mCBM

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FAIR, Darmstadt

H4F WS Detectors & Accelerators
27-29 July 2016

CBM in 2022++

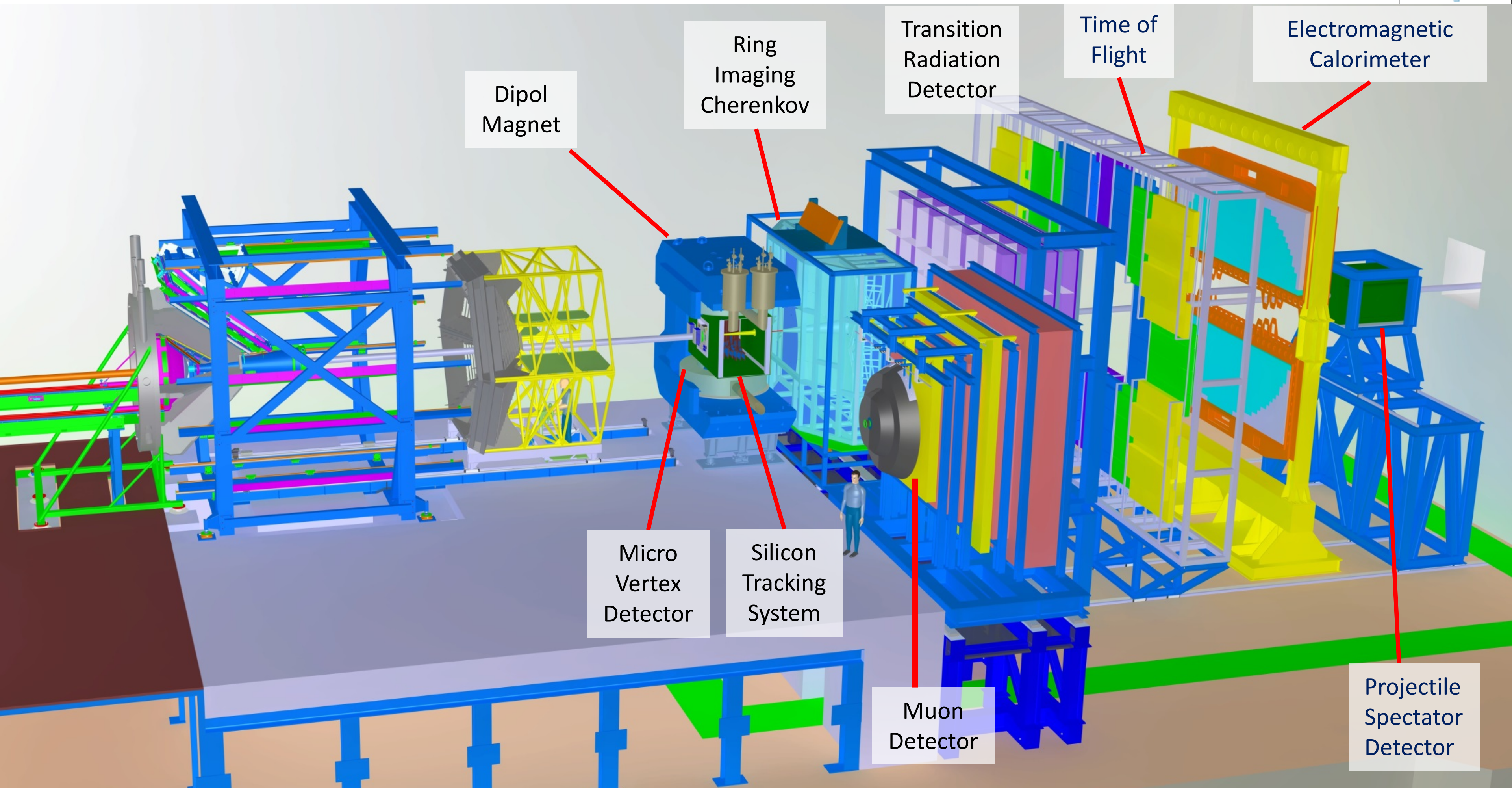
Rare Probes → High Rates

- Key observables are rare probes
  - either low cross section (e.g. Ω^+,d, or J/Ψ)
  - or low branching ratio (e.g. $\rho,\omega.\varphi \rightarrow e^+e^-$)
- High interaction rate
  - design point: 10^7 Au+Au int/sec @ 11 A GeV
    → high count rate detectors
    → significant radiation level for FEE
- Selective triggers
  - key triggers are 'tracking triggers' (decay topology)
    → *no hardware trigger, 'data push' architecture*
    → *event selection in software*
    → high DAQ bandwidth
    → high computing requirements

Detector → Electronics

- Large R&D effort done on high rate detectors
  - TOF: 25 kHz/cm^2
  - TRD: 100 kHz/cm^2
- Complemented by high rate electronics
  - typ. shaping times ~30-80 ns
  - typ. buffer times ~25-100 µsec
- and high bandwidth readout
  - about 50.000 FEE ASICs (hottest have 1 Gbit/sec)
  - use CERN GBTx concentrator ASIC → 4.8 Gbps links
- Note: FEE and readout must be designed for peak rate
  → good beam time structure is essential !!

