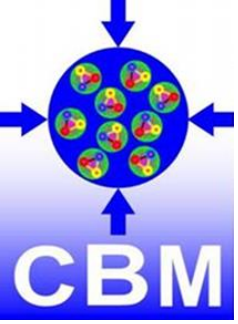


DPG-Frühjahrstagung
Bochum, 26. Februar - 02. März 2018
HK 20.5

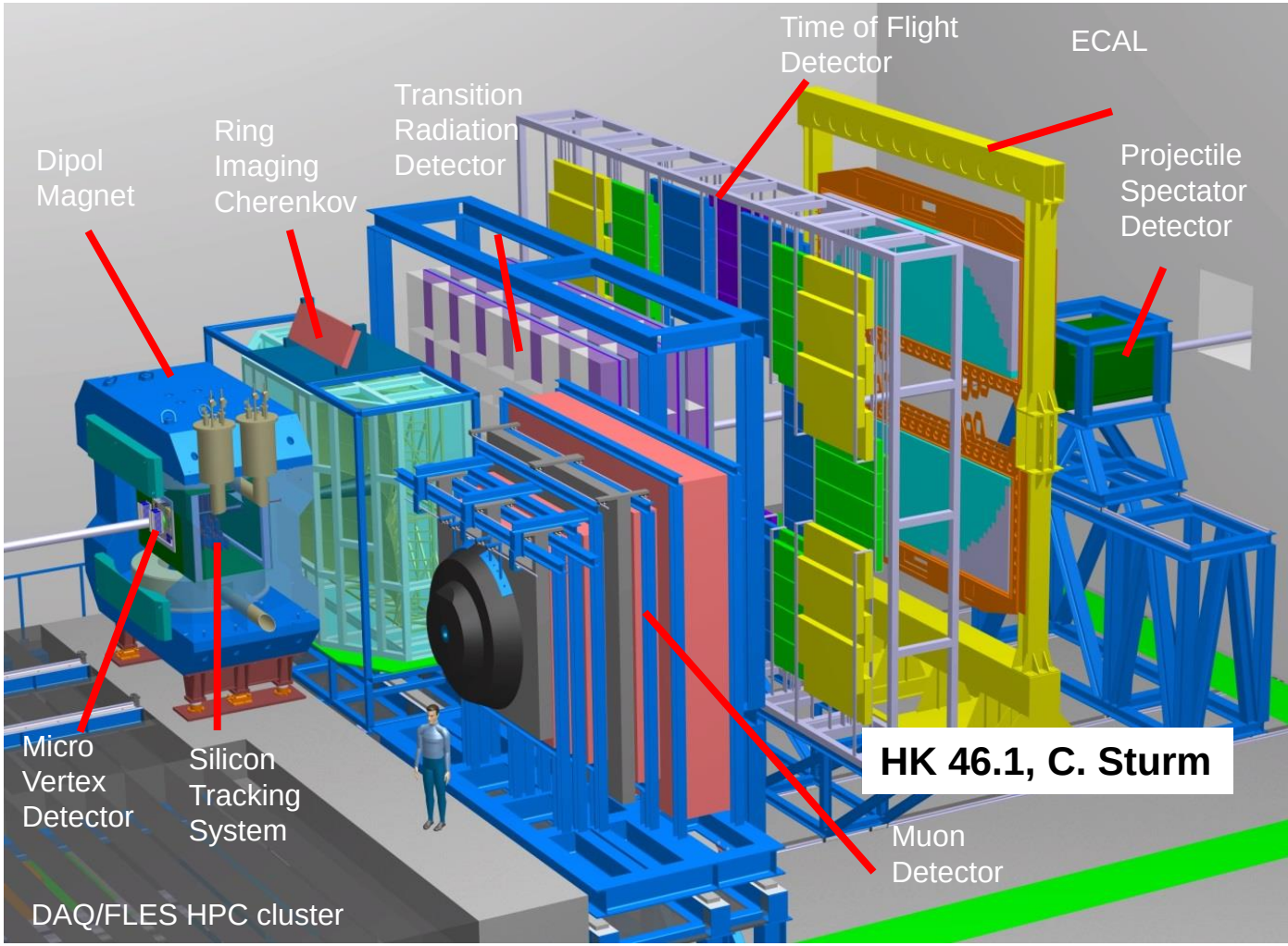
Towards a demonstrator of the free-streaming data acquisition system for the CBM experiment at FAIR

