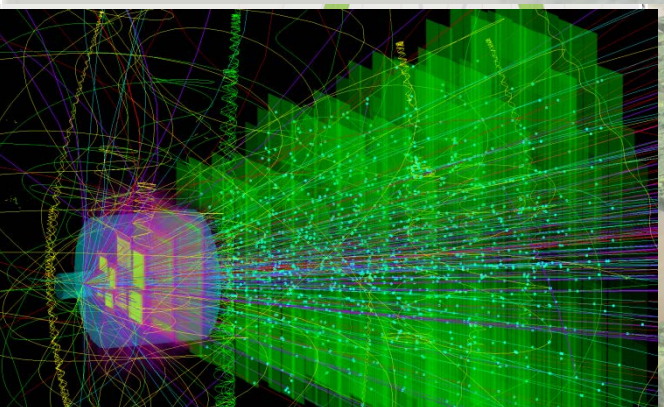
Connecting **R**ussian and **E**uropean **M**easures for **L**arge-scale Research **IN**frastructures – **"CREMLIN"**

WP3 - Science cooperation with the NICA collider facility in the field of ion beams and heavy ion physics

Jürgen Eschke
(WP Leader)
FAIR GmbH

CREMLIN Kick-off meeting
Moscow, 07 October 2015



CREMLIN Kick-off Meeting

PARALLEL SESSION October 6th 2015:

17:15 **WP3 - Science cooperation with the NICA collider facility in the field of ion beams and heavy ion physics**
V.D. Kekelidze, JINR & J. Eschke, FAIR

- **Overview WP3 and Status of FAIR** - J. Eschke (WP Leader and CBM Resource Coordinator) (20 min)
- **Status of NICA** - V.D. Kekelidze (Director of the Veksler and Baldin Laborator of High Energy Physics of JINR) (20 min)
- **Status of CBM experiment at FAIR** – P. Senger (CBM spokesperson) (20 min)
- **Status of the CBM Silicon Tracking System** – J. Heuser (CBM-STS project Technical Coordinator) (20 min)
- **Status JINR participation in the construction of Silicon Detectors for experiments at NICA and FAIR** – Y. Murin (Head of STS Department, VBLHEP JINR) (20 min)
- **Discussion**

19:00 *Dinner at Art Hotel*

Overview WP3

J. Eschke (WP Leader and CBM Resource Coordinator)

- Status NICA at Joint Institute of Nuclear Research (JINR) in Dubna, Russia
- Status Facility for Antiproton and Ion research (FAIR) in Darmstadt, Germany

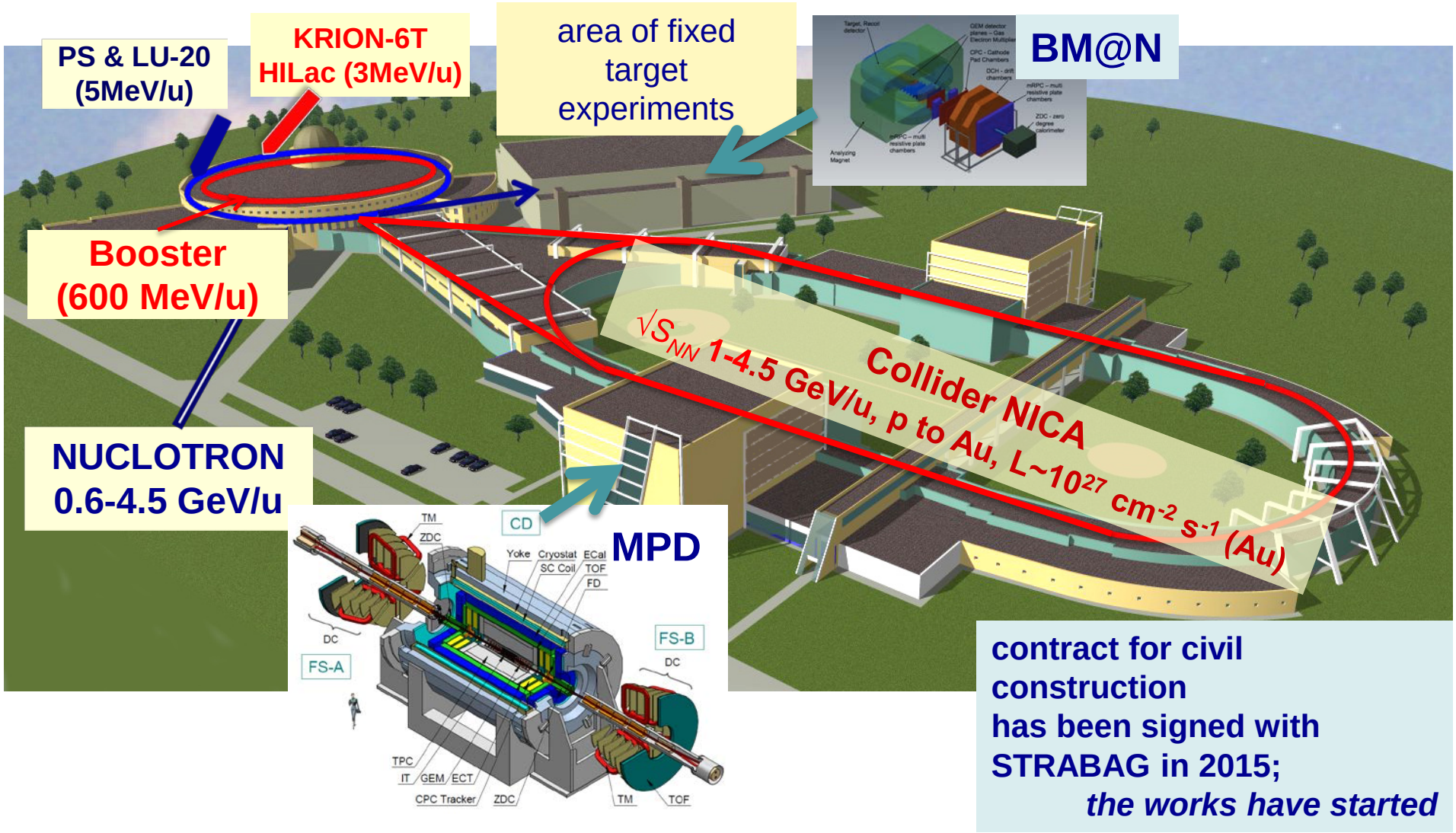
- Cooperation of FAIR and JINR
  - in the field of accelerator components
  - for the Compressed Baryonic Matter experiment (CBM) at FAIR and for the BM@N and MPD experiments at JINR

- Overview WP3
  - scope (main objective of this WP in CREMLIN is the joint development of silicon tracking detectors
  - tasks
  - deliverables