Full HADES+CBM Setup in CBM Cave



HADES

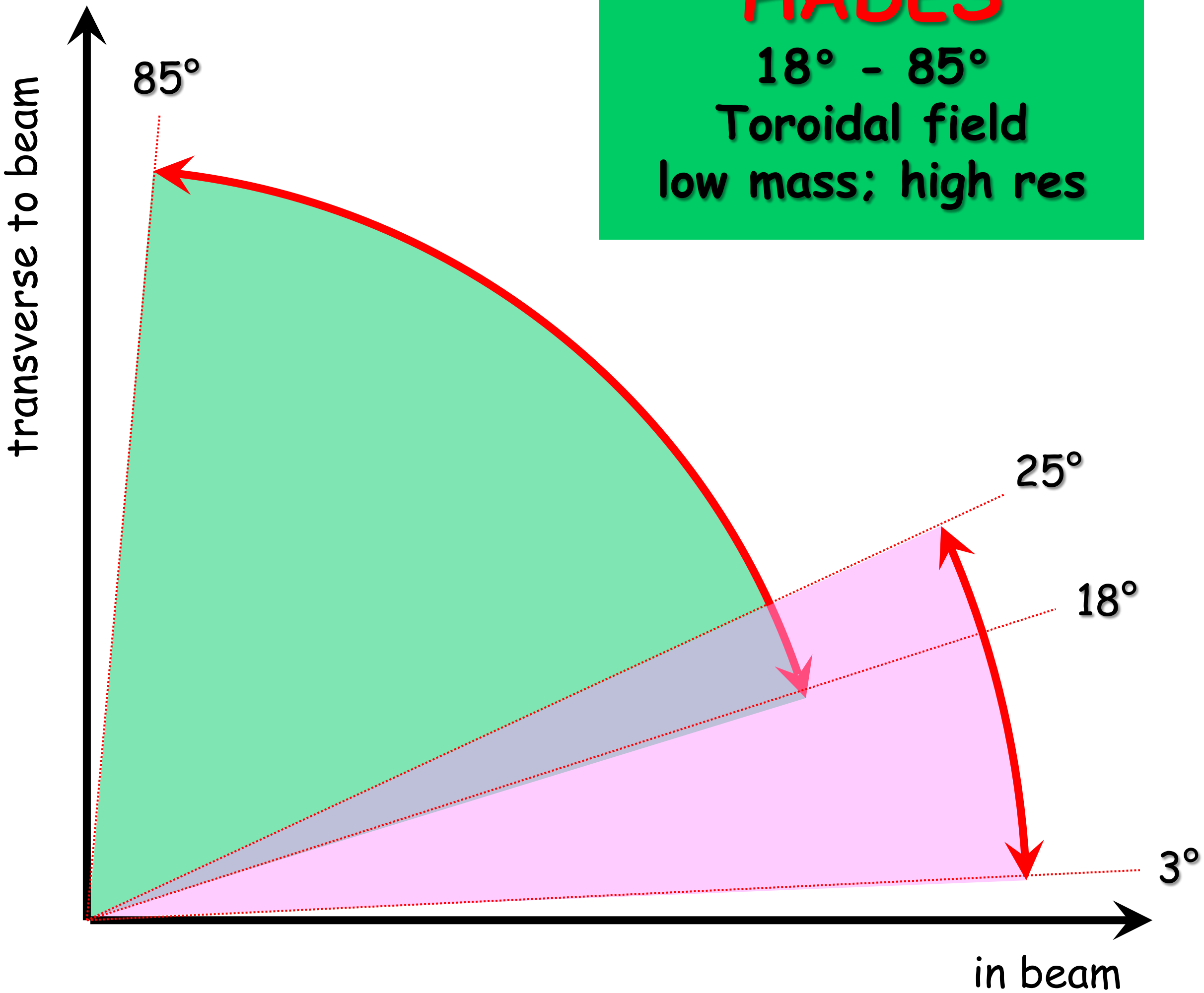
p+p, p+A, A+A (low mult.)

