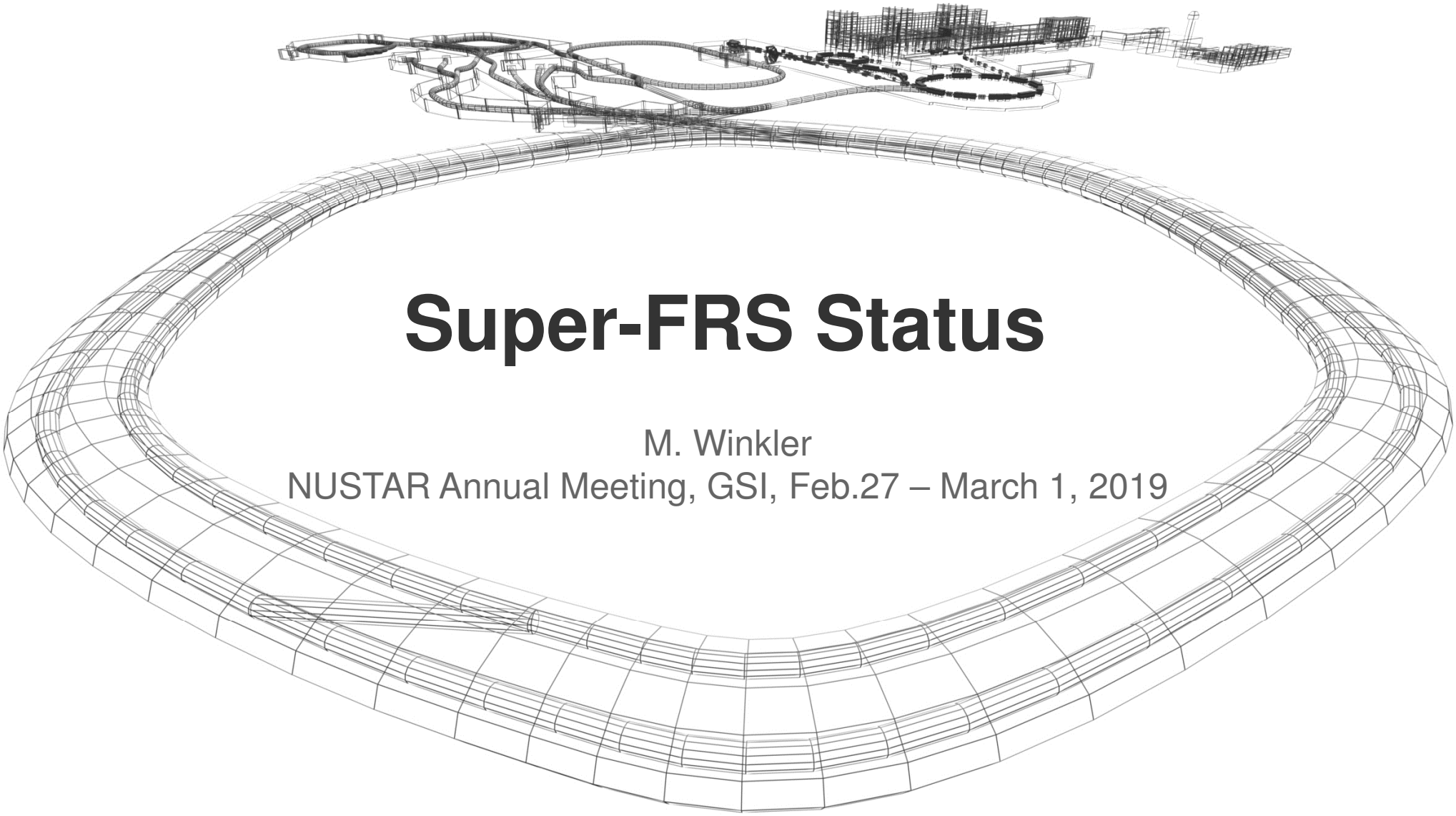


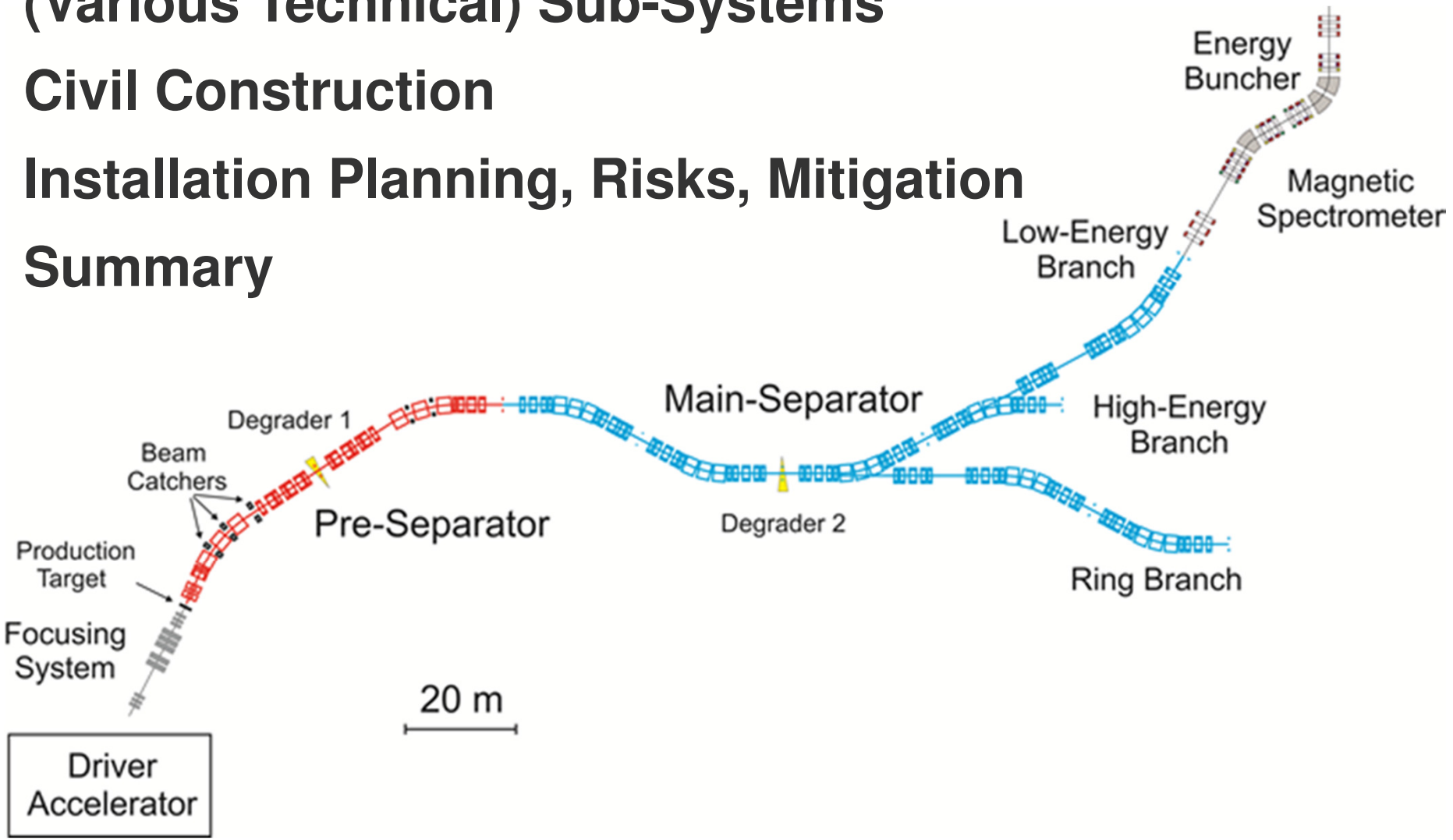
Super-FRS Status

M. Winkler

NUSTAR Annual Meeting, GSI, Feb.27 – March 1, 2019

Outline

1) (Various Technical) Sub-Systems
2) Civil Construction
3) Installation Planning, Risks, Mitigation
4) Summary



Magnets I
(SC Multiplets, Overview)

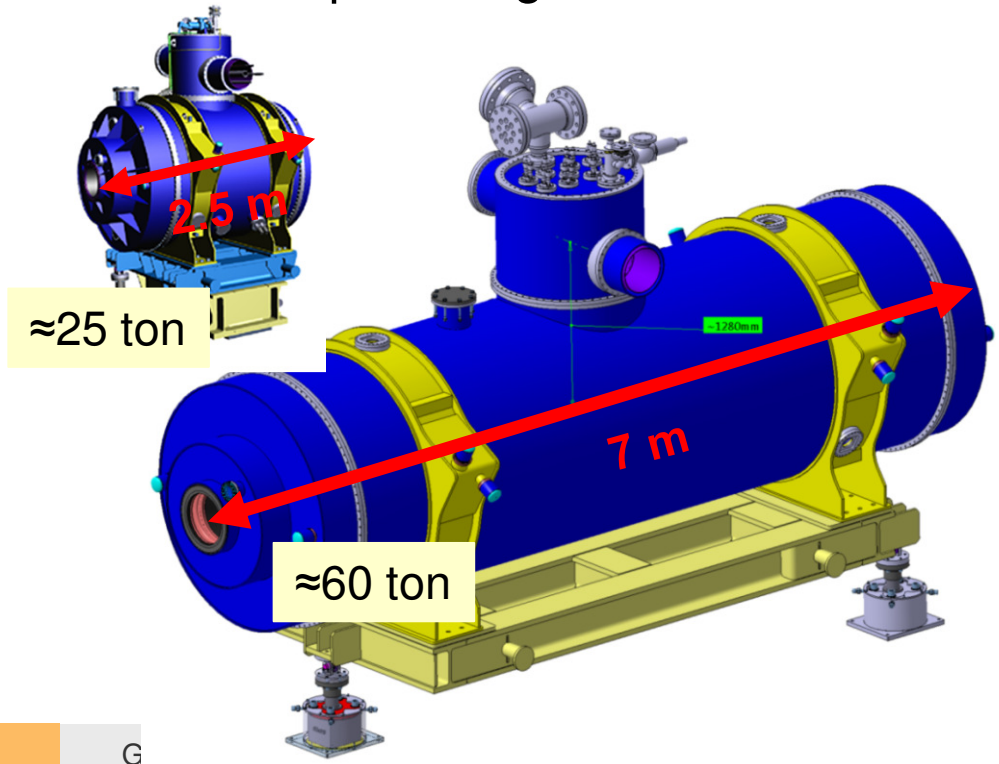
H. Müller,
E.J. Cho et al.

