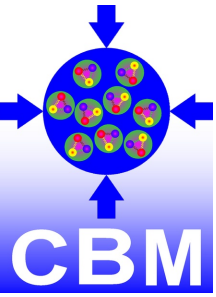


Cracow, 2024-10-21 15:00-15:18



Open Science and the Compressed Baryonic Matter experiment

Dr. Eoin J. Clerkin

tel: (GSI ext) 2028
email: e.clerkin@gsi.de

KBW 4.006
**Facility for Anti-proton and
Ion Research in Europe**
Planckstraße 1
64291 Darmstadt

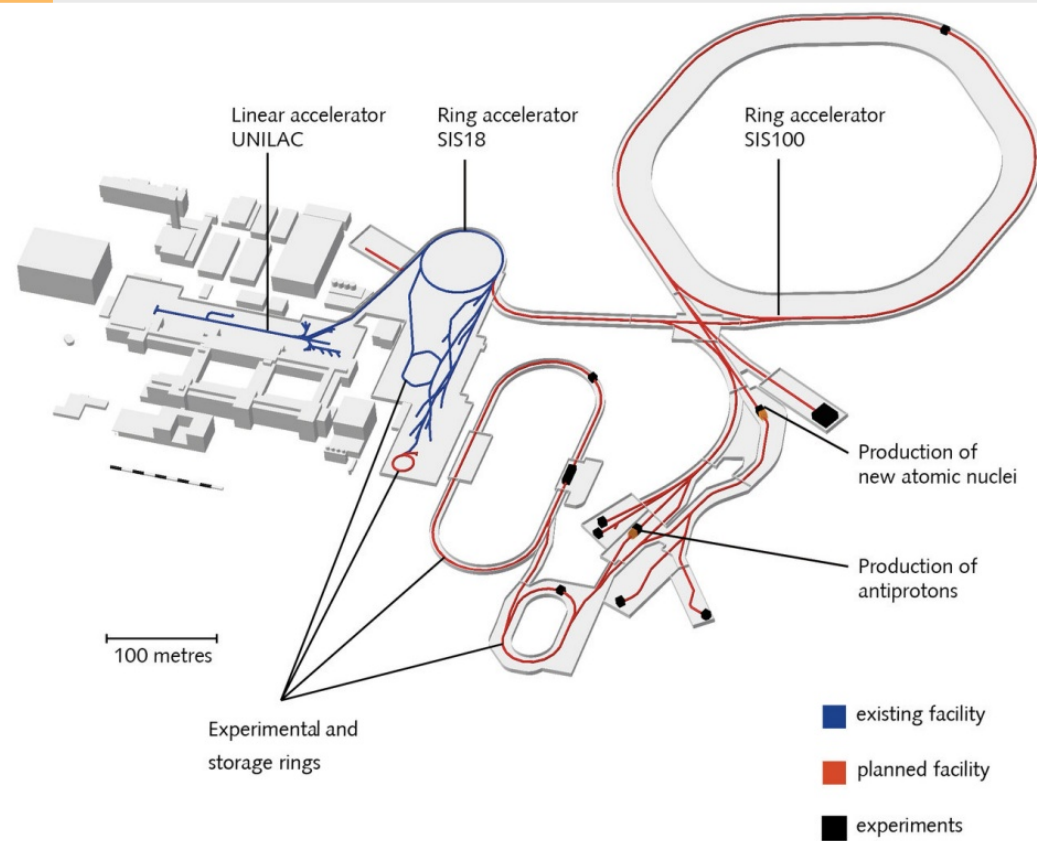
October 19 - 25, 2024

**CHEP
2024**



- Introduced the new FAIR facility.
- Basic Physics Goal of CBM Experiment.
- The CBM experimental hall, CBM setup and data
- Discussed some validation and verification tests on an open data policy
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- Recounted our story on the “opening” of our software suite
- The Open Science Working Group of FAIR/GSI
- [Time permitting] Personal Citizen Science experience.

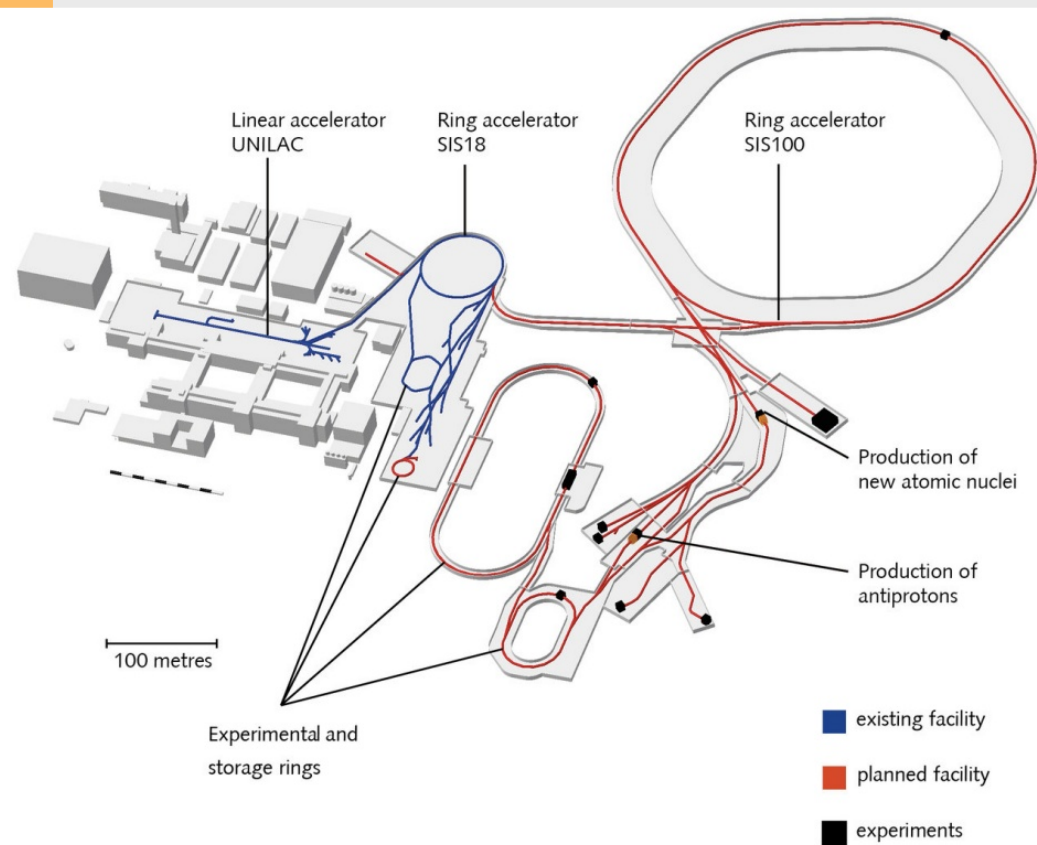
Facility for AntiProton and Ion Research The Plan



