NA1 – QCD Physics at FAIR/GSI

STRONG-2020 ANNUAL MEETING (2022)

Fritz-Herbert Heinsius

Ruhr-Universität Bochum
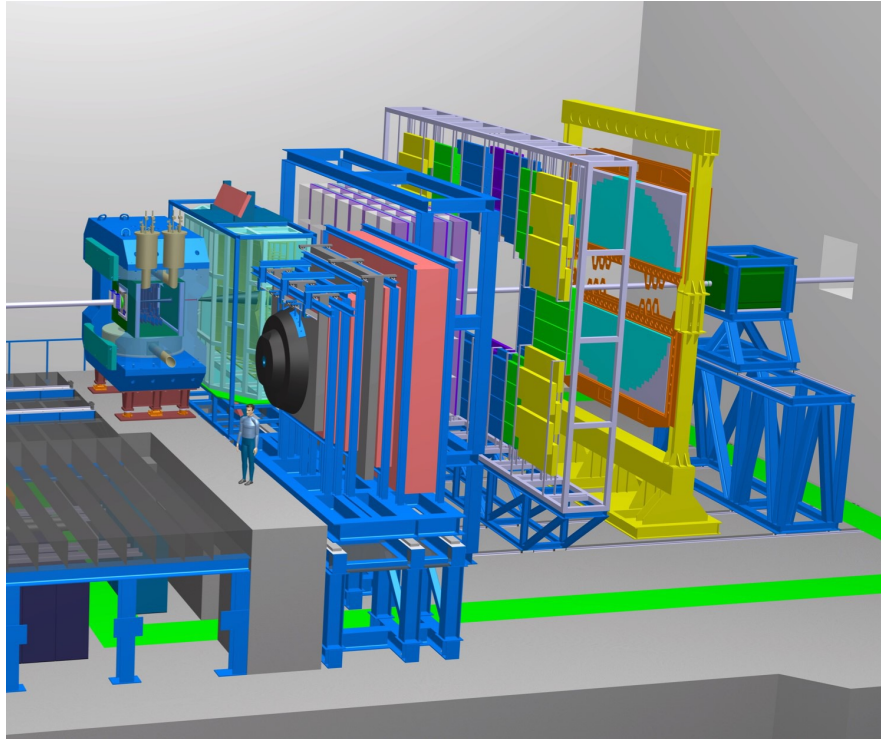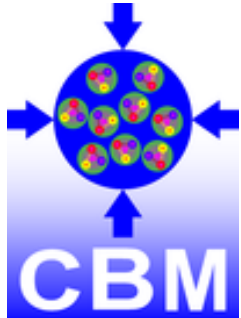
Explore properties of strongly interacting matter under extreme conditions
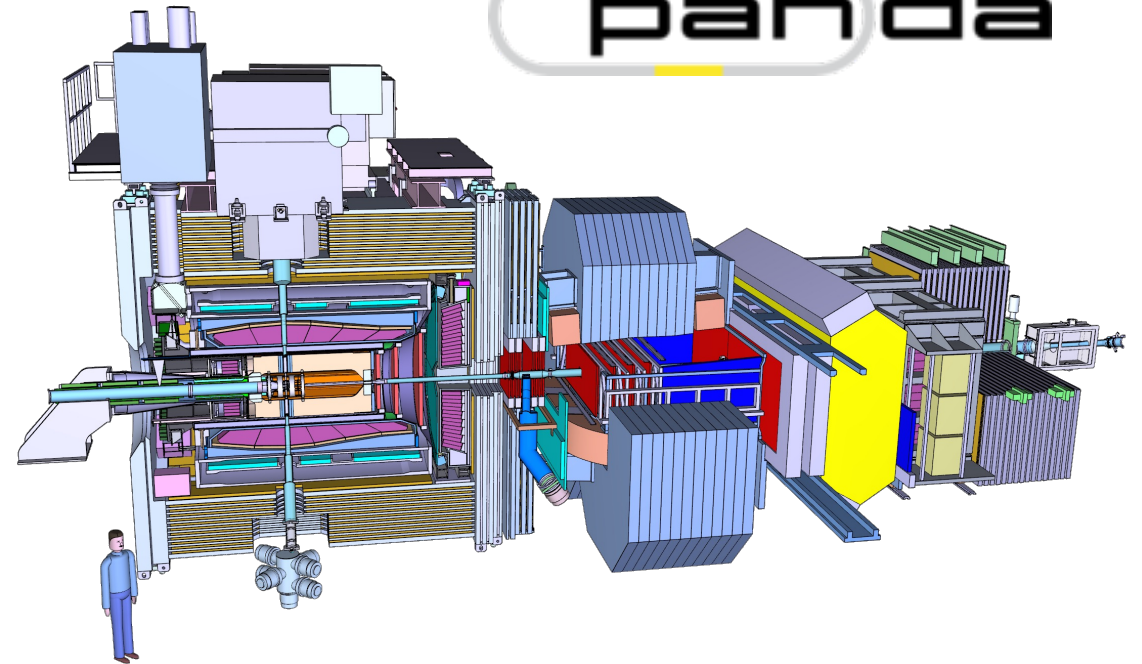
Investigate the nature of the strong force at the quark level