Scope:

- 8 short multiplets, 25 long multiplets
  - ➢ QS or QT, including correctors

Main characteristics:

- iron dominated, cold iron, common helium bath
- warm beam pipe (38 cm inner diameter)
- individual powering, max. current <300A



Status / Schedule

- ✓ Contract closed 07/2015 (ASG, Genova)
- ✓ Design phase (FDR 12/16, PRR 12/17)
- **Construction phase for FoS running**
  - ✓ **FAT FoS SM 01/2019**
  - ✓ **shipment to CERN Feb. 20, 2019**
  - ➢ **SAT FoS SM 11/2019**
  - ✓ FAT FoS LM expected Q4/2019
- Series production phase
  - ➢ Release (Q3)/Q4 2019
  - ➢ FAT last multiplet **Q4/2023**

Magnet II
(SC Standard Dipole)

H. Müller,
E.J. Cho et al.

Scope

- 3 units 11°, 18 units 9.75° + support (standard)
- 3 units 9.75° + support (branched)
- Warm iron, SC coil
- Aperture ±190mm x ±70mm

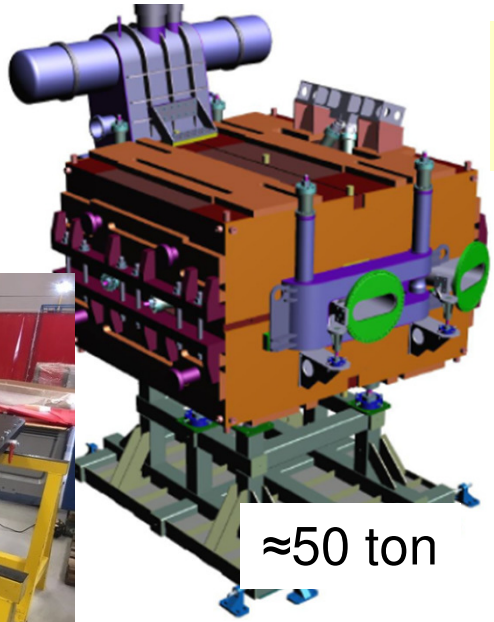
Status standard sc dipole :

✓ Contract award Elytt (Sp) Feb. 8, 2018
✓ Design verification phase
✓ DRR: Q2 2018, FDR: Q4 2018
➢ Coil mock-up runing
➢ FOS production in preparation
- FAT of FoS expected Q3/2019

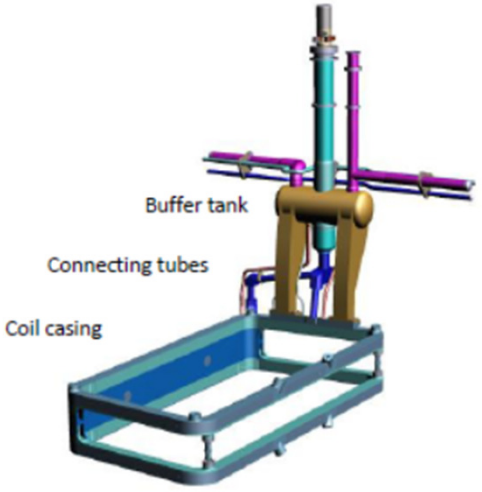
Collaboration with CEA, Saclay on design and follow-up

Status branched sc dipole (R&D work):

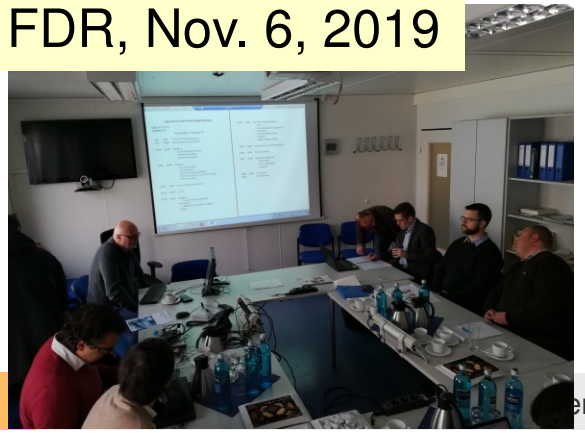
✓ Design phase completed
  ➢ PDR Q4/2017, FDR Q3 /2018
  ➢ CDR, Spec, 3D Model estblished
    → approval process running
➢ FAIR tender start Q2/2019



CDR branched sc dipole



FDR, Nov. 6, 2019



Magnets III
(Testing@CERN, status)

K. Sugita et al.

- Collaboration Agreement between CERN and GSI
- Cold (4K) testing of the SC magnet module at CERN
- Addendum to the CA (operation phase)
  - ✓Signed January 2018
  - ✓Relevant budget approved by management
- **4 GSI colleagues employed, seconded to CERN**
- Facility commissioning running
- **The first magnet arrived on Feb 20, 2019**

Training GSI, Dec .2018

Magnets IV
(Radiation Resistant Magnets)

H. Leibrock,
T. Blatz et al.

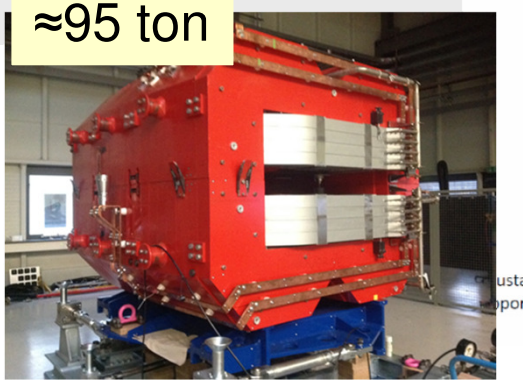
interfaces: sextupole, beam catcher, pillow seal, support structure

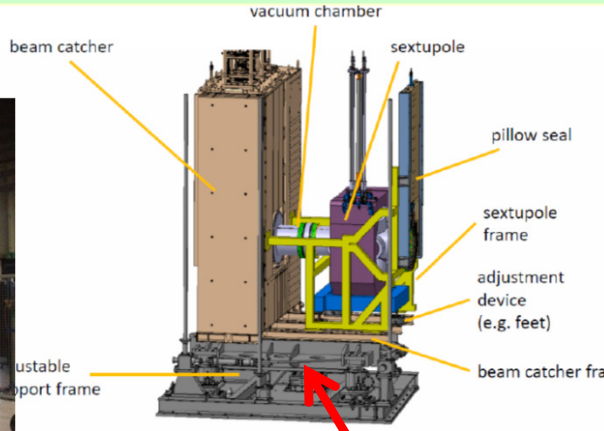
Scope:

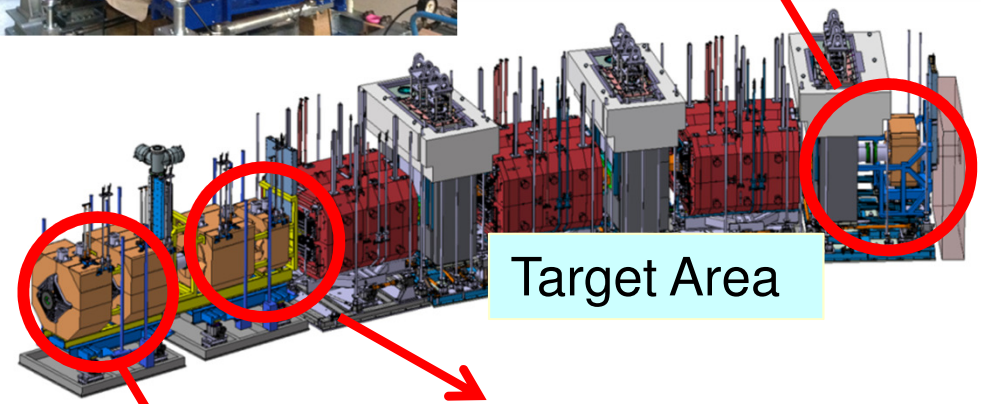
- NC magnets using MIC cable
- WP1: 3 dipole magnets
  (one prototype dipole built and tested)
- WP2: 3 quadrupoles & 2 sextupoles
- Dedicated support structure
- Remote connectors and alignment

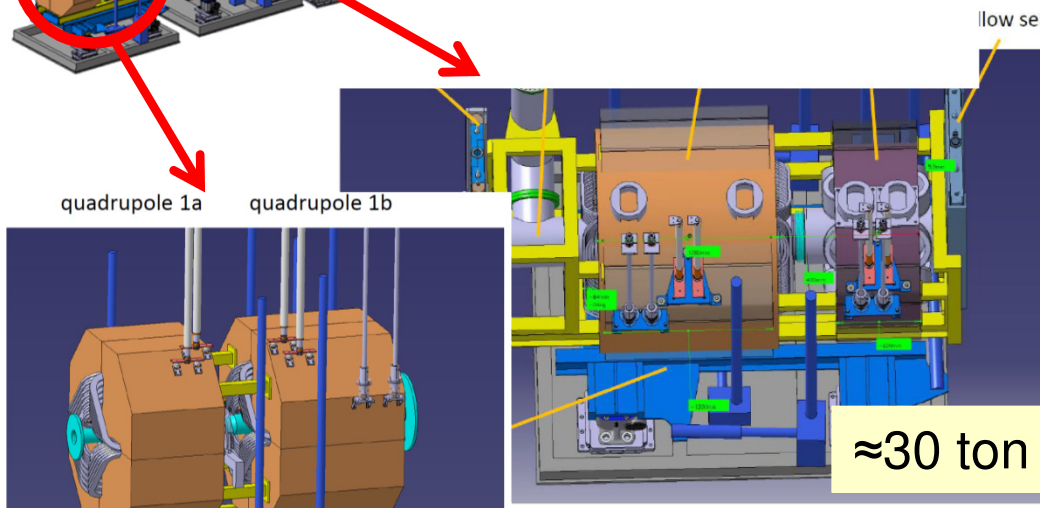
Status / Schedule

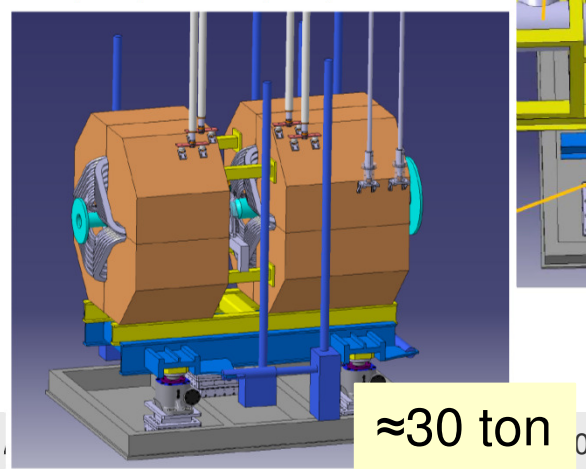
✓ DS for individual magnets released
✓ CC BINP for WP1 circulating
✓ MIC ordered by FAIR
➢ CC BINP for WP2 in discussion
  - FAIR Council assignment required
  - CC expected to be signed 07/2019;
➢ otherwise tender required
  (→ delivery required 03/2023,
  only few months float left)