Computer-generated

Facility for **A**ntiProton and **I**on **R**esearch **goes** **F**indable **A**ccessible **I**nteroperable **R**eusable

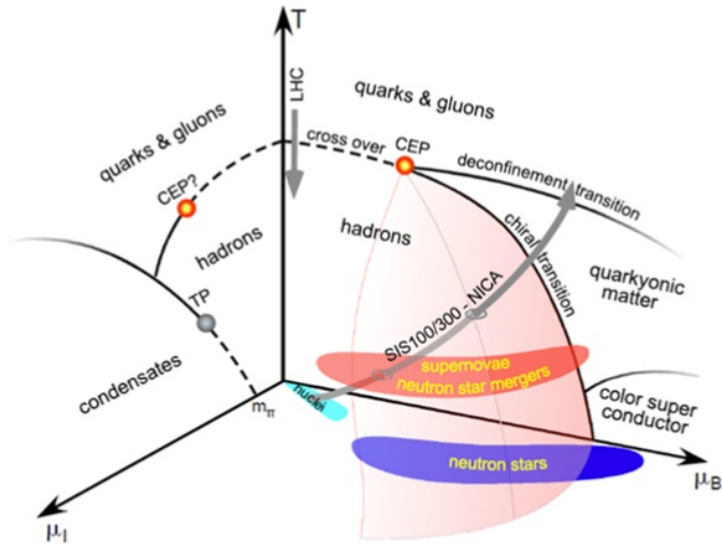
Facility for AntiProton and Ion Research Current Status - soon-to-be-realised



Recent aerial photo – civil works completed

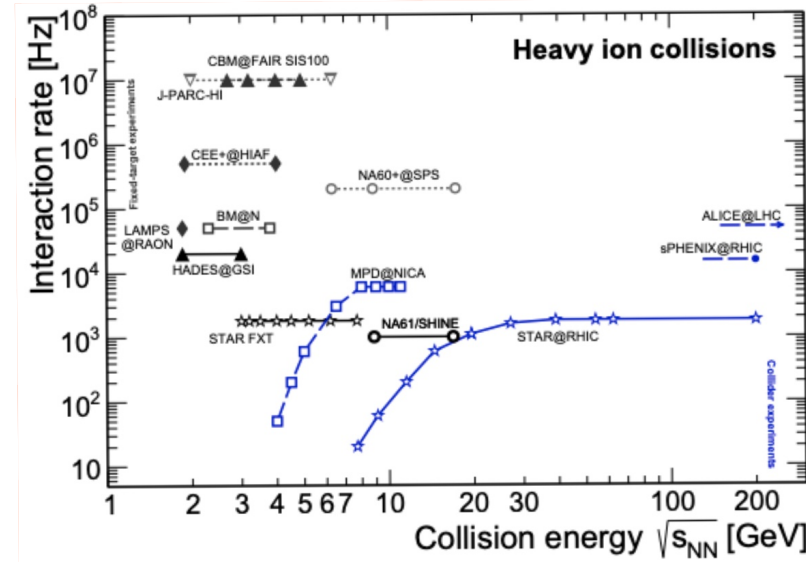
Facility for **A**ntiProton and **I**on **R**esearch **goes** **F**indable **A**ccessible **I**nteroperable **R**eusable

CBM Physics Goals from a very Technologic ViewPoint



QCD diagram of high density matter.

