CREMLIN PLUS

Connecting Russian and European Measures for Large-scale Research Infrastructures

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Beam monitor / T0 counter concept

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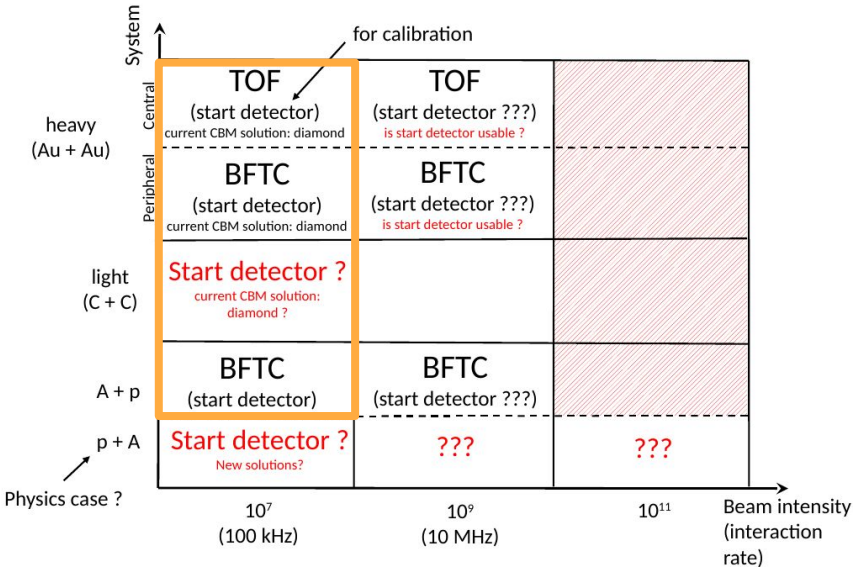
Outline

- CBM T0 requirements

- Beam detector system in CBM
  → Possible detector concept
  → Needed read-out concept
  → Idea of a beam focusing concept

- Summary and ToDo list

Introduction: CBM T0 requirements



[Ingo Deppner, Heidelberg University]

- A large variety of collision systems with different expected beam intensities will be used in the CBM experiment

  → We currently focus on the development of a beam detector system for HI at rates up to ~1 MHz/ch

- 15 years experience with T0 in HADES (~10^7 ions/s)

Beam detector system in CBM

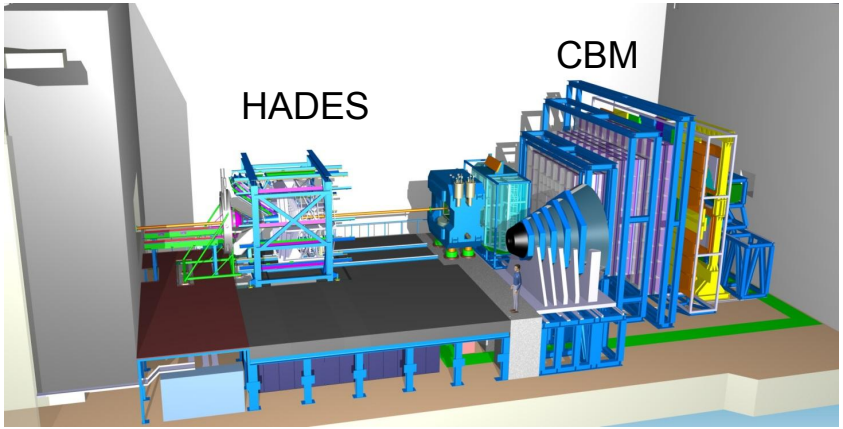
Possible applications:

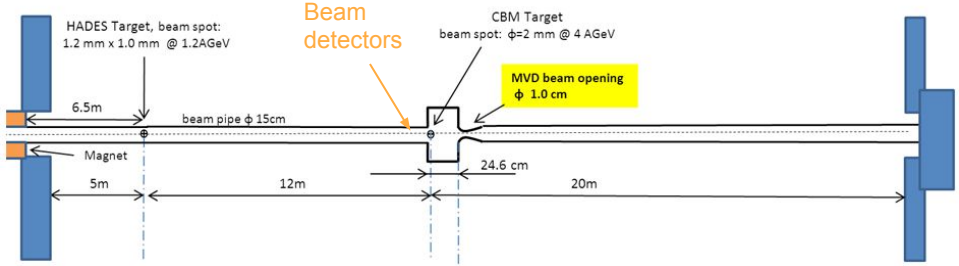
- Online beam quality monitoring:
  → Beam position, time structure, halo
- Start time of the reaction (T0) measurement
  → Particle identification, pile-up rejection
- Part of a fast beam abort system
  → Independent readout system needed

Challenges:

- Handle beam intensities up to 10^7 ions/s
- Time precision < 50 ps
- Position information < 0.5 mm
- Low interaction probability
- In-vacuum operation

Beam detector system in CBM





- Beam size at CBM target: $\sigma_{x,y} < 1$mm
- Target area and geometry details needed (i.e. segmented 1% interaction length, diameter 2 mm)
- Locate detectors as close as possible to the target
  → Compact sensor of ~ 1 cm²
  → In-vacuum operation

Needed infrastructure: HV, LV power supplies, network infrastructure and readout system

A detector concept based on CVD diamond

- Utilize segmented double sided pc(sc)CVD diamond sensors with a thickness of ~ 100 µm