NA1 – QCD PHYSICS AT FAIR/GSI

1) Scientific results obtained since the last year

Task 1: Front-end electronics, DAQ and Online

**Task 2:** Demonstrator

Task 3: Data analysis challenge

(Task 4: Outreach and education)

ToASt : a 64 channels readout ASIC for silicon strip detectors in 0.11 μm CMOS technology

G. Mazza et al. TWEPP Sept. 2022

➤ Each channel provides particle time of arrival (ToA) and energy deposited informations (via ToT)

➤ The particle ToA and ToT and channel address are packed in a 32 bits data word and transmitted via 1(2) 160 Mb/s serial link(s)

➤ A slower (80 MS/s), bidirectional serial link is used for ASIC configuration
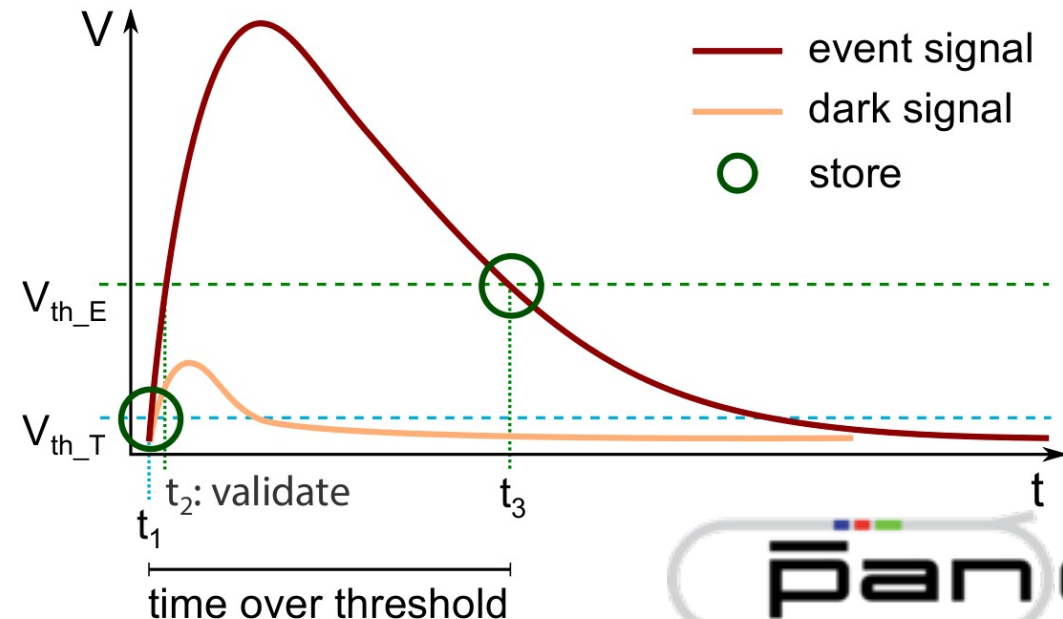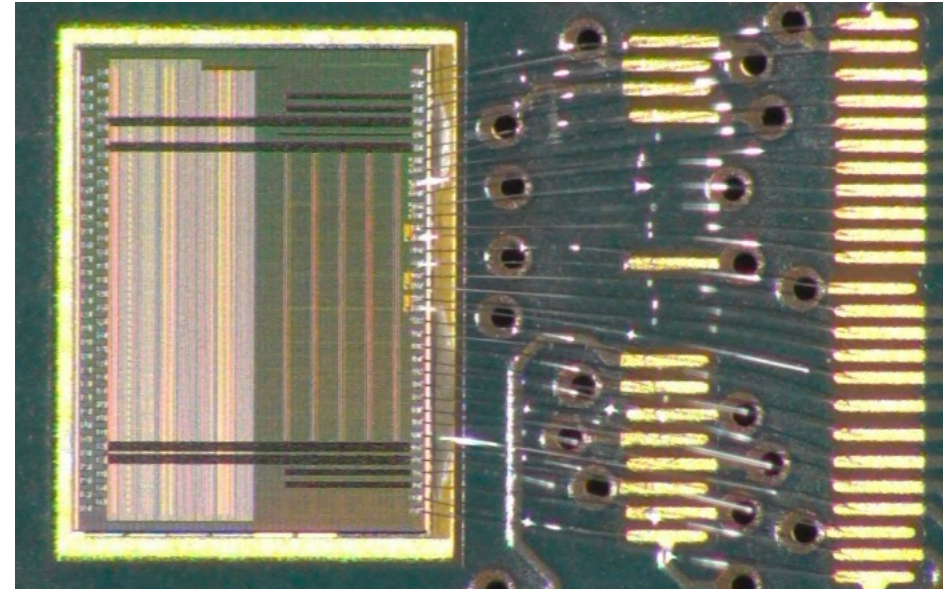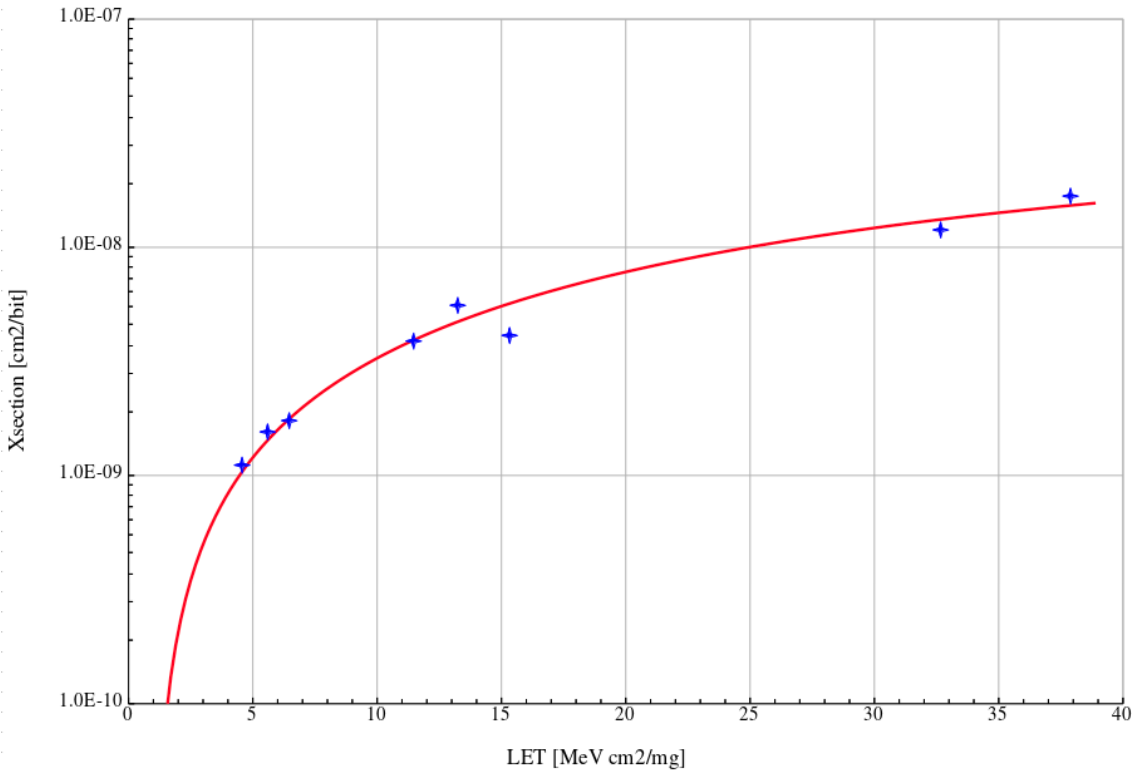
TOAST: 64 CHANNEL ASIC

➢SEU test @ INFN LNL SIRAD facility

➢SEU tests show a critical point in the configuration register. The problem has been identified and will be corrected in the next version.