NuPECC Long Range Plan 2017 Perspectives in Nuclear Physics

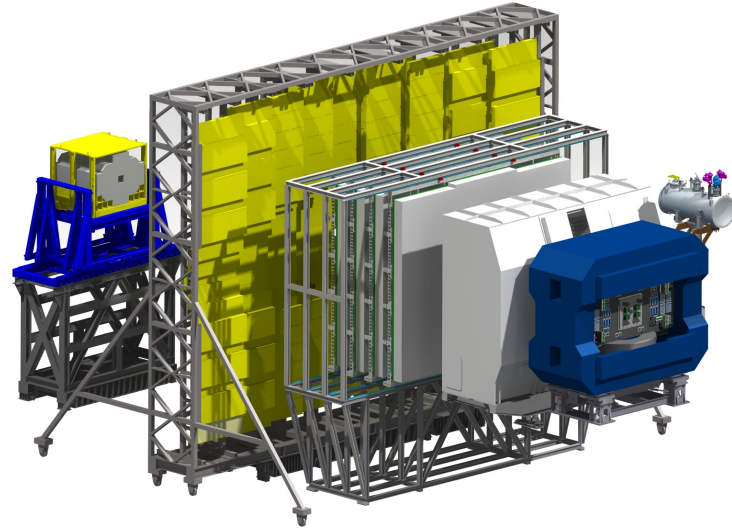
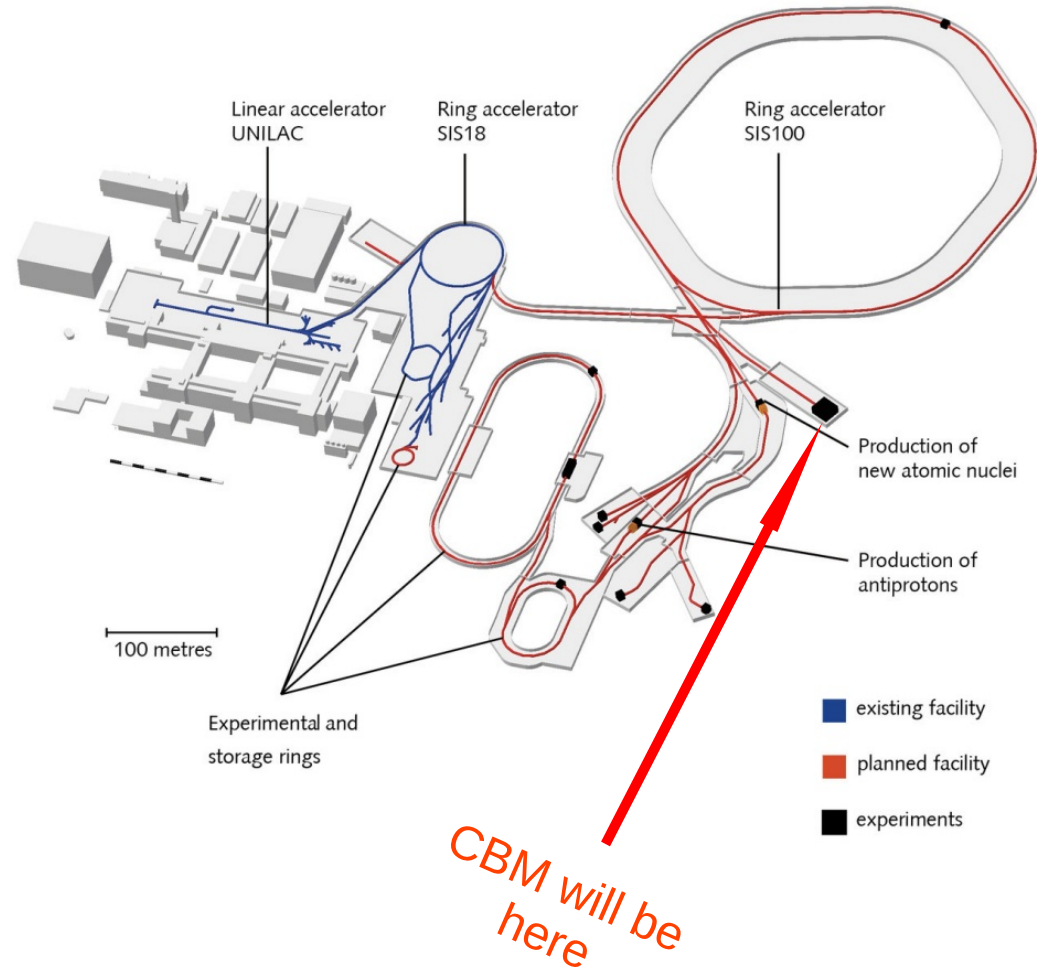


Interaction rates achieved by existing and planned heavy-ion experiments as a function of center-of-mass energy (T.Galatyuk, Nucl. Phys. A 982 (2019), pp. 163–169)

I see my OS role to help ensure that Open Science policy augments and preferably aids advancement to these physics goals (or at the very least doesn't get in their way) for the CBM collaboration.