CBM

p+A, A+A

HADES & CBM: Complementary Setups

HADES
18° - 85°
Toroidal field
low mass; high res



CBM
3° - 25°
Dipole field
high rate

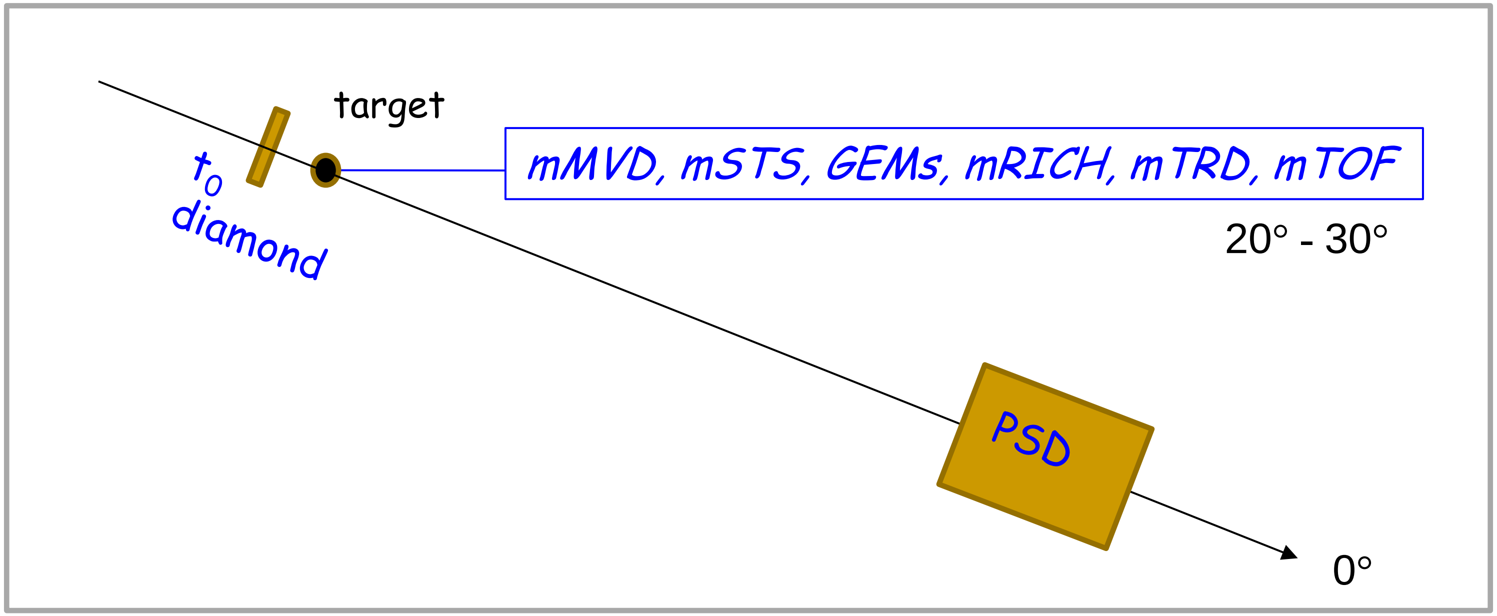
mCBM in 2018 - 2020

mCBM – a CBM full System Test

- Key goals
  - (re-)validation of (pre-)series detector modules
  - test and optimization of
    - free streaming data transport (to mFLES or FLES)
    - online reconstruction
    - offline data analysis
- Approach
  - 'slice test' geometry
  - high-rate multi-particle environment
    - → use produced particles from ion-ion collision
    - → use SIS-18 beam

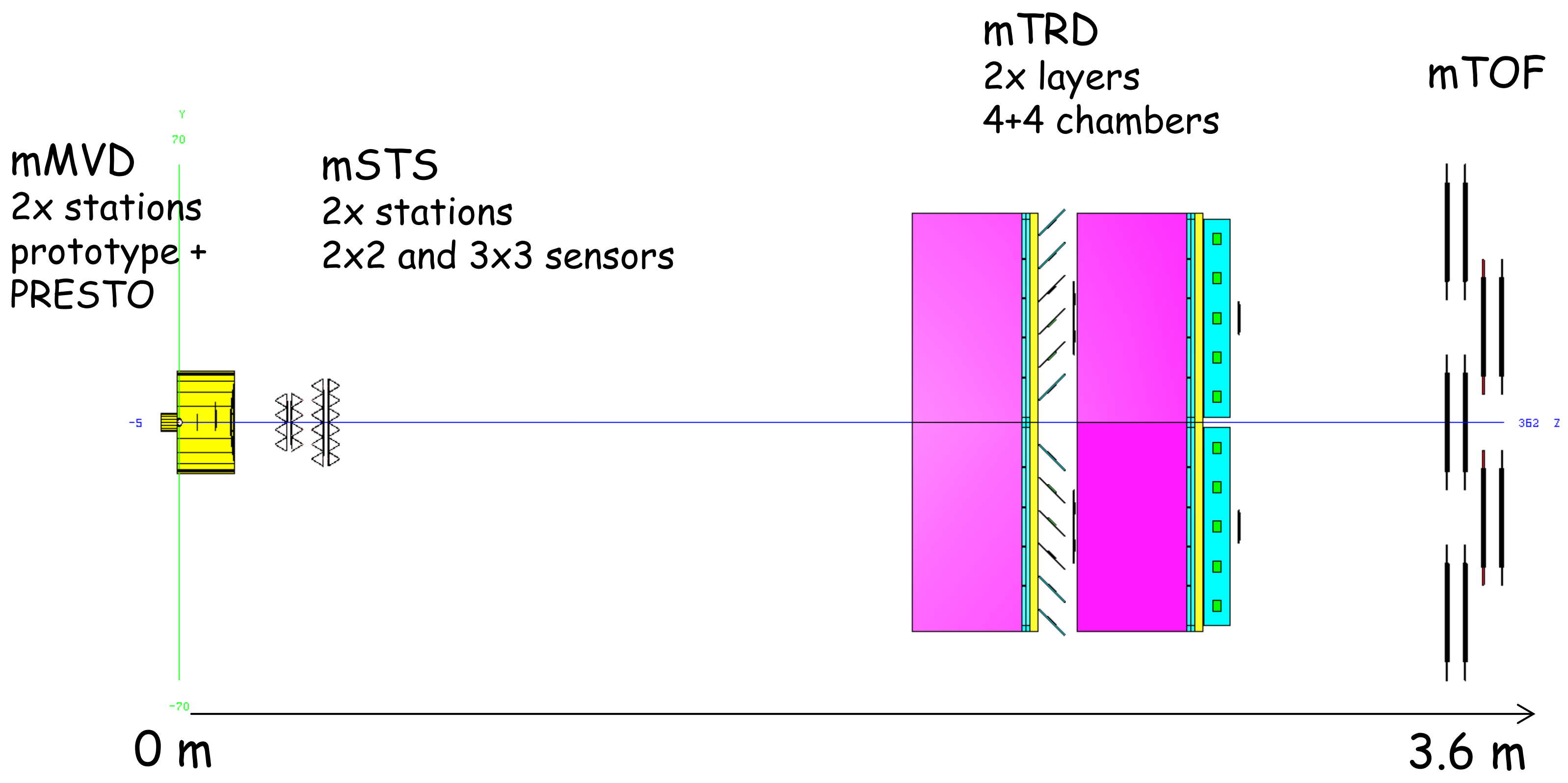
mCBM planning by Ch.Sturm and D.Emschermann
with help from W.Niebur and F.Uhlig and many others