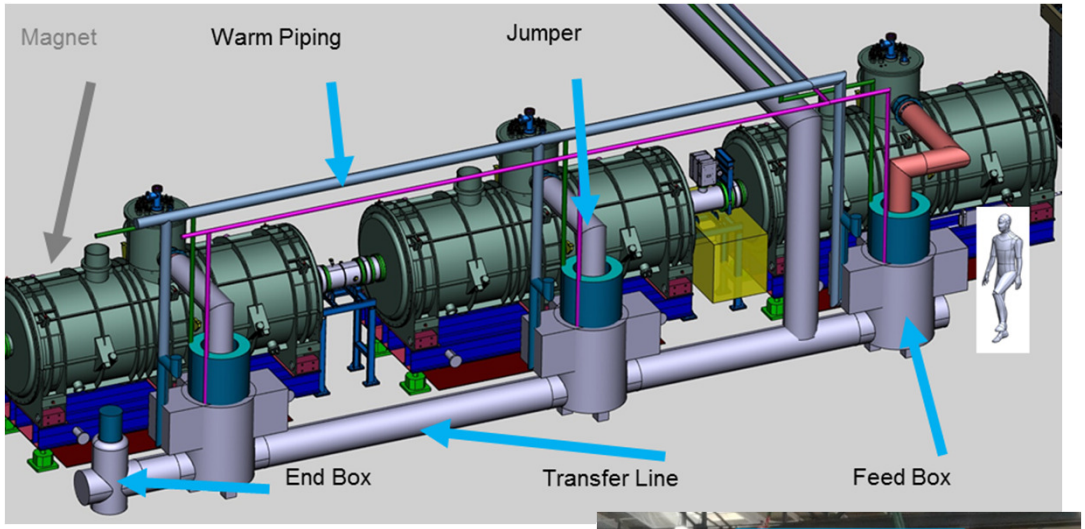


Super-FRS Local Cryogenics

Scope:

- 1 large Branch Box
- Feedboxes (≈60)
- End Boxes (7)
- ≈60 Jumper connections (≈250 m)
- Transferlines (≈300 m)
- 1 large Branch Box
- ≈1.5 km Warm-Gas Piping

~ 120 t of stainless steel



Status / Schedule

✓ DMU concept ready

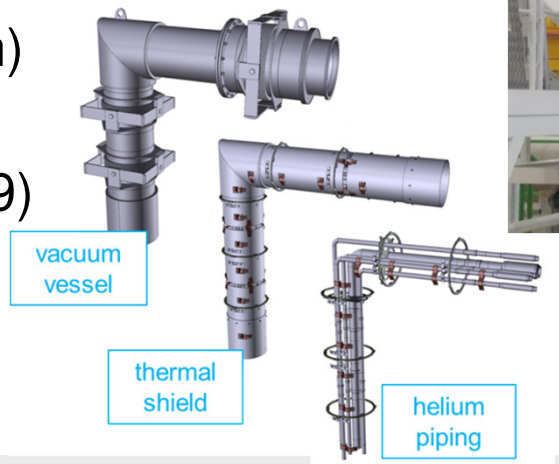
✓ Common specs released (= scope definition)

➢ Contract negotiation initialized

➢ IKC with Poland in preparation (M4 06/2019)

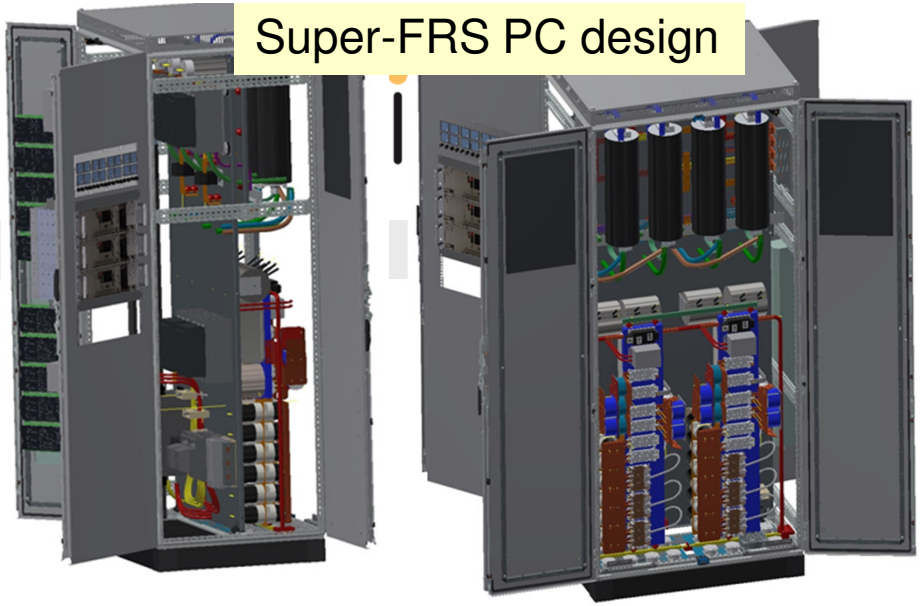
Deliverables expected end 2022

! most critical WP in respect of component availability for installation-window



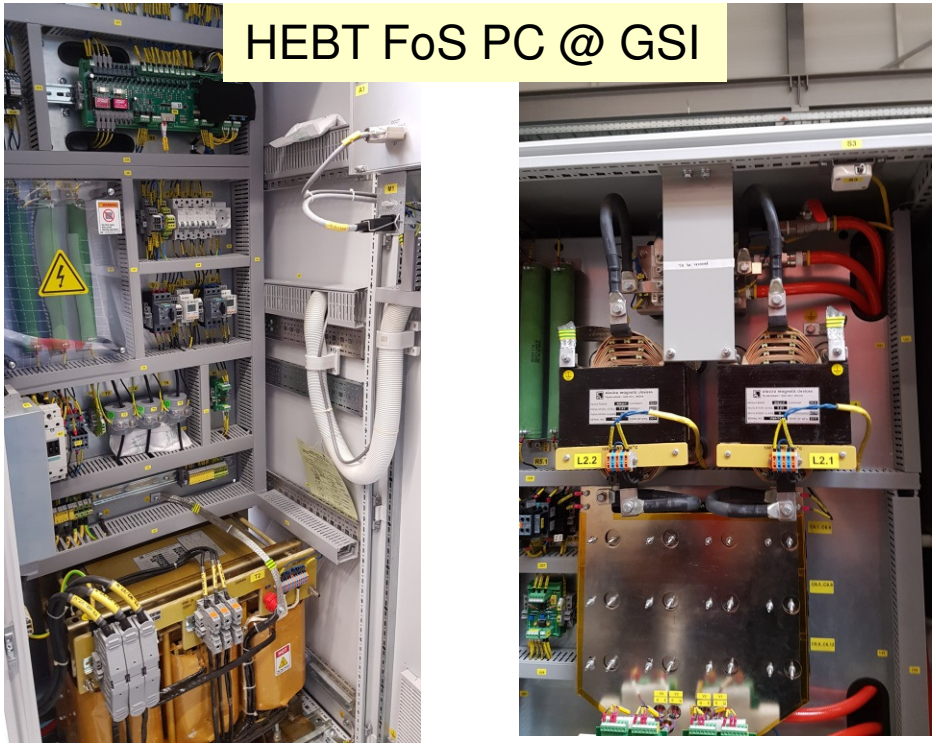
Power Converter

A. Wiest,
W. Freisleben
A. Kratz et al.



Scope & (main) features

- in sum ~250 PC required
- large voltage and current range
- all PC are bipolar
- energy recovery system
- QD electronics: rack-integrated
  - ➢ common infrastructure → cost saving