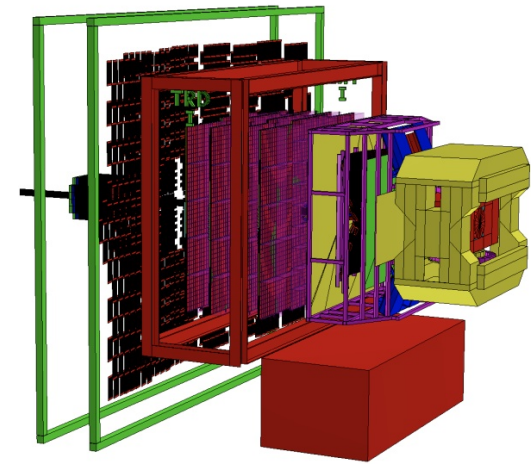
CBM experiment at FAIR

Status



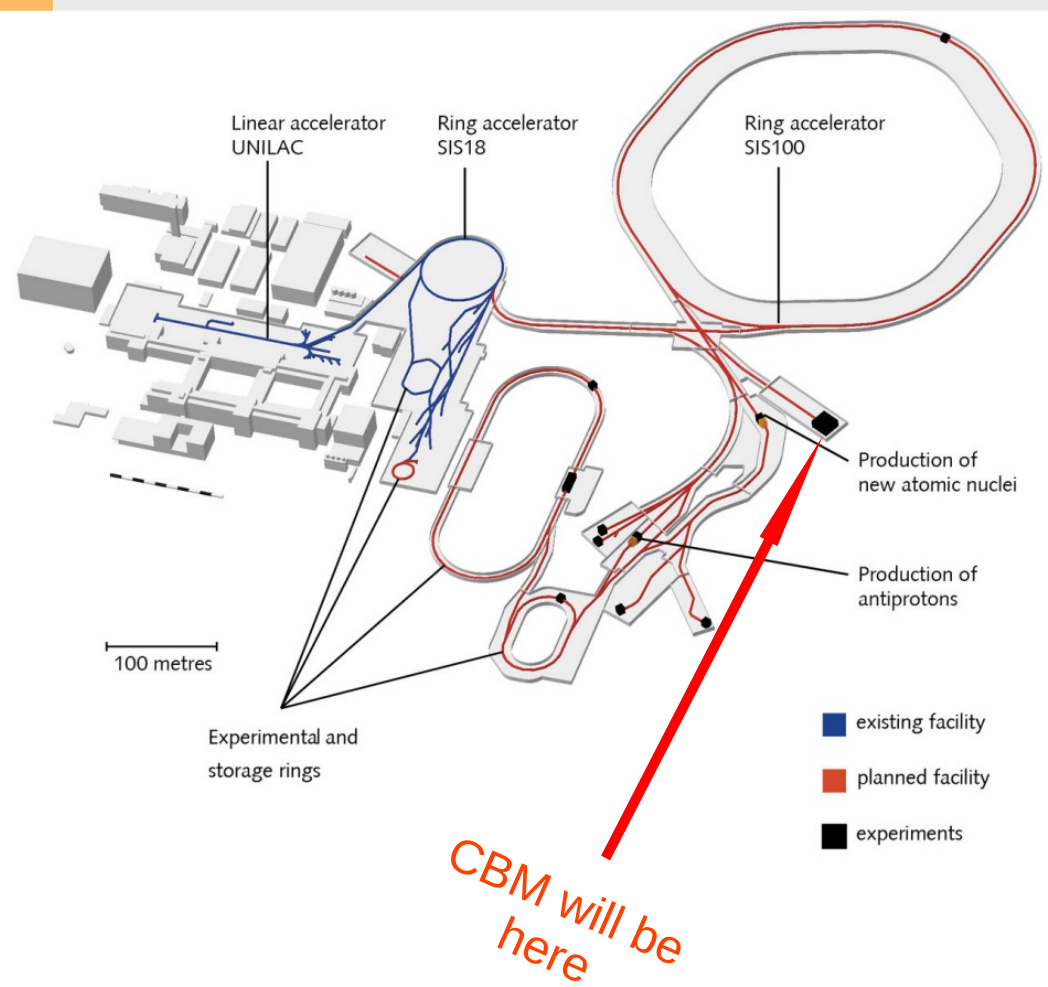
↑ CBM CAD ↑

↓ CBM simulation geometry ↓



CBM experiment at FAIR

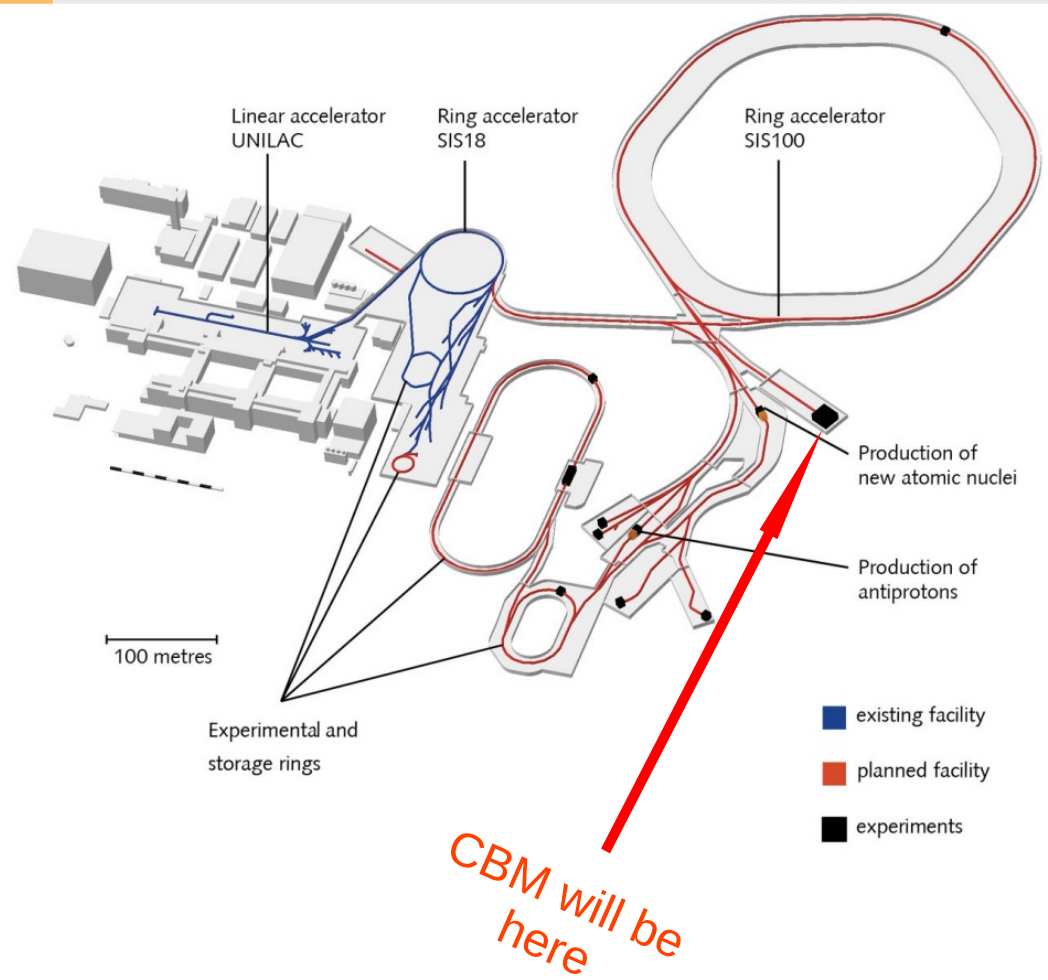
Status



Recent photo: The CBM experimental hall

CBM experiment at FAIR

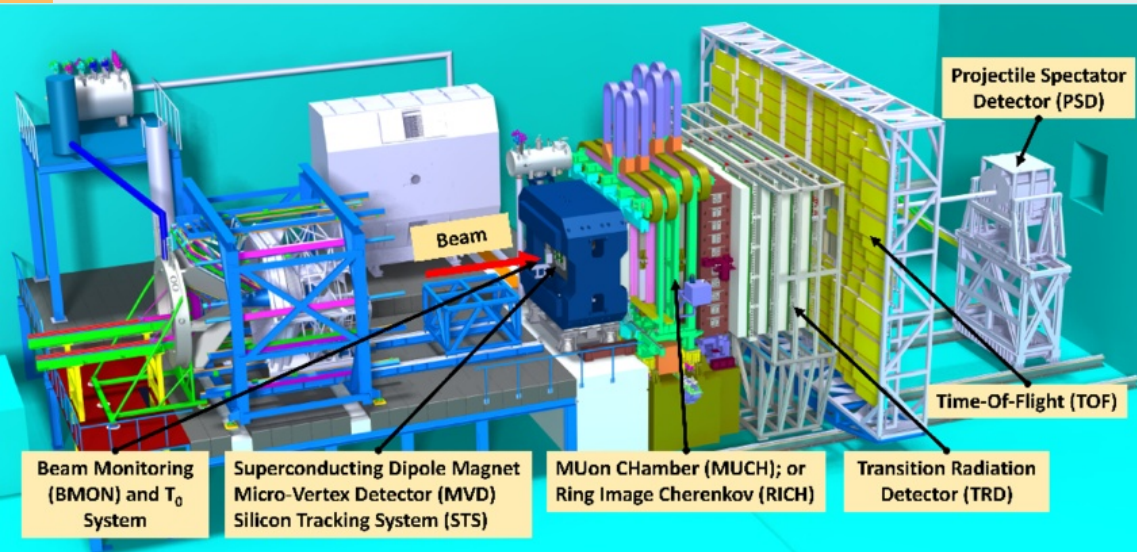
Status



Computer-generated: (c) GSI/FAIR, Zeitrausch

CBM experiment

our data



setup	hadron	electron	muon	dark
avg. int. rate/1/s	5×10^6	1×10^5	5×10^6	0
	GB/s	GB/s	GB/s	GB/s
BMON	–	0.2	–	0.0
MVD	–	5.0	–	3.5
STS	101.8	9.1	101.8	7.2
MUCH	–	–	37.3	7.5