Pierre-Alain Loizeau and David Emschermann
for the CBM collaboration

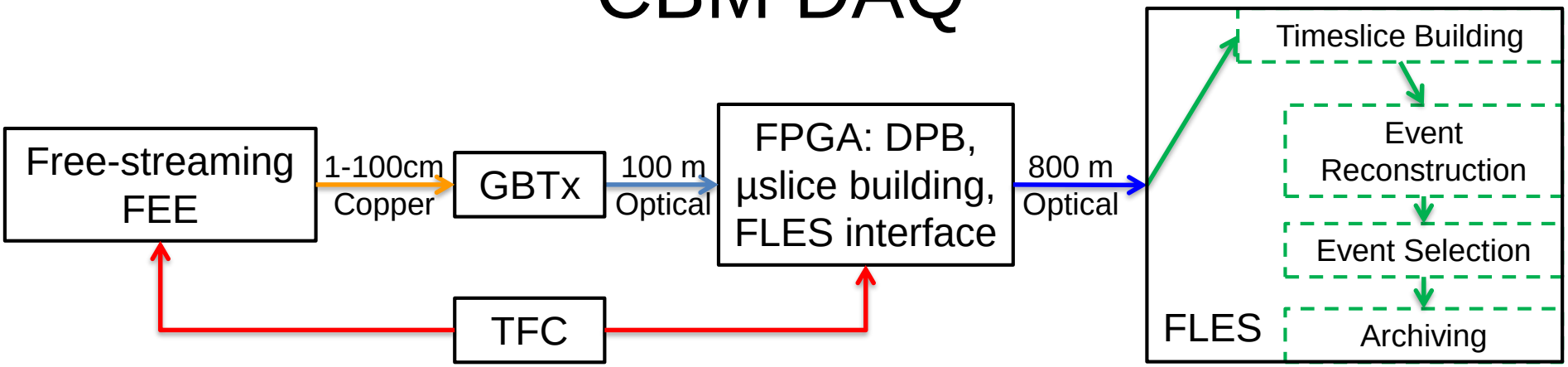
The CBM experiment

Perform measurements at unprecedented reaction rates

- ⇒ **10^5 - 10^7 Au+Au reactions/s**
- ⇒ **Fast and radiation hard detectors**
- ⇒ **Free-streaming read-out electronics**
- ⇒ **High speed data acquisition**
- ⇒ **high performance computer farm for**
  - **4-D online event reconstruction**
  - **online event selection**