➢Lab tests show that the ToASt performances are as expected

➢ToASt tests with detector just started
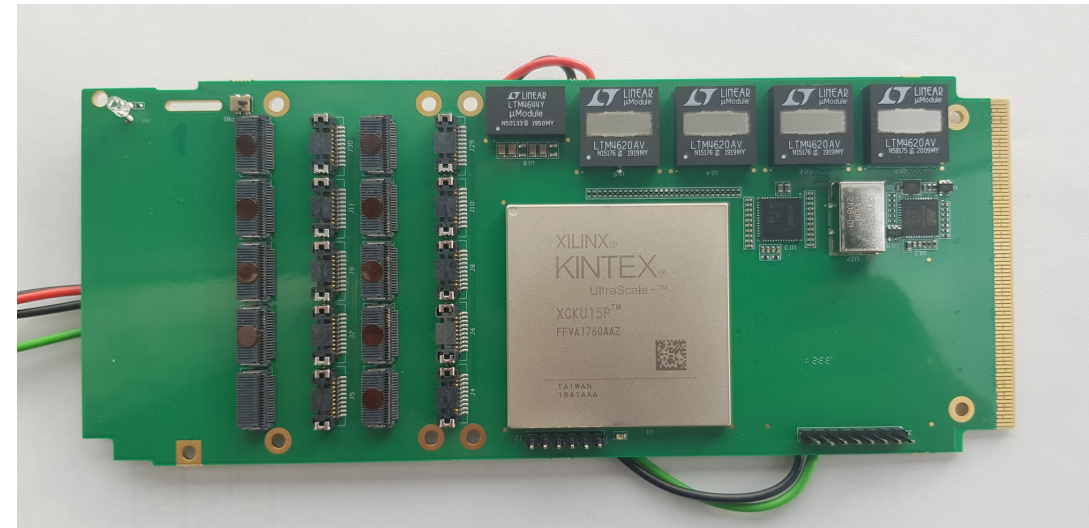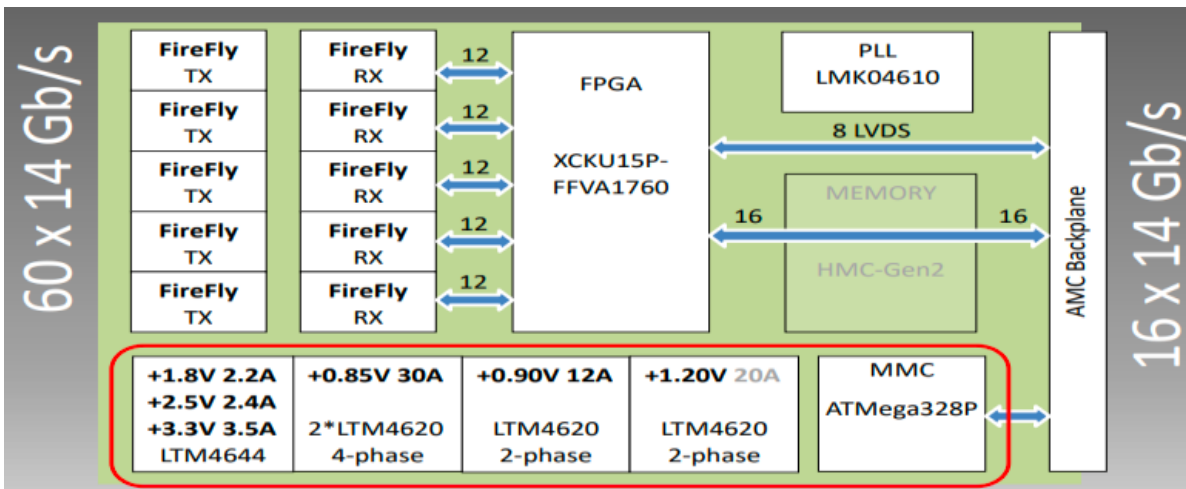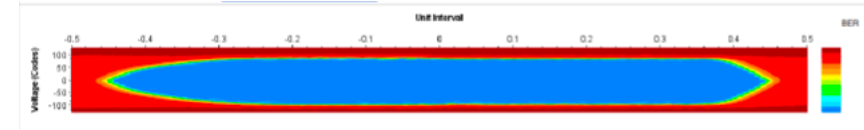
HIGH SPEED DATA CONCENTRATOR