  → Radiation hard

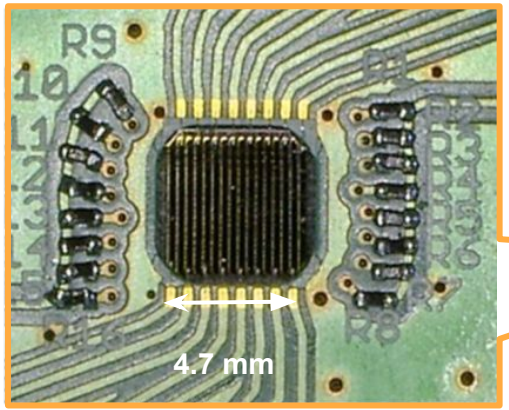
  → High rate capability

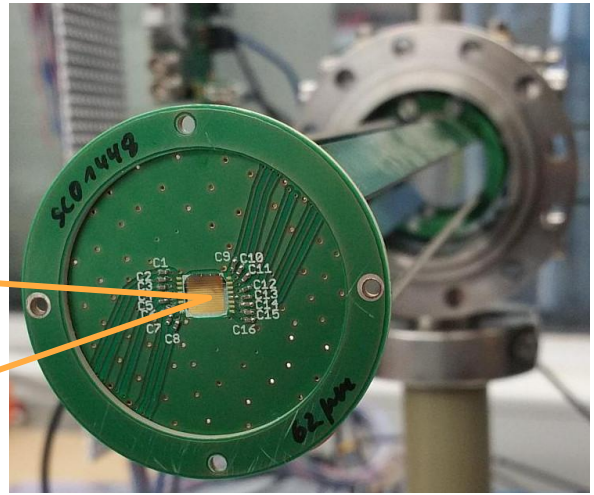
  → Low Z material

  → Sufficient time precision < 60ps

  → In-vacuum operation w/o cooling

[A. Rost et al., doi:10.18429/JACoW-IPAC2019-WEPGW019]

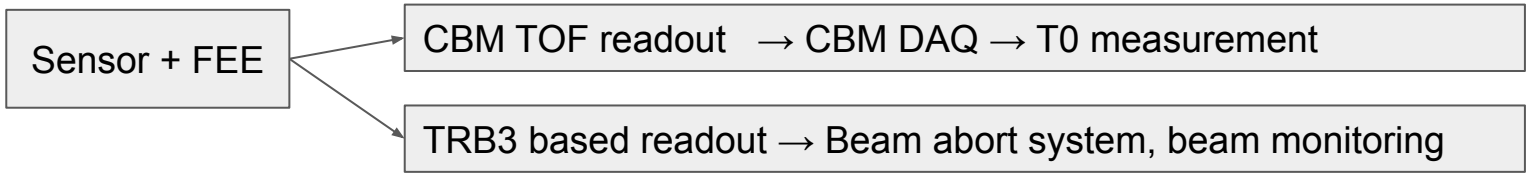




Example: Segmented diamond detector used in HADES

Sensor read-out concept

- Two independent readout chains are essential:
  - Standard CBM readout
  - Independent readout for beam monitoring and beam abort system

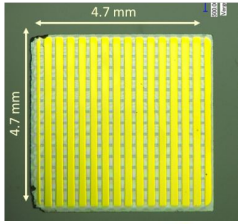


- Front-end electronic

  → Dedicated pre-amplifier board with analog or digital signal splitting (needed for an independent beam abort system)
  → PaDiWa discriminator board?

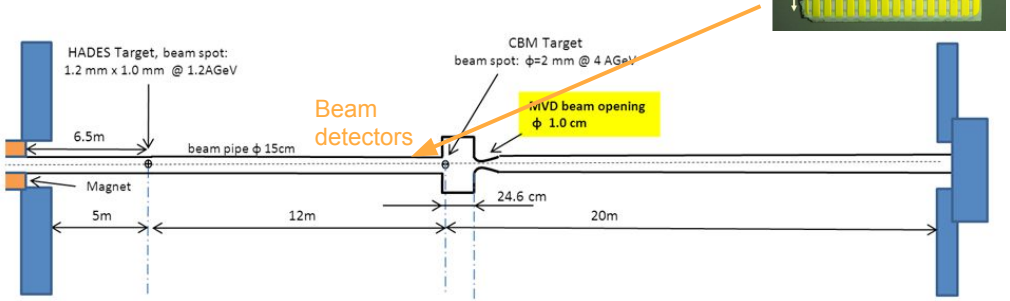
- Beam abort system, beam monitoring concept needs to be prepared
  → Use TRB3 platform: FPGA based TDCs with a precision of 8 ps (RMS) [see http://trb.gsi.de/]
  → Already well tested in several test and production beam times [A. Rost et al., doi:10.18429/JACoW-IPAC2019-WEPGW019]

The beam focusing concept



Double-sided multi-strip diamond based sensor used in HADES

- 16 stripes on each side
- Strip width: 200 µm
- Gap: 90 µm
- Sensor thickness: ~ 60 µm



- Focus in X/Y and in Z need to be controlled and measured
- Focus in X/Y
  → Use segmented diamond sensors and the STS tracking system
  → Correlate T0 pixels with reconstructed vertex from STS → Target position
- Focus in Z direction still needs a conceptual design
  → Diamond based tracking system?

Summary and ToDo list

- T0 reconstruction system with online beam monitoring capability based on diamond detectors
- Independent beam abort system → concept in preparation

ToDo list:

- System concept (Sensor type?, beam abort system, beam focusing concept)
- Mechanical design of the system
- FEE and DAQ
- Full system test
- Installation
- ...

Deliverable/ Milestone	Title	Verification	Date
D2.7	Design of beam monitors	Report	12/2020
MS10	Technical design of beam monitors	Report	12/2022
D2.8	Beam monitors	Report	12/2023

Thank you for your attention!!!