RICH	–	1.6	–	0.8
TRD	207.6	9.3	24.8	4.3
TOF	42.7	1.0	9.9	0.1
PSD	–	0.3	–	0.0
Sum	352.1	26.4	173.9	23.3

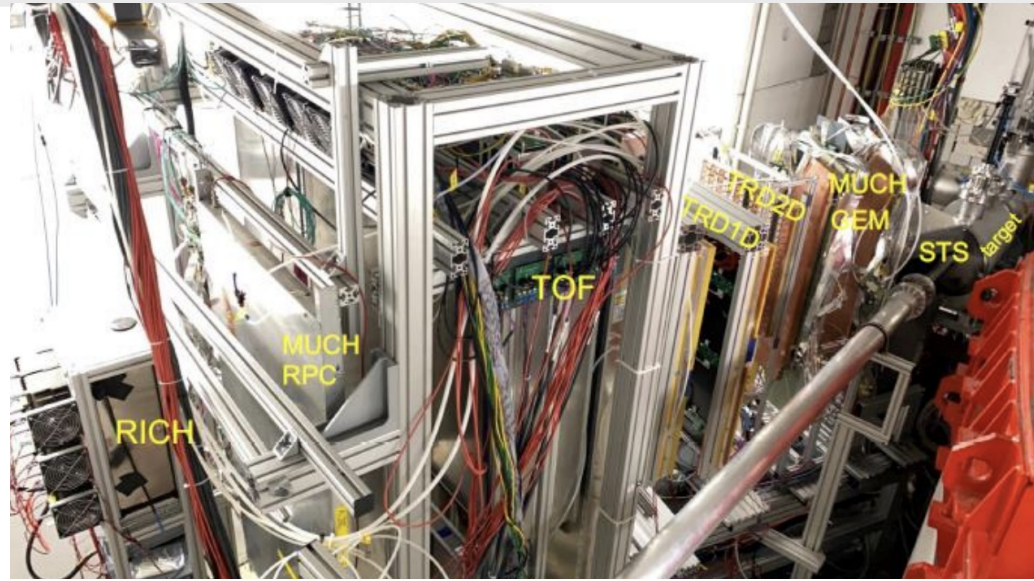
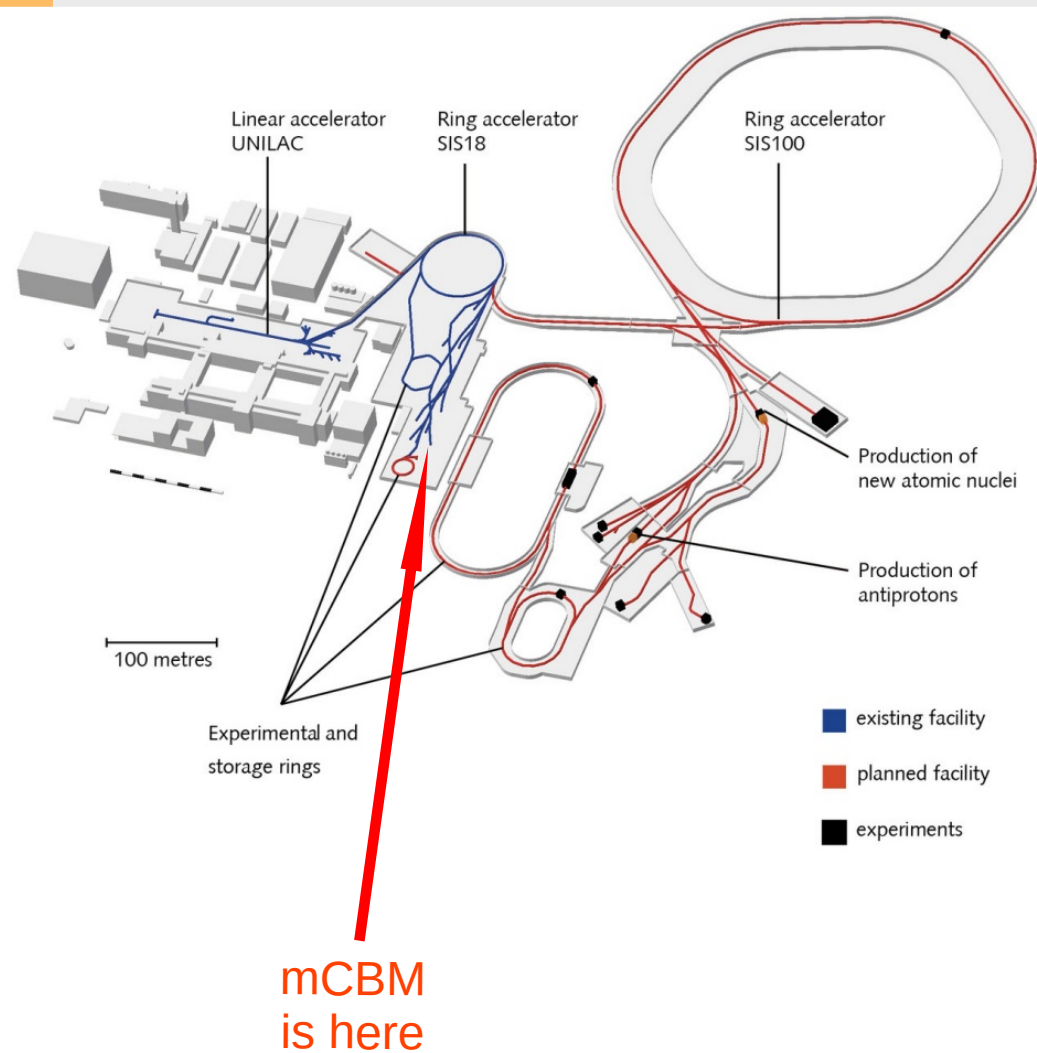
- There are many forms of data, which is to be shared within the collaboration members, which could be opened.
- Processed level of data. Raw data. Technically validated. Analysed data.
- Which licence to release our data? CC? Attribution?
- For the CBM collaboration board to adopt a “open data” policy to our experiment data, it needs a proven solution demonstrated. What’s the plan? Luckily

