open issues/risks

- **Limited manpower (overlap with MIMOSIS-1 testing)**
- Engineering support (detector integration, CAD)
- Covid-19: Co-operation w/ Fraunhofer IGB (travel)

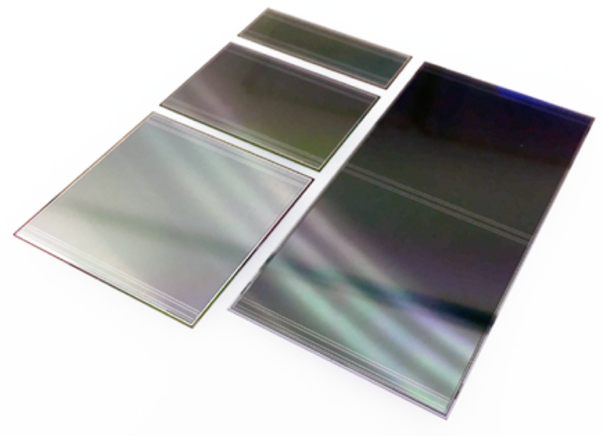
STS – SILICON TRACKING SYSTEM

Sensors & Modules

Main achievements

Sensor Delivery and QA:

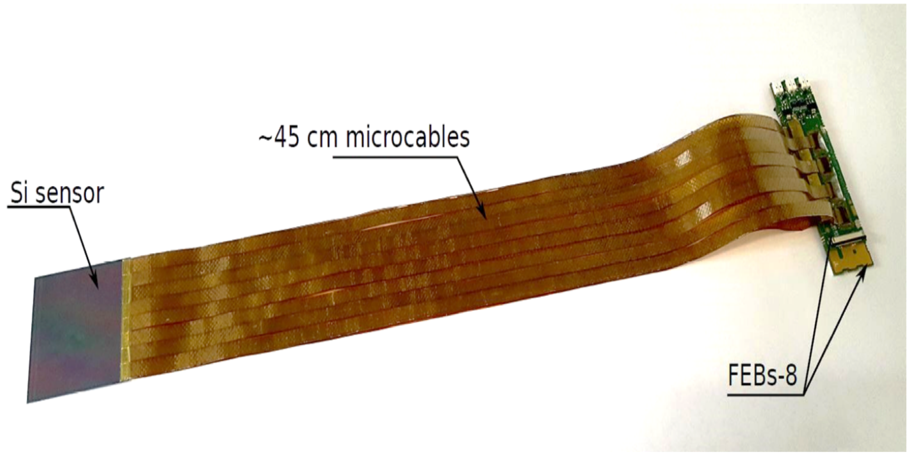
- **11/12 batches (97%) received from Hamamatsu**
- Optical QA - 88% done
  - Al open & shorts
  - implant open & shorts
- Electrical QA - 76% done
  - IV/CV curves
- **All sensors w/i specs**
- Categorized according to rad. hardness (breakdown voltage)



Outlook

Module Preparations and Preproduction:

- 890 modules (+spares) will be produced at three assembly sites (GSI, KIT, JINR):
- **Module assembly procedure and basic throughput established**
- Functional modules produced at all sites
- Modules test setups ready
- Production time 2.5 years (starting mid 2021)
- Ladder assembly procedures under development



Steps towards final ST-System

Outlook

- **Front-End Boards (FEBs):**
  - Final design done
  - LDO and ASICs available
  - Few open issues for high-bandwidth variant (FEB8-5)
- **Powering:**
  - Investigation of HV/LV scheme and manufacturer (Wiener, CAEN) ongoing
  - EDR on power scheme shifted 04/202
- **Cooling:**
  - FEE cooling (50 kW) based on mono-phase NOVEC developed
  - baby cooling plant (7.5 kW, NOVEC) plant is being installed
  - thermal demonstrator to verify sensor forced convection cooling concept (2021)
- **Infrastructure:**
  - STS mainframe (C-frames, mounting scheme, cabling) addressed in mech. demonstrator (2021)
  - STS insulation box (concept existing, otherwise open)
  - STS CF beam pipe (concept existing, otherwise open)

Open issues/risks

- Delays in module/ladders assembly due to missing HR (e.g. technicians)
- Micro cables (only single supplier – LTU, Ukraine)
- Risk of cost increase of CRIs and power supplies”

MUCH – MUON CHAMBERS

MUCH project progress

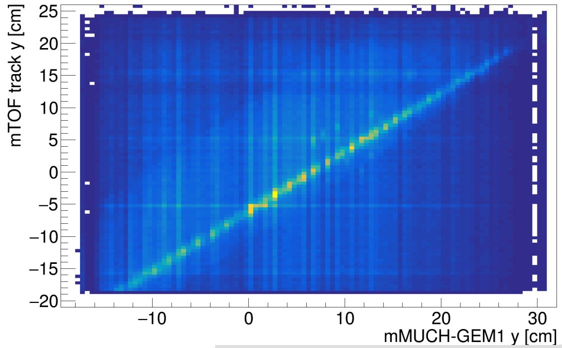
Main achievements

- **1st version of mainframe mechanical design completed, services included,** **CDR ready**
- Integration done of the chamber movement system and services in the super-structure
- Two clean-rooms built at Bose and at VECC for detector assembly
- Extensive R&D in progress on RPC readout using STS-XYTERV2.1, pad and strip geometry
- **LV distribution system CDR positively reviewed**
- **LDOs produced at SCL-Chandigarh, MUCH-FEB design complete, under fabrication**
- Detailed design layout completed for the 2nd station GEM chamber, fabrication in progress
- Simulations performed for design changes

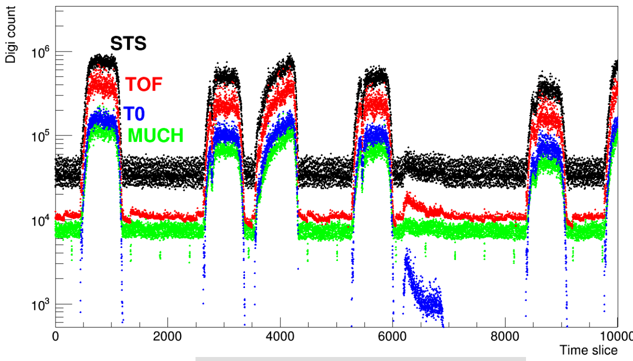
mCBM test beam (March-May 2020)

- **Two triple GEM detectors, including LVDB and controls**
- **Spatial correlation observed between GEMs and GEM-TOF**

VECC clean room



GEMY-TOFY correlation

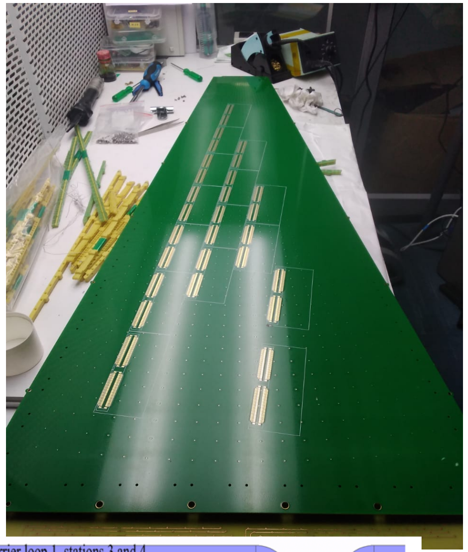


Spill--structure

Phase 0
Research Program

MUCH project progress

PCB for 2nd station chamber (1.2 m)

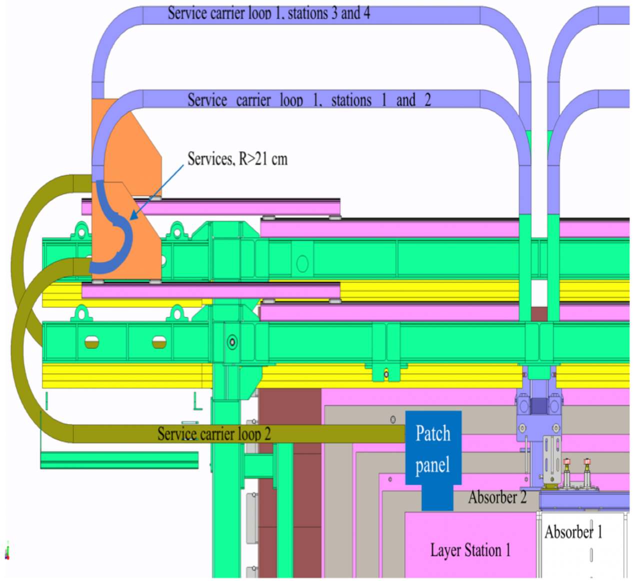


Essential steps in next months

- **Investigate and solve the problem associated with data link**
- **Build a full sized GEM module for 2nd station;** components in place, assembly ongoing
- **Decide on final configuration of RPCs with STS-XYTER V2.1 readout**: Both being read by V2.1
- **Include RPC in mini-CBM setup**; Plan for the next beam campaign
- CDR review of the MUCH mechanics; Planned in November 2020
- CDR review of the MUCH gas system; Under discussions
- Test beam at COSY for GEM: proposal submitted
- In-house Development of a HV system and controls: Prototype built, being tested

Open issues/risks

- **e-Link loss problem at high HV and higher beam intensity**
- **Noise improvement in RPC**

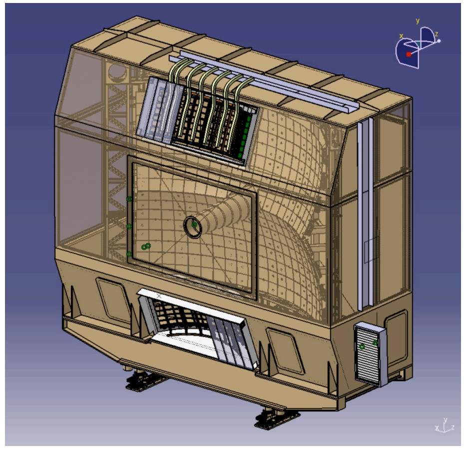


Service distribution in MUCH mechanics

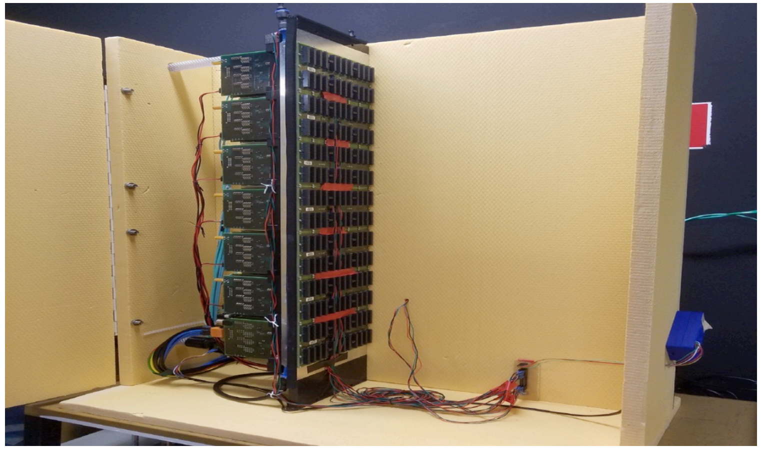
RICH – RING IMAGING CHERENKOV

RICH project progress

Main achievements



- **Gas system EDR accepted**
- Significant steps forward towards a CBM RICH mechanical design
- **RICH mechanics CDR and RICH camera CDR under review**
- **Preparation and successful operation of cooling prototype of RICH electronics**
- Shielding box design converging – 4 different calculations confirm feasibility of current design
- Successful mRICH operation in mCBM, promising results from data analysis
- Porting of DAQ firmware to CRI ongoing
- Systematic mirror gluing tests, reflectivity measurements,
  study of influence of humidity