mCBM – Concept



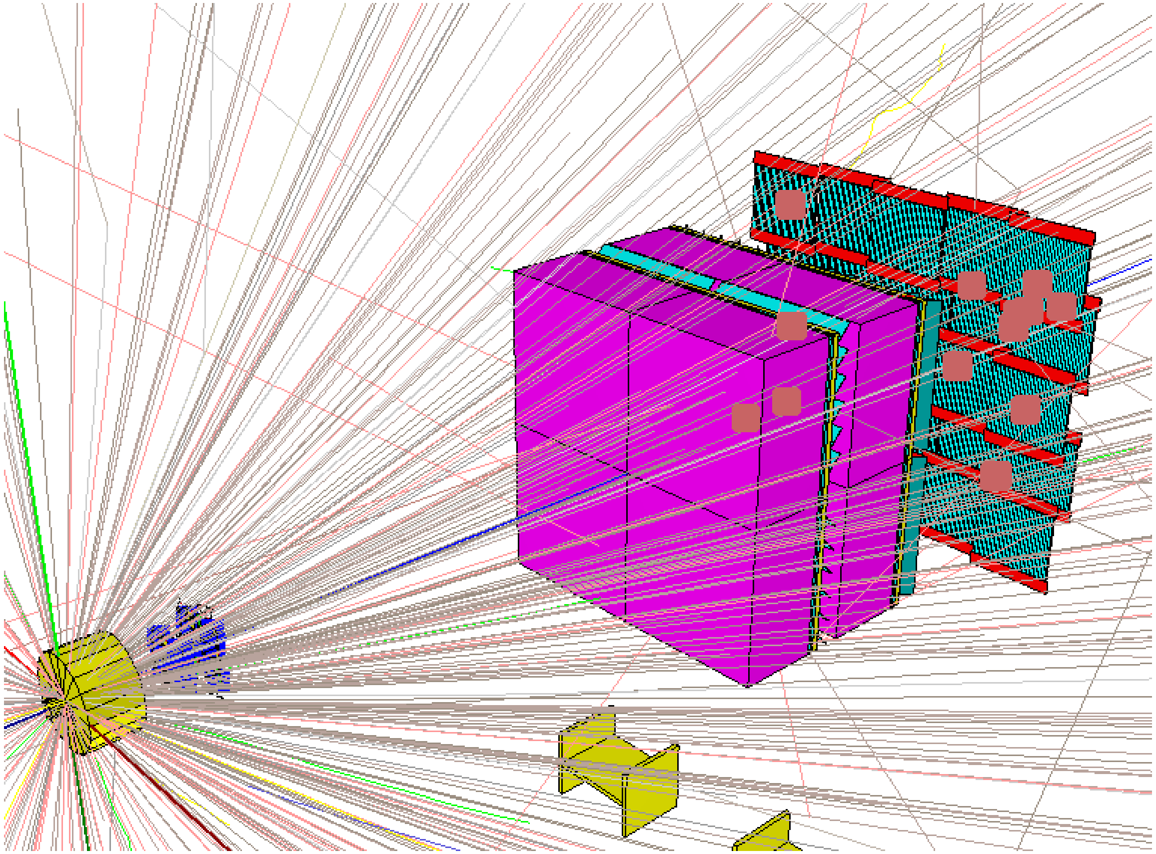
- Detectors at $\theta_{lab} \approx 20° - 30°$
- straight tracks, no B-field
- high resolution TOF (t_0 to mTOF)
- event characterization with PSD modules (t.b.c.)