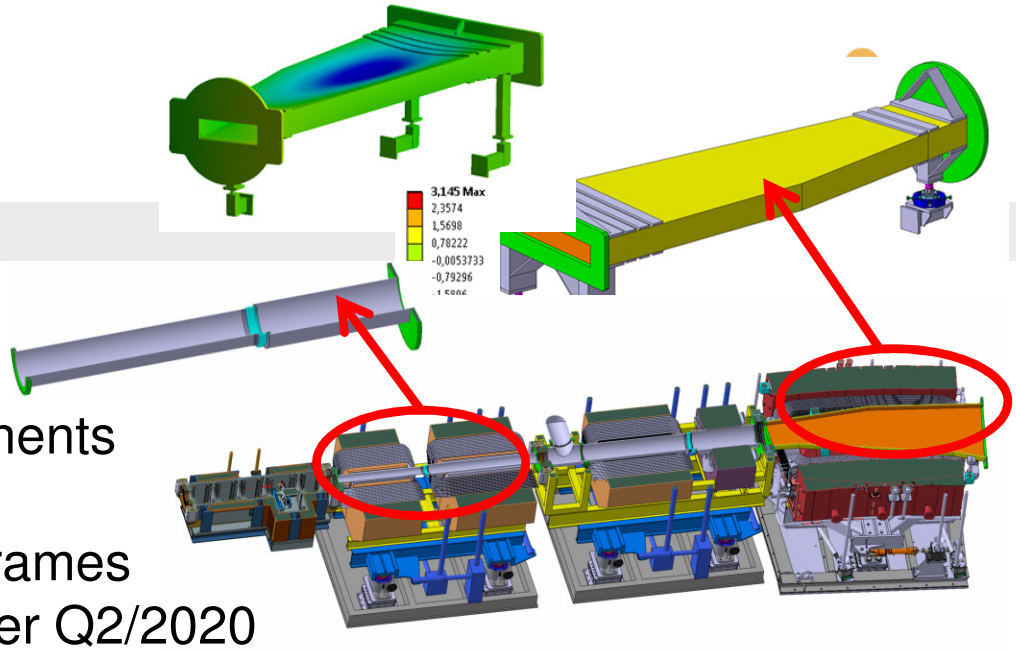


Status / Schedule

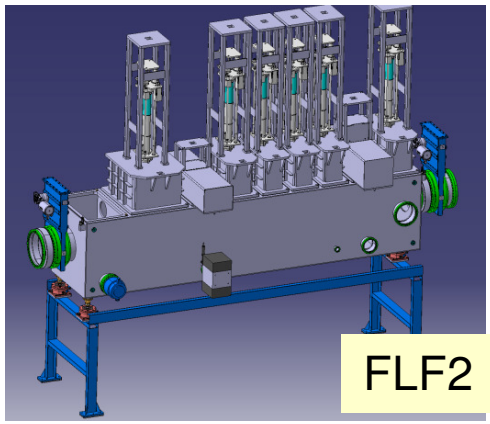
- ✓ in-kind assignment to India
  - PC for Super-FRS, HEBT, SIS 100
  - ✓ IKC for HEBT signed
  - ✓ FoS PC HEBT built, SAT done
  - ➢ IKC for Super-FRS in preparation
- ✓ Specifications released
- Prototype PC under construction
  - ✓ cabinet designed
  - ✓ electric circuits developed
  - ➢ final assembly until Q2/2019
  - ➢ SAT: GSI (NC dipole, Q3/2019),
    CERN (FoS SM, Q4/2019) ?

Vacuum System

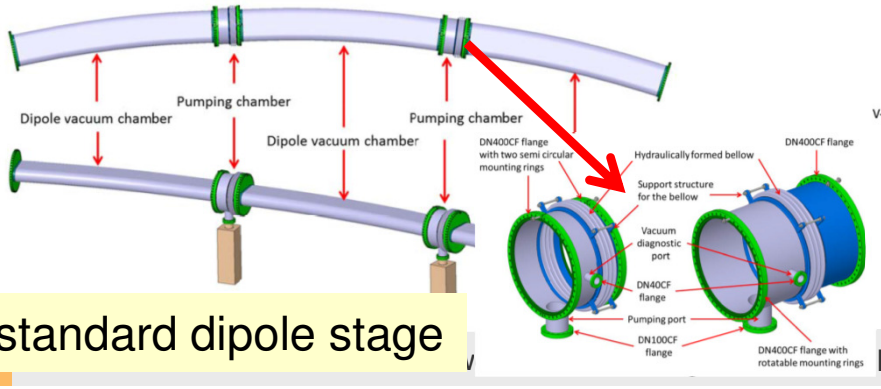
S. Purushotaman,
I. Mukha,
J. Kurdal et al.



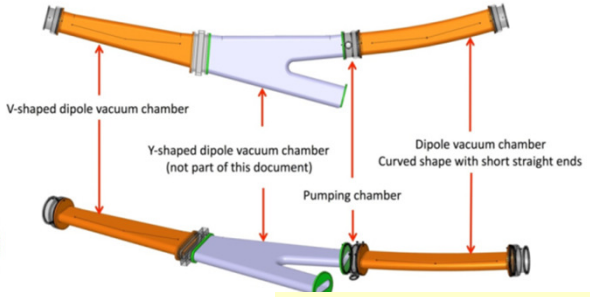
- Vacuum system subject of CBWG 2018
  ✓ ATB optimized → cost saving
- FAIR wide procurement of standard components
- **1st BINP workshop (11/2018)**
- 21 focal plane chambers including support frames
  ➢ CC BINP, ready for signature, FoS chamber Q2/2020
- 24 vacuum chambers for sc dipoles
  - 21 for standard dipoles including pumping ports
    ➢ CC BINP circulating, M4 Q2/2019
  - 3 for branching dipoles, part of dipole procurement
- Vacuum chambers for target area magnets
  - R&D contract for dipole chambers circulating
  - Beam pipes for NC quadrupoles/sextupoles
  - will be included in CC for multipole procurement

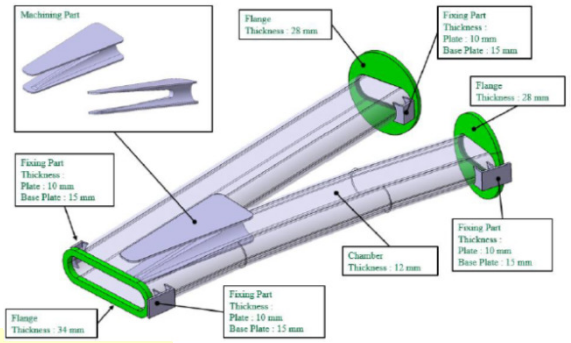


FLF2



standard dipole stage



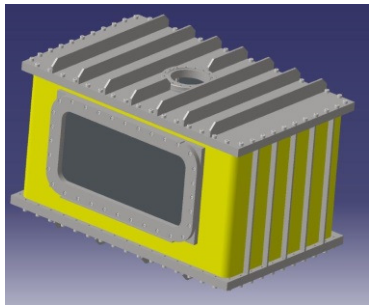


branching dipole stage

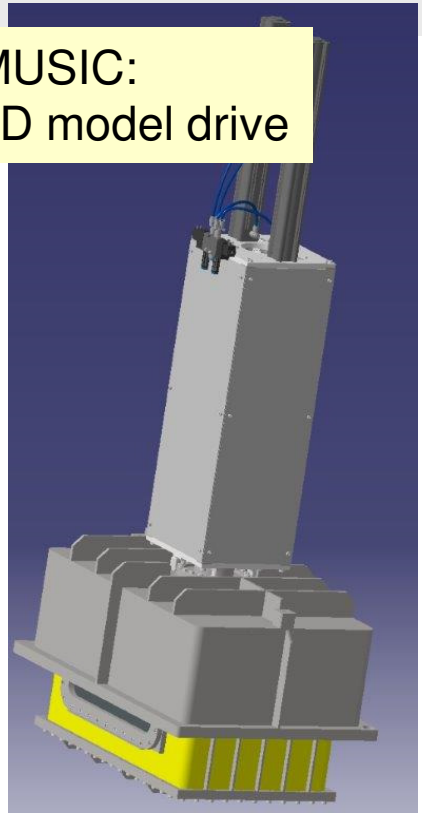
Beam Instrumentation I
('Nordic' contribution)

C. Nociforo
B. Voss, et al.

MUSIC: gas pocket



MUSIC:
3D model drive



- MUSIC (energy-loss, Finnish in-kind)
  - ✓ 1st IKC for Super-FRS signed (12/2017)
  - ✓ CDR done (11/2018). design phase running
    - ➢ FAT FOS expected Q3/2020
    - ? beam test in 2020 possible (SAT) ?
  - – PreAmps by CEA Bruyeres: contractual issues
- SEM Grid (profile monitor), Finnish In-kind
  - IKC to come
    (signed by FAIR and Sw, waiting for Fi)
  - R&D already under way
- GEM-TPC (tracking), Finnish in-kind
  - DS approved, IKC drafted
  - Beam test 2018 postponed
  - – final electronics still to be decided
  - ➢ calibration tool (SciFi + SiPM) in preparation

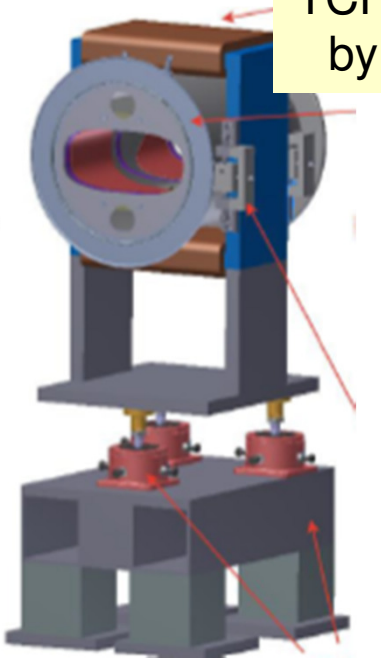
UNIVERSITY OF JYVÄSKYLÄ
JYVÄSKYLÄN YLIOPISTO

- Position drive, Finnish in-kind
  - common drive for SEM and GEM
  - ✓ DS approved, IKC drafted
- Plastic scintillators, Swedish in-kind
  - ✓ DS approved, IKC drafted

Beam Instrumentation II
(some of the other systems)

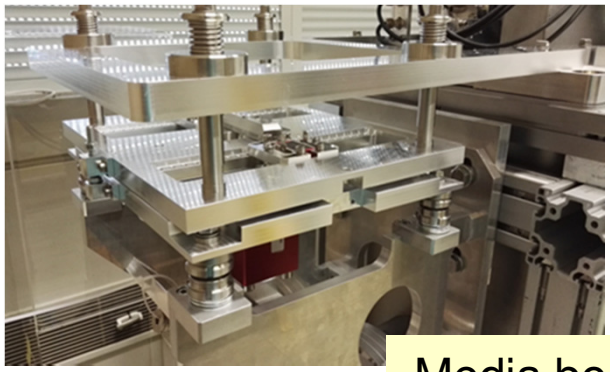
C. Nociforo,
F. Schirru,
O. Kiselev et al.