Phase 0
Research Program

RICH project progress

Essential steps in next months

- **Continue measurements on cooling prototype**, including additional direct water cooling of aluminum front structure
- Detailed design for CBM RICH cooling system
- **Mirror EDR, PRR, ordering**
- Setup for mirror series testing ready
- Production of all RICH readout backplane PCBs (first electronic component to be build)
- First version of new power module with improved concept of DCDC convertors
- Preparation for series testing of electronic modules
- First version of CRI firmware ready for mCBM testbeam campaign
- Simulations: Optimize background from STS, beampipe concept

Open issues/risks

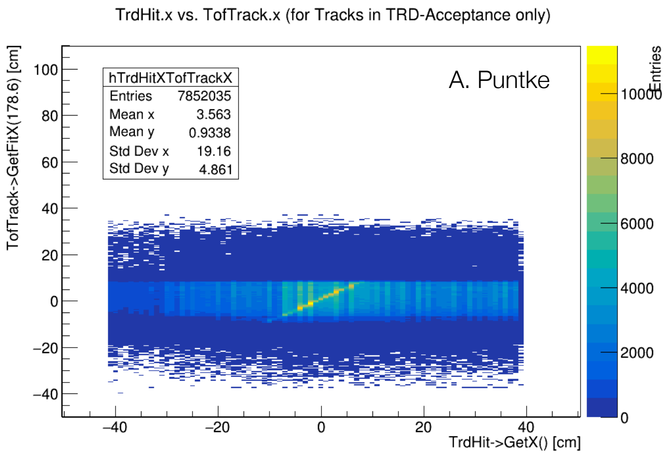
- BMBF funds for Core Invest still frozen/ just released; More than tight to spend money within funding period (until mid 2021)
- **Funds required for 2nd half of readout electronics is beyond “secured funds” of BMBF**
- Very little B-field safety margin with current shielding box design
- Presently foreseen cooling concept not sufficient for fully equipped camera box

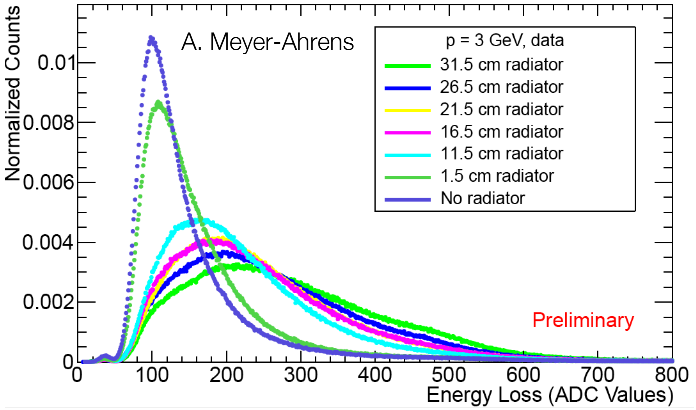
TRD – TRANSITION RADIATION DET.

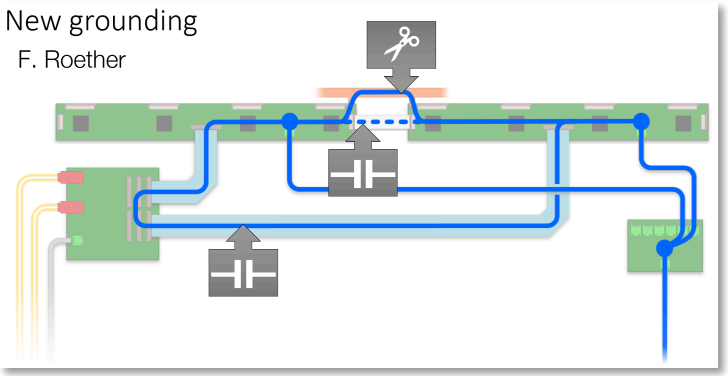
TRD project progress

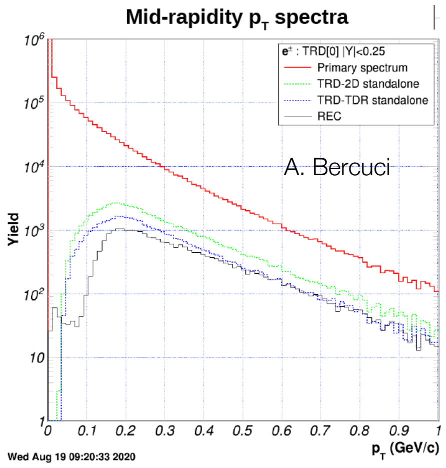
Main Achievements

- Important events:
  - TRD Retreat: Münster, Aug. 19 – 21 2020
  - **PRR Outer modules and CDR mainframe, Oct. 1st 2020**
- Data analysis + software
  - Internal note on TRD digitization (E. Bechtel) (https://indico.gsi.de/event/10853/contributions/46200/)
  - mCBM data: spatial correlations between TRD and TOF
  - DESY: systematic study of different radiator layers
- Infrastructure
  - Design of support structure being evaluated
  - Gas system: test loop being setup in Münster
- FEE and readout
  - Finalization of FEB design and grounding scheme
- Inner TRD region
  - **Performance studies on tracking (seeding) with TRD-2D**
  - Components for FASP / GETS based readout prepared, test setup in Bucharest









TRD project progress

Essential steps in next months

- Important milestones:
  - **CDR: Inner modules (Nov. 2020);** EDR: Radiator, LV/HV (Nov. 2020), Gas system (Feb. 2021)
  - **Start of outer module production (Q1.2021)**
- mCBM data taking
  - Include: second large module and small inner module prototype with FASP/GETS based readout
- FEE and readout
  - **Test submission SPADIC 2.3 (Dec. 2020); decision on improved SPADIC 2.4 after evaluation (Q1.2021)**
  - Implement and test SPADIC based readout with CRI-chain (⟶ mCBM)
- Software and performance studies
  - Geometry update: evaluate impact of support structure and modified z-positions / layer distance

Open Issues and Risks

- SPADIC chip: noise level should be improved in ver. 2.4
- FASP/GETS: radiation tolerance of FPGA based readout needs to be verified (mCBM 2021)
- Water cooling for inner region: test setup in laboratory (Münster), needs to be re-evaluated for FASP/GETS readout
- Gas system: design activities started in Münster, but funding is not secured
- Physics case for TDR addendum (inner detector region) to be assessed
- Radiator: evaluation of fire safety issues related to PE foam foils. Encapsulation needed?

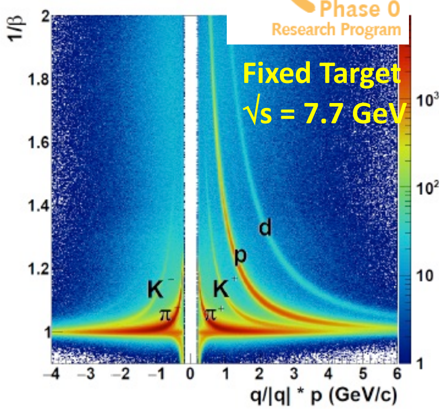
TOF – TIME OF FLIGHT

TOF project progress

Main Achievements

eTOF @ STAR

- RUN 20 (BES II) successfully completed (fixed target runs at 6 different energies + 2 collider runs)
- PID capability demonstrated, calibration, simulation and physics analysis ongoing

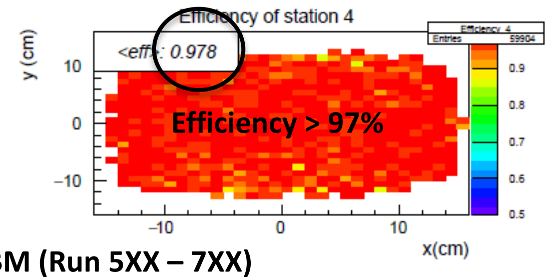


Cosmics and mCBM beam tests

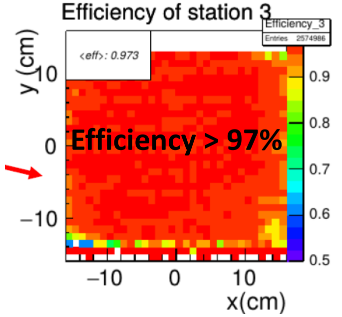
- New ASIC PADI XI successfully tested
  - **efficiency increase from 94% to 98% (wrt. to PADI X)**
  - **unprecedented time resolution of 35 ps reached (prelim.)**
- Several rate scans performed at mCBM (analysis of data ongoing)
  - unprecedented high fluxes reached (> 30 kHz/cm²)
  - data losses at high interaction rates caused by firmware observed
  - **increase in dark rate and aging effects on MRPCs observed**
- HV current data with detector rates correlated and simulations

on total current consumptions performed

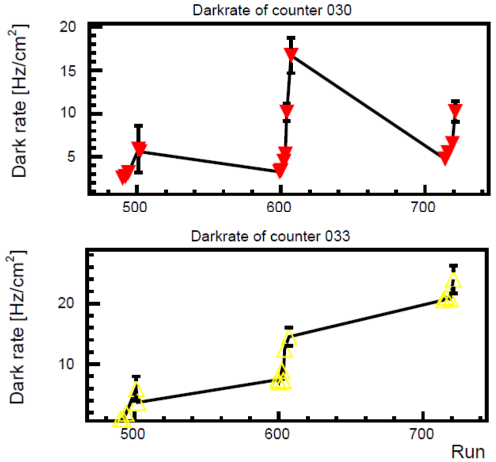
Cosmics



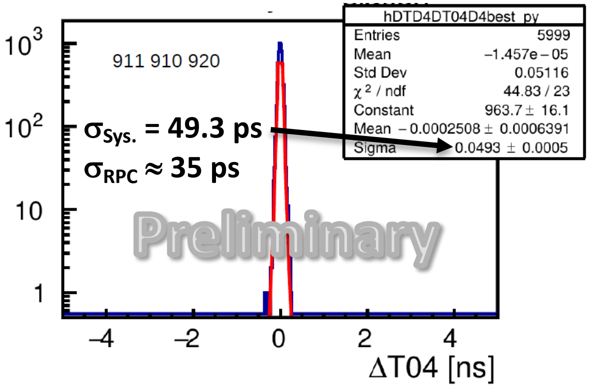
mCBM (Run 831)



mCBM (Run 5XX – 7XX)