CBM DAQ



GBTx = CERN rad.-hard interface ASIC

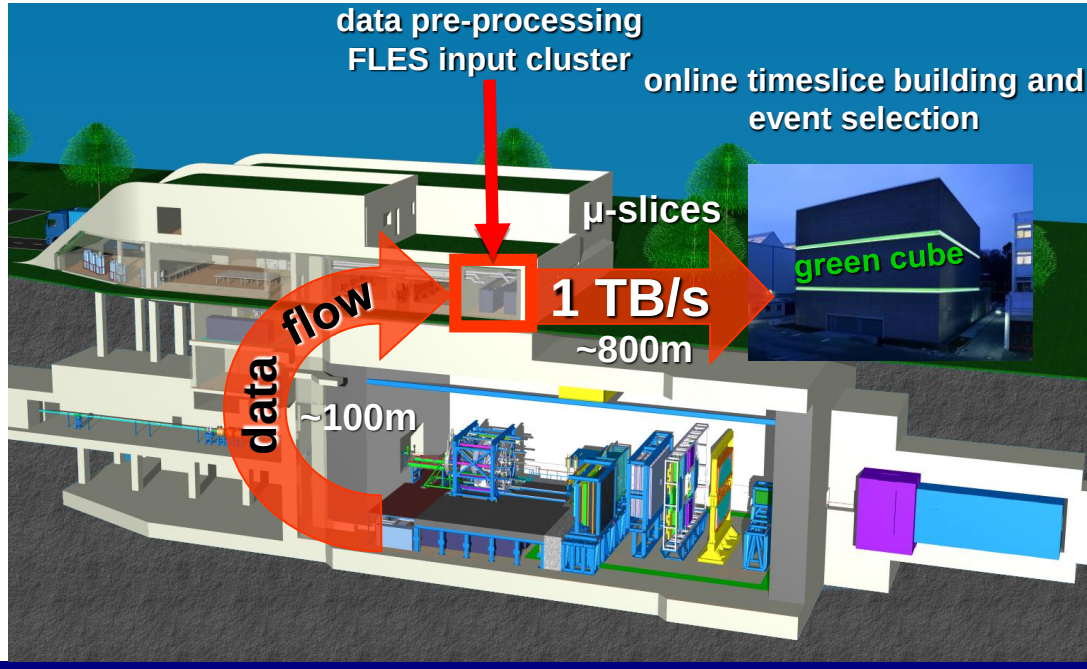
DPB = Data Processing Board

TFC = Timing and Fast Control Syst.

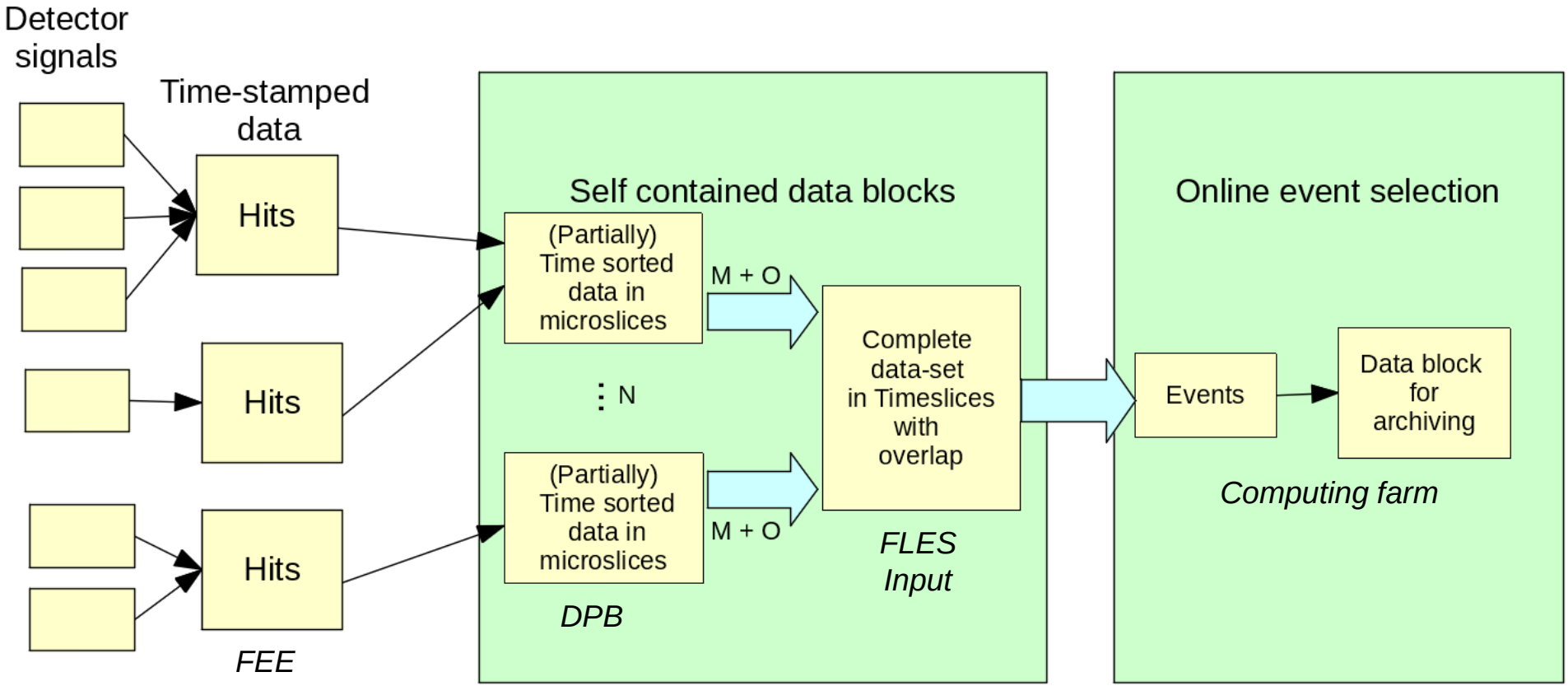
Microslice (µS) = self contained data block for a subset of the experiment, minimal size depends on degree of data time sorting