- Beam Position Monitor (BPM)
  - topic at BINP workshop (11/2018)
  - ✓ Design of TCR1 BPM by BINP existing
  - ➢ we aiming for CC with BINP adapting their desigr
- Time-of-Flight (Russian in-kind, IOFFE StP)
  - ➢ CC negotiation running since 22 months ☹☹
- Slit systems
  - Collaboration contract running with KVI-CART
  - FoS x-slit and y-slit existing
  - Media board developed (RH for pre-separator)
  - Material for series production acquired,
  - ready for assembly
  - ? KVI-CART can finalize contract ?
- PDC
  - combination of particle rate detectors (diamond) and beam current monitors (IC, SEETRAM)
  - ✓ System design by GSI, DS approved, to be built in-house
- Other systems (intensity monitor, target ladder, beam stopper, ...)



TCR1 BPM by BINP

FoS y-slit



Media board prototype

Target Area I

H. Weick,
C. Karagiannis
F. Amjad et al

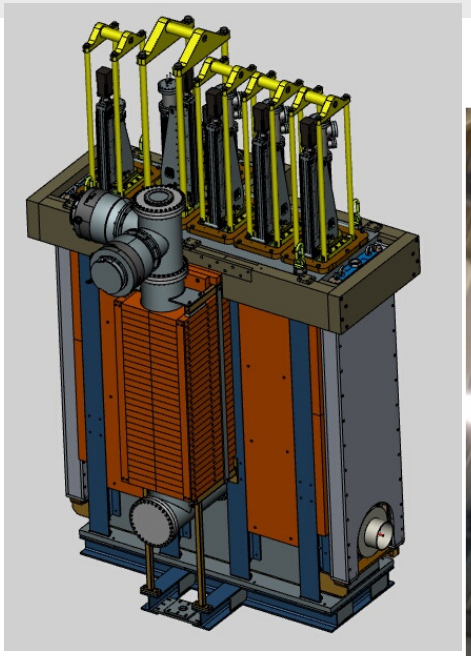
university of groningen

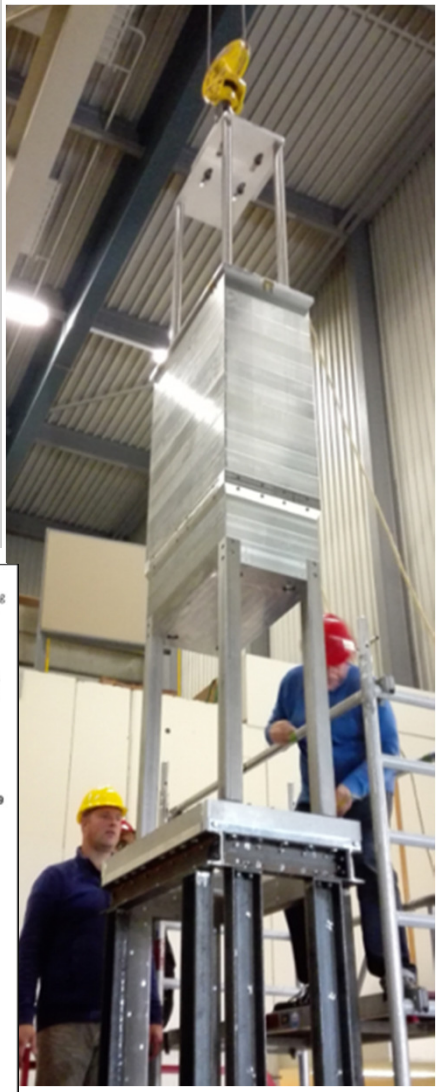
Target chamber

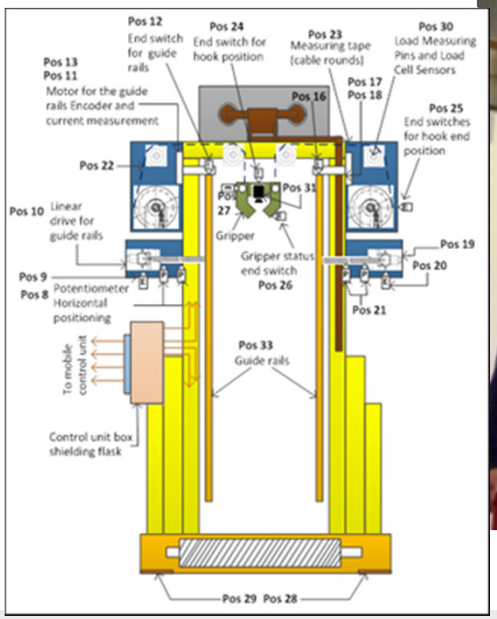
- ✓ Collab. Contract (on design) with KVI-CART
- ➢ Design phase running, includes:
  - chamber design including plug design
- ✓ plug mock-up built , plug guidance verified
- ➢ CDR scheduled March 27, 2019
- ? Final Design Phase still by KVI-CART ?
- ? tender for construction phase required
  - ➢ additional 6 to 9 month required
    - → float will be consumed

Shielding flask

- ✓ DS in approved, IKC (Finland) in preparation
- – Shielding flask detailed design assumed to be processed by subcontractor KVI-CART
- ➢ Mitigation started by Finland







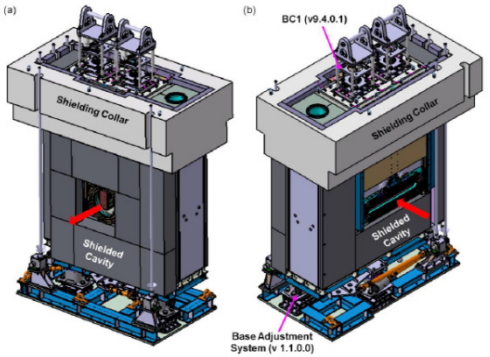
Target Area II

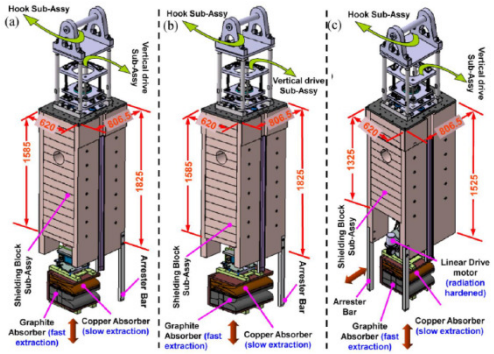
H. Weick,
C. Karagiannis
A. Kratz et al

CSIR - CMERI
सी एस आई आर - केन्द्रीय यांत्रिक अभियांत्रिकी अनुसंधान
CSIR - Central Mechanical Engineering Resear

Beam catcher

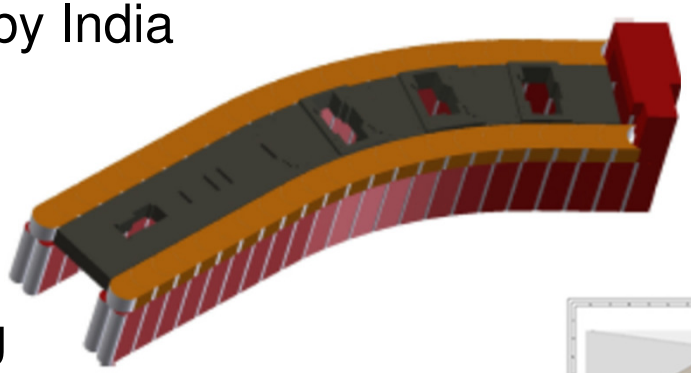
- Indian in-kind, design by CMERI
- DS in approval process , IKC in preparatio
- CDR done, FDR approaching
  - ➢ few open points, quality issue with technical drawings
  - – absorber mock-up missing → test RH capability
- Tender (manufacturing) initiated by India

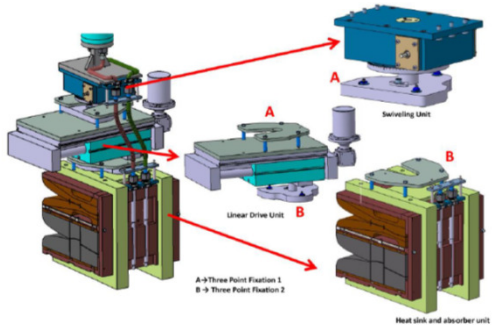


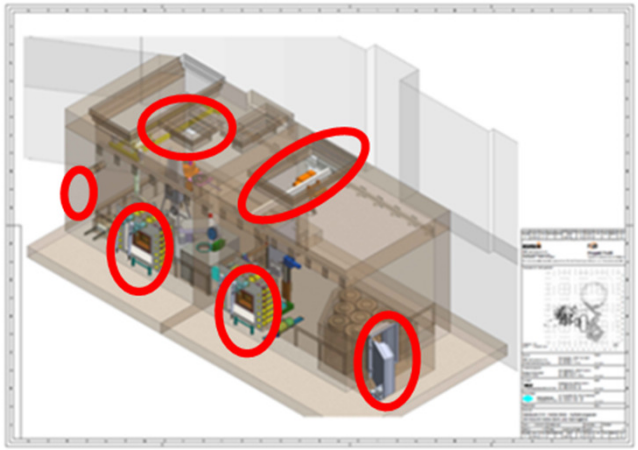


Buiding related items

- Target (iron) shielding
  - ✓ CBWG approved
  - ➢ two parts: **side** / roof shielding
  - ➢ negotiation with potential in-kind provider running
  - ➢ if no result: start tender in Q3/2019
- Hot Cell
  - ✓ shell relevant components defined
    → included in LV for FAIR CC South