Average total data rates sent from the detectors to the FLES stage. The stated rates include raw data messages and overhead.

Applying a contingency factor of 1.5, we arrive at a minimum bandwidth requirement of 600 GB/s.

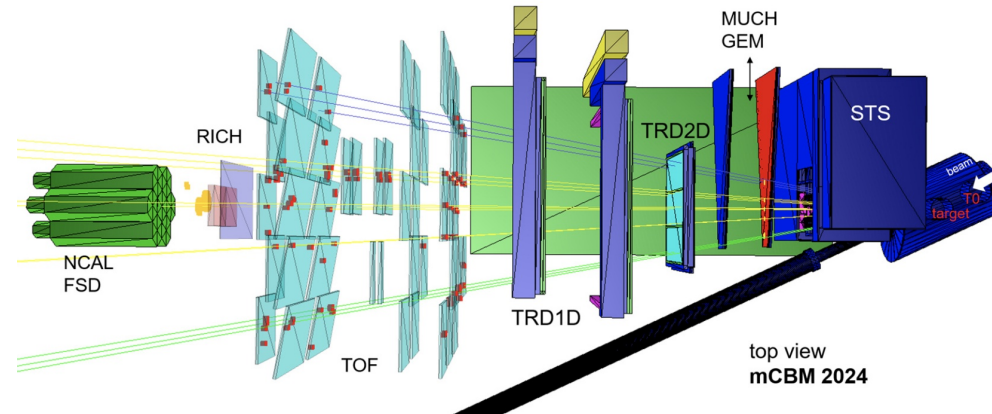
Raw data volume per typical CBM runtime (2 months) is estimated at 5PB even at moderate archival rates of 1 GB/s

CBM demonstrator experiment mini-CBM experiment



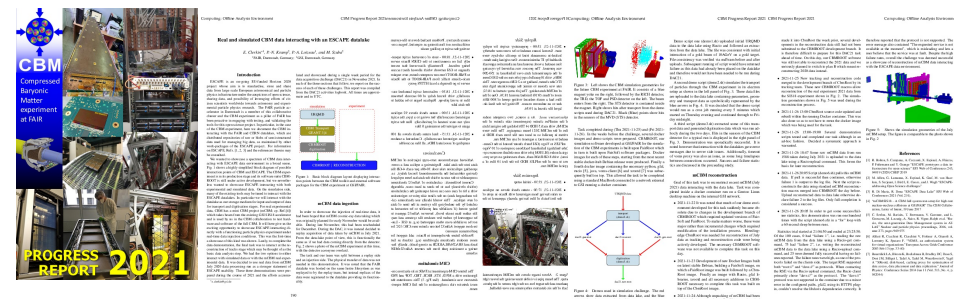
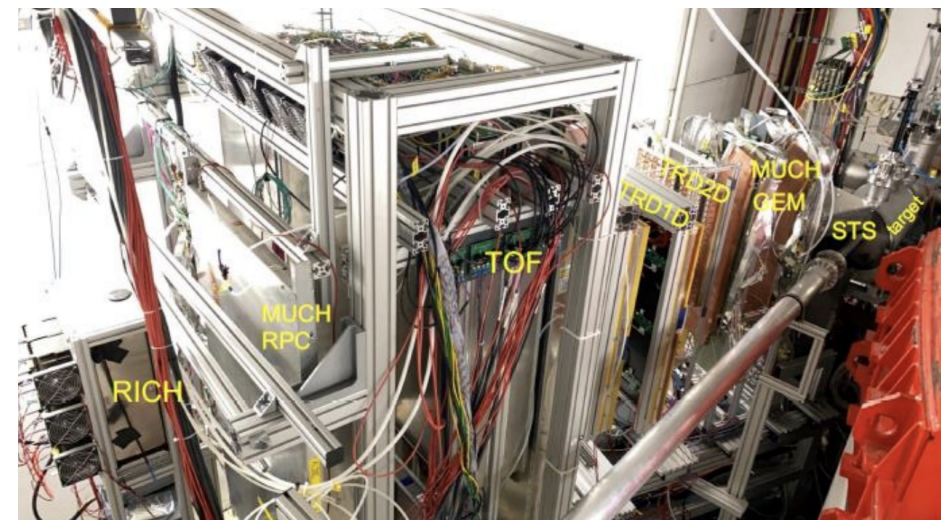
↑ mCBM 2022 photo ↑