NICA complex

existing facility

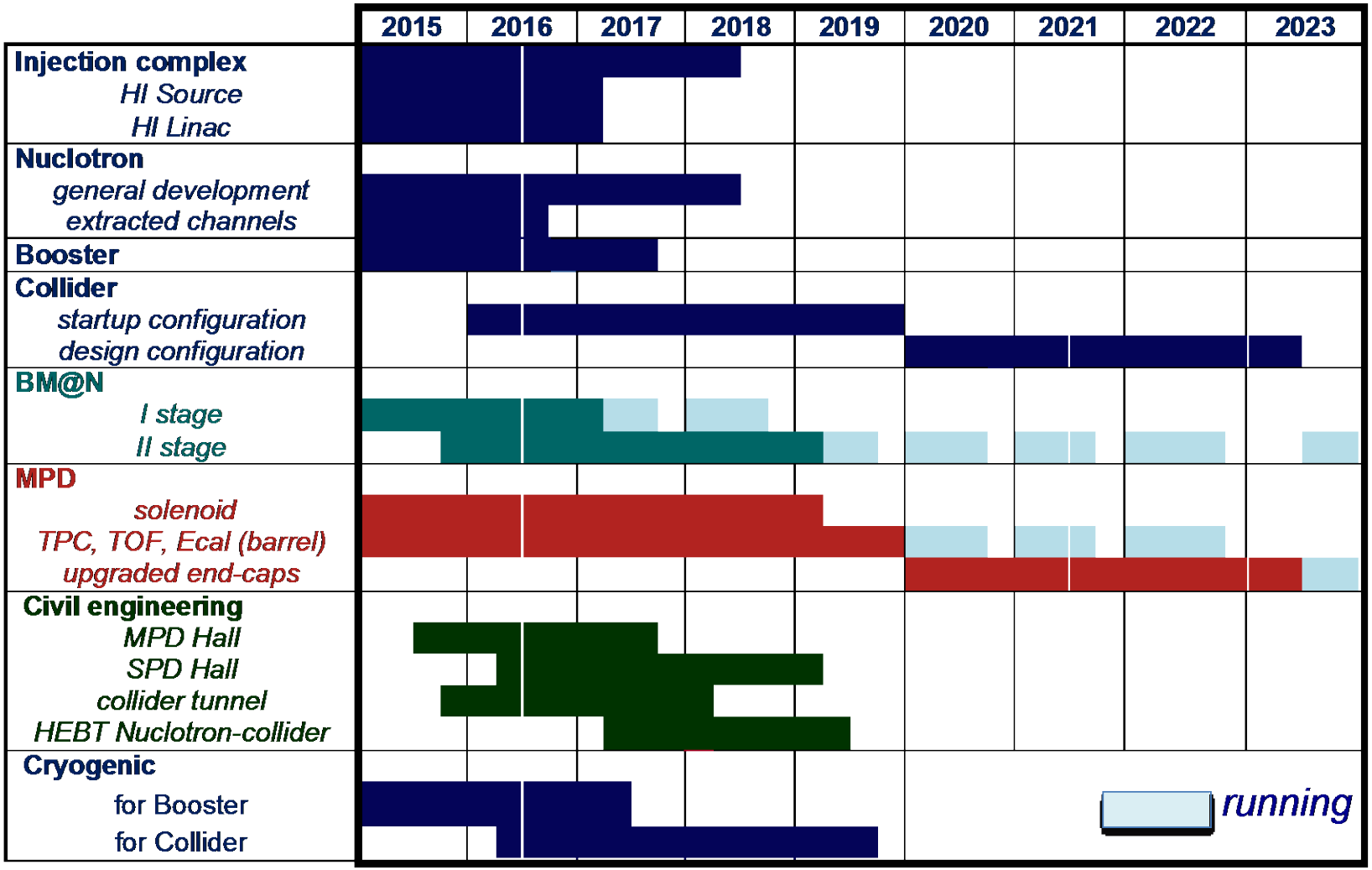
to be constructed



contract for civil construction has been signed with STRABAG in 2015;

the works have started

NICA schedule



Facility for Antiproton and Ion Research

Primary Beams

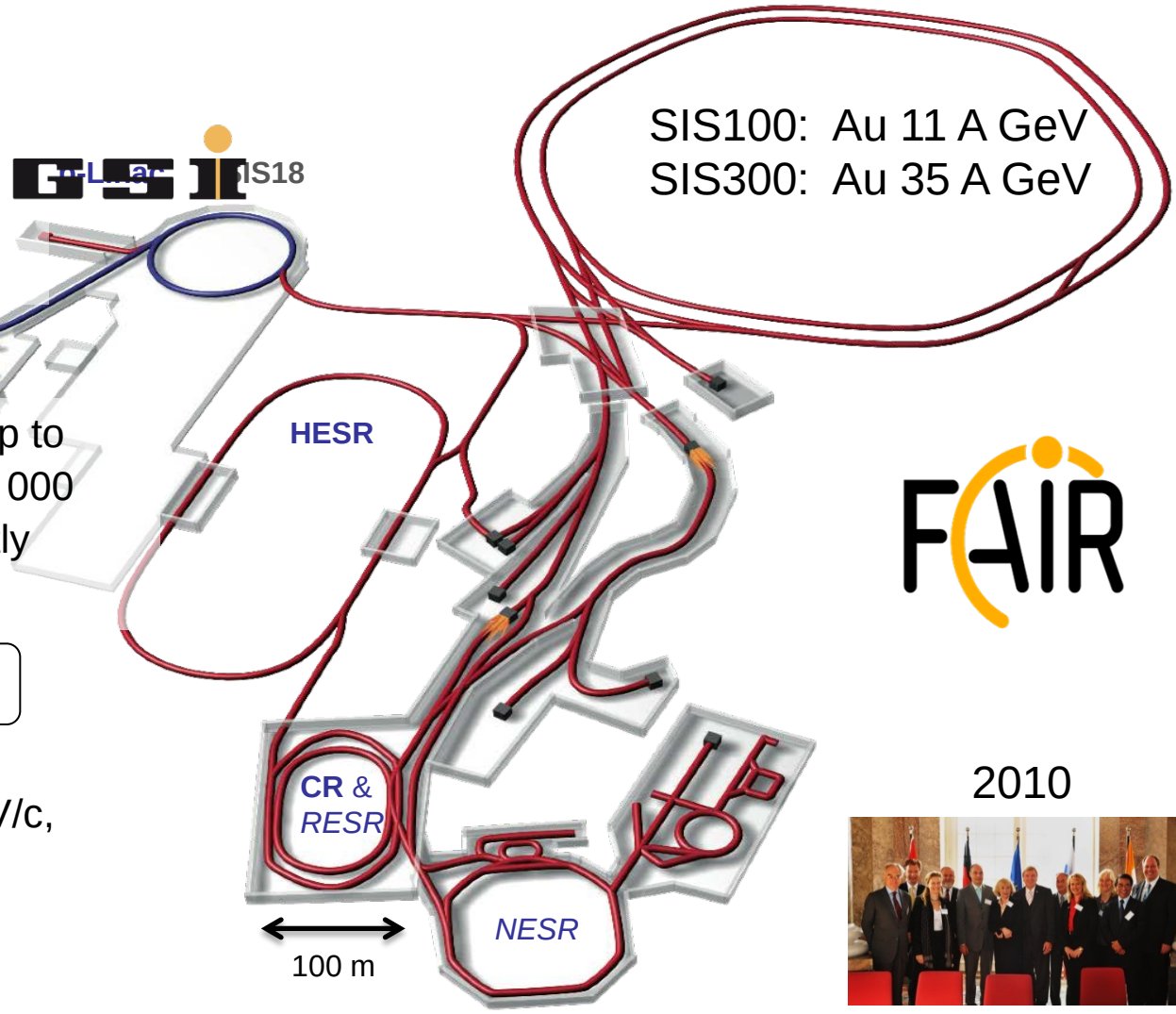
- 10^{12}/s; 1.5 GeV/u; $^{238}U^{28+}$
- 10^{10}/s $^{238}U^{73+}$ up to 35 GeV/u
- $3x10^{13}$/s 30 GeV protons

Secondary Beams

- range of radioactive beams up to 1.5 - 2 GeV/u; up to factor 10 000 higher in intensity than presently
- antiprotons 3 - 30 GeV

Storage and Cooler Rings

- radioactive beams
- 10^{11} antiprotons 1.5 - 15 GeV/c, stored and cooled



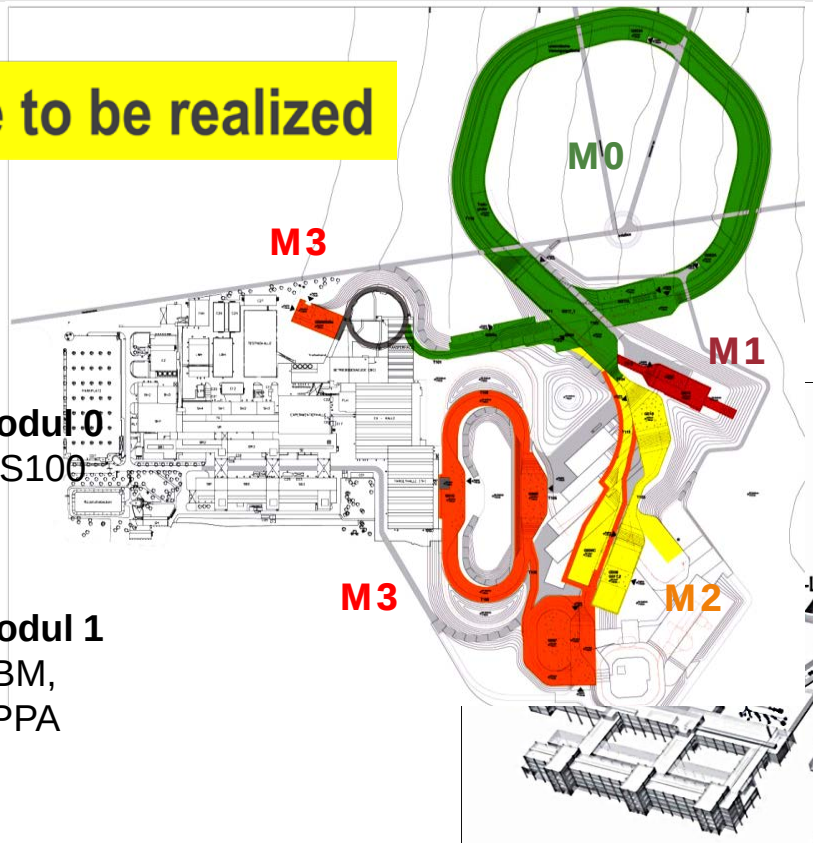
FAIR

2010

Finland France Germany India Poland Romania Russia Slovenia Sweden UK

FAIR Modularized Start Version (MSV)

