



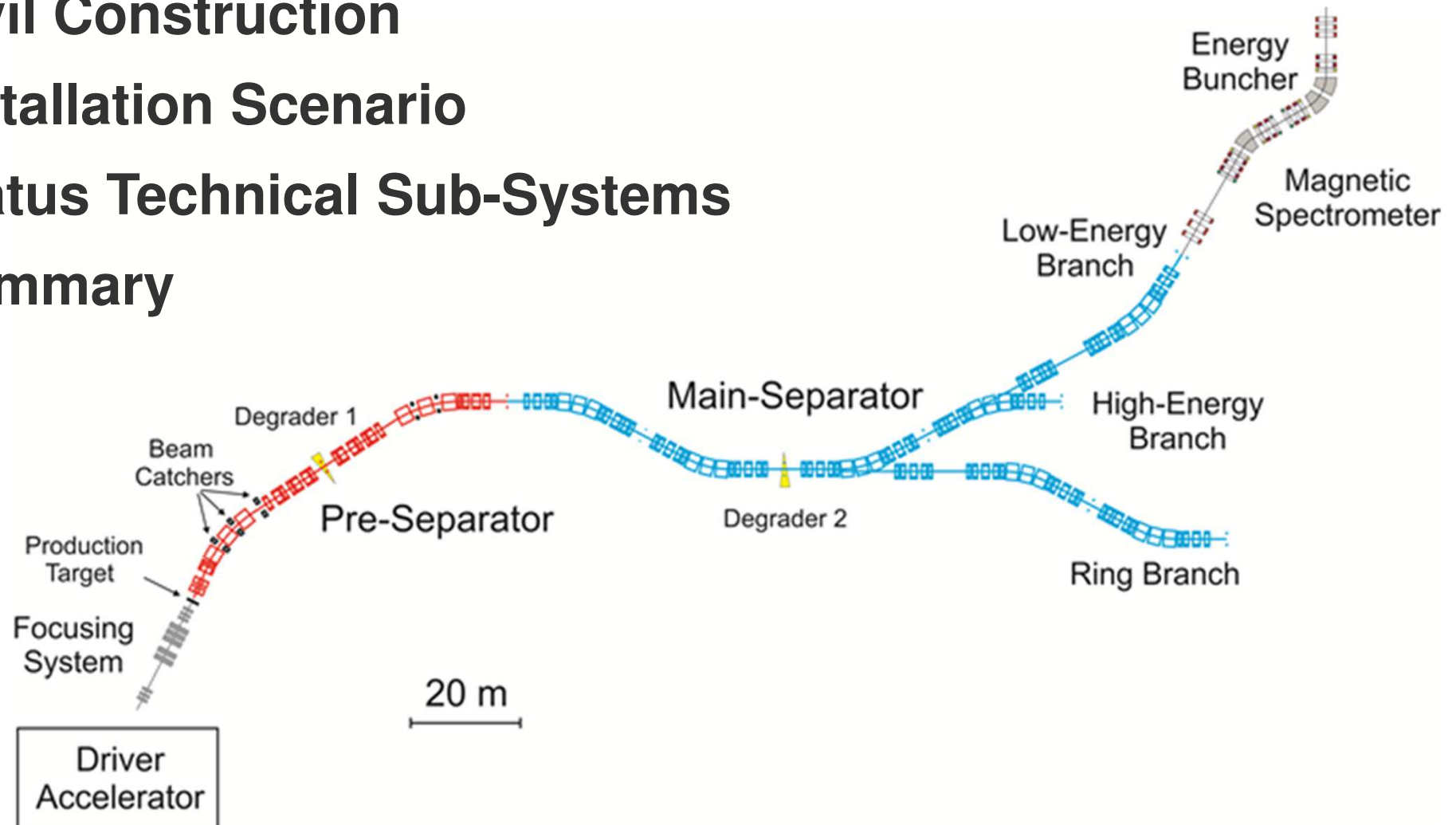
Super-FRS Project Report

M. Winkler

NUSTAR Week 2019, Gif-sur-Yvette, September 25–27, 2019

Outline

- 1) Project Review (and Objectives)
- 2) Civil Construction
- 3) Installation Scenario
- 4) Status Technical Sub-Systems
- 5) Summary