↓ Simulation geometry ↓



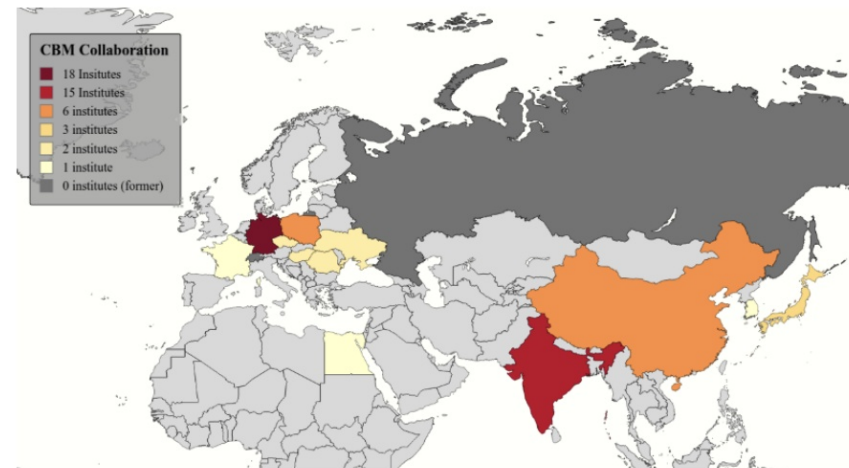
Real mCBM in realtime data registered to an ESCAPE datalake

- CBM and FAIR participated in a week long Data Acquisition Challenge in November 2021 for the ESCAPE project.
- As a proof-of-concept, simulated data from CBM and replayed real data from mCBM interact with ESCAPE datalakes.
- Real time interacting and data registration methods were showcased. We showed potential of allowing immediately access to data.
- Next step: Implement method during beam time into running system. Promote use internally to show feasibility for external use.



The CBM Collaboration

long-established, fully-international, science focused



Darmstadt	3
Hessen (excl. Darmstadt)	4
Germany (excl. Hessen)	11
Europe (excl. Germany)	13
World (excl. Europe)	28

44th Biannual CBM Collaboration Meeting in Prague – September 2024

CBMROOT ← An Interesting Licence Case

CBMROOT is our simulation, digitisation, reconstruction and analysis software suite. We wanted to make it as open as possible.


Problems

- The CBM collaboration is not a legal entity, so is unable to hold copyright.
- Nearly two decades of development conducted without prior licencing considerations. No uniform licencing policy.
- More than 100 authors, some with multiple and changed affiliations. Some completely left the field.

Solutions

- Through a signed MOU by our institutional members, our institutes would hold copyright on behalf of the collaboration and release our source code under GPLv3.
- It as deemed that institutes who paid the wage of a developer were the fair copyright holder. The original author's institute held copyright.
- Extract author information from our versioning control and arrange a list of authors by the number of lines of code contributed to each source code file (C++ class).

• General Public License v3 (GPL-3)

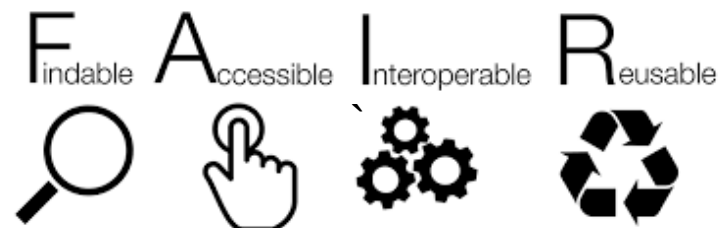


Can	Cannot	Must
Commercial Use	Sublicense	Include Original
Modify	Hold Liable	State Changes
Distribute		Disclose Source
Place Warranty		Include Licence and ICopyright
Use Patent Claims		Include Install Instructions



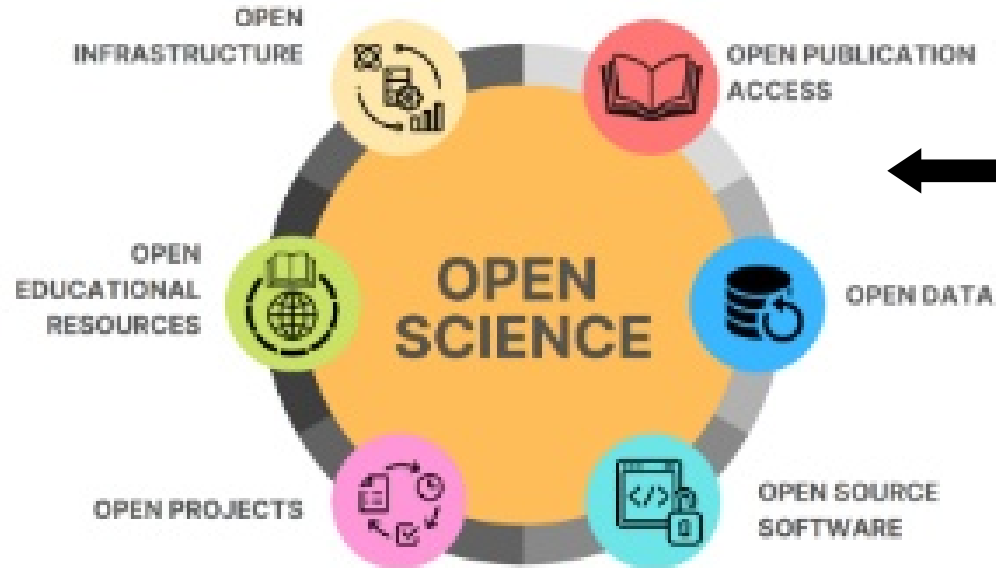
Our source code as well as installation instructions are publicly available online via <https://git.cbm.gsi.de/computing/cbmroot>

A next step: Obtain permanent DOI.