scope to be realized



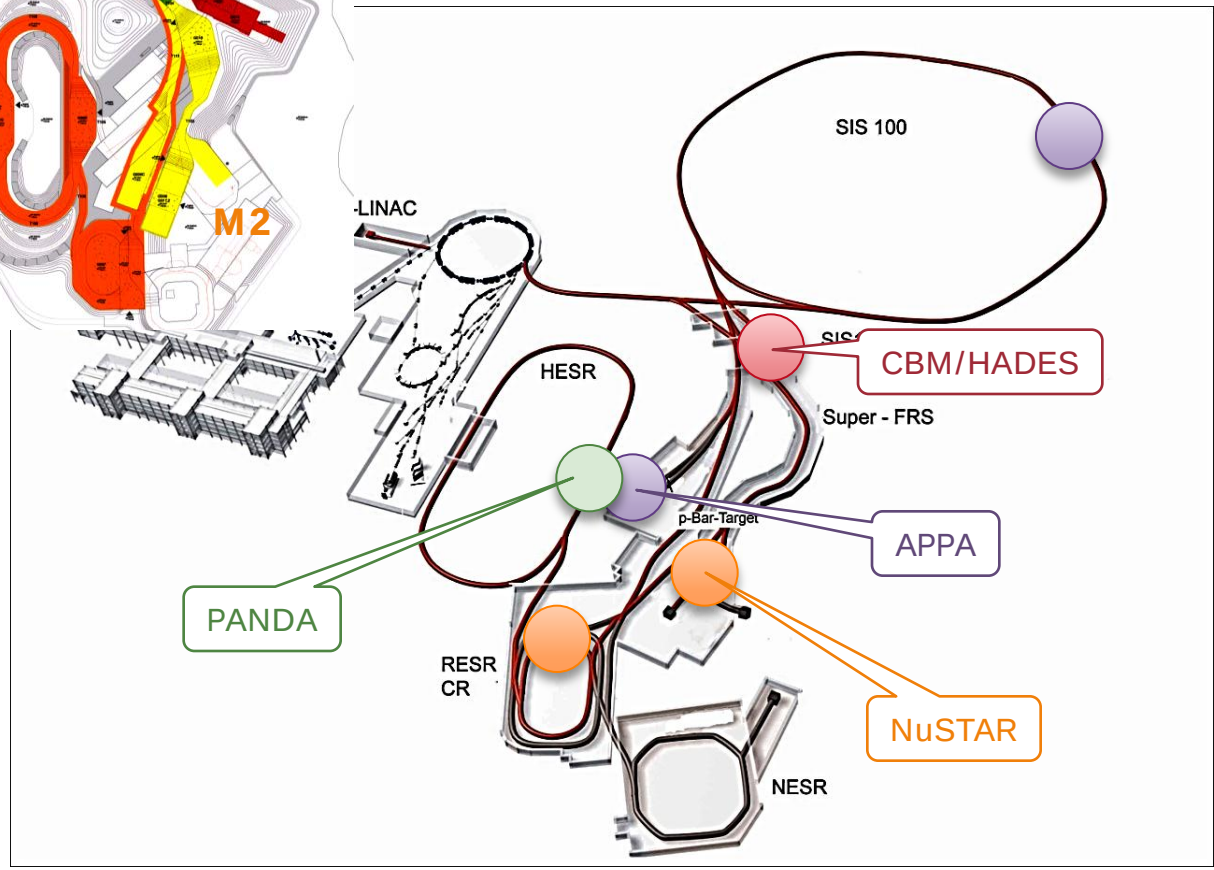
Experiments
M1: APPA
M1: CBM/HADES
M2: NuSTAR
M3: PANDA

Modul 0
SIS100

Modul 1
CBM,
APPA

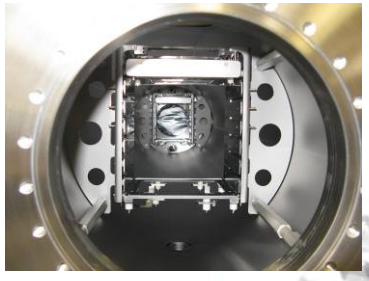
Modul 2
Super-FRS

Modul 3
Antiproton-target, CR, p-Linac, HESR

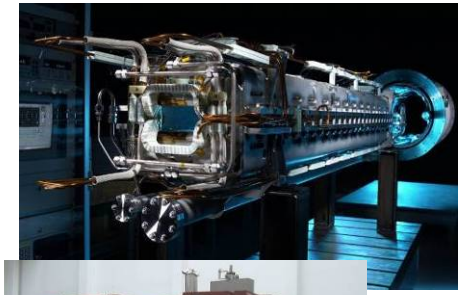


FAIR accelerator challenges

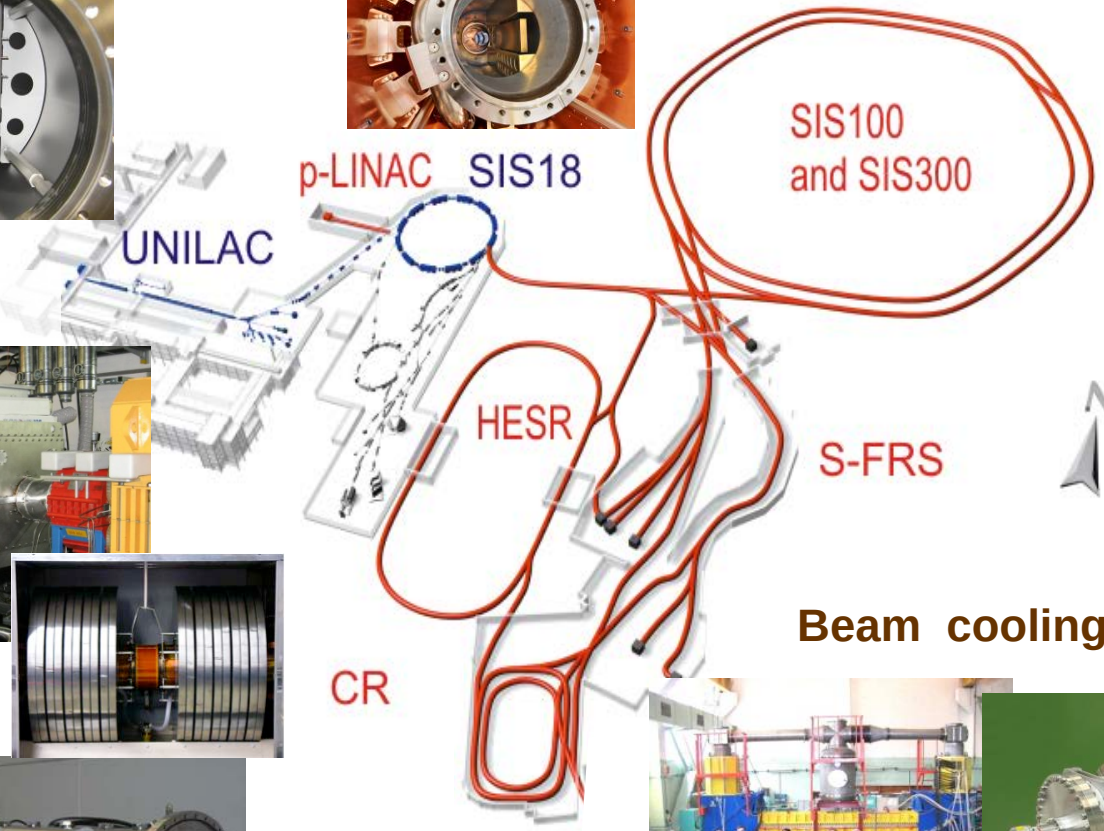
Diagnostic and XHV at highest intensities



Superconducting magnets



Rf-cavities



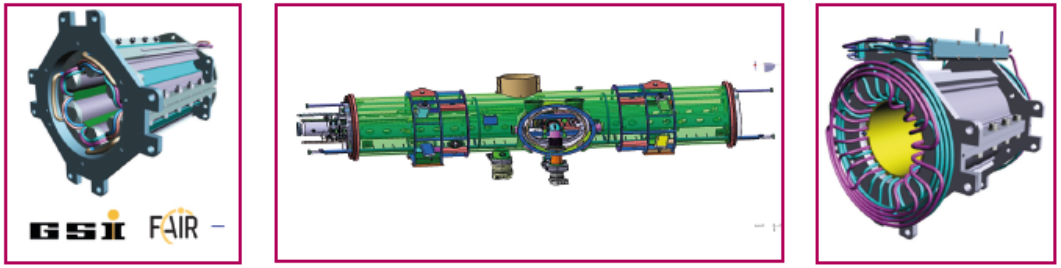
Beam cooling

FAIR HELMHOLTZ GEMEINSCHAFT GSI

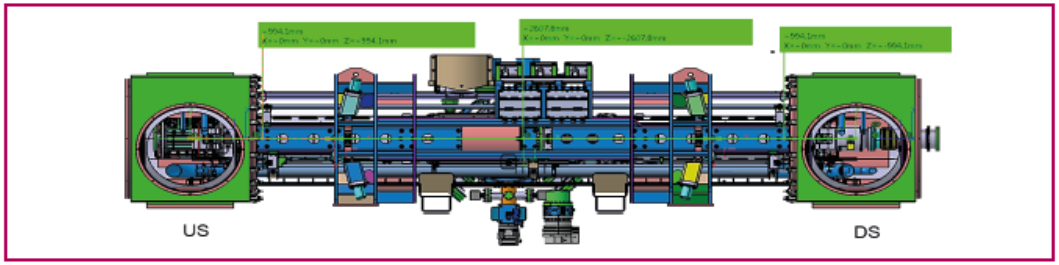
Intense Cooperation between GSI/FAIR and JINR in the joint developement and construction of components for accelerators