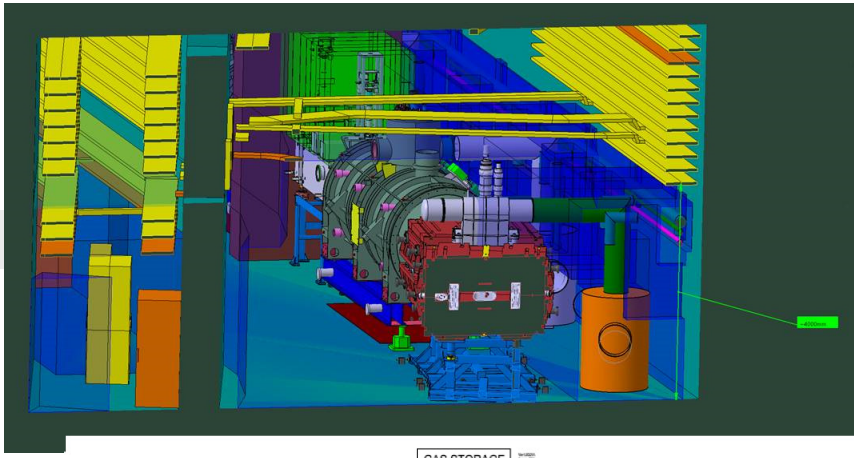




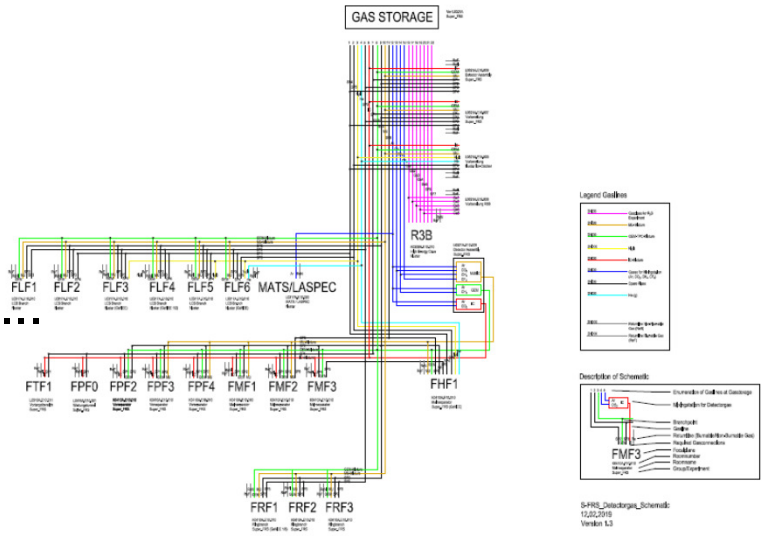


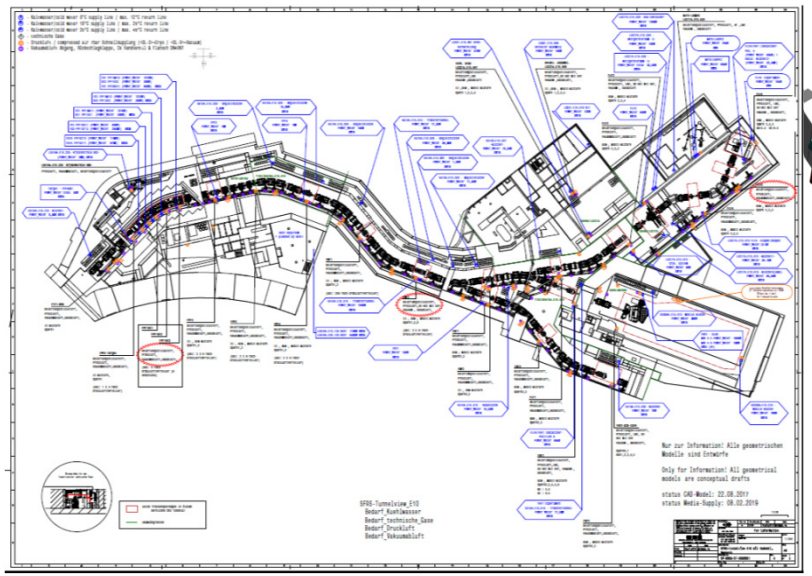
Civil Construction

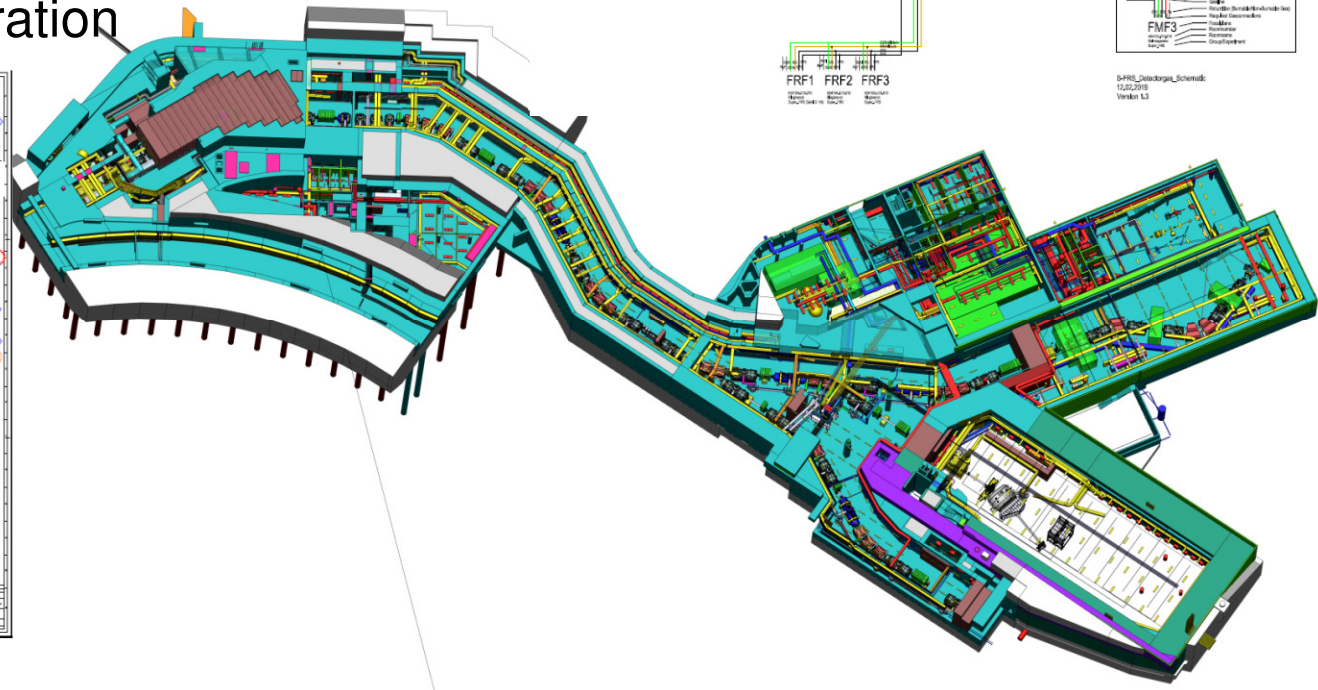
M.M. Schmidt,
A. Bergmann,
S. Pietri et al



- ✓ Tender documents (LV) FAIR CC south released
  - ➢ Tender on market
- Technical service planning (TGA planning) running
  - ➢ Cable planning (CDB) close to be finalized
  - ➢ Cable rooting (collision planning / local cryogenics)
  - ➢ Installed el. power and cooling power
  - ➢ Auxiliary: vacuum exhaust, dry N2, pressurized air, …
- Detector-gas system (CBWG → user task)
  - ➢ Execution planning in preparation