mCBM – Basic Design of a 'Full Setup'



side view

mCBM – Early Simulation Study



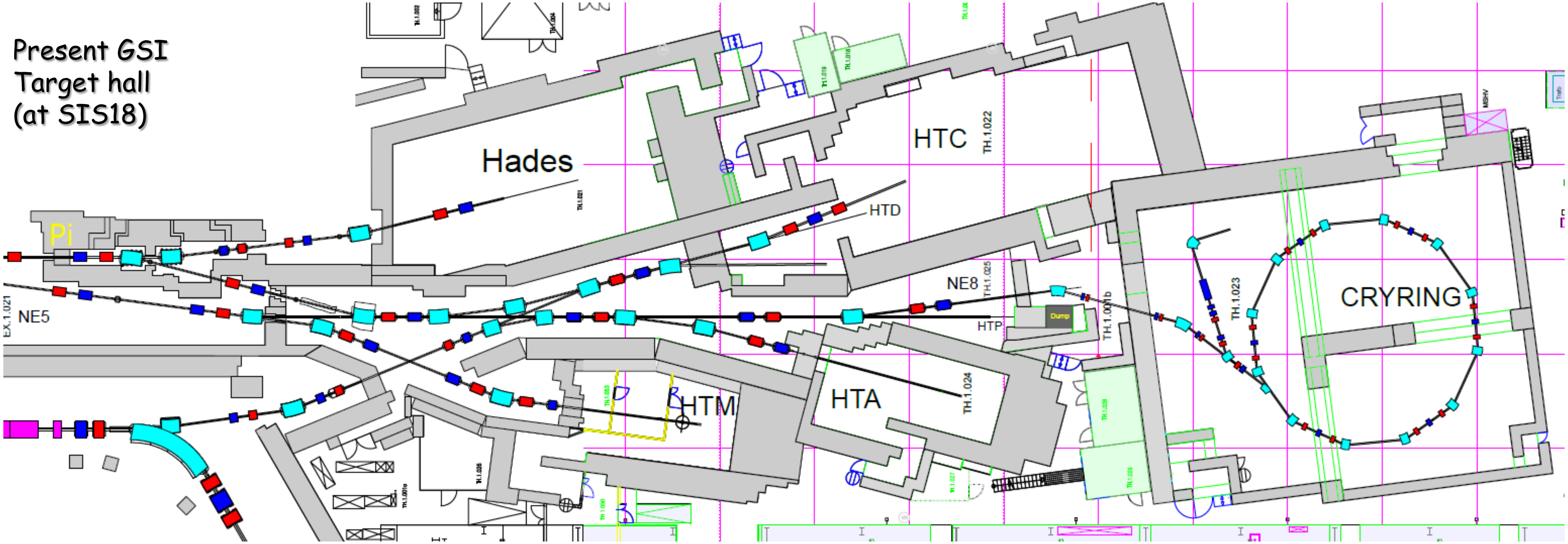
UrQMD event:
Ni+Au 1.93 AGeV
central collision

First results
from simulation:
$M_{track} \approx 7$

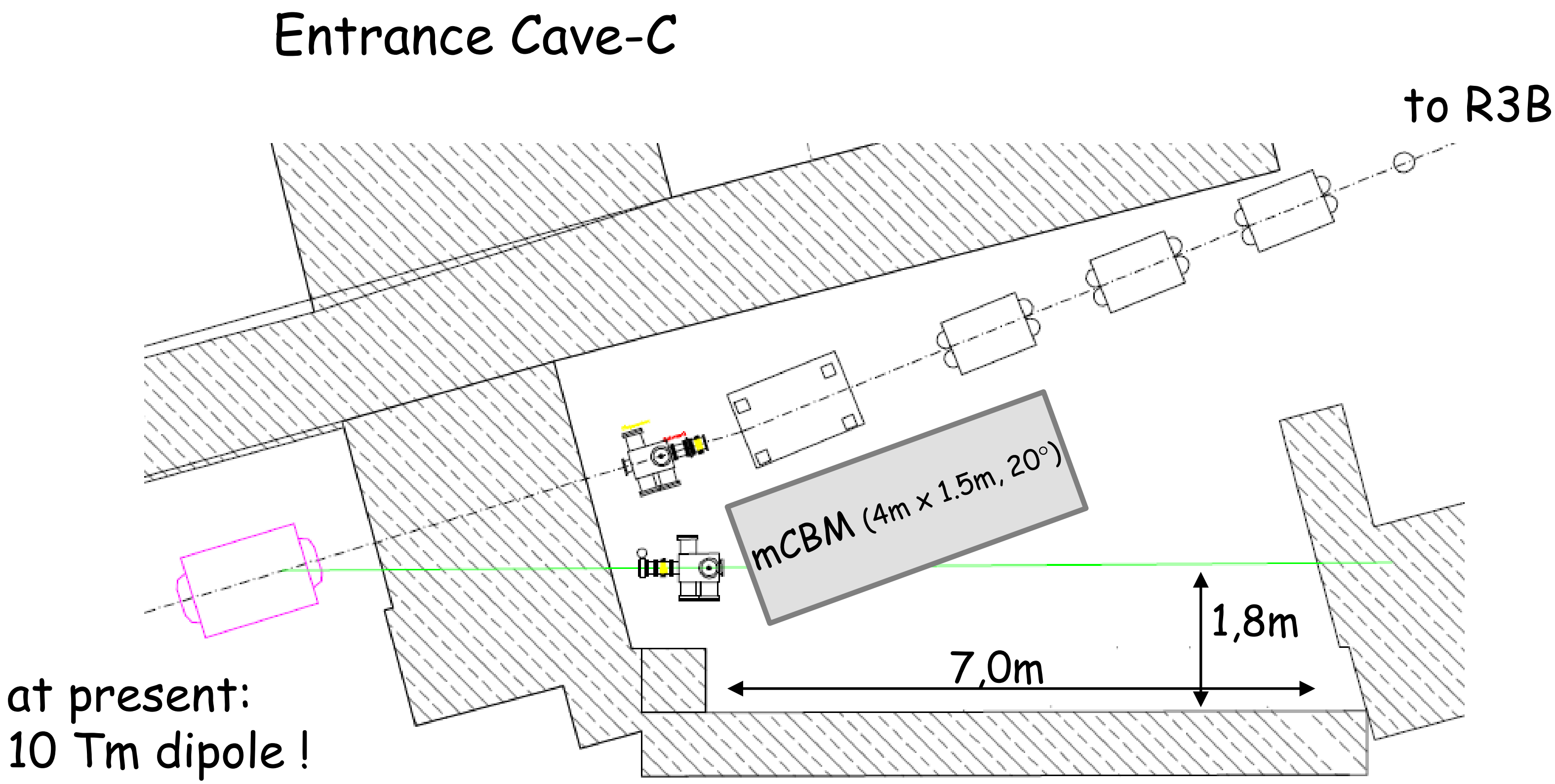
mCBM – Where to setup ?