Cryomagnetic Quadrupole Modules for SIS100

- Manufacturing design of first of series module (FoS), completed by GSI design department, models and drawings send to JINR
- In-kind contract for production of quadrupole units with JINR (Russia) are signed
- R&D contract on QA and magnet test facilities between GSI and JINR are signed
- Production of FoS quadrupole units expected for end of 2015



Design of pre-series modul and components by GSI Design Office



Design of QM module including end boxes (link to local cryogenics)

Prototypes and Pre-Series Components for Quadrupole Magnets

Prototype Cryogenic Beam Position Monitor

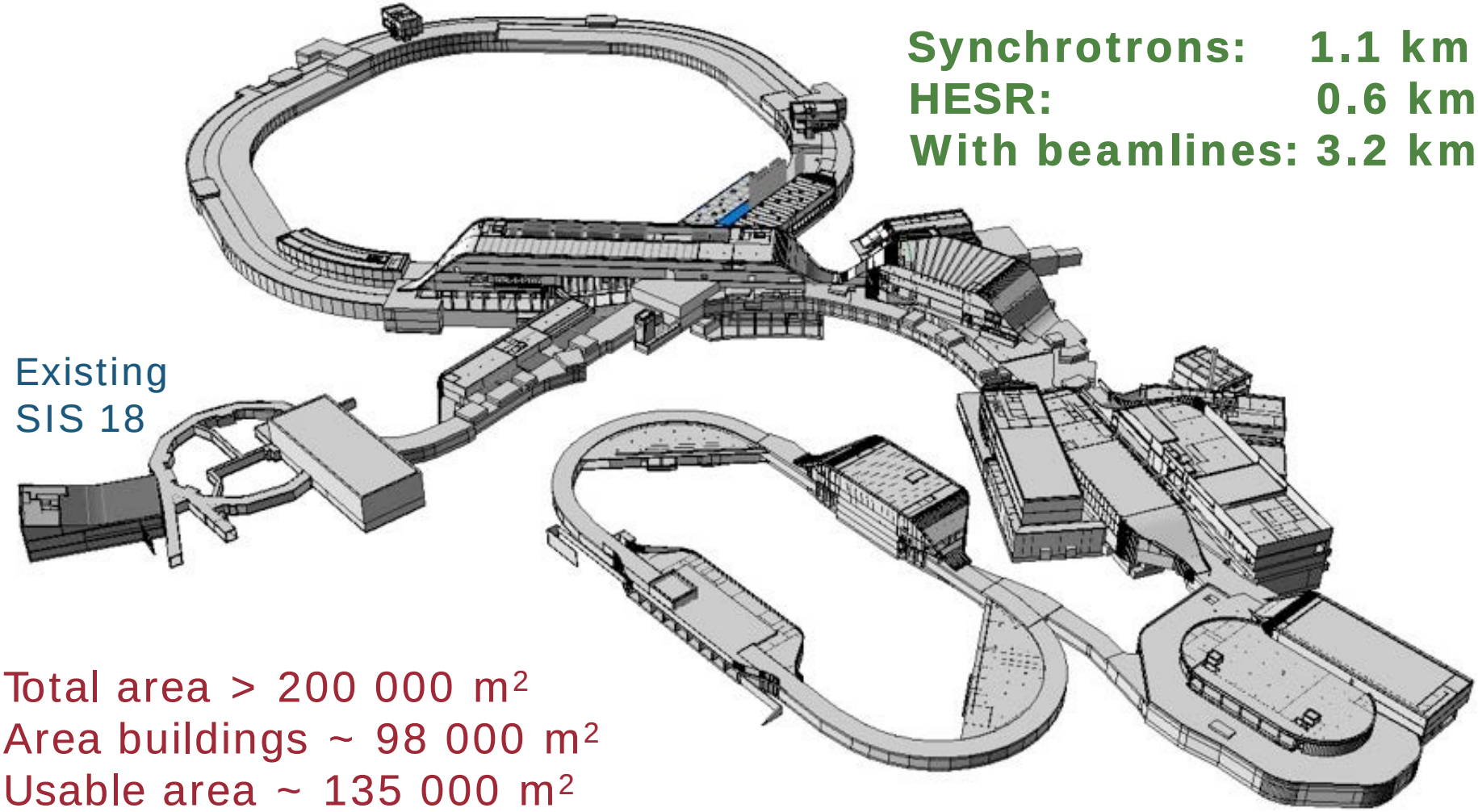
FoS and Series Cryogenic Beam Position Monitor
- Tendering planned for Q3/2015

Prototype Cryocatcher

FoS and Series Cryocatcher
- Tendering ongoing. Offers received

Civil construction is presently the lead process

FAIR accelerator complex



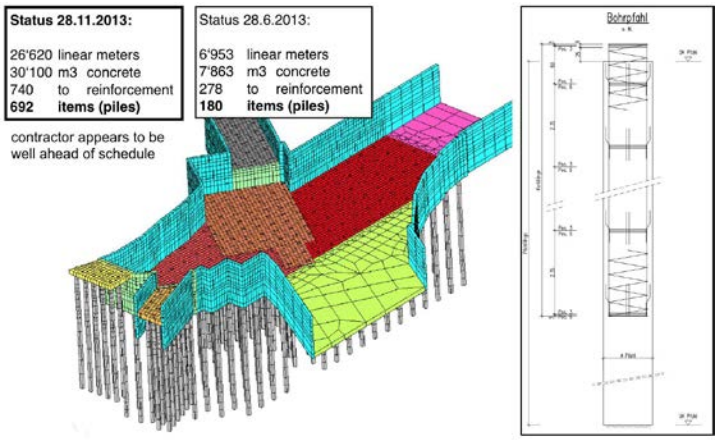
Total area > 200 000 m²
Area buildings ~ 98 000 m²
Usable area ~ 135 000 m²
Volume of buildings ~ 1 049 000 m³
Substructure: ~ 1500 pillars, up to 65 m deep