Cosmics



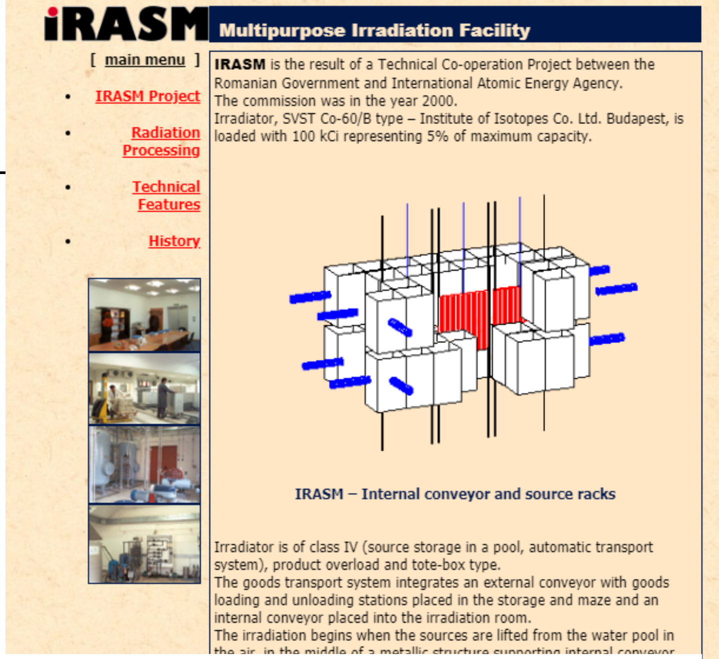
Efficiency Bucharest counter

Efficiency	Gap 140 µm	Gap 200 µm
PADI X	81 %	93 %
PAD XI	92 %	98 %

TOF project progress

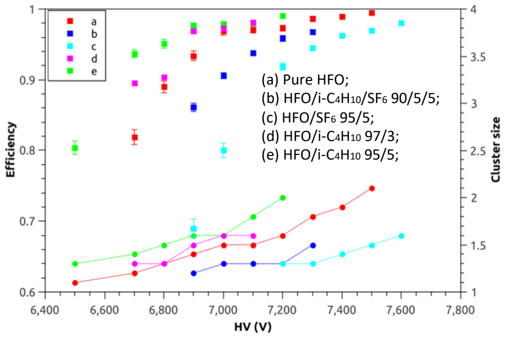
Essential steps in next weeks/months

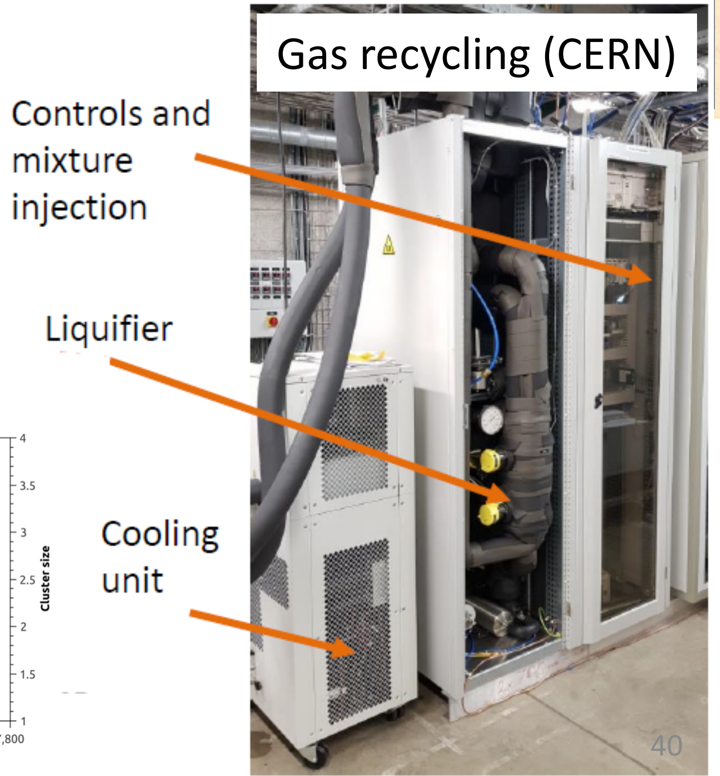
- **LV CDR on 28th of October**
- Gas system, HV, Main frame CDRs – end/beginning of 2020/2021
- Aging test in Bucharest (ISRAM facility) -> essential for glass and counter PRR
  - delayed due to CORONA situation in Europe
- ASIC PRR – end of 2020
- Migration to CRI based readout till Mar 2021



Open issues/risks

- **Low resistive glass faces aging or does not fulfill the rate requirements**
  - ultra high rate detector and readout test with fluxes up to 35 kHz/cm^2 (next mCBM run)
- **Long-term stability of the counters – need further investigation**
- Missing GBTx chips for full TOF wall (several solutions in hand)
- Gas system development including a recycling system for RPC gas
  - study on alternative gases ongoing
- BFTC under development (IKC still to be signed)



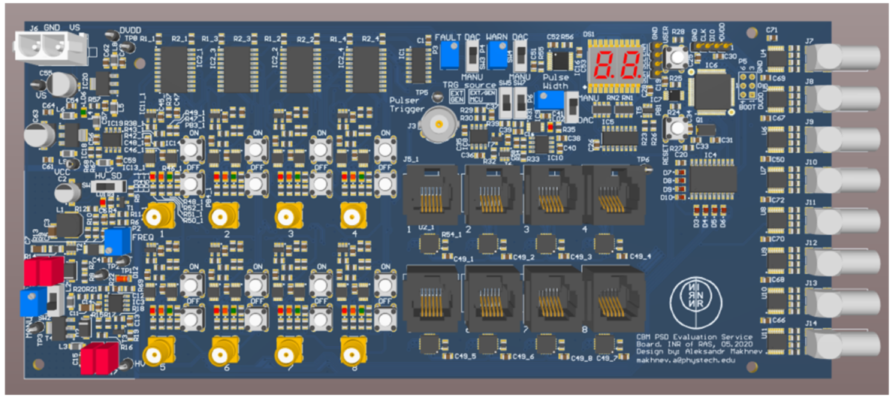


PSD – PROJECTILE SPECTATOR DET.

PSD project progress

Main achievements

- **PSD at FAIR-Phase-0**
  - 20 CBM PSD modules are used at the BM@N FHCAL and 13 CBM PSD modules - at the NA61/SHINE MPSD.
  - The FHCAL and MPSD are at the stage of commissioning and new approach of cosmic muon calibration is being tested.
- **PSD platform**
  - The PSD support platform developed at Czech Technical University, Prague, and constructed at Czech has been delivered and tested at FAIR.
- **PSD electronics development**
  - One PSD FEE board and evaluation version of the service board was produced, assembled and is being verified .
- **mPSD test at mCBM**
  - PSD module readout is successfully integrated in the mCBM readout.
- **Machine learning approach has been developed for centrality determination with the PSD with beam hole**



PSD project progress

Essential steps in next months

- **FAIR- Phase-0: BM@N FHCal, NA61 MPSD - commissioning, cosmic muon calibration, first physics runs (2021)**
- **Full PSD signal readout chain tests at mCBM (2021 run)**

Open issues/risks

- **Final PSD position and geometry for Day-1 CBM**
- PSD beam hole – final geometry, radiation conditions, physics performance - simulations!
- **Second (bottom) part of the PSD support**

ONLINE SYSTEMS

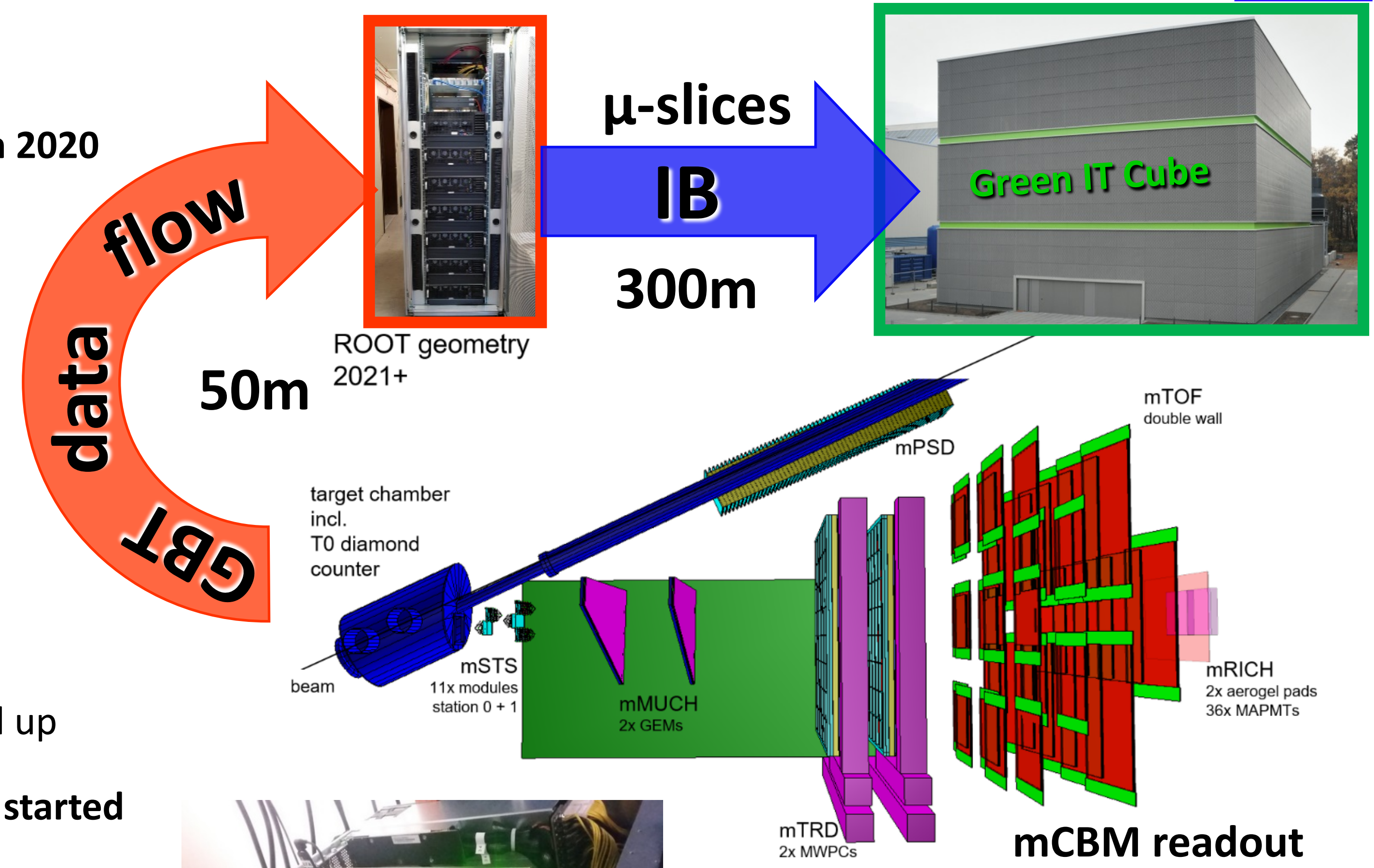
Online systems - achievements

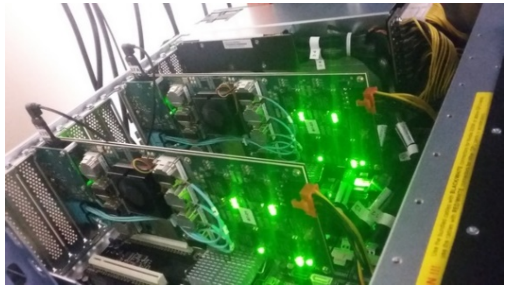
Essential steps in past 6 months

- **Successful operation of DPB+FLIB readout in mCBM run 2020 from March-May**

Upgrade to CRI readout chain:

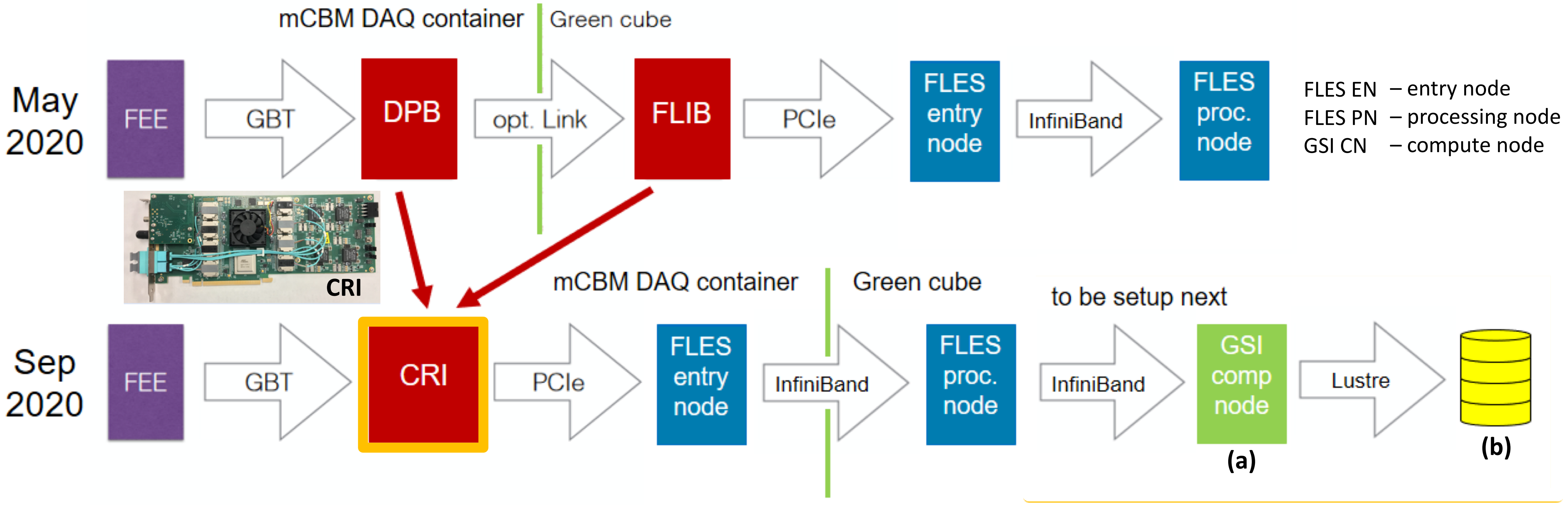
- **DAQ prototype rack setup in the mCBM DAQ container**
- All Entry Nodes moved from the Green Cube to mCBM
- Long-range connection to GC switched to InfiniBand
- 1st delivery of six CRI boards from BNL received
- CRI-based Timing and Fast Control (TFC) prototype wired up
- **Implementation of firmware for CRI based readout has started**
- New controls software for CRI operation under development
- Upgrade to CRI readout chain to be documented in the **Online Systems TDR (Part 1) – Data Acquisition**





2 CRI cards installed in one entry node

Online systems - main goals



FLES EN – entry node
FLES PN – processing node
GSI CN – compute node

Essential steps in the next 6 months

- Adapt DPB and FLIB firmware to the CRI board for each mCBM subsystem
- Extend the mCBM readout chain to (a) include compute nodes from the GSI-IT Virgo cluster and (b) access Lustre
- **Complete the DAQ upgrade to CRI, to be ready for mCBM data taking for the February 2021 run**

Summary

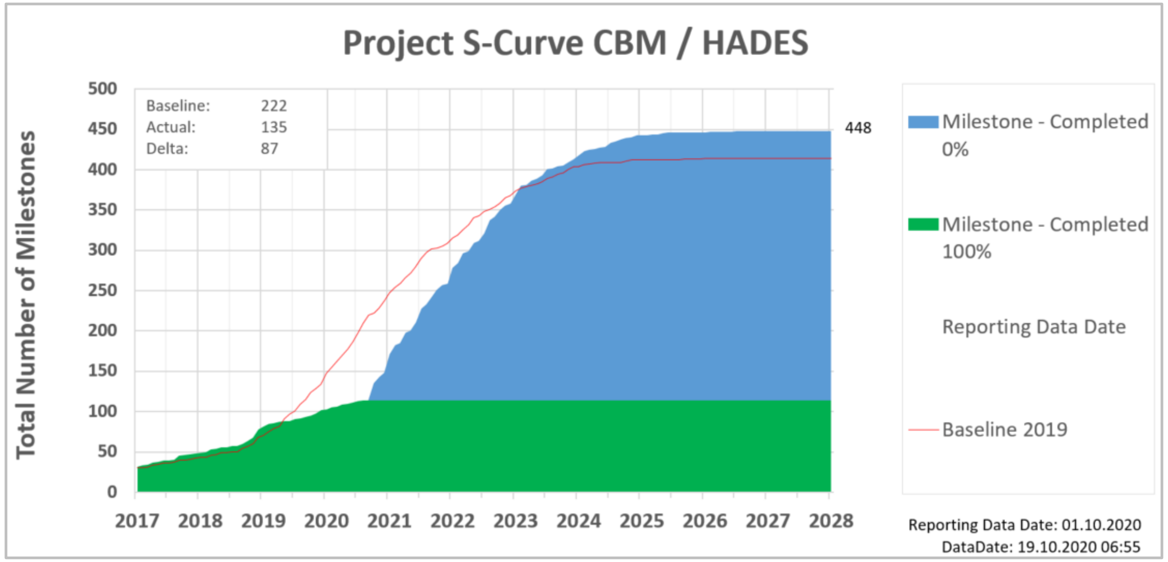
- CBM enters crucial phase of production of its main detector components.
- Closely watch the critical component production, stating from reviews to SATs
- FAIR phase-0 program very successful and will continue – invaluable experience for the future operation of CBM

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

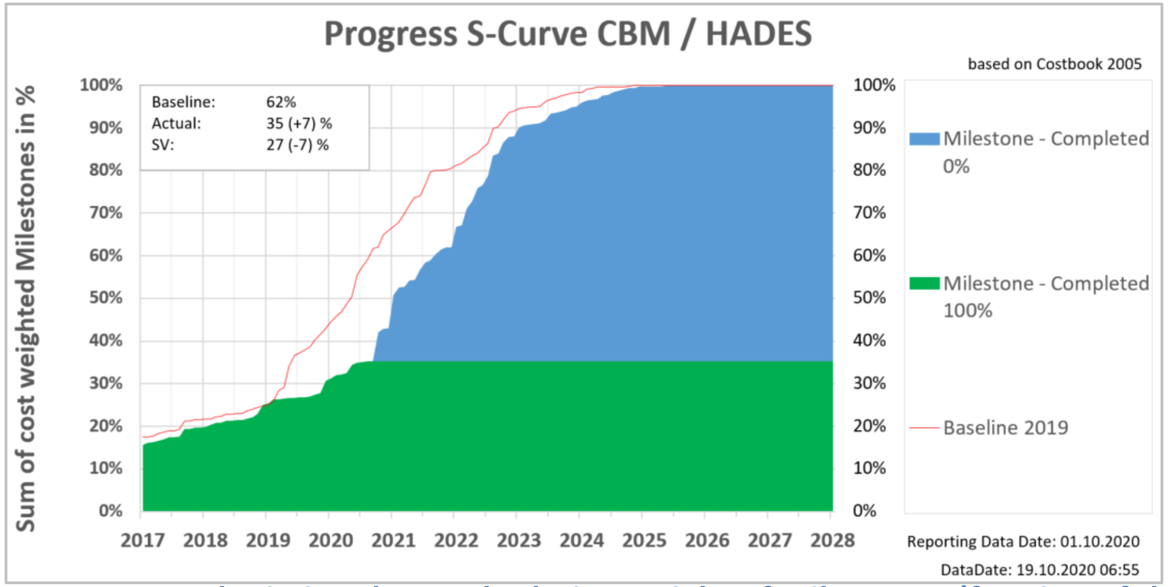
- Updated FAIR project baseline will be implemented in the CBM installation plans
- CBM milestones “ready for installation” remain unchanged
- The time difference between CBM and SIS100 readiness is our project contingency

BACKUP SLIDES

S-curves



CBM s-curve summing the number of milestones fully completed (green) and expected (blue)



CBM s-curve depicting the total relative weight of milestones (fraction of the components' value).

The list of milestones has been updated since the definition of the baseline. Thus, an over/under-shooting of the baseline curve is visible in the plots. The construction progress is increasing steadily. Within the next 2 years, a substantial number of reviews (conceptual design, engineering design and production readiness) is expected to be accomplished, followed by the start of production process in all CBM subsystems.

Risk register

Risk ID	Status	SubProject	Sub-subproject	Work package	Work Package Code	PSP Code	Country	PSP Supplier	Risk title	Risk description	Probability	time_critical	Performance impact	Risk Score	Strategy	Preventive mitigation	Contingency plan	Performance impact a.m.	Residual Risk	Deadline for decision	Approval status	Risk identification date
114	Mitigation planned	CBM / HADES	CBM	STS_C07	1.1.1.2.7	1.1.1.2.			Cost increase of STS Common Readout Interface boards.	Cause: Higher than expected FPGA resource consumption. Event: Cost increase of CRI boards of 300.000€. Impact: Exceeding budget.	30%	FALSE	major	13	mitigate	Optimize FPGA design for link density; review hardware-software task split.	More CRI boards or higher capacity FPGAs because full connectivity needed.	none	0		decided @ CBM	2018-03-07
343	Mitigation ongoing	CBM / HADES	CBM	Silicon Tracking System (STS)	1.1.1.2	1.1.1.2.1	Germany	GSI	Delay in STS modules and ladders production.	Cause: Volume and complexity of validation testing for STS module and ladder production. Event: Delay in transition from pre-series to final series production of STS modules and ladders. Impact: Delay of STS assembly and installation or installation of reduced configuration (7 of 8 planes) for initial commissioning.	50%	FALSE	major	13	mitigate	Review verification planning (ongoing). Status 08/20: workflow well established, tools developed and steps verified, module testing needs to be streamlined. EDR on module and ladder assembly planned in 12/20.		moderate	6		decided @ CBM	2019-08-01
112	Mitigation ongoing	CBM / HADES	CBM	STS_C01	1.1.1.2.1	1.1.1.2.1.2.5	Germany	GSI	Timely availability of CBM STS microcables	Cause: Lower than expected yield of Aluminium microcables and limited production capacity. Event: Not all microcables available on time. Impact: STS module assembly will take longer.	20%	TRUE	major	11	mitigate	Improve production process (ongoin); reduce bottlenecks by installing additional machinery (potentially on loan basis). Status 08/20: Contract with Science and Technology Center in Ukraine (STCU) signed - allows to cooperate on developments with LTU company in Ukraine. Frame contract with LTU established to allow easy, consecutive orders.	Limited possibilities after contract is awarded.	major	8	2020-05-01	decided @ CBM	2018-03-07
110	Mitigation ongoing	CBM / HADES	CBM	Micro Vertex Detector (MVD)	1.1.1.1	1.1.1.1	0	0	MVD assembly complexity.	Cause: Large uncertainty of assembly yield. Event: Assembly sequence has a large number of steps with limited re-work capabilities. Impact: Increased cost and/or delays.	20%	FALSE	major	11	mitigate	Investigate more modular assembly sequences with more intermediate repair Options (ongoing).	Reduce number of stations.	none	0		decided @ CBM	2018-03-07
166	Mitigation ongoing	CBM / HADES	CBM	Infrastructure	1.1.1.10	1.1.1.10	0	0	CBM infrastructure availability.	Cause: The budget for CBM infrastructure is not approved yet. It is supposed to come from common fund that requires a signed or at least agreed MoU. Event: No budget available to order infrastructure. Impact: Installation of experiment cannot start.	5%	TRUE	major	8	mitigate	MoU sent to RRB and signing procedure in June or July 2020 as a preparation for the next planned mitigation. Status 07/20: It is now agreed to start the signing procedure. Can start ordering components (first part of the funding to be allocated to cave infrastructure). GSI or FAIR should give cash advance to infrastructure measures latest mid 2020; total common fund volume is 3 MEUR.	Other funding source have to be made available.	none	0	2020-04-30	decided @ CBM	2018-03-08