- Intended usage profile (2018 – 2020)
  - small but dedicated area
    → to allow permanent basic infrastructure
  - 3 month/year SIS-18 beam 'available'
  - beam request per year: parasitic + 3-5 days main user

Present GSI Target hall (at SIS18)



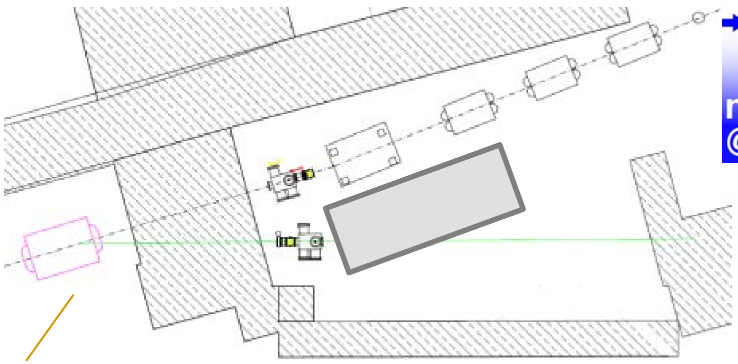
mCBM – Potential Location: HTD



drawing: W.Niebur

mCBM – Potential Location: HTD

	T_{lab} [GeV] or [AGeV]		
Rigidity (beamline)	10 Tm	13 Tm	18.66 Tm
p	2.21	3.08	4.74
Ca	0.83	1.23	2.02
Ni	0.79	1.17	1,93
Ag (46^+)	0.65	1.02	1.65
Au (69^+)	0.45	0.72	1.24



at present:
10 Tm dipole !

- available from Q4 2016
- minor civil construction cost
- limited but sufficient space
- **key limitation**:
  - currently only 10 Tm rigidity beamline
  - at least 13 Tm needed (→ possible with FAIR HBT dipole)

mCBM – Next Steps

- full design
  - get highest possible beam rigidity
  - get highest possible beam intensity
- cost estimate
- submission of proposal
- decision on financing

The CBM Collaboration

Croatia:
Split Univ.
China:
CCNU Wuhan
Tsinghua Univ.
USTC Hefei
CTGU Yichang
Czech Republic:
CAS, Rez
Techn. Univ.Prague
France:
IPHC Strasbourg
Hungary:
KFKI Budapest
Budapest Univ.

Germany:
Darmstadt TU
FAIR
Frankfurt Univ. IKF
Frankfurt Univ. FIAS
Frankfurt Univ. ICS
GSI Darmstadt
Giessen Univ.
Heidelberg Univ. P.I.
Heidelberg Univ. ZITI
HZ Dresden-Rossendorf
KIT Karlsruhe
Münster Univ.
Tübingen Univ.
Wuppertal Univ.
ZIB Berlin

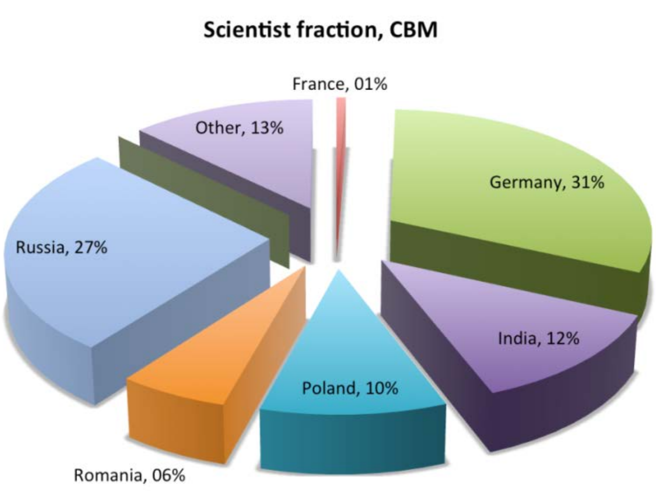
India:
Aligarh Muslim Univ.
Bose Inst. Kolkata
Panjab Univ.
Rajasthan Univ.
Univ. of Jammu
Univ. of Kashmir
Univ. of Calcutta
B.H. Univ. Varanasi
VECC Kolkata
IOP Bhubaneswar
IIT Kharagpur
IIT Indore
Gauhati Univ.