Important Milestones

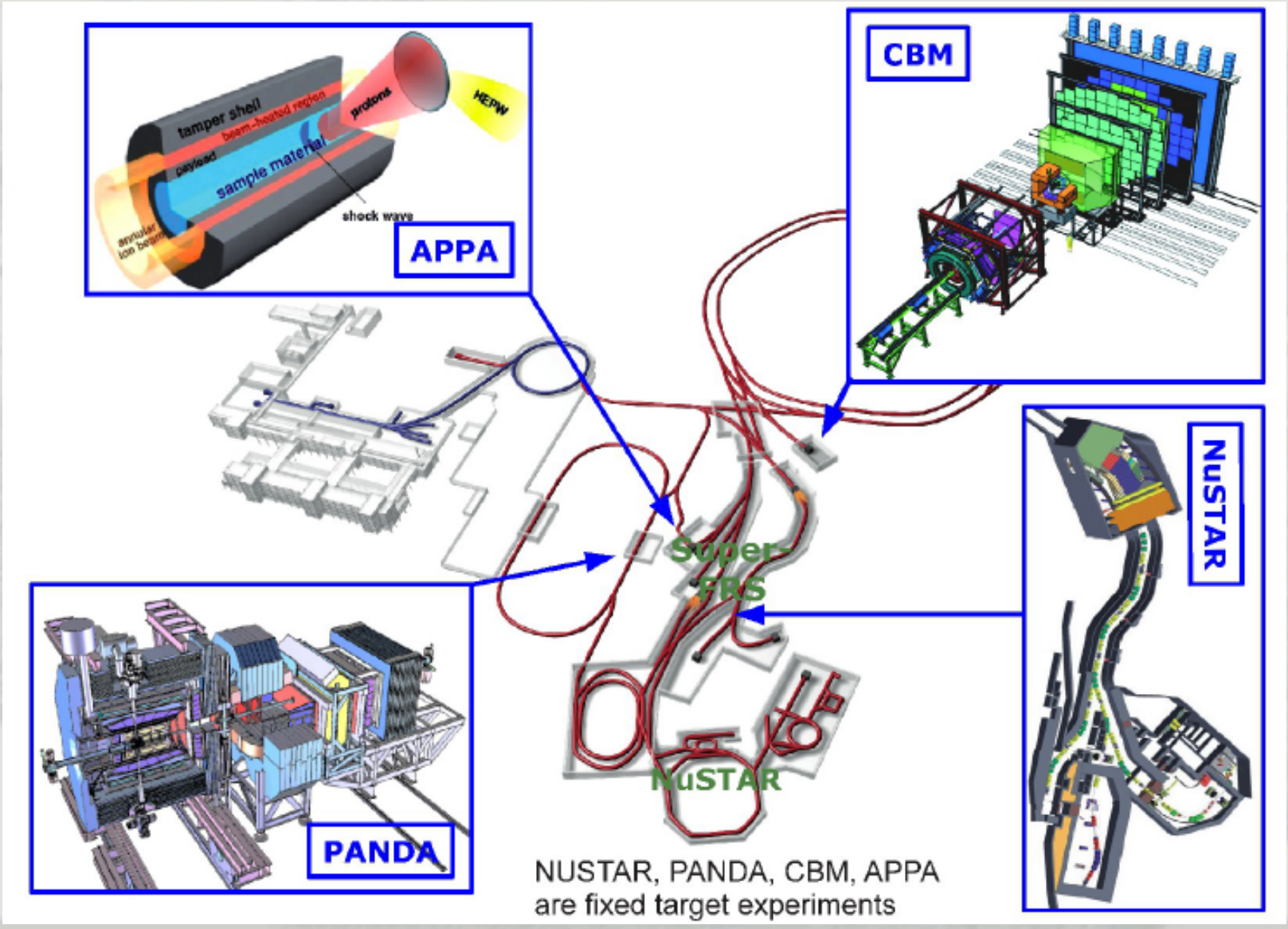
- Last construction license (radiation protection) received

Ceremonial handover on **May 22nd, 2014** of last (11th) partial construction approval regarding radiation protection. Representatives of the hessian ministry of HMUKLV took part in the celebration.

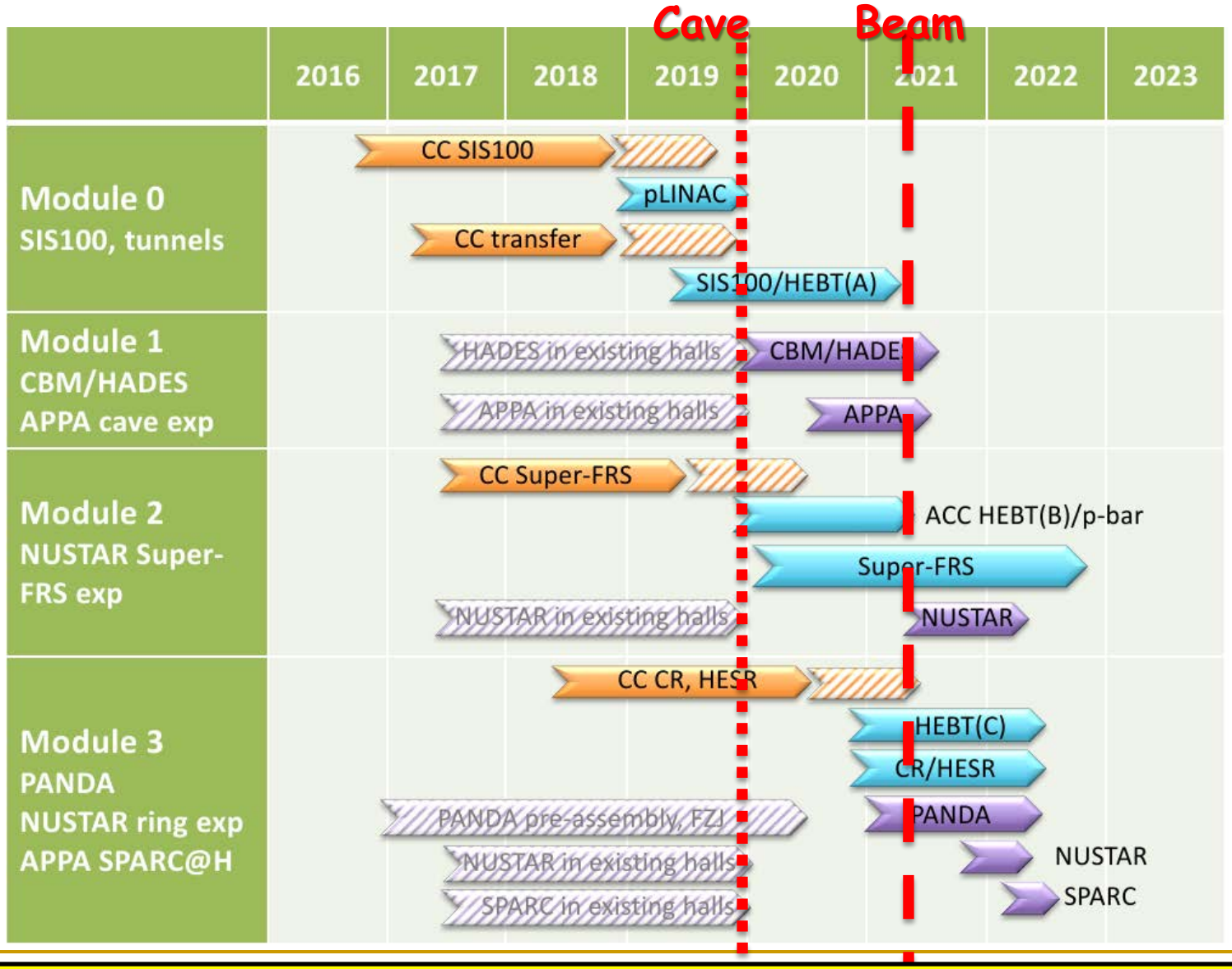
- Drilling of 1350 piles finished ahead of time



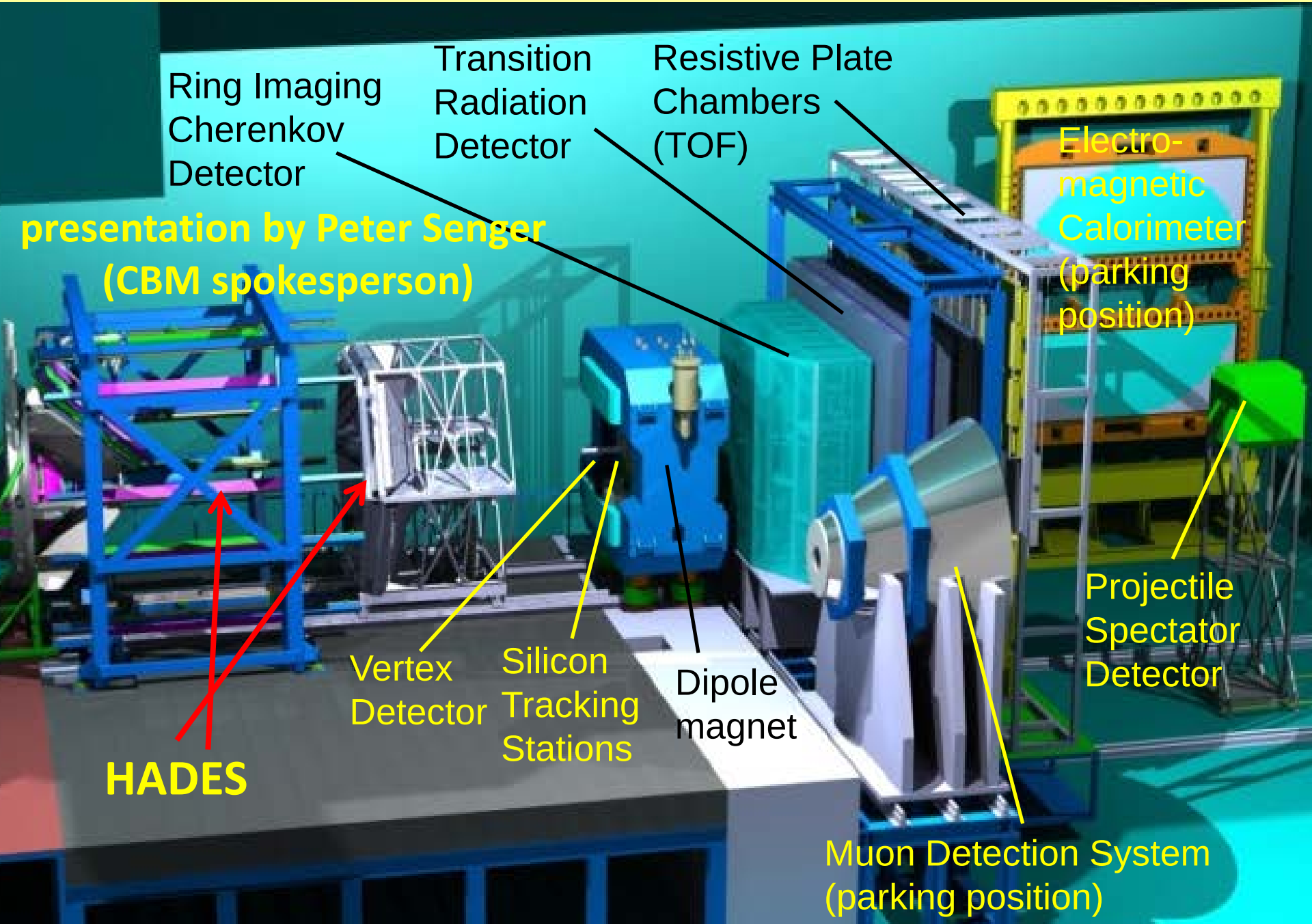
FAIR experiment collaborations more than 2100 scientist