Risk register

115	Mitigation ongoing	CBM / HADES	CBM	RICH_C01	1.1.1.3.1.1	1.1.1.3.1.2.2	Russia	PNPI Gatchina	RICH shielding box cost increase	Cause: Higher than expected magnetic stray field of CBM magnet. Event: Cost increase of shielding box. Impact: Reduced photon detection efficiency.	10%	FALSE	major	8	mitigate	Consider safety value of factor 2 in shielding box design (ongoing). Status 08/20: current design of shielding box is sufficient, confirmed by 3 independent simulations. Magnet FDR (see Risk ID 126) necessary for the final decision.	Design	none	0		decided @ CBM	2018-03-07
120	Mitigation ongoing	CBM / HADES	CBM	Micro Vertex Detector (MVD)	1.1.1.1	1.1.1.1	0	0	MVD MIMOSIS testing delays	Cause: Late availability of final MIMOSIS sensor. Event: Delays in testing MIMOSIS generations and impact on design. Impact: Increased cost and human effort and/or delays.	10%	FALSE	major	8	mitigate	Long term commitment of IPHC engineering department (ongoing). Status 08/20: MIMOSIS detector available, tests started and will last until mid 2021. In parallel, the successor (MIMOSIS-2) will be designed.	Reduce number or sensor generations for day-1.	none	0		decided @ CBM	2018-03-07
126	Mitigation ongoing	CBM / HADES	CBM	Dipol Magnet	1.1.1.7	1.1.1.7	Russia	INP-Budker	CBM dipol magnet delivery delay.	Cause: Delayed FDR [M7] acceptance and delayed start of series production [M81]. Event: Delivery of magnet delayed. Impact: Magnet not available in time for installation window.	10%	TRUE	major	8	mitigate	Close follow-up during production. Status 08/20: Magnet FDR planned in Fall 2020, delayed due to COVID-19 and lockdown of BINP.	Install magnet after Building Acceptance.	none	0		decided @ CBM	2018-03-08
345	Mitigation ongoing	CBM / HADES	CBM	Online Systems (DAQ and FLES)	1.1.1.8	1.1.1.8.1	Germany	GSI	DAQ local testing at partner institutes hindered.	Cause: Punitive custom duties or trade sanctions. Event: Significant hindrances in the exchange of DAQ systems planned for local testing at partner institutes. Impact: Time delays due to re-planning and implementation of substitution measures; increased cost and man power.	40%	FALSE	moderate	7	mitigate	Substitute critical components (ongoing).	Relocate testing to host lab which would raise costs.	none	0		decided @ CBM	2019-08-01
346	Mitigation ongoing	CBM / HADES	CBM	Ring Image Cherenkov Detector (RICH)	1.1.1.3.1	1.1.1.3.1	0	0	Loss of detection efficiency of RICH detector.	Cause: Presently unaccounted conversion in material in front of the RICH detector. Event: Loss of detection efficiency, increased combinatorial background. Impact: Reduced physics performance.	30%	FALSE	moderate	7	mitigate	Review STS design, prevent further material budget increase. Status 07/20: - Working on improvements (ongoing). - CBM simulations how RICH performance is influenced by material, budget, other detectors and beampipe (ongoing).		minor	1		decided @ CBM	2019-08-01
347	Mitigation ongoing	CBM / HADES	CBM	Time of Flight System (TOF)	1.1.1.5	1.1.1.5	0	0	Time of Flight reduced granularity.	Cause: Cost overrun in inner TOF wall. Event: Reduced granularity or use of new technology lower cost glass. Impact: Delay of engineering design review; inner part not fully available for initial commissioning.	30%	TRUE	moderate	7	mitigate	Re-iterate engineering design.		none	0		decided @ CBM	2019-08-01

Risk register

122	Mitigation ongoing	CBM / HADES	CBM	TOF_C01	1.1.1.5.1	1.1.1.5	0	0	TOF counters performance.	Cause: Low resistive glass shows ageing with accumulated dose. Event: Performance of the counters containing low resistive glass drops with accumulated dose. Impact: Reduced lifetime or performance of the innermost counters.	20%	FALSE	moderate	6	mitigate	Perform ageing test with prototypes (ongoing). Status 08/20: measurements in Bucharest are shifted due to COVID-19 to the end of 2020.	Exchange innermost counters.	none	0			decided @ CBM	2018-03-07
121	Mitigation ongoing	CBM / HADES	CBM	TRD_C01	1.1.1.4.1	1.1.1.4	0	0	TRD MWPC performance.	Cause: Ageing effects in readout chambers. Event: Performance of MWPCs drops with accumulated dose. Impact: Reduced lifetime of MWPCs.	10%	FALSE	moderate	5	mitigate	Components tests at ageing test facility at GSI (ongoing). Status 07/20: During test they did not detect ageing effects, but tests are still ongoing - longterm tests.	Exchange of innermost chambers.	none	0			decided @ CBM	2018-03-07
117	Mitigation ongoing	CBM / HADES	CBM	MUCH_C01	1.1.1.3.2.1	1.1.1.3.2.1	India	VECC Kolkata	MUCH counters suitability	Cause: RPC counters not suitable for inner part of station 3 or even station 4. Event: Usage of GEM based counters for inner part. Impact: Increased design complexity and cost.	10%	FALSE	moderate	5	mitigate	More testing and Validation (ongoing). Status 08/20: timeline shifted by ~6 months due to COVID-19 situation	Use GEM chambers in inner part.	none	0			decided @ CBM	2018-03-07
118	Mitigation ongoing	CBM / HADES	CBM	MUCH_C01	1.1.1.3.2.1	1.1.1.3.2.1	India	VECC Kolkata	MUCH readout performance	Cause: STS-XYTER readout of RPC based stations not suitable. Event: Usage of TOF type electronics necessary. Impact: Reduced granularity or increased cost.	10%	FALSE	moderate	5	mitigate	More testing and validation ongoing but with interruption due to the lockdown in India. It has now resumed.	Use TOF type electronics with minimal granularity.	none	0			decided @ CBM	2018-03-07
119	Mitigation ongoing	CBM / HADES	CBM	TRD_C01	1.1.1.4.1	1.1.1.4.1	0	0	TRD MWPC efficiency	Cause: High rate operation instabilities. Event: Reduced efficiency or degradation of gas gain at high space charges. Impact: Limits rate capability or requires increased calibration efforts.	10%	FALSE	moderate	5	mitigate	Prototype tests at CERN-GIF++ and mCBM. Status 08/20: - Test measurements at GSI (mCBM) done, but data analysis is still ongoing.	Disable innermost detectors or reduce interaction rate.	none	0			decided @ CBM	2018-03-07
344	Accepted	CBM / HADES	CBM	Online Systems (DAQ and FLES)	1.1.1.8	1.1.1.8	0	0	Delays in DAQ system development	Cause: Lack of manpower for FPGA firmware development. Event: Delays in DAQ system development. Impact: Reduced scope and functionality in initial commissioning Phase.	10%	FALSE	moderate	5	accept	Hire additional qualified manpower (difficult to recruit under academic salary conditions). Status 07/20: 1 FTE is hired (done).	Downgrade functionality and Performance.	moderate	5				2019-08-01

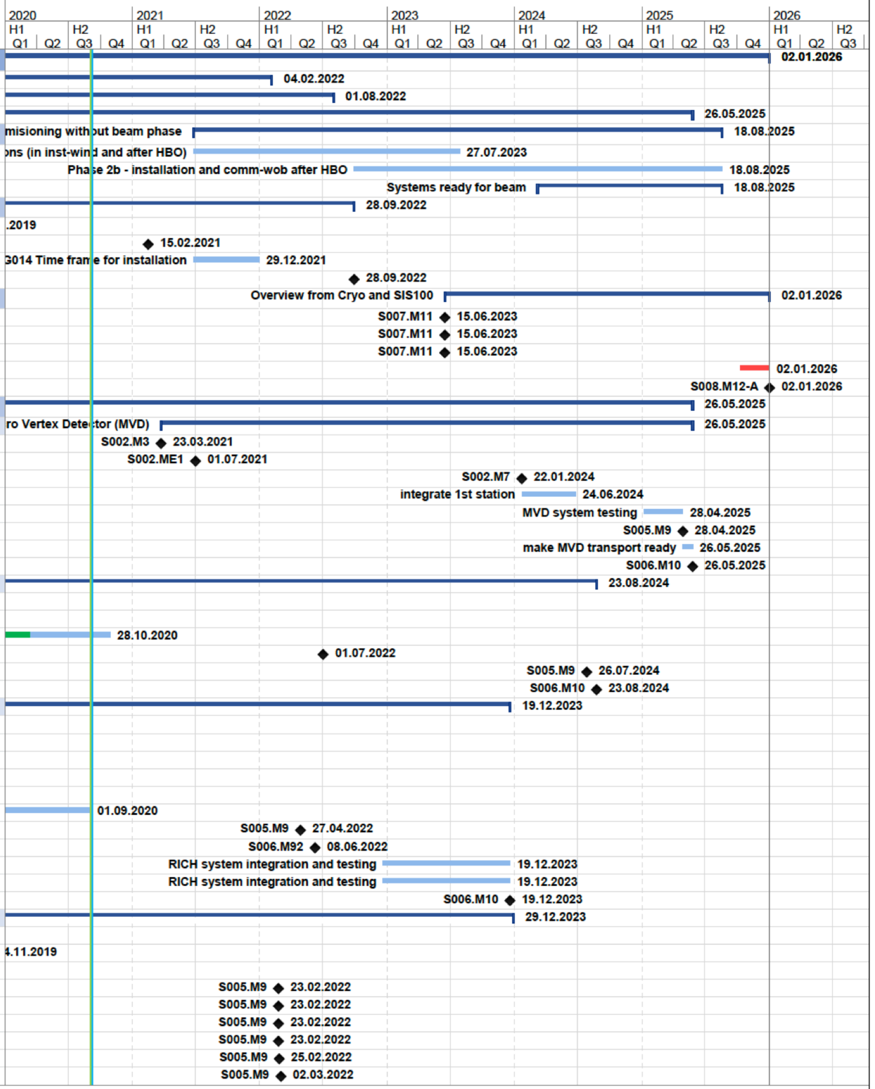
Risk register

309	Action ongoing	CBM / HADES	CBM	Silicon Tracking System (STS)	1.1.1.2	1.1.1.2	0	0	STS cooling system design alternative.	Cause: Systematic studies of cooling system design alternatives. Event: Mono-phase cooling seems a vital option. Impact: Reduction in cost (400k €) and especially in complexity.	90%	FALSE	+moderate	9	exploit	Prototyping. Status 07/20: - ordered cooling plant (done) and prepare for measurement station (ongoing). - testing cooling plant ((start in Oct. 2020))		+moderate	9		decided @ CBM	2019-03-05