Data collector from front-end electronics and clock distribution to FEE

60 FireFly optical transceivers 12 Gbit/s

16 backplane links 12 Gbit/s

Kintex Ultrascale+ FPGA

AMC board finally delivered in February 2022, being tested
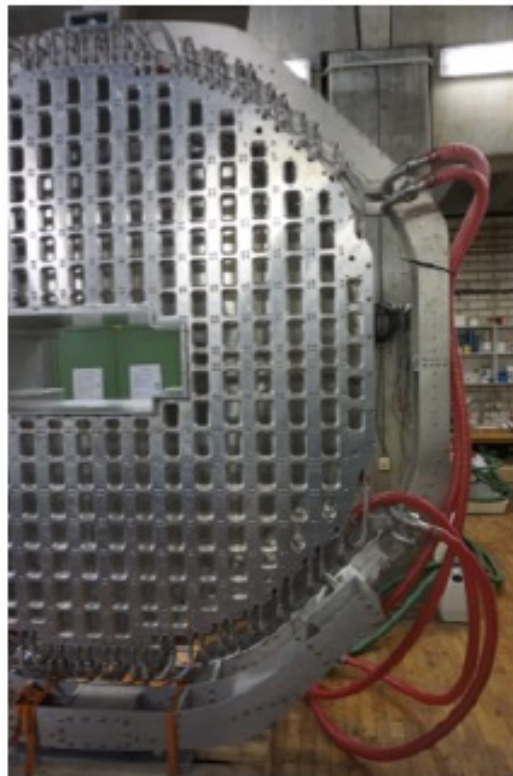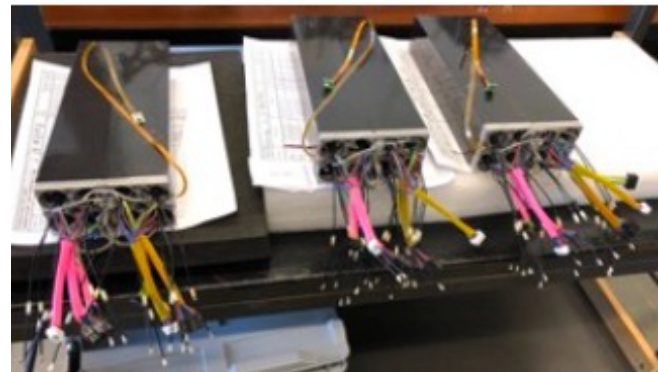

P. Marciniewski

RESULTS IN TASK 2 – DEMONSTRATOR PREPARATION FOR TESTS AT COSY

Forward endcap electromagnetic calorimeter
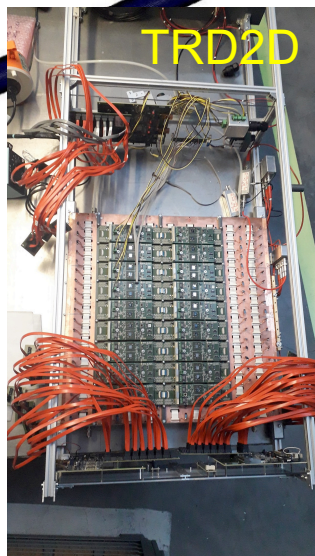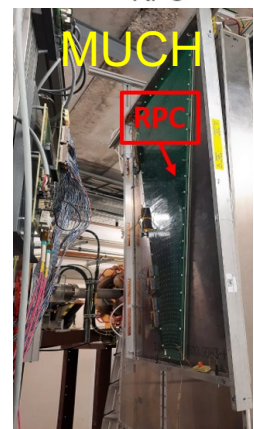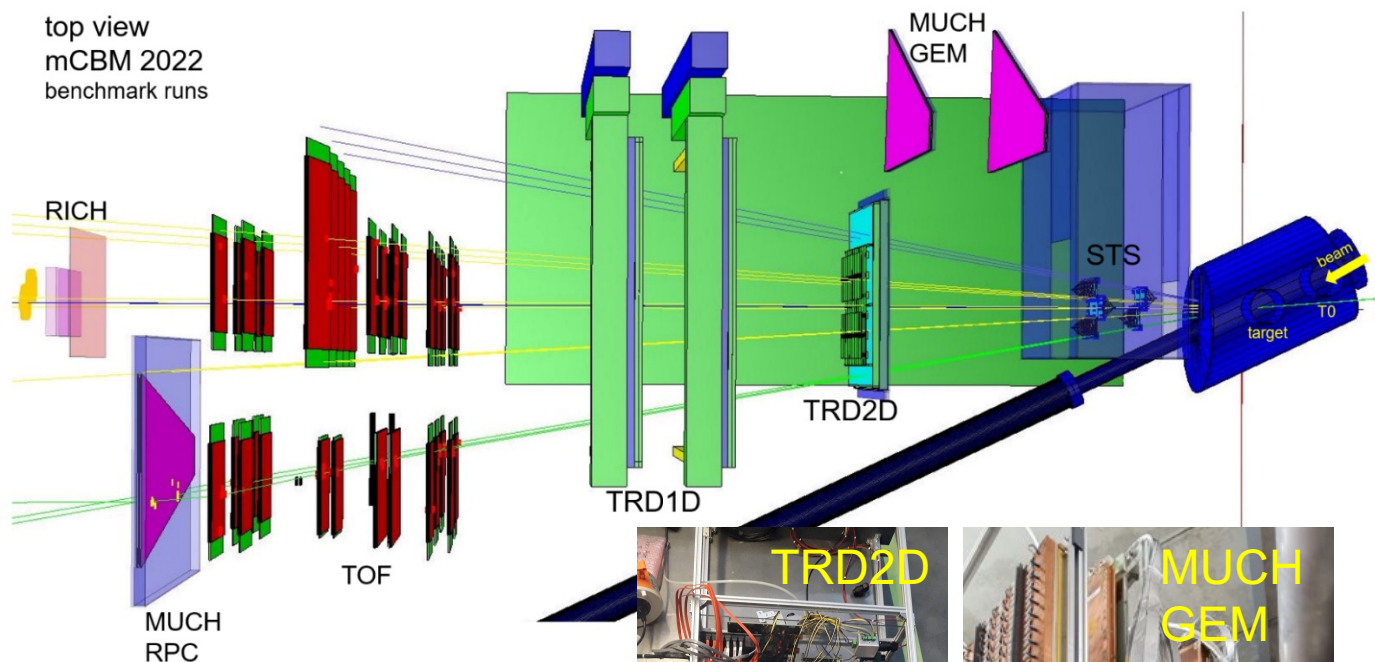