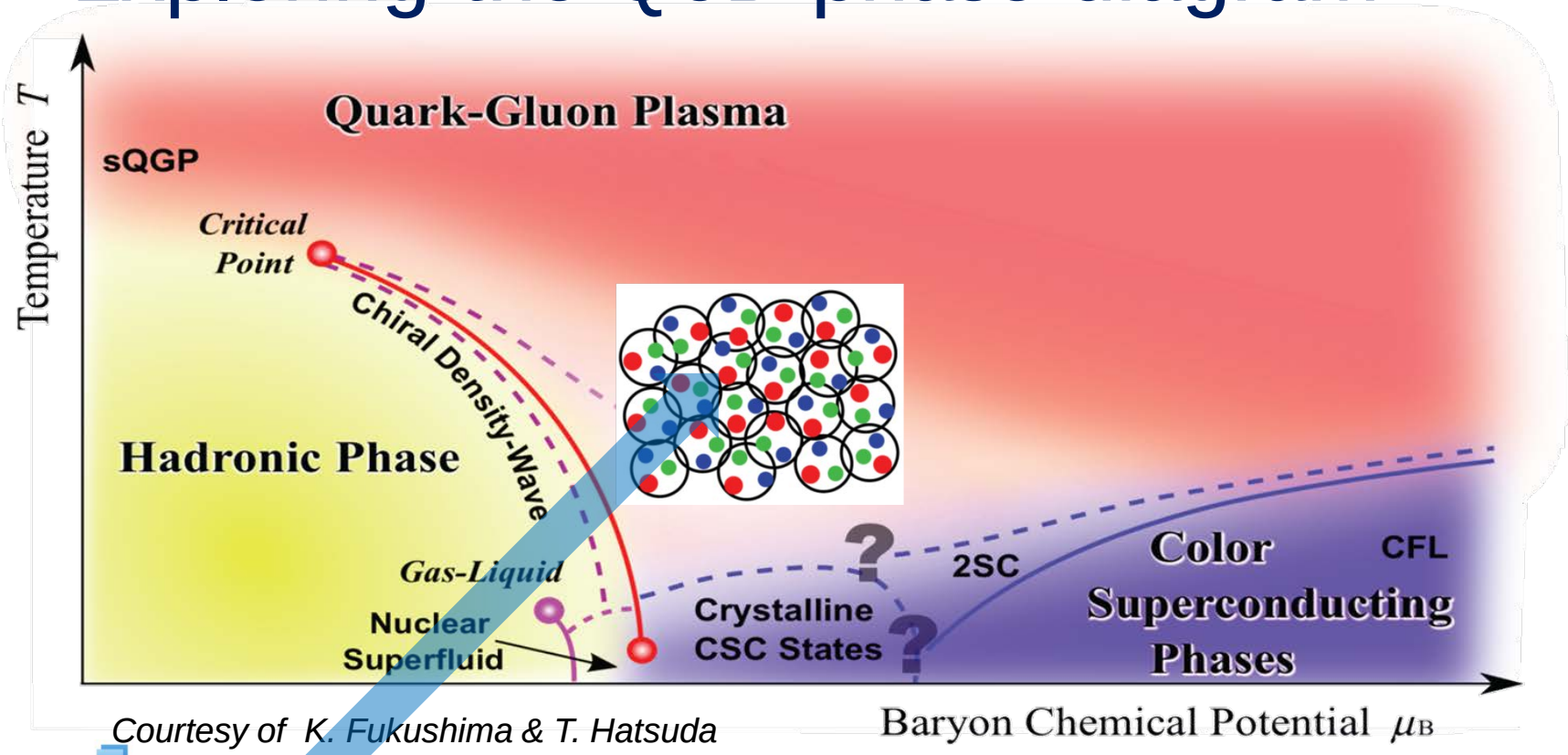
FAIR Time Lines (as shown to Council June 2015)



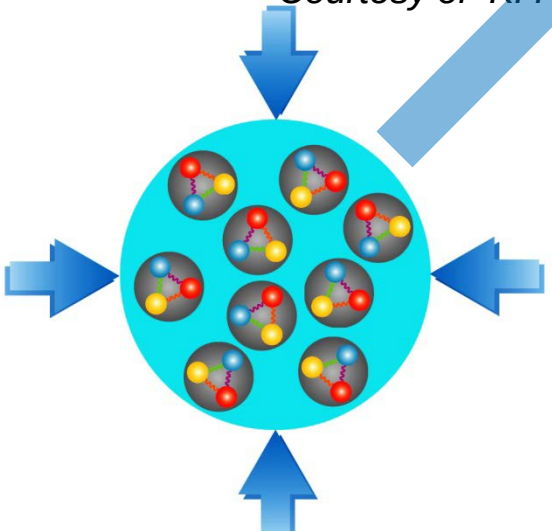
Compressed Baryonic Matter Experiment (CBM) at FAIR