Level-2 plans

Level2_CBM

Nr.	Vorgangsname	Dauer	Anfang	Ende
0	**Level2_CBM**	**163,02 Monate**	**Fre 05.07.13**	**Fre 02.01.26**
1	**design and planning phase**	**112,05 Monate**	**Fre 05.07.13**	**Fre 04.02.22**
42	**pre-series phase**	**82,25 Monate**	**Fre 08.04.16**	**Mon 01.08.22**
64	**manufacturing + shipment & SAT A phase**	**119,05 Monate**	**Mon 11.04.16**	**Mon 26.05.25**
97	**installation & commisioning without beam phase**	**54,1 Monate**	**Fre 25.06.21**	**Mon 18.08.25**
98	Phase 1b - basic installations (in inst-wind and after HBO)	27,25 Monate	Fre 25.06.21	Don 27.07.23
99	Phase 2b - installation and comm-wob after HBO	37,65 Monate	Don 29.09.22	Mon 18.08.25
100	**Systems ready for beam**	**18,85 Monate**	**Don 07.03.24**	**Mon 18.08.25**
114	**Overview from FSB for Installation**	**40 Monate**	**Don 05.09.19**	**Mit 28.09.22**
115	Start with Building Shell	0 Monate	Don 05.09.19	Don 05.09.19
116	Building shell completed-G014/T112S	0 Monate	Mon 15.02.21	Mon 15.02.21
117	G014 Time frame for installation	6,7 Monate	Fre 25.06.21	Mit 29.12.21
118	G014 Acceptance by HBO	0 Monate	Mit 28.09.22	Mit 28.09.22
119	**Overview from Cryo and SIS100**	**33,27 Monate**	**Don 15.06.23**	**Fre 02.01.26**
120	component accepted without beam (M11)	0 Monate	Don 15.06.23	Don 15.06.23
121	Cryogenics SuperFRS ready for operation	0 Monate	Don 15.06.23	Don 15.06.23
122	Cryogenics SIS100 ready for operation	0 Monate	Don 15.06.23	Don 15.06.23
124	SIS100 Execution - Stage A (pilot beam)	3 Monate	Fre 10.10.25	Fre 02.01.26
125	SIS100 ready for 'pilot beam' operation (single user, low-intensity)	0 Monate	Fre 02.01.26	Fre 02.01.26
126	**CBM WP View**	**155,1 Monate**	**Fre 05.07.13**	**Mon 26.05.25**
127	**Micro Vertex Detector (MVD)**	**54,45 Monate**	**Die 23.03.21**	**Mon 26.05.25**
128	Approval MVD TDR [M3]	0 Monate	Die 23.03.21	Die 23.03.21
129	Funding MVD established [ME1]	0 Monate	Don 01.07.21	Don 01.07.21
130	MVD - system PRR [M7]	0 Monate	Mon 22.01.24	Mon 22.01.24
131	integrate 1st station	5,5 Monate	Die 23.01.24	Mon 24.06.24
132	MVD system testing	4 Monate	Die 07.01.25	Mon 28.04.25
133	MVD - fully tested in assembly lab FAT [M9]	0 Monate	Mon 28.04.25	Mon 28.04.25
134	make MVD transport ready	1 Monat	Die 29.04.25	Mon 26.05.25
135	MVD - ready for installation [M10]	0 Monate	Mon 26.05.25	Mon 26.05.25
136	**Silicon Tracking System (STS)**	**145,3 Monate**	**Fre 05.07.13**	**Fre 23.08.24**
137	Approval STS TDR [M3]	0 Monate	Fre 05.07.13	Fre 05.07.13
138	STS - sensor contract signed [M4]	0 Monate	Don 28.03.19	Don 28.03.19
139	Production of sensors at vendor	20,75 Monate	Don 28.03.19	Mit 28.10.20
140	STS - Start system assembly, installation of units, cabling	0 Monate	Fre 01.07.22	Fre 01.07.22
141	STS - detector fully tested in assembly lab FAT [M9]	0 Monate	Fre 26.07.24	Fre 26.07.24
142	STS - detector ready for installation [M10]	0 Monate	Fre 23.08.24	Fre 23.08.24
143	**Ring Image Cherenkov Detector (RICH)**	**129,8 Monate**	**Die 07.01.14**	**Die 19.12.23**
144	Approval RICH TDR [M3]	0 Monate	Die 07.01.14	Die 07.01.14
145	RICH - MAPMT, SAT accepted	0 Monate	Die 30.10.18	Die 30.10.18
146	RICH - HADES/CBM electronics PRR [M7]	0 Monate	Mon 06.11.17	Mon 06.11.17
147	DiRICH installation	3,25 Monate	Mon 04.06.18	Fre 31.08.18
148	Ready for beam HADES 2019 [M11]	0 Monate	Fre 28.09.18	Fre 28.09.18
149	Conceptual design	25,25 Monate	Mit 26.09.18	Die 01.09.20
150	RICH - beampipe FAT [M9]	0 Monate	Mit 27.04.22	Mit 27.04.22
151	RICH Box,Mirror mount,gas system received	0 Monate	Mit 08.06.22	Mit 08.06.22
152	RICH system integration and testing	13 Monate	Mit 21.12.22	Die 19.12.23
153	RICH system integration and testing	13 Monate	Mit 21.12.22	Die 19.12.23
154	RICH - ready for installation [M10]	0 Monate	Die 19.12.23	Die 19.12.23
155	**Muon Detector (MUCH)**	**115,25 Monate**	**Mon 02.03.15**	**Fre 29.12.23**
156	Approval MUCH TDR [M3]	0 Monate	Mon 02.03.15	Mon 02.03.15
157	Contract MUCH VECC signed [M4]	0 Monate	Mon 04.11.19	Mon 04.11.19
158	Ammendment-1 to MUCH PNPI-1 signed [M4]	0 Monate	Don 19.10.17	Don 19.10.17
159	MUCH PNPI-1 platform & rail system FAT [M9]	0 Monate	Mit 23.02.22	Mit 23.02.22
160	MUCH PNPI-1 platform & rail system FAT [M9]	0 Monate	Mit 23.02.22	Mit 23.02.22
161	MUCH PNPI-1 absorber&beampipe FAT [M9]	0 Monate	Mit 23.02.22	Mit 23.02.22
162	MUCH PNPI-1 mainframe FAT [M9]	0 Monate	Mit 23.02.22	Mit 23.02.22
163	MUCH PNPI-1 station 1+2 gas sysyem FAT [M9]	0 Monate	Fre 25.02.22	Fre 25.02.22
164	MUCH PNPI-1 station 3+4 gas sysyem FAT [M9]	0 Monate	Mit 02.03.22	Mit 02.03.22

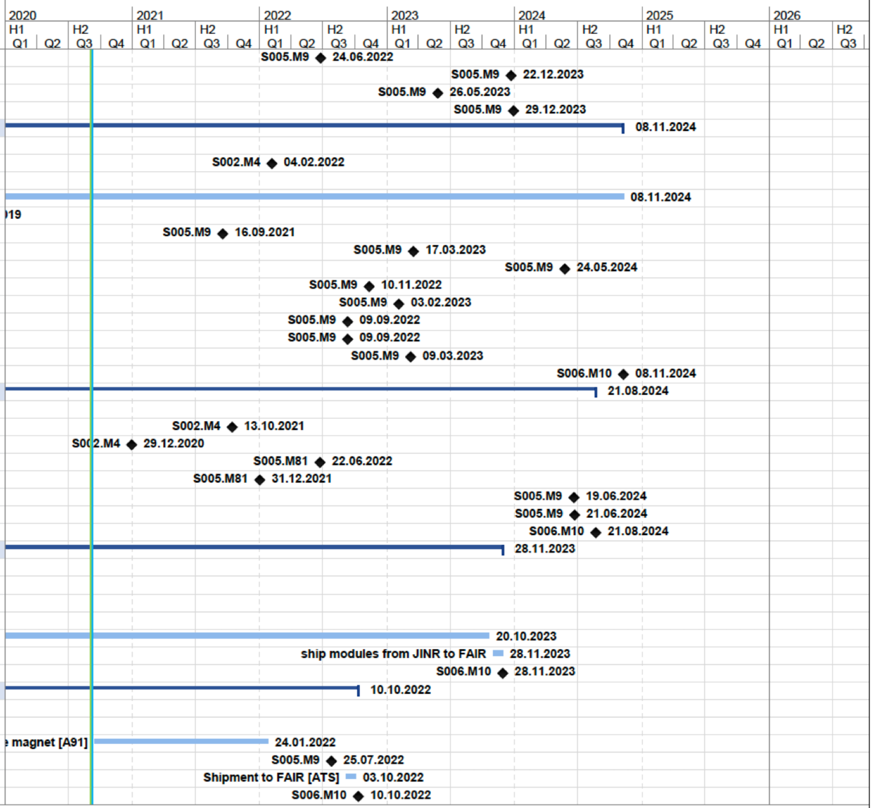


Seite 1

Level-2 plans

Level2_CBM

Nr.	Vorgangsname	Dauer	Anfang	Ende
165	MUCH - Station 1, all chambers build, FAT [M9]	0 Monate	Fre 24.06.22	Fre 24.06.22
166	MUCH - Station 2, all chambers build, FAT [M9]	0 Monate	Fre 22.12.23	Fre 22.12.23
167	MUCH - Station 3, all chambers build, FAT [M9]	0 Monate	Fre 26.05.23	Fre 26.05.23
168	MUCH - Station 4, all chambers build, FAT [M9]	0 Monate	Fre 29.12.23	Fre 29.12.23
169	**Transition Radiation Detector (TRD)**	**102,5 Monate**	**Mon 02.01.17**	**Fre 08.11.24**
170	Approval TRD TDR [M3]	0 Monate	Mit 10.10.18	Mit 10.10.18
171	Contract TRD IFIN signed [M4]	0 Monate	Fre 04.02.22	Fre 04.02.22
172	chamber support prototype design&production	15 Monate	Mon 01.01.18	Fre 22.02.19
173	Production phase	102,5 Monate	Mon 02.01.17	Fre 08.11.24
174	TRD - SPADIC tested and shipped, FAT [M9]	0 Monate	Mit 24.07.19	Mit 24.07.19
175	TRD - FEB FAT, all FEBs send [M9]	0 Monate	Don 16.09.21	Don 16.09.21
176	TRD - outer modules FAT [M9]	0 Monate	Fre 17.03.23	Fre 17.03.23
177	TRD - inner chambers, all build FAT [M9]	0 Monate	Fre 24.05.24	Fre 24.05.24
178	TRD - radiator box FAT [M9]	0 Monate	Don 10.11.22	Don 10.11.22
179	TRD - gas system FAT [M9]	0 Monate	Fre 03.02.23	Fre 03.02.23
180	TRD - HV system FAT [M9]	0 Monate	Fre 09.09.22	Fre 09.09.22
181	TRD - LV system FAT [M9]	0 Monate	Fre 09.09.22	Fre 09.09.22
182	TRD - support+mainframe FAT [M9]	0 Monate	Don 09.03.23	Don 09.03.23
183	TRD - all parts rdy for install [M10]	0 Monate	Fre 08.11.24	Fre 08.11.24
184	**Time of Flight System (TOF)**	**121,5 Monate**	**Don 30.04.15**	**Mit 21.08.24**
185	Approval TOF TDR [M3]	0 Monate	Don 30.04.15	Don 30.04.15
186	Contract TOF IFIN signed [M4]	0 Monate	Mit 13.10.21	Mit 13.10.21
187	Contract TOF ITEP signed [M4]	0 Monate	Die 29.12.20	Die 29.12.20
188	TOF - Start Module 1 assembly [M81]	0 Monate	Mit 22.06.22	Mit 22.06.22
189	TOF - Start Module 4-6 assembly [M81]	0 Monate	Fre 31.12.21	Fre 31.12.21
190	TOF - module 1 FAT [M9]	0 Monate	Mit 19.06.24	Mit 19.06.24
191	TOF - module 4-6 FAT [M9]	0 Monate	Fre 21.06.24	Fre 21.06.24
192	TOF - all parts rdy for install [M10]	0 Monate	Mit 21.08.24	Mit 21.08.24
201	**Projectile Spectator Detector (PSD)**	**114,1 Monate**	**Mon 02.03.15**	**Die 28.11.23**
202	Approval PSD TDR [M3]	0 Monate	Mon 02.03.15	Mon 02.03.15
203	Contract PSD-INR signed [M4]	0 Monate	Mon 09.11.15	Mon 09.11.15
204	PSD - module PRR [M7]	0 Monate	Fre 08.04.16	Fre 08.04.16
205	Assembly modules	6 Monate	Mon 21.11.16	Fre 05.05.17
206	test+physics beam at BM@N	54 Monate	Mon 02.09.19	Fre 20.10.23
207	ship modules from JINR to FAIR	1 Monat	Mit 01.11.23	Die 28.11.23
208	PSD - all parts rdy for install [M10]	0 Monate	Die 28.11.23	Die 28.11.23
209	**Dipol Magnet**	**114,15 Monate**	**Don 09.01.14**	**Mon 10.10.22**
210	Approval Magnet TDR [M3]	0 Monate	Don 09.01.14	Don 09.01.14
211	Contract Magnet BINP signed [M4]	0 Monate	Die 13.12.16	Die 13.12.16
212	Magnet - produce magnet [A91]	17,75 Monate	Die 15.09.20	Mon 24.01.22
213	Magnet - FAT accepted / acceptance test completed [M9]	0 Monate	Mon 25.07.22	Mon 25.07.22
214	Shipment to FAIR [ATS]	1 Monat	Die 06.09.22	Mon 03.10.22
215	Magnet - ready for installation [M10]	0 Monate	Mon 10.10.22	Mon 10.10.22