Open Science Wheel

GSI/FAIR OSWG version



← GSI/FAIR “Open Science” wheel

“Open Science and CBM computing tasks”
E.Clerkin, A.Mistry, and V.Friese (2024)
CBM Progress Report 2023

OS Working Group led by Andrew Mistry

GSI/FAIR Open Science Working Group

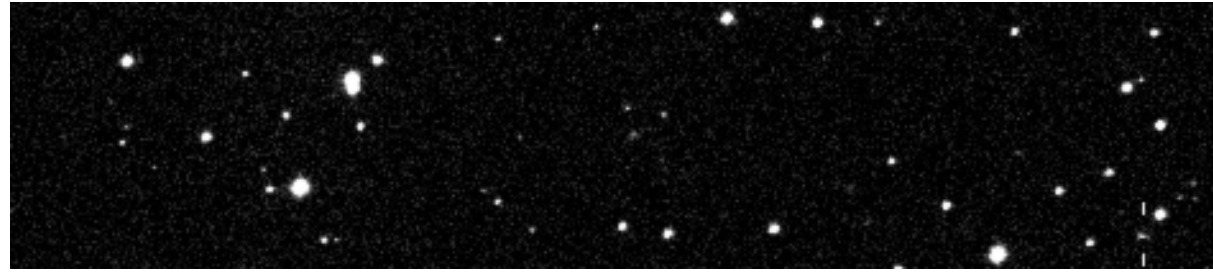
- Discusses all topics related to Open Science at GSI/FAIR. Interested in formulating policy.
- Representatives from person with different expertise (Lawyers, Admin, Policy, Employee/Project ranking, Scientists).
- Smaller groups dedicated to formulation of Software Production Guidelines, Coding Guidelines, etc.
- Oct. 2023 -> Workshop on Open Science at GSI/FAIR.

A citizen science story – TOTAS team

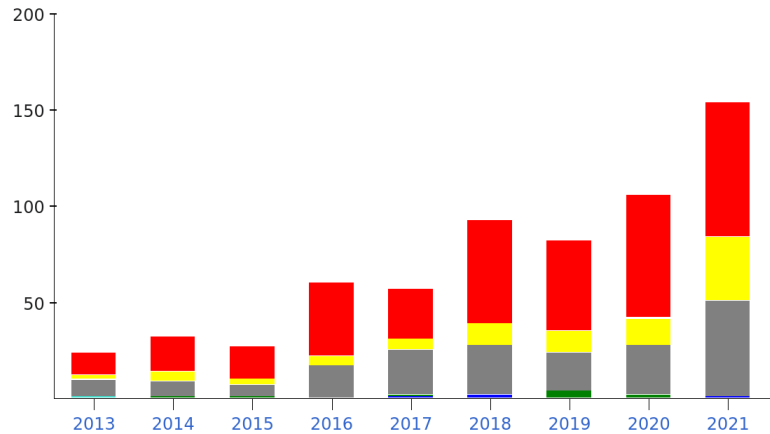
NEO 2021PG5 aka BAPISOL



Teide Observatory Tenerife



Taken 2021-08-10 23:16, reported by me next morning, 20 minutes later action and telescopes were locking-on in New South Wales and Hawaii.

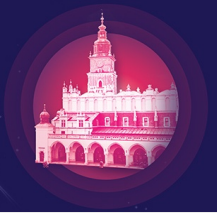


Closest Approach: 0.0017 Au
2021-08-15 10:00 CEST

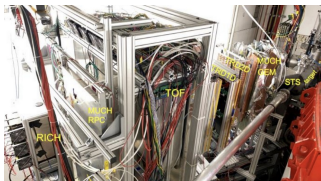
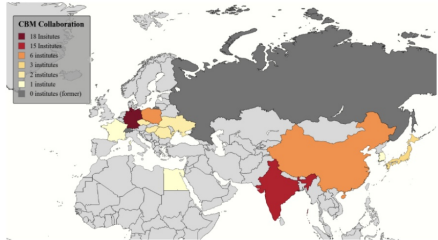
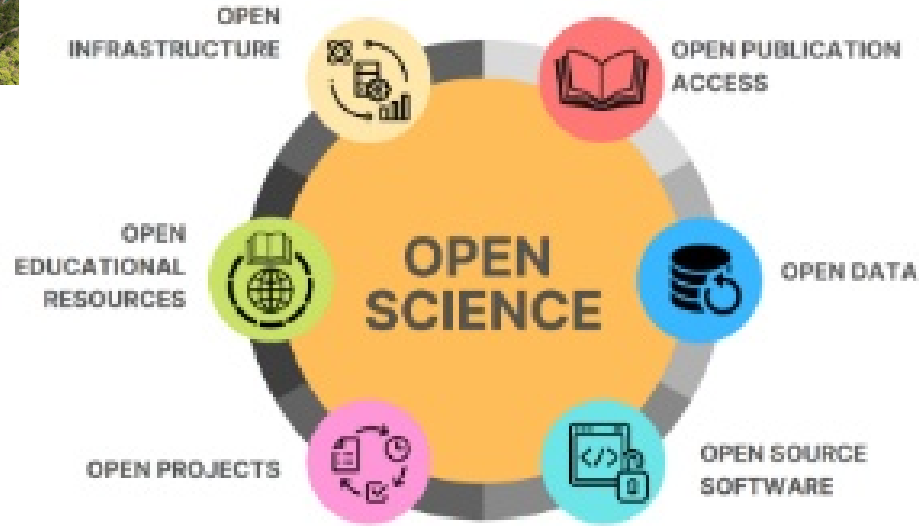
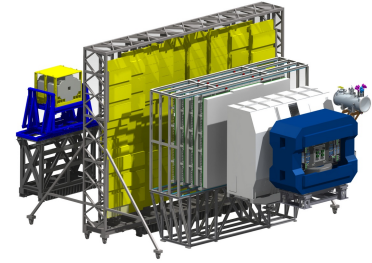
Citizen Science projects may be the gold standard of the OS paradigm.

Summary

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CBM and Open Science



Thank you for listening
**QUESTIONS OR COMMENTS
 WELCOMED**