Exploring the QCD phase diagram



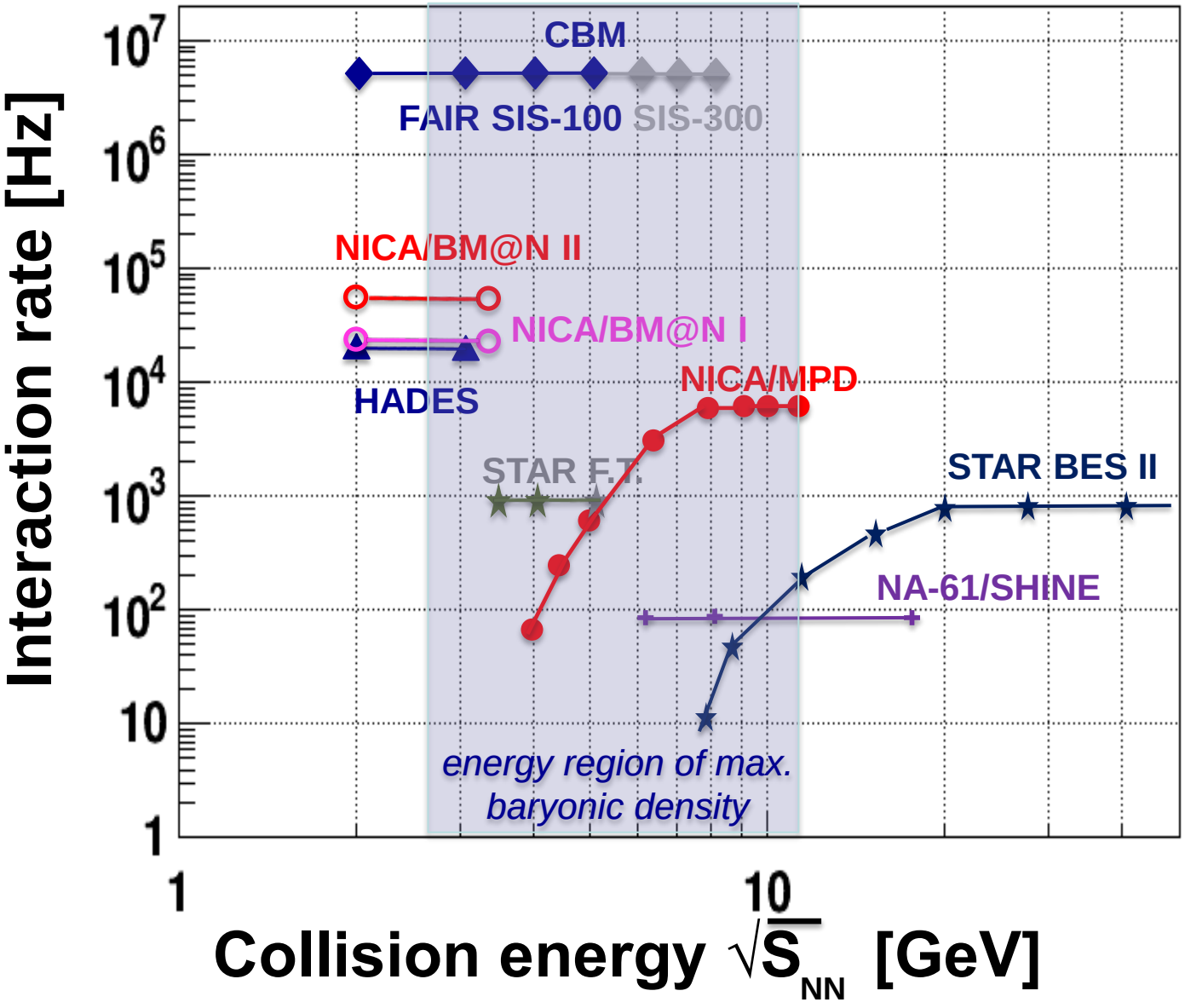
Courtesy of K. Fukushima & T. Hatsuda



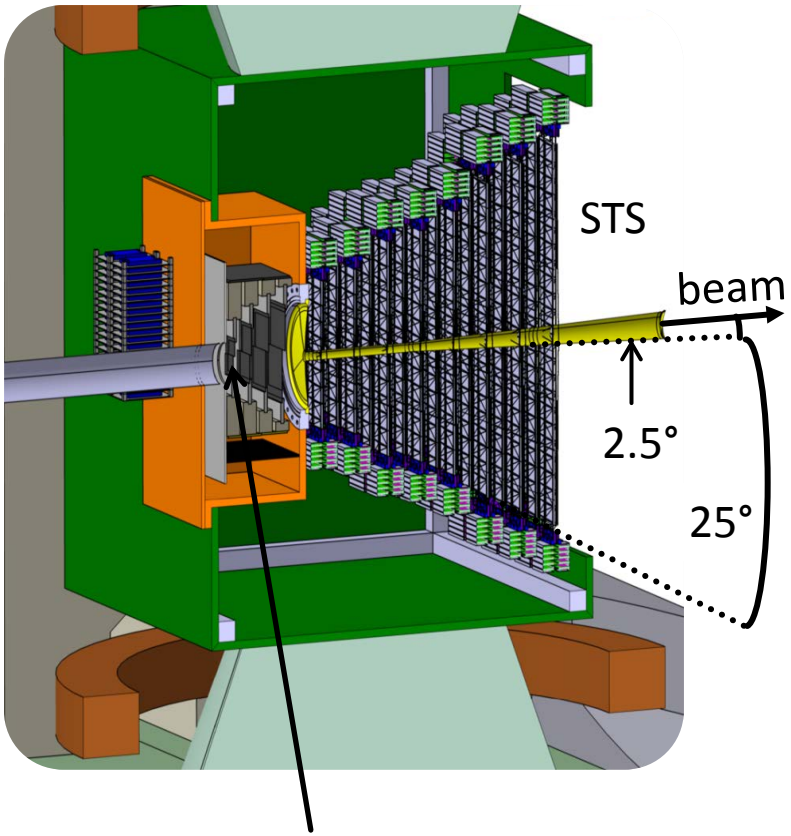
At high baryon density:

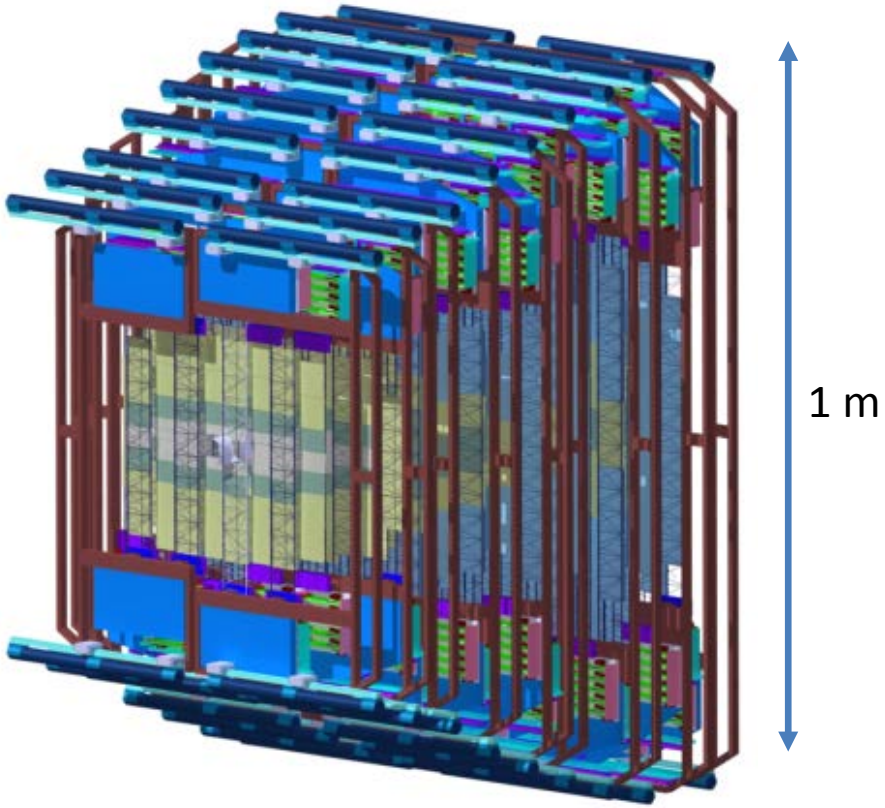
- N of baryons >> N of antibaryons
  Densities like in neutron star cores
- L-QCD not (yet) applicable
- Models predict first order phase transition with mixed or exotic phases
- Experiments: BES at RHIC, NA61 at CERN SPS, CBM at FAIR, NICA at JINR