Timeslice = collection of µS, self contained data block for the full experiment and a given time interval, includes overlap to avoid edge losses

FLES = First Level Event Selector



CBM data types up to event selection



N = Detector systems & “sectors” within
M = Number of microslices per timeslice
O = Number of overlap microslices needed to avoid edge losses in reconstruction
Typical size: microslices ~ 10-1000 µs, timeslices ~ 0.1-10 ms

mCBM

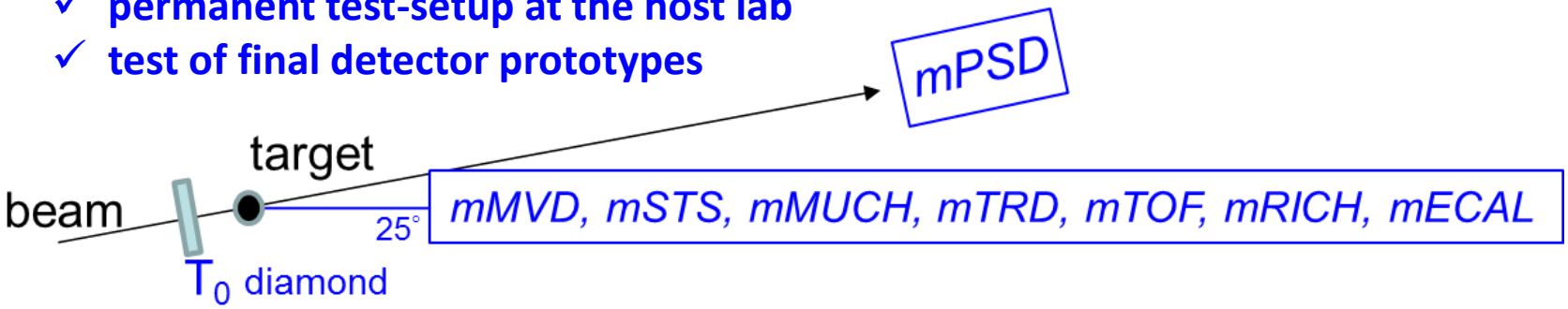
mCBM@SIS18 - a CBM full system test-setup in high-rate nucleus-nucleus collisions at GSI/FAIR, 2017 – 2021

with focus on the

- free streaming data transport to a mFLES or FLES
- online reconstruction
- offline data analysis
- controls