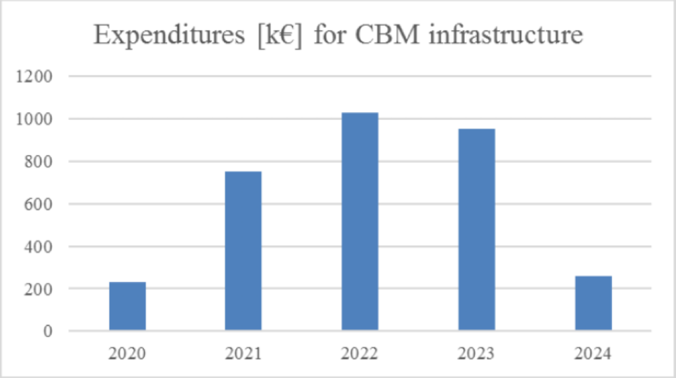
Seite 2

Common infrastructure

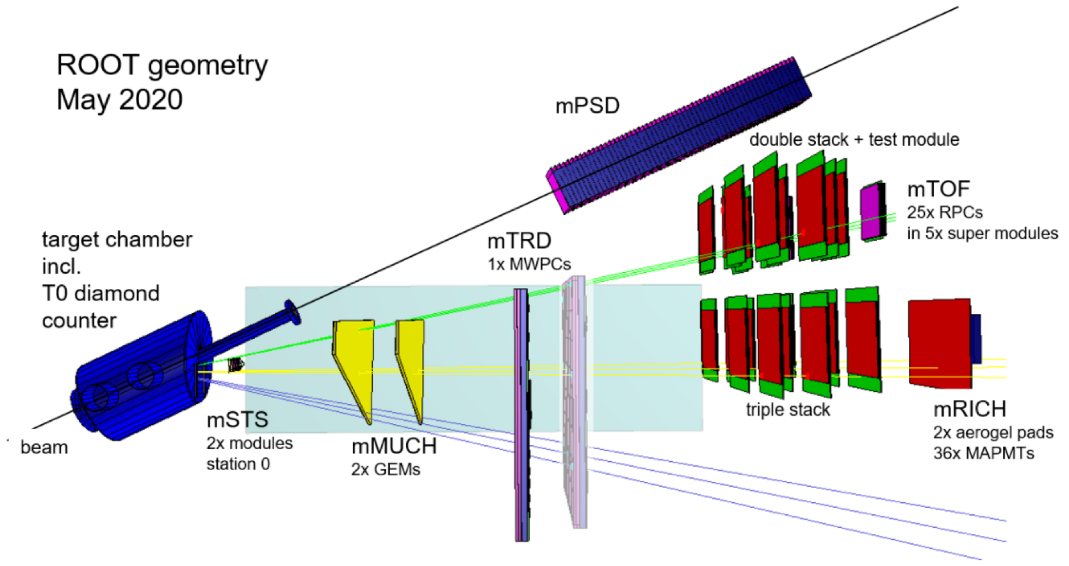
Work Package	2020	2021	2022	2023	2024	2025	sum [k€] all years
Rail System	100,0	300,0	96,5				
upstream plattform	130,0	145,0	90,0				
RICH-MUCH foundation		90,0	90,0				
Cryo - BB balcony		3,0	7,0				
Survey tools		25,0	25,0	25,0			
Tools, scaffolding, hoisting gear		50,0	35,0	35,0	75,0		
Safety gear			12,0				
Control room			43,0	43,0			
Gas container (E40)				15,0			
Gas alarm system (E30/E40)				20,0	20,0		
Gas lines (E40-E30)		30,0	57,9				
Gas lines (E30-E10)		50,0	92,5				
Racks E40			100,0	195,1			
Racks E30		10,0	24,5				
Racks E10		15,0	30,6				
Preparation area (E40)			42,0				
Cable trays		8,0	20,0				
Cooling water distribution		25,0	44,2				
Optical fibers (E10-E40)			122,6	300,0			
Optical fibers (E40-IT)			40,0	80,3			
Control system			15,0	30,0			
Target Box+Holder				35,0	35,0		
Beam pipes				35,0	35,0		
Vacuum pumps				39,0	40,0		
Beam diagnosis box				15,0	15,0		
Beam abort system				40,0	40,0		
CBM beam dump (rest)			15,0	25,0			
HADES beam dump			25,0	30,0			
Sum [k€]	**230,0**	**751,0**	**1027,8**	**962,4**	**260,0**		**3231,2**

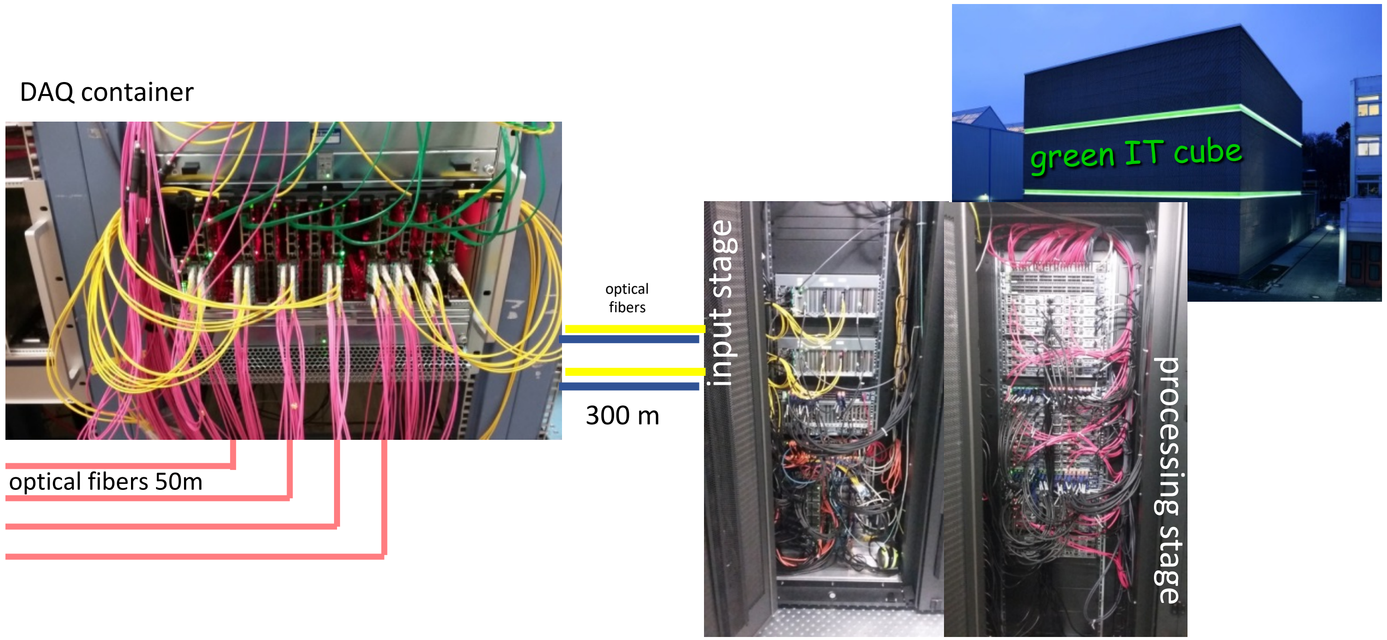
Updated cost breakdown and expenditures [2019 prices in k€] for the CBM Common infrastructure (PSP code 1.1.1.10):

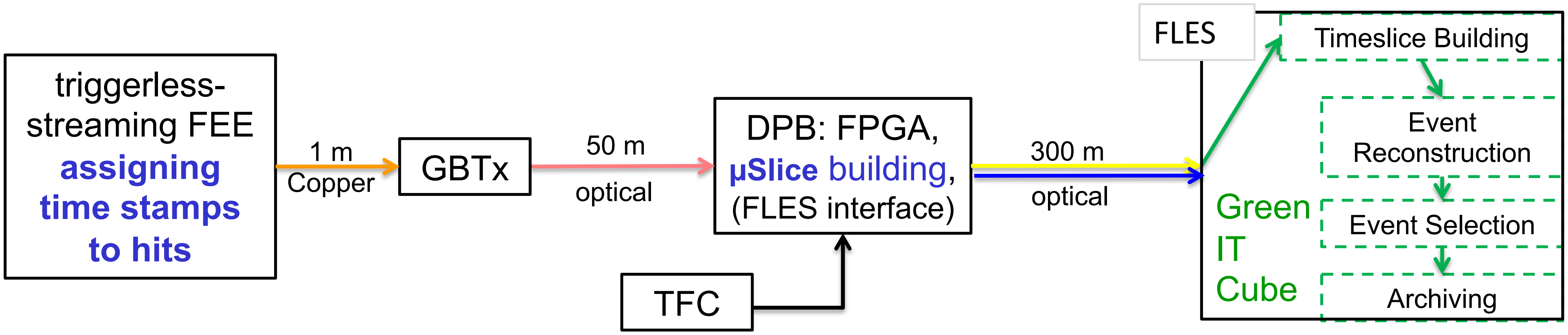
1.1.1.10	Infrastructure	no TDR foreseen	all countries involved in CBM	proposed to be covered by CBM Common Fund	all CBM member institutes		3231
1.1.1.10.1	Target area Beam pipe & vacuum		CBM	Common Fund	all CBM member institutes		329
1.1.1.10.2	Rail system		CBM	Common Fund	all CBM member institutes		497
1.1.1.10.3	Common data optical fibers		CBM	Common Fund	all CBM member institutes		543
1.1.1.10.4	Electronics Racks		CBM	Common Fund	all CBM member institutes		375
1.1.1.10.5	Cryogenics		CBM	Common Fund	all CBM member institutes		0
1.1.1.10.6	Detector gas infrastructure		CBM	Common Fund	all CBM member institutes		285
1.1.1.10.7	General infrastructure & safety		CBM	Common Fund	all CBM member institutes		546
1.1.1.10.8	Common support structures		CBM	Common Fund	all CBM member institutes		545
1.1.1.10.9	Power & standard media distribution		CBM	Common Fund	all CBM member institutes		111