Korea:
Pusan Nat. Univ.
Romania:
NIPNE Bucharest
Univ. Bucharest
Poland:
AGH Krakow
Jag. Univ. Krakow
Silesia Univ.
Katowice
Warsaw Univ.
Warsaw TU

in HADES only
+ IPNO Paris
+ TUM Munich
+ LIP Coimbra

Russia:
IHEP Protvino
INR Troitzk
ITEP Moscow
Kurchatov Inst., Moscow
LHEP, JINR Dubna
LIT, JINR Dubna
MEPHI Moscow
PNPI Gatchina
SINP MSU, Moscow
St. Petersburg P. Univ.
Ioffe Phys.-Tech. Inst. St. Pb.
Ukraine:
T. Shevchenko Univ. Kiev
Kiev Inst. Nucl. Research

24th CBM Collaboration meeting in Krakow, Poland
8 -12 Sept. 2014



Countries: 12
Institutes: 60
Members: 526

The End

Thanks for your attention

Backup Slides

mCBM subsystems – tracking layers

mMVD, 2 layers:

- station-1 2x2 sensors (present prototype)
- station-2 5x3 sensors (PRESTO)

mSTS, 2 layers:

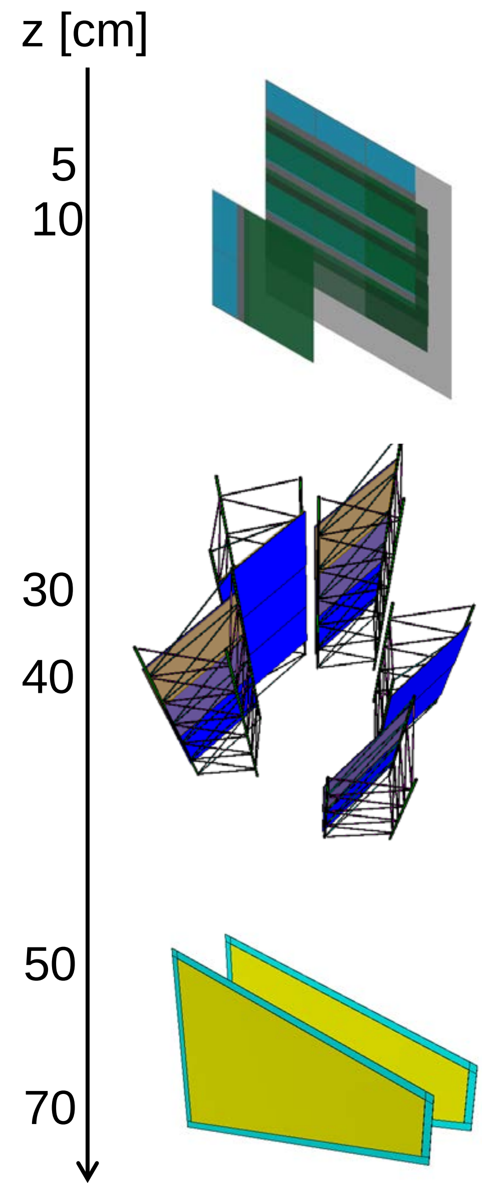
- station-1 2x2 modules
- station-2 3x3 modules

o 5 half-ladders (carbon fiber ladders from v15b)
o FEB boxes and cooling on top
o 208x STS-XYTER
o 26x FEB-8-1 in total
o 6x ROB3 in total

mMUCH, 2 layers:

- 2x full size prototypes (COSY2014 prototype)