✓ **permanent test-setup at the host lab**

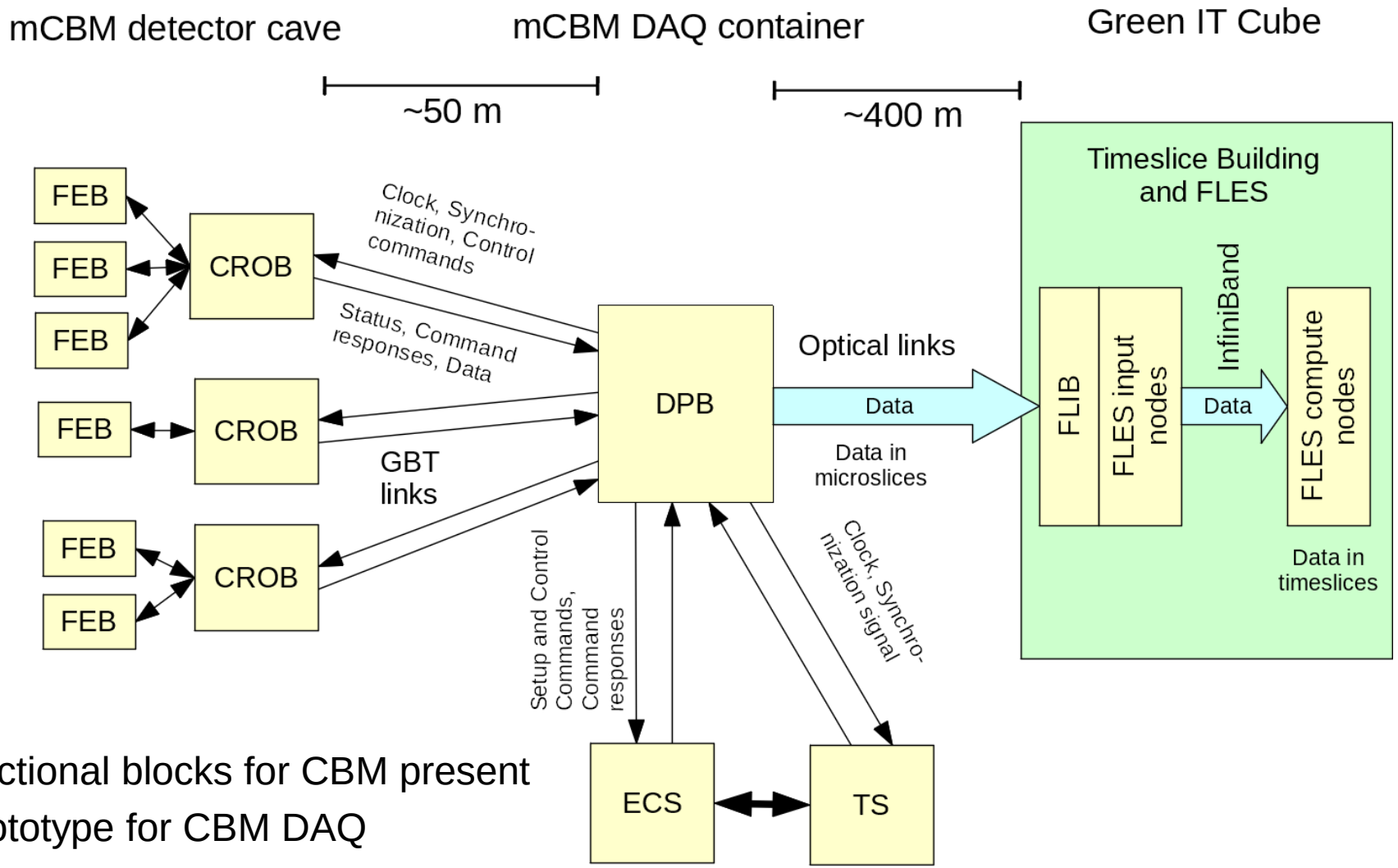
✓ **test of final detector prototypes**



Current status: HK 46.1, C. Sturm

- detector prototypes at $\theta_{lab} \approx 15° - 20°$
- straight tracks, no B-field
- high resolution TOF (t_0 – TOF stop wall)
- event characterization with PSD prototype