The mCBM experiment at SIS18 - precursor and demonstrator for CBM @ SIS100



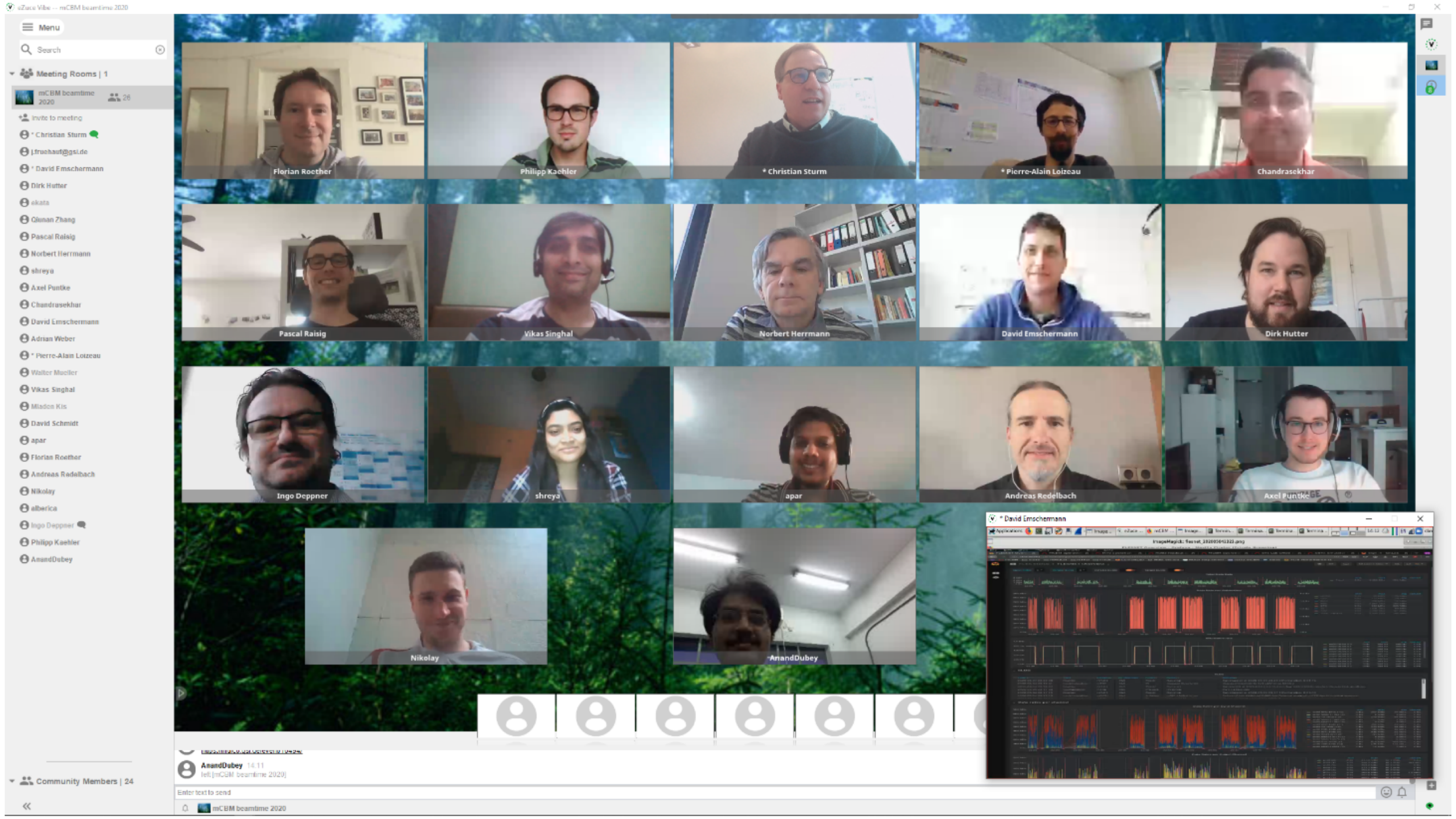




mCBM data taking during March - May 2020

mCBM data taking during
the covid19 lockdown:

excellent machine operation
excellent support by GSI/FAIR

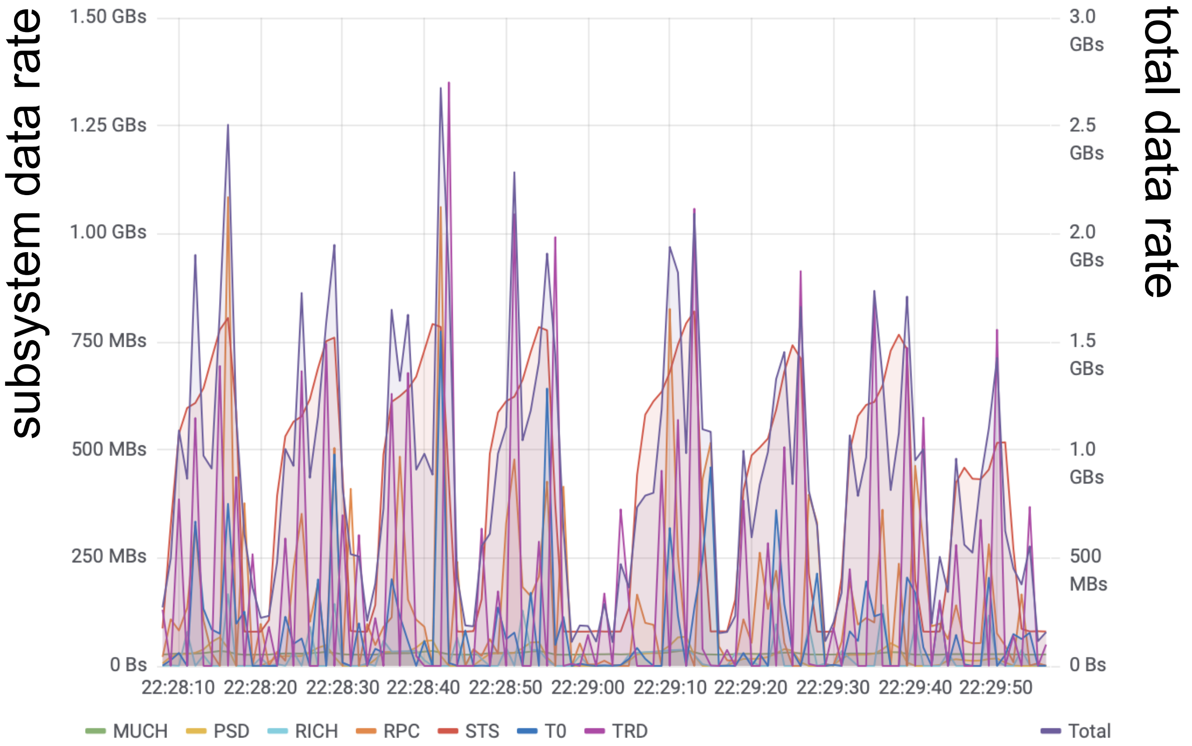


How could we manage ?

Remote operation of mCBM
per VNCs and a permanent vibe room

Small core-team on site (3 - 4 experts), 20 - 30 experts online world-wide

mCBM commissioning with beam, first results from May 2020



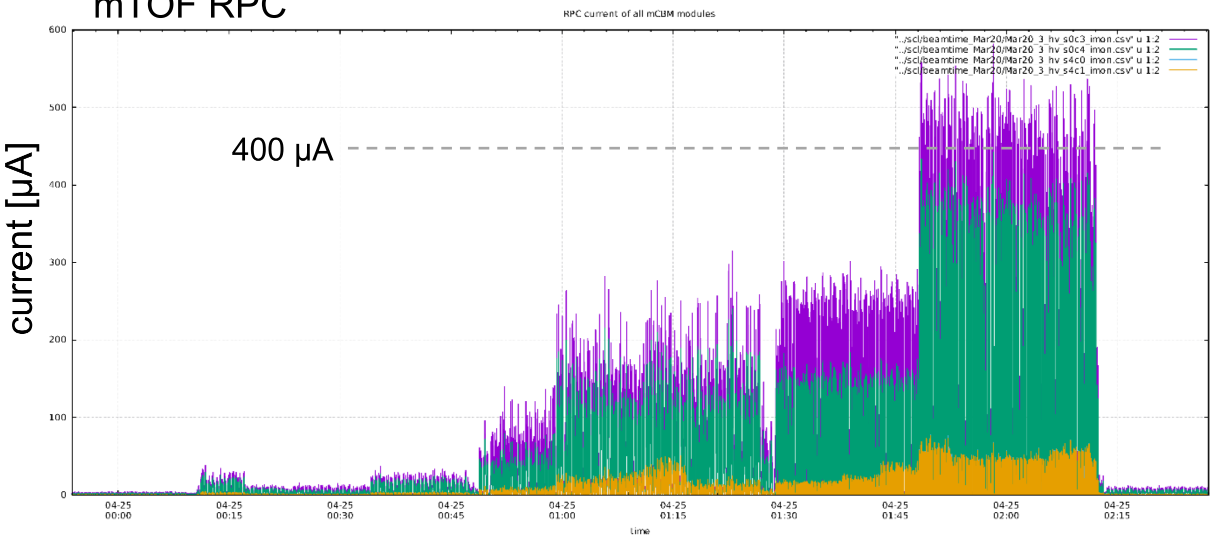
May 4th, 2020, run 858

^{208}Pb + Au, 1.060 AGeV, 1.1 MHz averaged collision rate

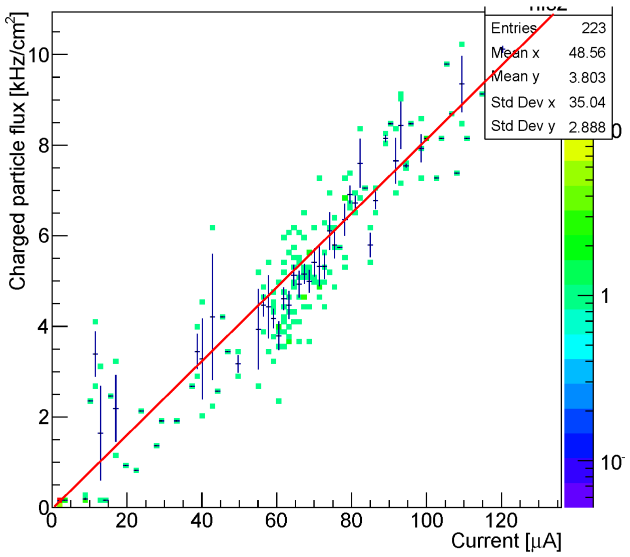
March 27 - May 24, 2020 campaign:

- max. collision rate: 4 MHz
- max. total data rate: 3 GB/s
- 20 TB data taken

mTOF RPC



charged particle flux - RPC current calibration



100 μA → 8 kHz/cm^2

↓

peak fluxes > 30 kHz/cm^2

(CBM TOF design limit: 25 kHz/cm^2)

ECE 11 recommendations

From the ECE11/ECSG02 meeting

***R09** We encourage the CBM collaboration to look into opportunities to form a team for Integration and Installation, also to coordinate the installations planned within the Construction Common Funds. We encourage FAIR Management to take a strong oversight of the experimental team in the above efforts.*

- Service and infrastructure installation planning process raised in priority and coordinated by the TC team: Cave Coordinator, CBM engineers, TC (TC team structure in statu nascendi.)
- We are working with FAIR site management on detailed installation plans that also give realistic estimate of extra and third party resources/workers