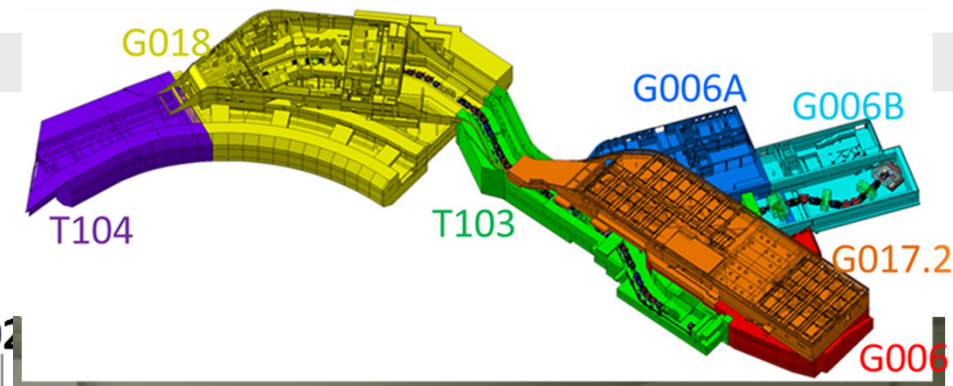




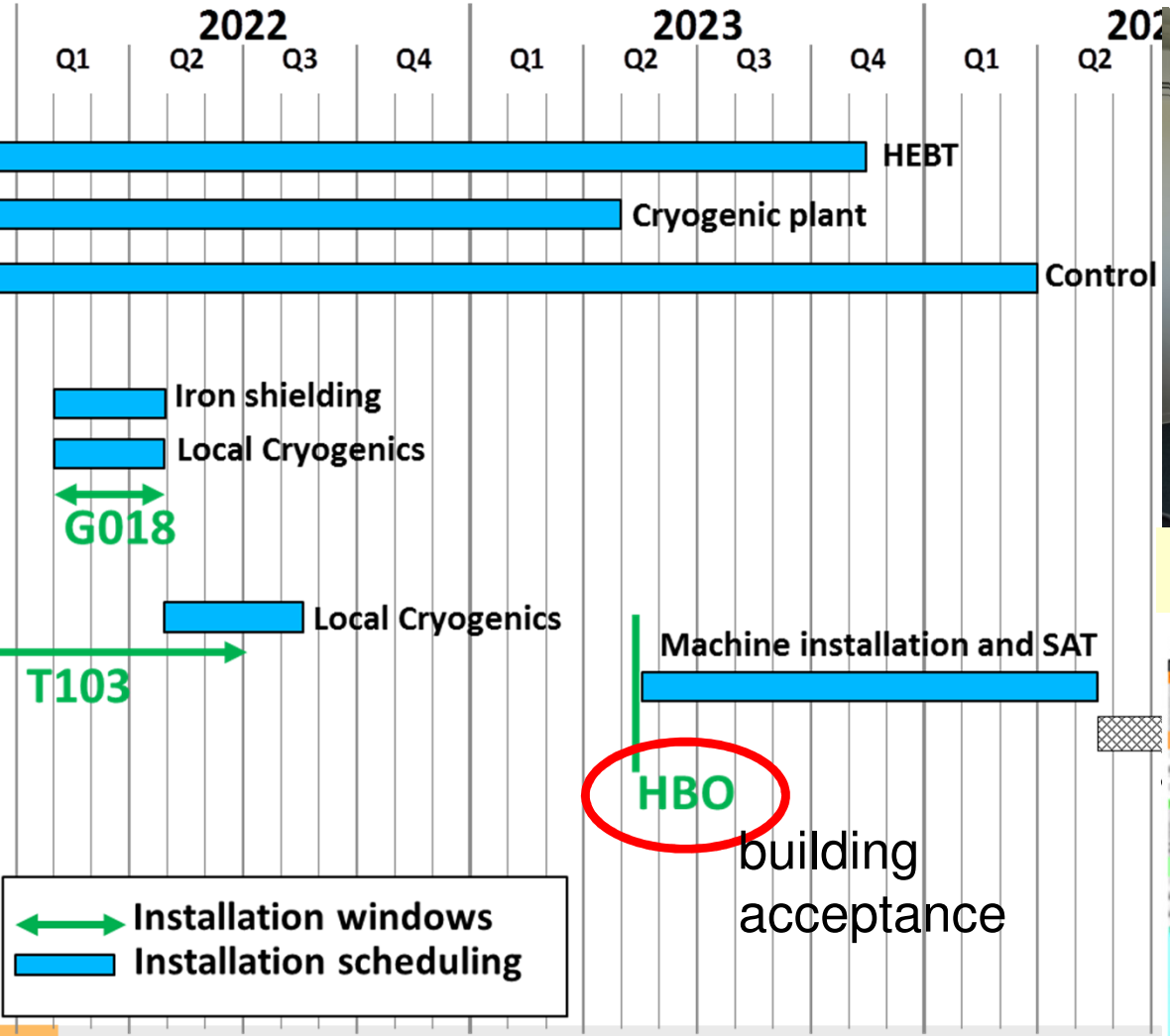
M.V. Ricciardi
WPLs

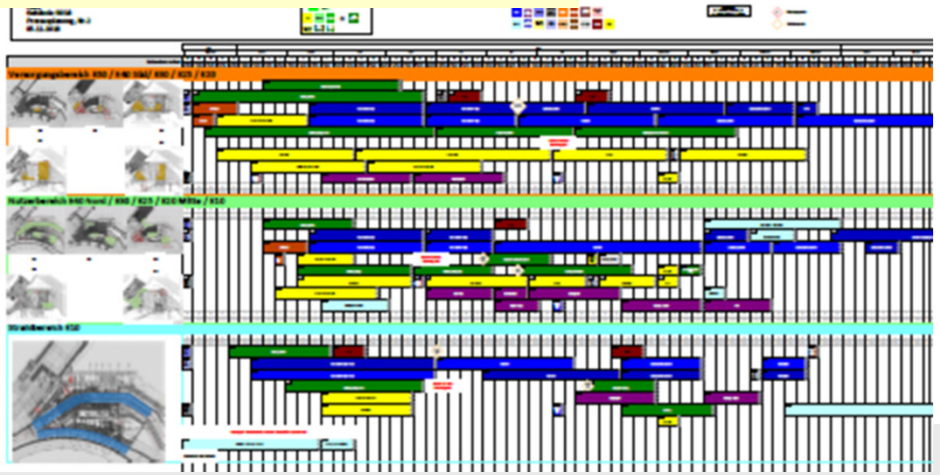
Super-FRS Installation Plan

- LCM coordinates installation windows
  - ➢ two installation windows (for each building)
  - ➢ defines: who does what, when

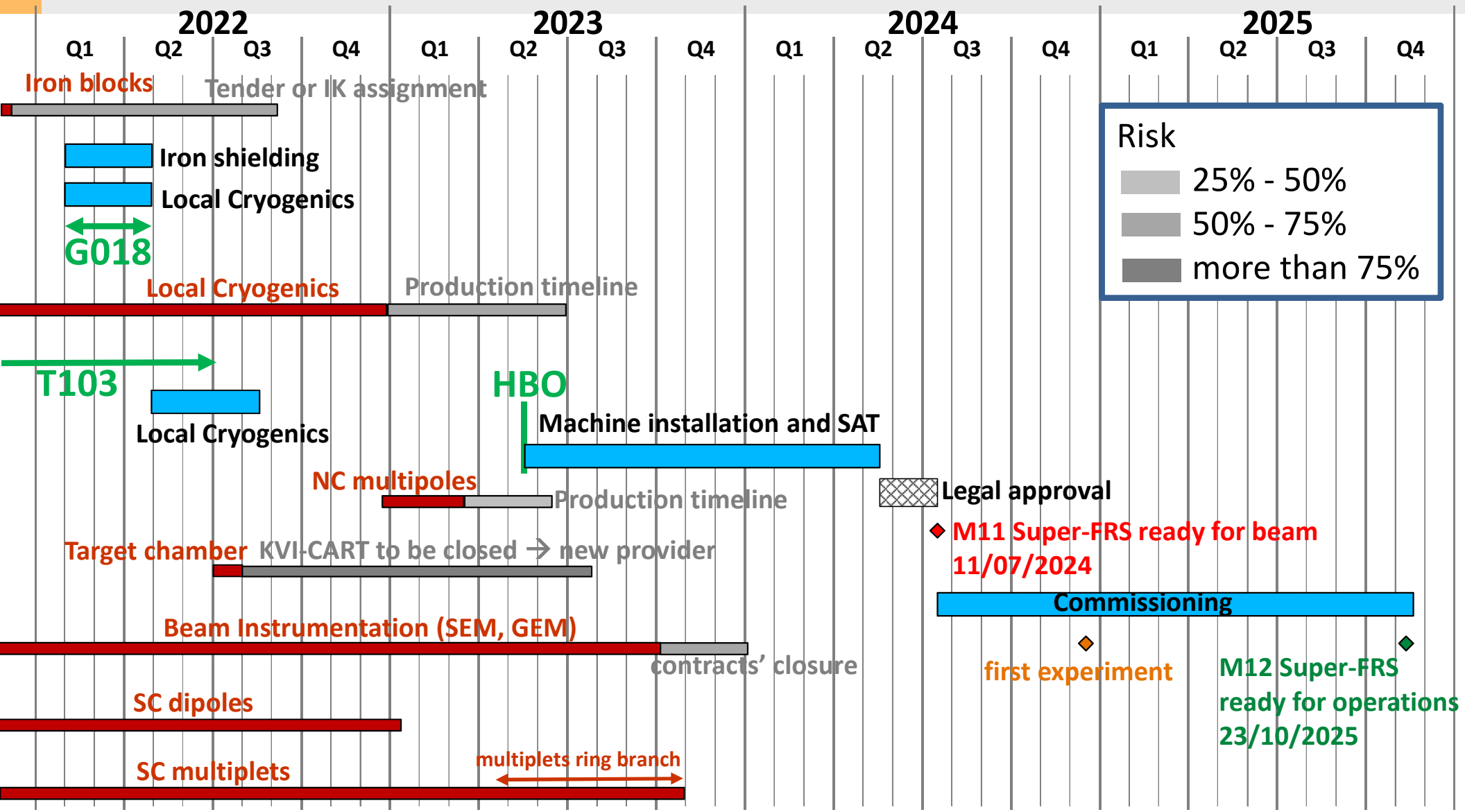


LCM G018 (each floor)





Actual installation plan
(possible delays)



Local cryogenics is the most critical component

Procurement List
(most critical items)

	PSP-number	Component name	Country	Provider	Ordered to Provider / Sub Provider	Delivery date (Contracted/Planned) from	until	Status
S-FRS	2.4.11.3.1	Target chamber	Germany	GSI	No / Yes	04.04.2022	02.05.2022	
S-FRS	2.4.12	Local Cryogenics	Poland	WUT	No	03.03.2021	04.01.2023	
S-FRS	2.4.2.2.3	SC multiplets	Germany	GSI	Yes / Yes	04.11.2019	21.09.2023	
S-FRS	2.4.2.2.1	NC Multipoles	Russia ?	FAIR	No	03.10.2022	31.10.2022	
S-FRS	2.4.11.4.1	Iron Radiation Lateral Shielding	CB8		No	16.09.2021	14.10.2021	

- Target Chamber: KVI-CART will not be available to take over the production.
- Local Cryogenics: Criticality depends on manufacturing capacities.
- SC Multiplets: Float is uncertain, depends on the result of the test of first-of-series.
- NC Multipoles: Delay in M3. Criticality depends on contract negotiation.
- Iron Shielding: decision to be taken either for an IK partner or to start a FAIR tender.

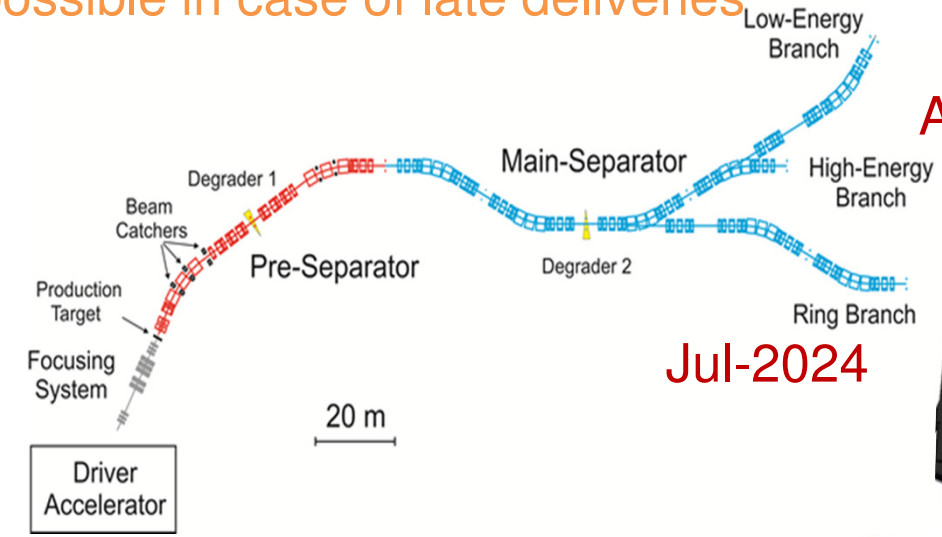
Installation Scenarios
Goal: early operation