mDAQ phase I: prototype



All functional blocks for CBM present

⇒ Prototype for CBM DAQ

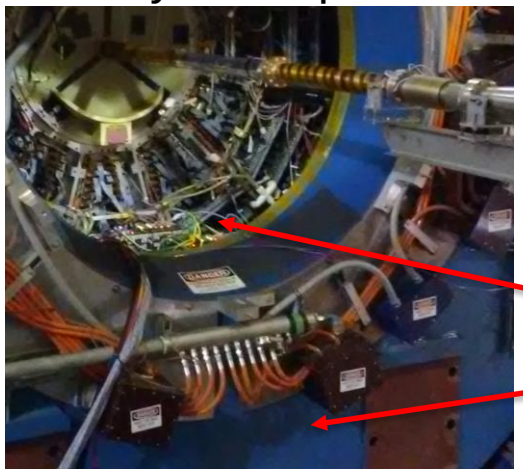
mDAQ phase I: status

- All hardware prototypes designed and tested
- CROB under production
- DPBs, FLIBs and TS components available
- DPB FW under conversion to include GBTx support

Preparations through beamtime activities ongoing for 2 systems:

- TOF with eTOF in STAR (01/2018)
- STS at COSY (02/2018)

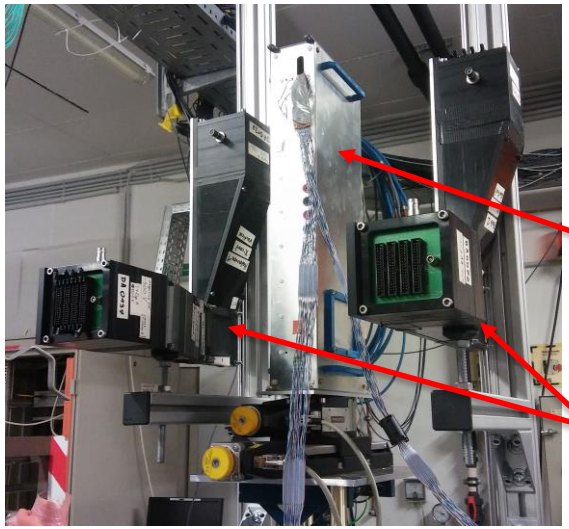
⇒ System operation and software development under real conditions