Planning for beam at COSY TOF hall

including

➢ 240 SADCs with feature extraction

➢ data concentrator

➢ free running DAQ

→ beam in fall 2023

top view
mCBM 2022
benchmark runs

RICH

MUCH
GEM

STS

beam

target

T0

TRD2D

TRD1D

TOF

MUCH
RPC

MUCH

RPC

TRD2D

MUCH
GEM

T0
diamond
counter

Diamond interface PCB
with pneumatic drive
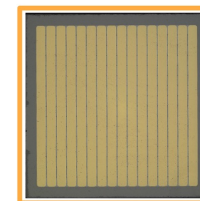
New 10 mm x 10 mm x 80 μm
16-channels pcCVD diamond sensor

➢ New T0 diamond detector - 16 ch. each side (x,y)

➢ Modified MUCH GEM HV distribution for high-rate tests

➢ 1st test of a full-size MUCH RPC for the 3rd and 4th layer of the CBM MUCH system

➢ Active area of TRD2D significantly expanded → intermediate high-res. tracking station

Christian Sturm for the CBM Collaboration

Sketch of the triggerless-streaming data transport system of CBM applied to the mCBM experiment: from the front-end chips (ASICS) to the time-slice building and event reconstruction in the Green IT Cube.
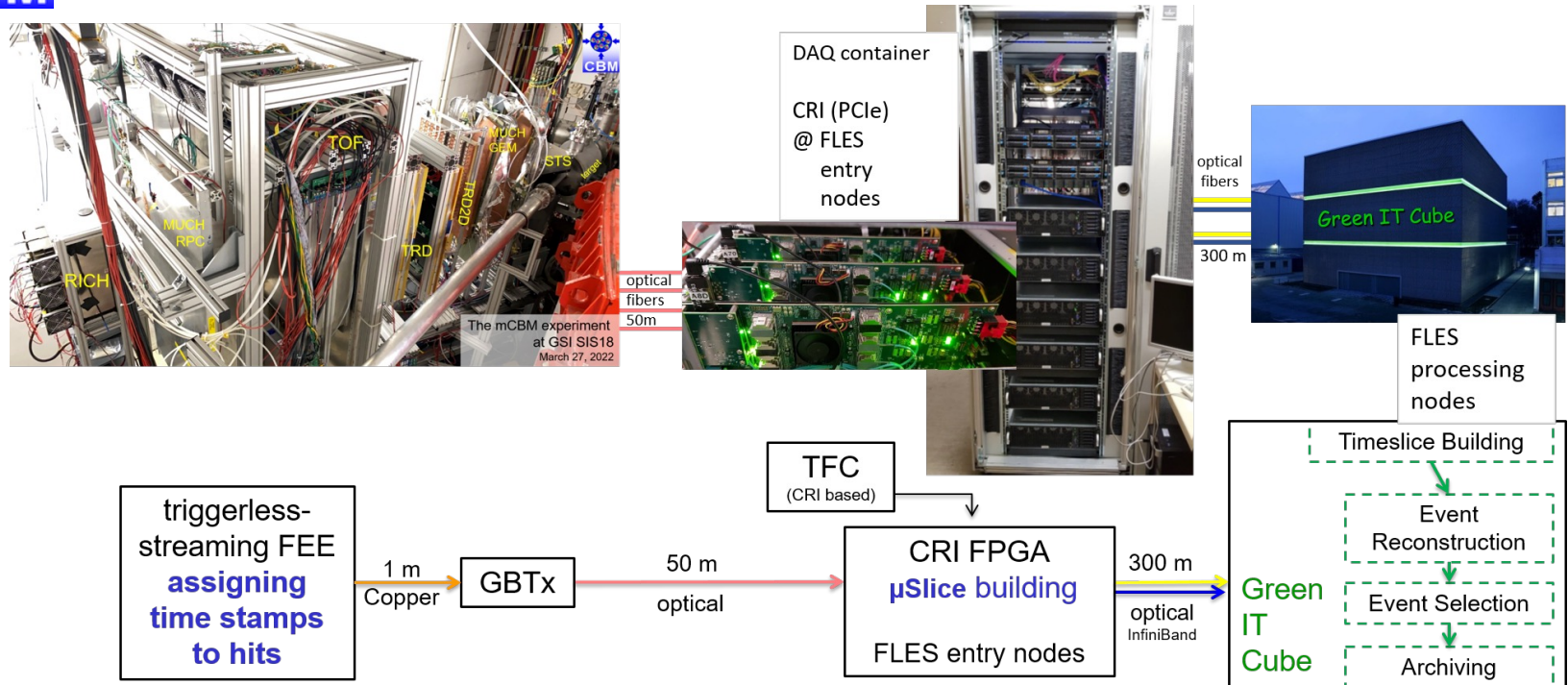
➤ 1st revision of CRI-based FGA designs of detector systems successfully tested