o 30x MUCH-XYTER
o 1x ROB3 in total



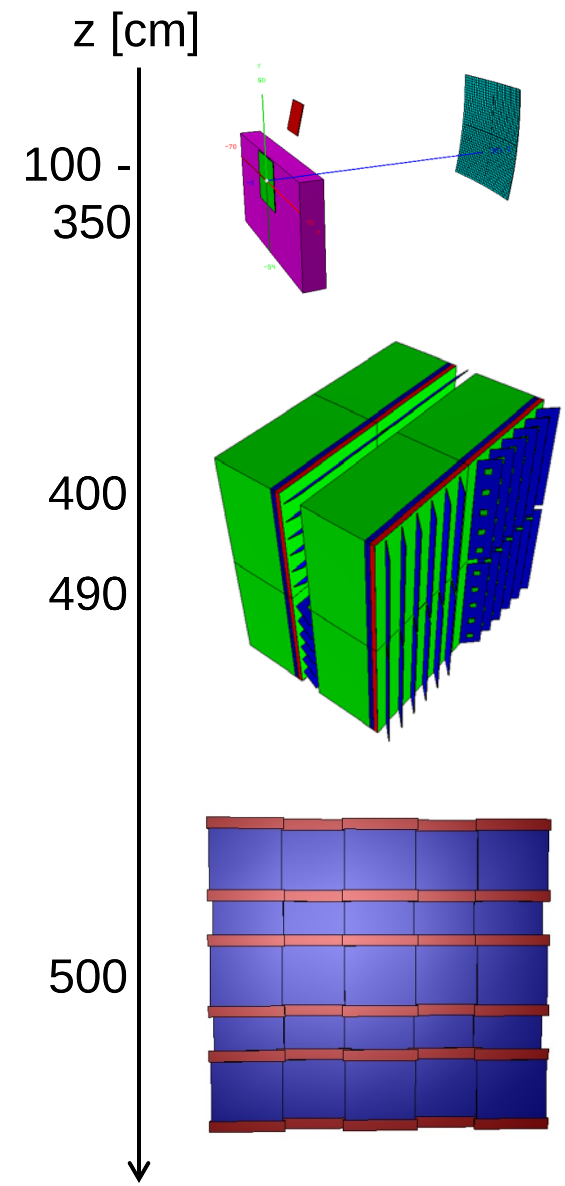
mCBM subsystems

mRICH :
- RICH CERN PS prototype

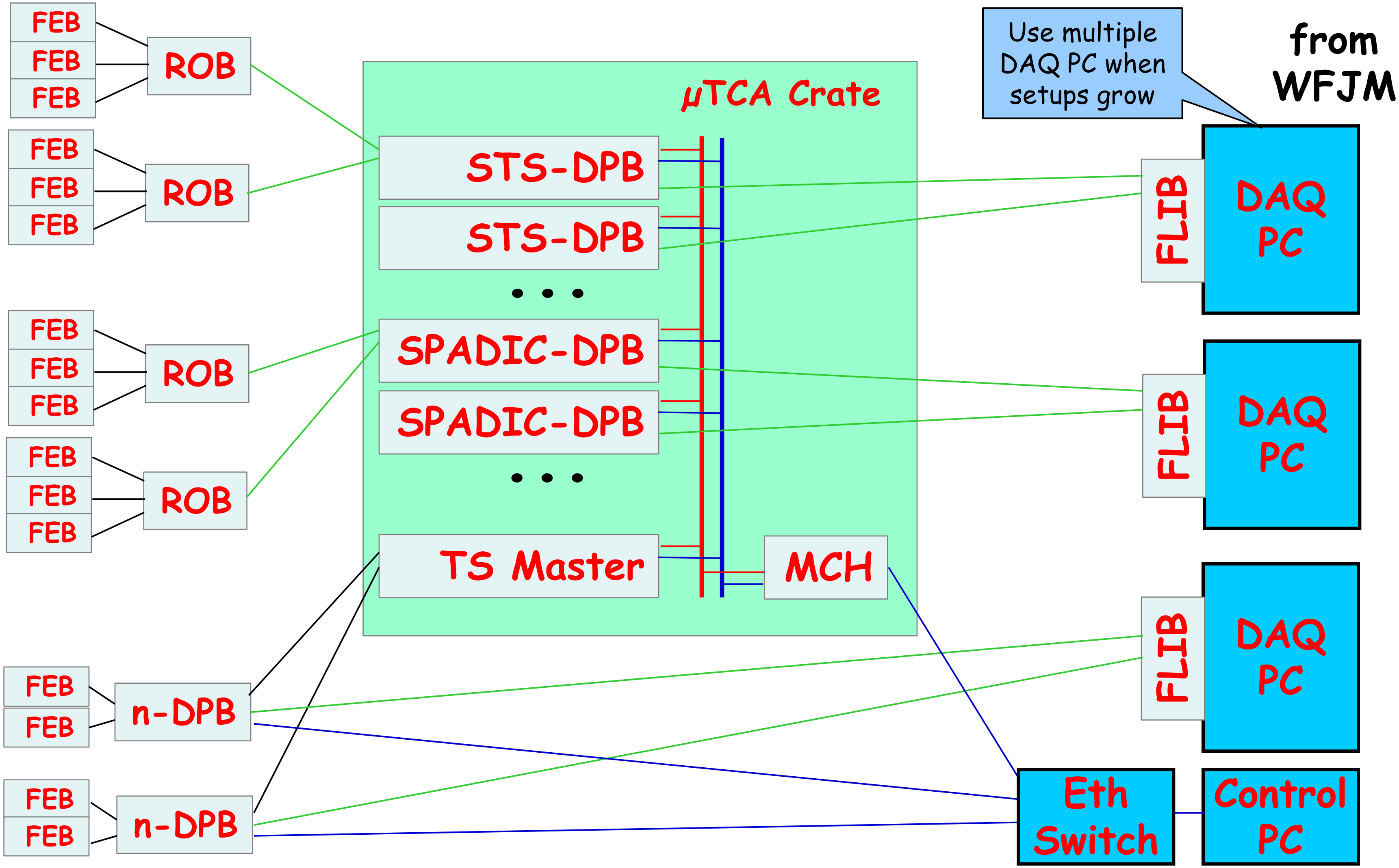
study current acceptance
larger MAPMT camera ?

mTRD, 2 layers:
- 8x TRD module type 3
  - o 6x Spadic v2.0 FEB-5 each
  - o 8x ROB3

mTOF:
- 5x M4 modules (STAR MRPCs)
  about 150 cm x 150 cm large



mCBM data transport



Cave C incl. R3B, 2018 -