Staged realisation of branches possible in case of late deliveries

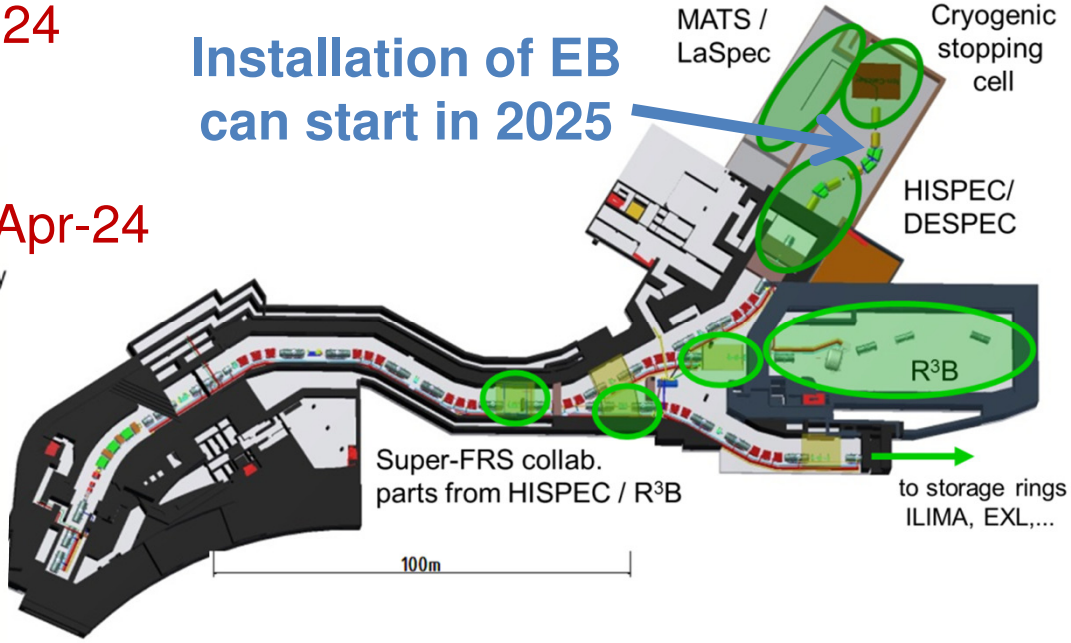
May-24

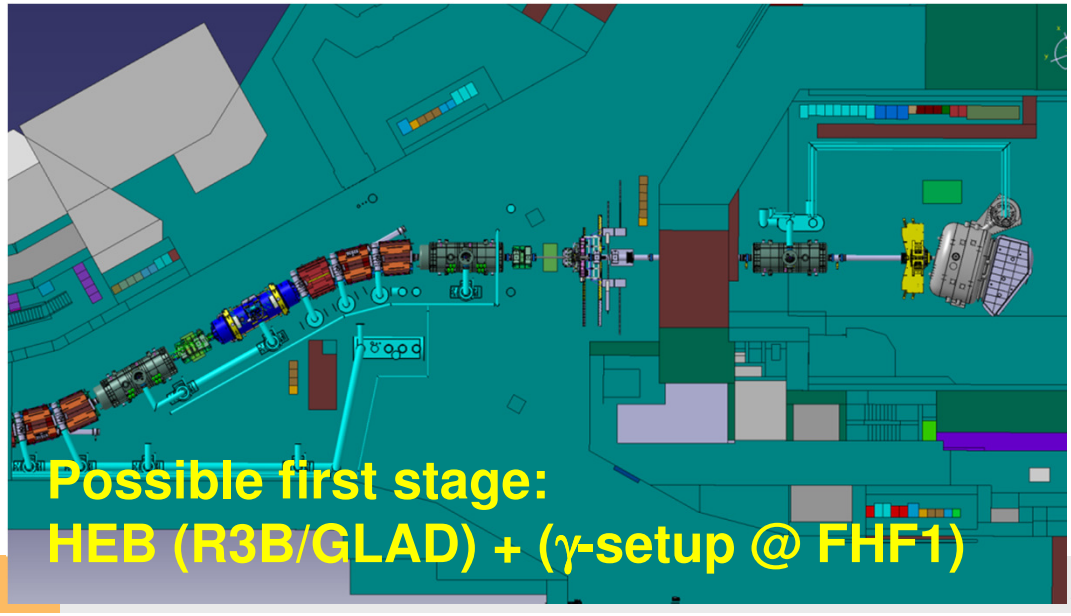
Apr-24

Jul-2024

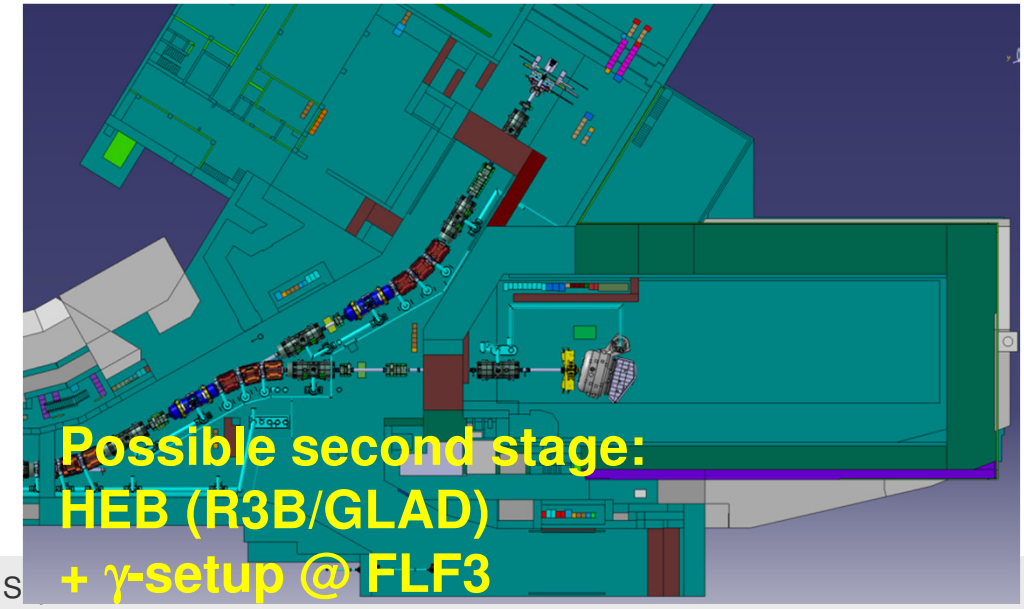


Installation of EB can start in 2025





Possible first stage:
HEB (R3B/GLAD) + (γ-setup @ FHF1)



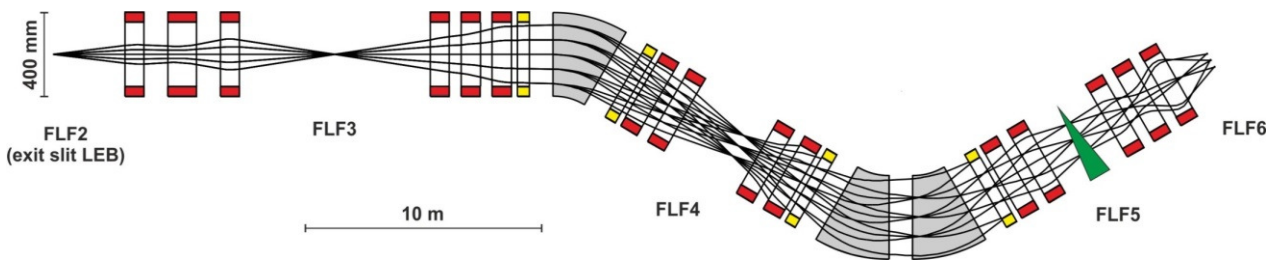
Possible second stage:
HEB (R3B/GLAD)
+ γ-setup @ FLF3

Status Energy Buncher (S-shape, magnets)

J. Winfield et al.

Scope:

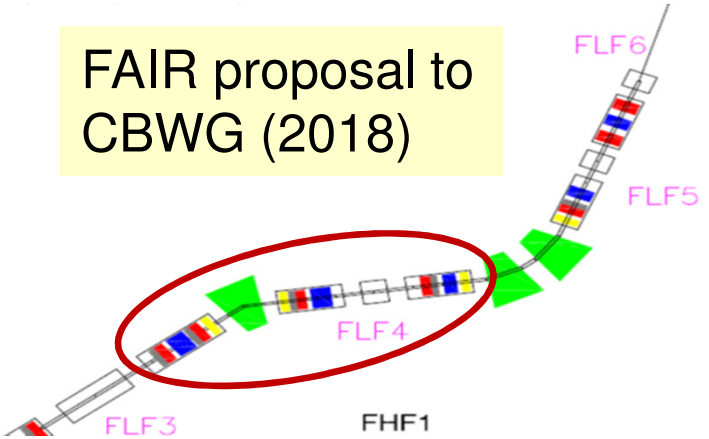
- 3 sc dipole magnets, α=30°
- 5 sc multiplets,
  - ➢ individual magnets same like separator multiplets,



Status / Schedule

- 2010: in-kind assignment India
- ✓ establishing CDR (2017), including cost estimate
  - ➢ Δ3.8 M€ (CB 2005)
- subject of CBWG (2018)
  - ➢ FAIR proposal:
    restrict to first spectrometer stage + focal plane for stopping cell
  - ➢ CBWG: go for full EB → implemented in CB 8
- FAIR Council 12/2018: India ask to step back from in-kind assignment
  - ➢ FAIR needs to procure magnets; potential interest of France on dipoles
  - ➢ production design for dipoles still tbd; magnets will be last in testing sequence;

FAIR proposal to CBWG (2018)



Summary

- SC Magnets & Testing (most time critical items):
  - SC Multiplets: FoS SM delivered to CERN, SAT started
  - SC dipoles contracted; FoS expected this year
  - NC dipoles: CC ready to be signed with BINP
- Development and procurement of various other sub-systems under way
  - (Time) critical items: local cryogenics
  - Low rate of IKC closing (in particular beam instrumentation)
  - Potential issue in case the collaboration with KVI stops (target chamber)
- Civil Construction main topic:
  - Tender FAIR CC south on market
  - Building services planning running
- Installation planning
  - Coordination of installation windows started
  - Staged realisation of branches possible (in case of late deliveries)

Thank you for you attention !