➤ Development of a revised CRI-based Timing and Fast Control system (TFC2) ongoing

➤ Link to GSI's White Rabbit system established, high synchronization stability observed

➤ Fast and extended disc arrays (storage) at processing nodes installed

➤ 1st version of an (MQ based) online reconstruction and selection developed and tested

Christian Sturm for the CBM Collaboration
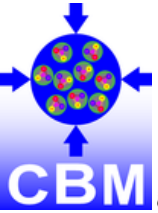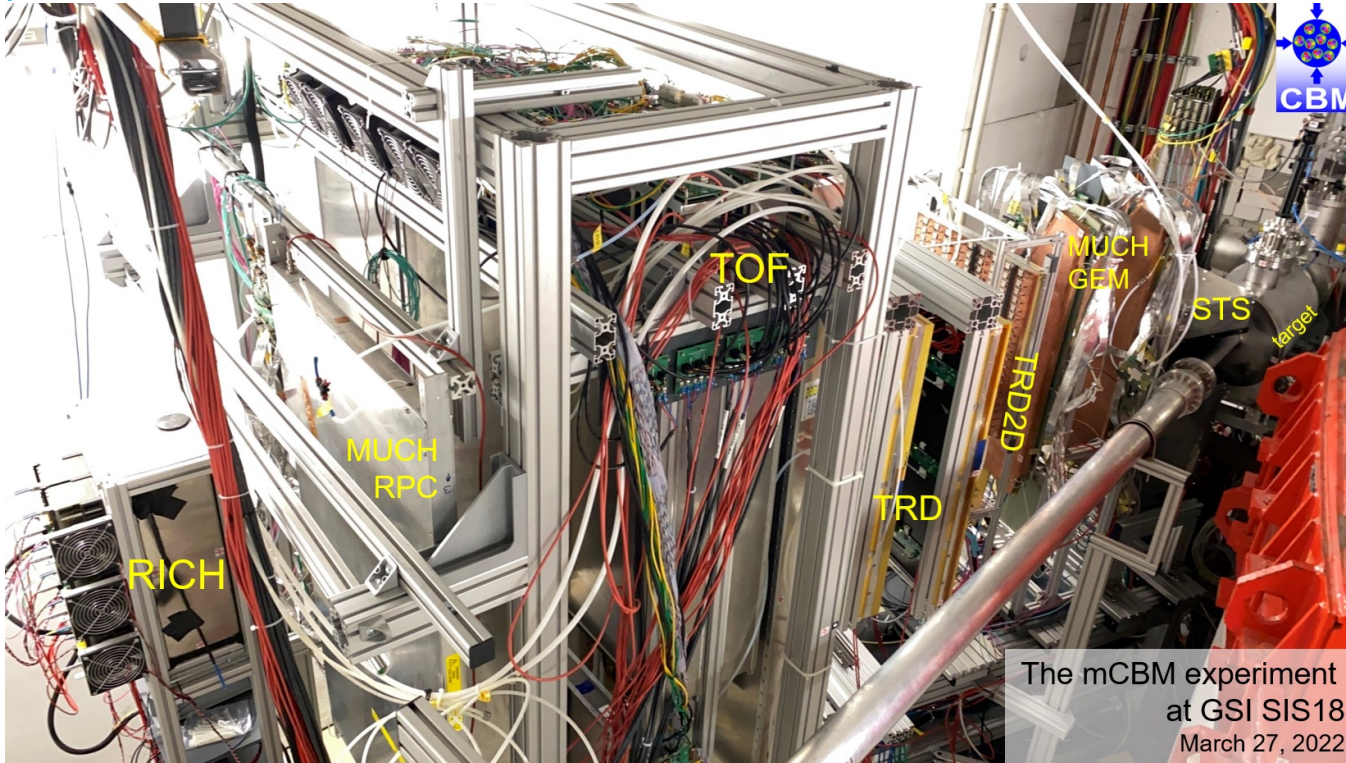
The mCBM experiment at GSI SIS18 March 27, 2022