eTOF in STAR

TOF modules + electronics

STAR endcap



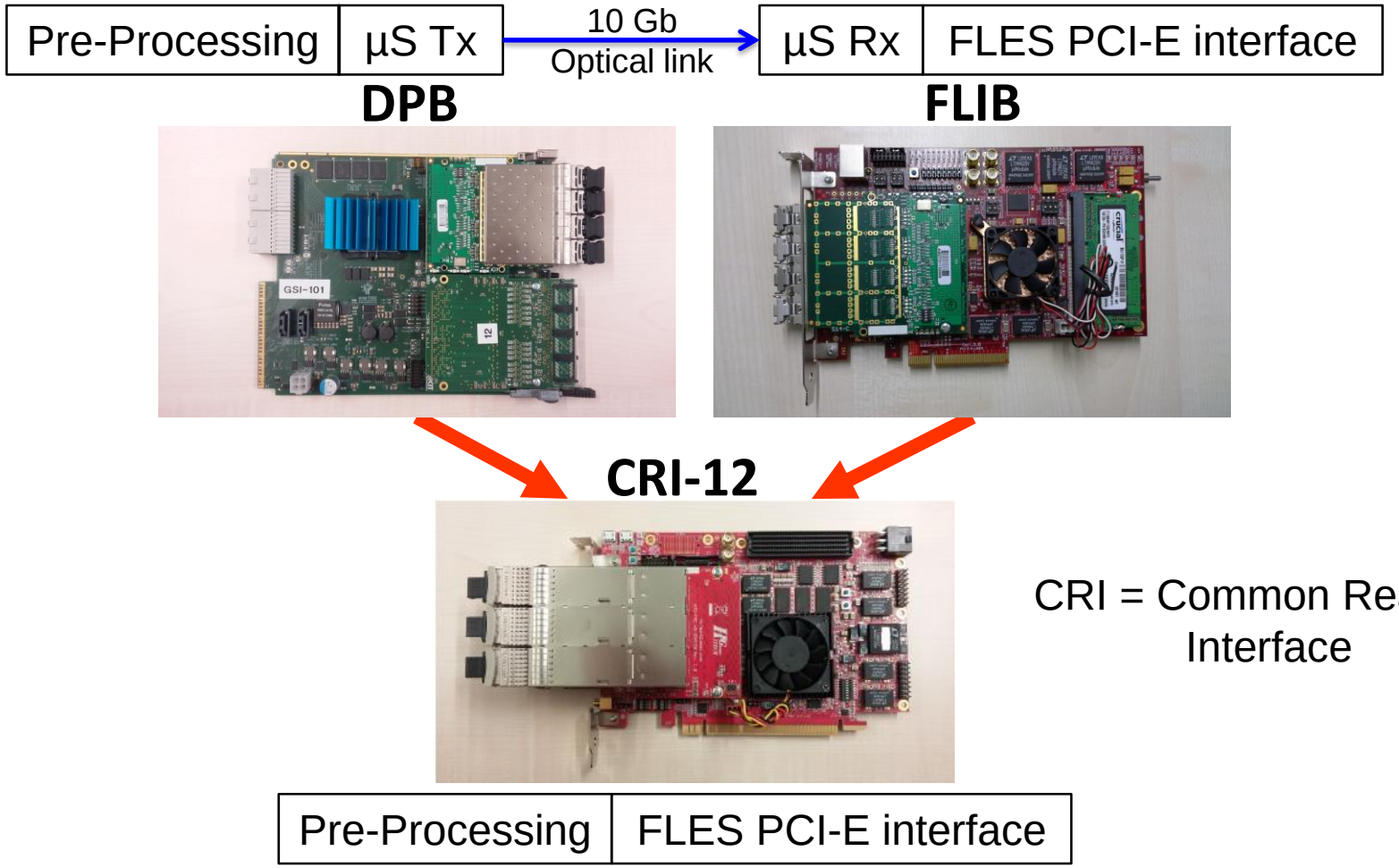
COSY, Feb. 2018, STS

STS sensor + electronics

Fiber Hodoscopes

HK 6.1, **I. Deppner**, HK 13.1, **W. Zhou**

Phase I to Phase II: Hardware upgrade

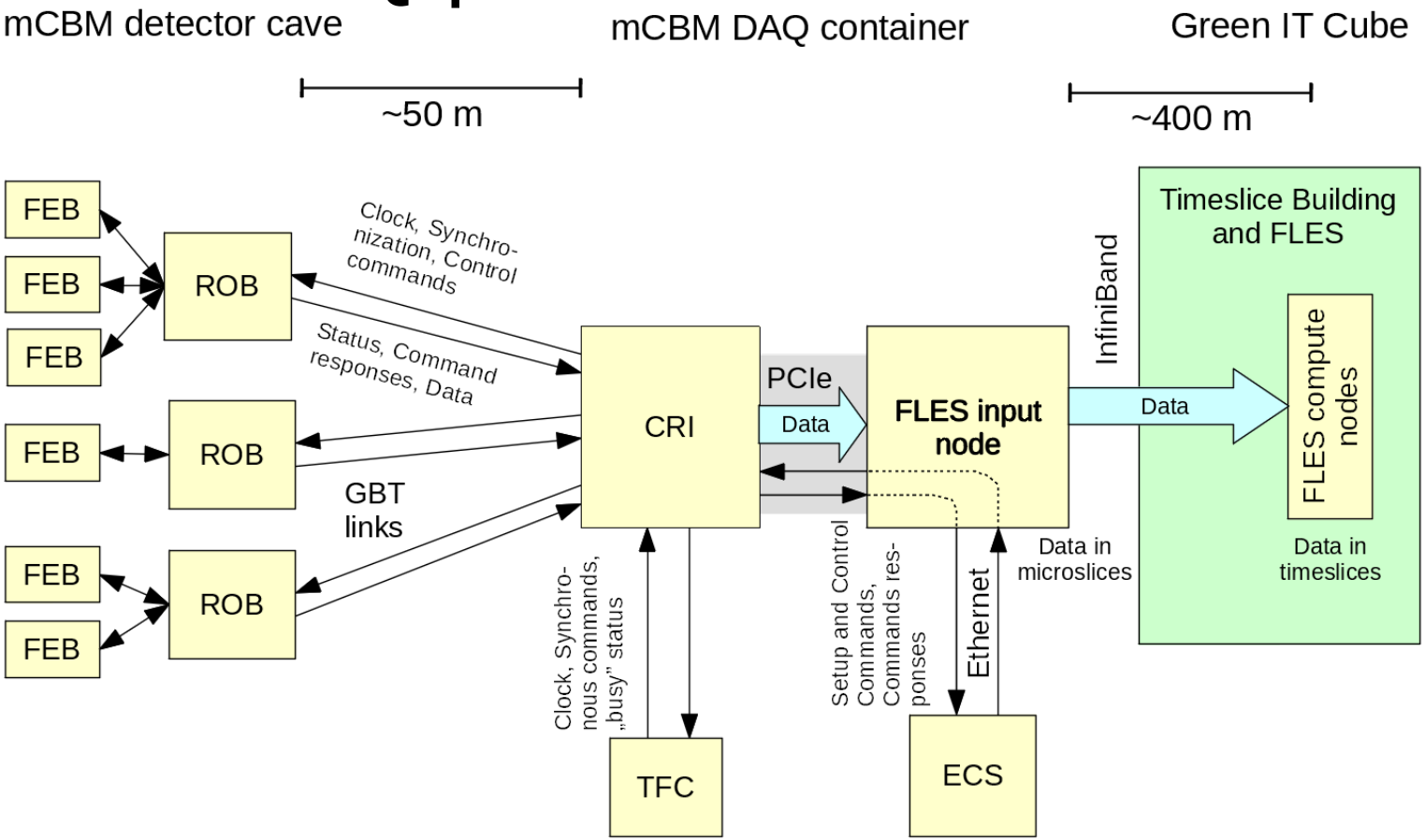


CRI = Common Readout Interface

⇒ 2 KINTEX-7 FPGA boards replaced by a ZYNQ Ultrascale+ FPGA board

⇒ Firmware functionality stays the same

mDAQ phase II: demonstrator



- CRI prototype available: **HTG-Z920**
- All hardware close to final CBM
- Performance will be tested up to physics analysis

⇒ Demonstrator for CBM DAQ

Conclusion

- CBM DAQ based on free-streaming concept: high bandwidth acquisition of time-stamped data followed by online reconstruction and selection
- The mCBm setup at SIS18 (GSI) will be used to test such a system in two phases:
  - In Summer 2018 with prototype hardware, participation of most of the CBM detectors and all planned functionalities

  ⇒ Prototype
  - In 2019+ with pre-series hardware for the detectors and DAQ, participation of all CBM sub-system and performance test up to online physics selection and offline analysis

  ⇒ Demonstrator
- Main upgrade between phase I and II is replacing two FPGA boards (DPB and FLIB) by a single one with a bigger FPGA (CRI) while keeping the firmware functional blocks
- Beamtime activities for single detector systems currently ongoing to prepare the mCBM phase I

Thank you for your attention

Detailed information can be found in the mCBM proposal, available on the CBM website