Present and future HI experiments/machines



CBM Silicon Tracking System

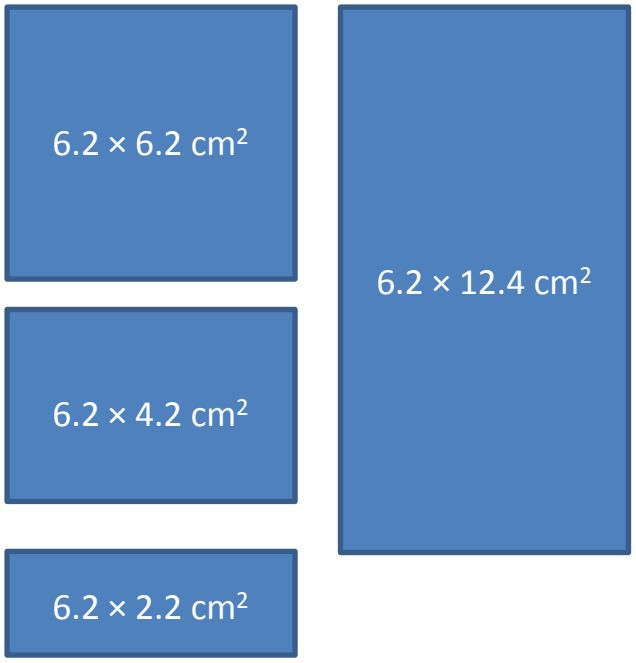




presentation
J. Heuser - Status of the CBM-STS

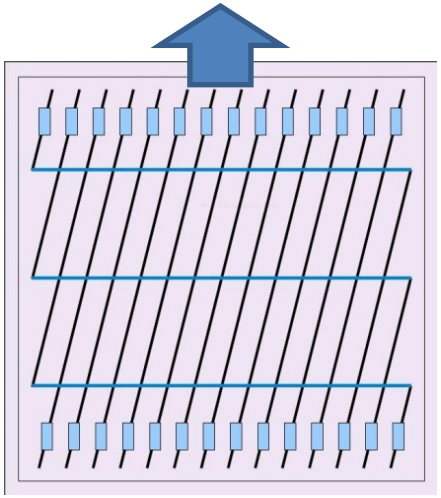
Silicon microstrip sensors

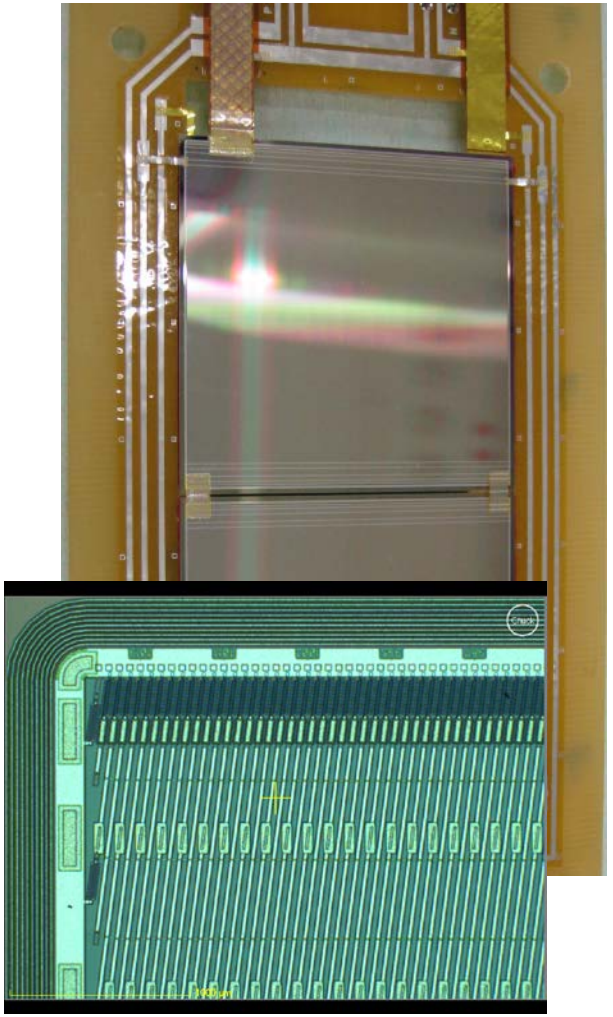
4 sensor shapes, differing only in strip length: short strips deployed in central part, long strips in outer part of the STS stations



sensor structure:

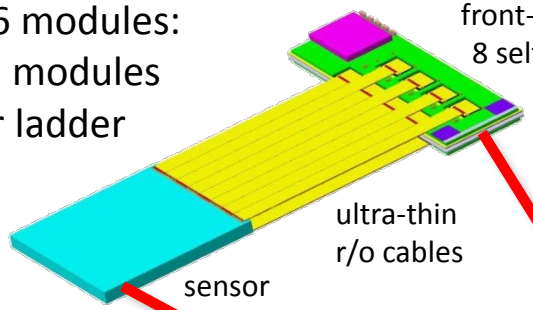
- 300 µm thick, n-type silicon
- double-sided segmentation
- 1024 strips of 58 µm pitch
- strip length 2/4/6/12 cm
- angle front/back: 7.5 deg
- read-out from top edge
- rad. tol. up to 10^{14} n_{eq}/cm^2



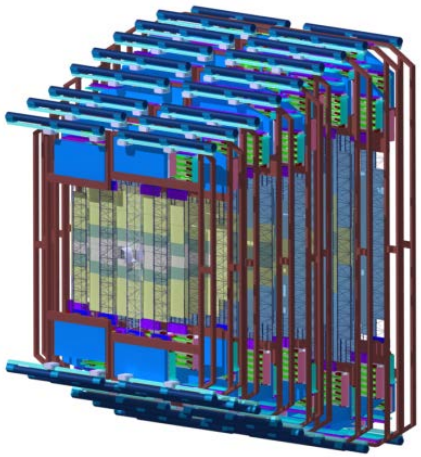


STS integration

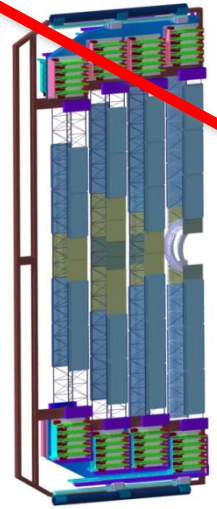
896 modules:
4-5 modules
per ladder



- 8 stations, volume 2 m^3, area 4 m^2
- 896 detector modules
  - 1220 double-sided microstrip sensors
  - ~ 1.8 million read-out channels
  - ~ 16 000 r/o STS-XYTER ASICs
  - ~ 58 000 ultra-thin r/o cables
- 106 detector ladders with 4-5 modules
- power dissipation: 42 kW (CO_2 cooling)

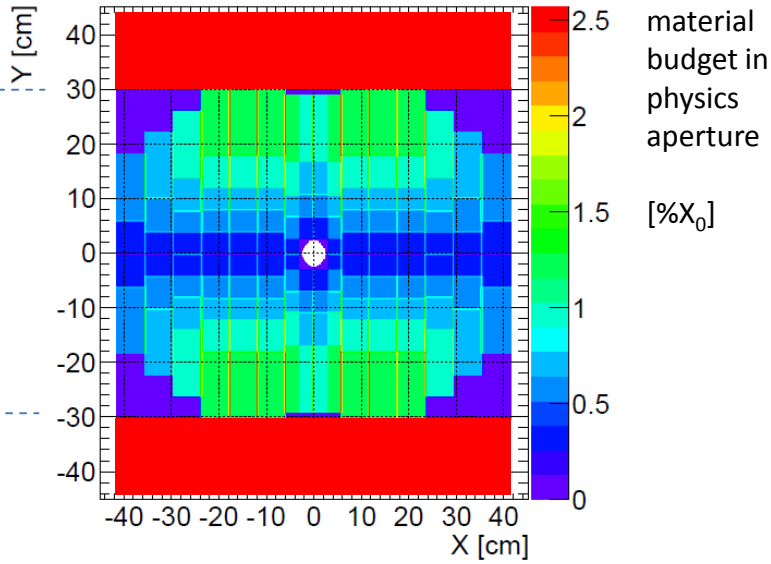


8 tracking stations



18 half-units

106 ladders



material budget in physics aperture

[%X_0]

CBM-STS Workshops

Forthcoming meetings and workshops will be organized within the framework of CREMLIN.

JOINT VB LHEP-GSI module/ladder assembling lab at Dubna

June 18th, 2015

Tasks WP3

3.1: Coordination of joint developments of main components of the Silicon Tracking System

3.1.1: Technical management - development of STS modules/ladders

3.1.2: Organization of technical review meetings for each component and final Production Readiness Review

3.1.3: Initiation of expert training for the assembly of the components to modules and ladders

3.1.4: Organization of workshops for the joint development of experiment and accelerator components for NICA and FAIR

3.2: Lesson learned and internationalization of the NICA experiment collaborations

Tasks WP3

3.1: Coordination of joint developments of main components of the Silicon Tracking System

3.1.1: Technical management - development of STS

3.1.2: Organization of technical [illegible] and fi[illegible]

3.[illegible] [illegible]ng for the assembly of the components [illegible]odules and ladders

Main objective of this WP in CREMLIN is the coordination of the joint development of silicon tracking detectors

3.1.4: Organization of workshops for the joint development of experiment and accelerator components for NICA and FAIR

3.2: Lesson learned and internationalization of the NICA experiment collaborations

Deliverables WP3:

- D 3.1 Report on production of prototype silicon detector ladder (M24 - FAIR)
- D 3.2 Report on knowledge exchange for the joint development of components for the silicon detector and for components for the low energy heavy ion collider NICA (M36 - FAIR)
- D 3.3 Report on lesson learned and development of strategy regarding the internationalization of the NICA collaborations (M36 - JINR)

Who will be responsible for the milestones and deliverables; workshops and meetings?

CREMLIN WP3

Tasks related to the STS:

3.1: Coordination of joint developments of main components of the Silicon Tracking System
3.1.1: Technical management - development of STS modules/ladders
3.1.2: Organization of technical review meetings for each component and final Production Readiness Review
3.1.3: Initiation of expert training for the assembly of the components to modules and ladders
3.1.4: Organization of workshops for the joint development of experiment and accelerator components for NICA and FAIR
3.2: Lesson learned and internationalization of the NICA experiment collaborations

Organizational aspects:

- Which are the concrete objectives of the WP?
  - development of CBM-STS module and ladder assembly
  - preparation and passing of the CBM-STS Production Readiness Review
  - start of module and ladder production at the assembly centers GSI and JINR-VBLHEP
- Who will be responsible for the milestones and deliverables; workshops and meetings?
  - milestones and deliverables: GSI and JINR
  - meetings and workshops: weekly CBM-STS workgroups (GSI) , (semi)-annual workshops (GSI + JINR)
- What is the current status of the EU-Russian cooperation in the scientific field of the WP?
  - very active, years of cooperation embedded in CBM Collaboration and other FAIR-NICA contacts

Manpower in WP3

for main objective: joint development of silicon tracking detectors

<u>Personnel effort</u>

FAIR: 48 person months

- 24 person months own contribution (J. Eschke)
- 24 person months paid by EC funds (M. Teklishyn) (Post-Doc hired since 1st September 2015)

JINR: 48 person months

- 24 person months own contribution (Y. Murin)
- 24 person months paid by EC funds (NN)

Connecting **R**ussian and **E**uropean **M**easures for **L**arge-scale Research **IN**frastructures

“CREMLIN”

WP3 - Science cooperation with the NICA collider facility in the field of ion beams and heavy ion physics

Thank you very much
for your attention!