Dec. 2021 - Mar. 2022:
dry runs and cosmics runs

March 10 & 25:
commissioning with beam
$^{12}C + {}^{58}Ni$, T_{lab} = 2.0 AGeV
$^{56}Fe + {}^{58}Ni$, T_{lab} = 1.80 AGeV

March 30 - April 1 :
high-rate runs
$^{238}U(73+) + {}^{197}Au$, T_{lab} = 1.06 AGeV
up to 10^9 U ions per spill (10 MHz coll. rate)

May 23 & 25/26
June 16 - 18   benchmark runs (Λ reconstruction)
$^{58}Ni + {}^{58}Ni$, T_{lab} = 1.93 AGeV and $^{197}Au(69+) + {}^{197}Au$, T_{lab} = 1.23 AGeV

June 18 - 20   high-rate runs, $^{197}Au(65+) + {}^{197}Au$, T_{lab} = 1.13 AGeV

Data analysis ongoing !

Christian Sturm for the CBM Collaboration

Study of Excited Baryons via the $\overline{\Xi}^+ \Lambda K^-$ Final State

Baryon studies with high $\Xi \overline{\Xi}$ production cross section of 2 μb

Sparse knowledge in strange baryon sector
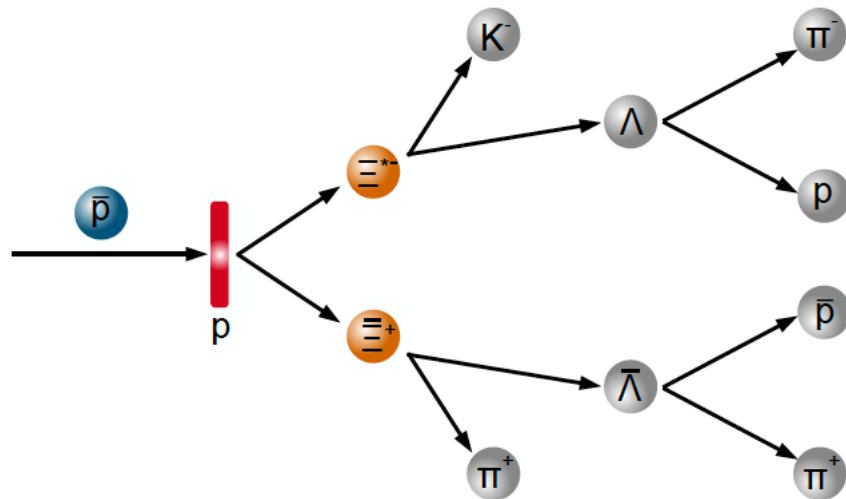
- ➢ Feasibility study performed to determine the spin and parity for specific Ξ resonances

- ➢ $\Xi(1690)^-$ and $\Xi(1820)^-$ simulated including detector response

- ➢ Model includes interference effects, proper angular distributions and barrier factors

- ➢ Fit was able to identify the correct spin and parity quantum number and resonance parameters

arXiv: 2201.03852

2) MODIFICATIONS OF THE SCIENTIFIC WORK PLAN (AS COMPARED TO THE INITIAL PLAN IN THE GRANT AGREEMENT)

Task 1: Front-end electronics, DAQ and Online

➢ Delays in production and tests of electronics

Task 2: Demonstrator

➢ No modifications

Task 3: Data analysis challenge
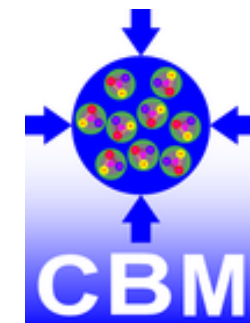
➢ No modifications

Task 4: Outreach and education

➢ Covid-19 restrictions

3) POSSIBILITIES/NEEDS OF ANOTHER REQUEST FOR THE EXTENSION OF THE PROJECT (BEYOND 30 NOVEMBER 2023)

Extension possible and would be helpful

L. Möller, Aug. 2022