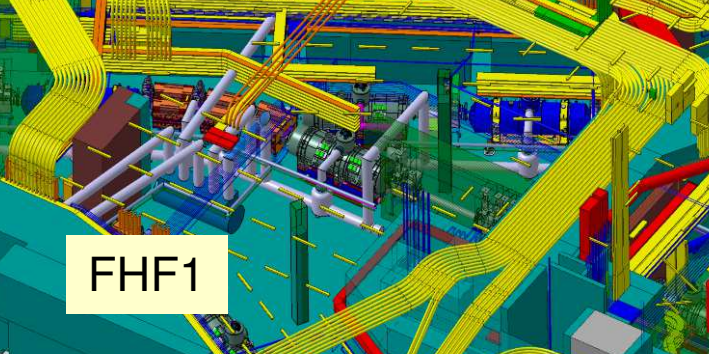
Project Review

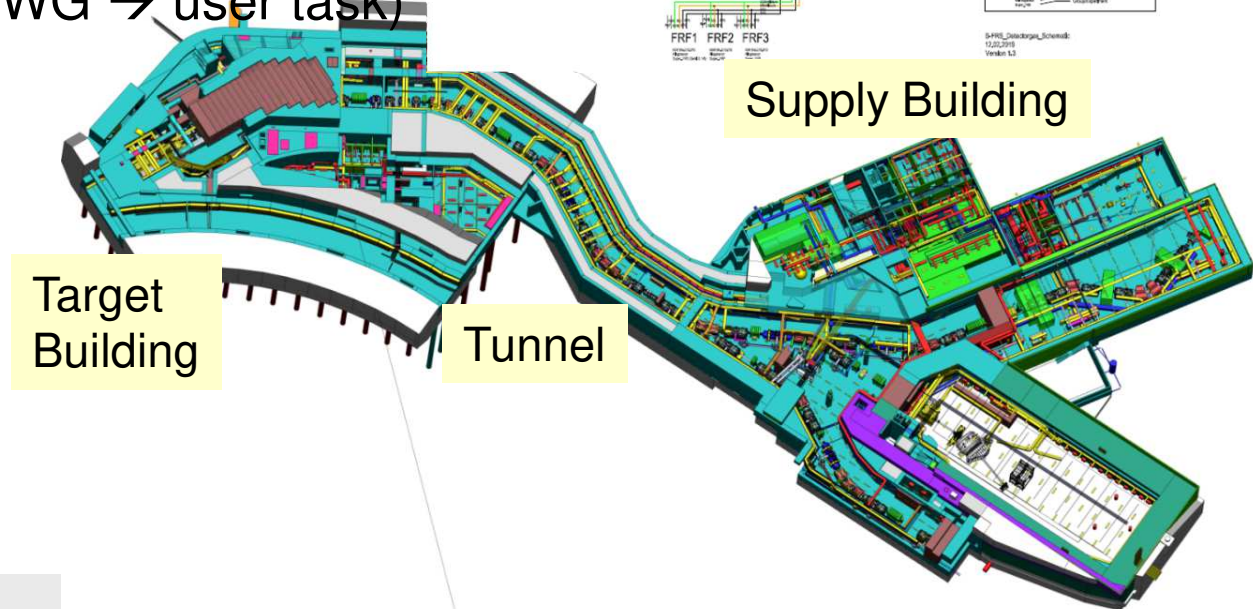
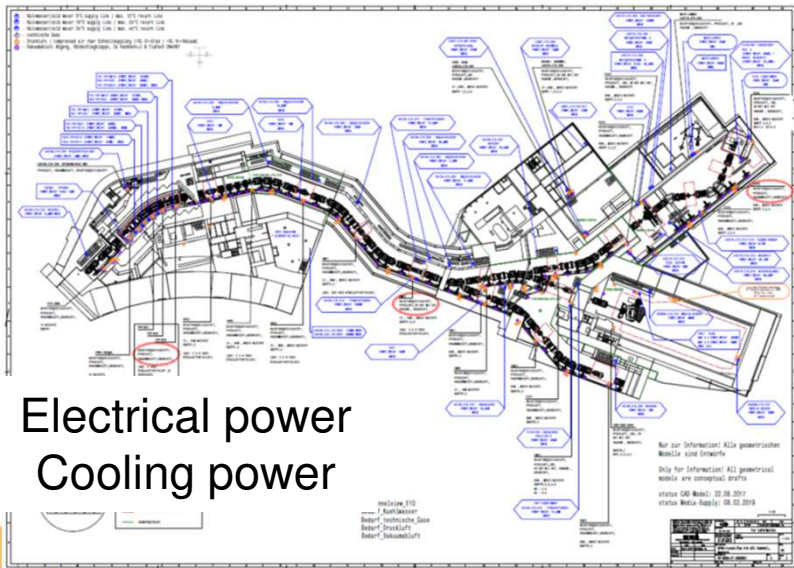
- Cost Review 2018 (CBWG)
 - Project Review 2019
 - final report of Review Board presented at FAIR Council April 29, 2019
- https://www.gsi.de/fileadmin/oeffentlichkeitsarbeit/fair/RevBoardReport_190429_Public.pdf

Recommendations:

- 1) MSV should be realised in full
- 2) Civil construction should be completed without any further delays
- 3) In-kind contributions have to be monitored closely
- 4) Issue with cryogenics should be solved
- 5) The first machine to be commissioned should be Super-FRS
 - ... beginning to produce world leading since before the end of 2025 ...
 - ... using the SIS 18 – Super-FRS beam line for commissioning ...
- 6) Spare parts need to be available

...

- 



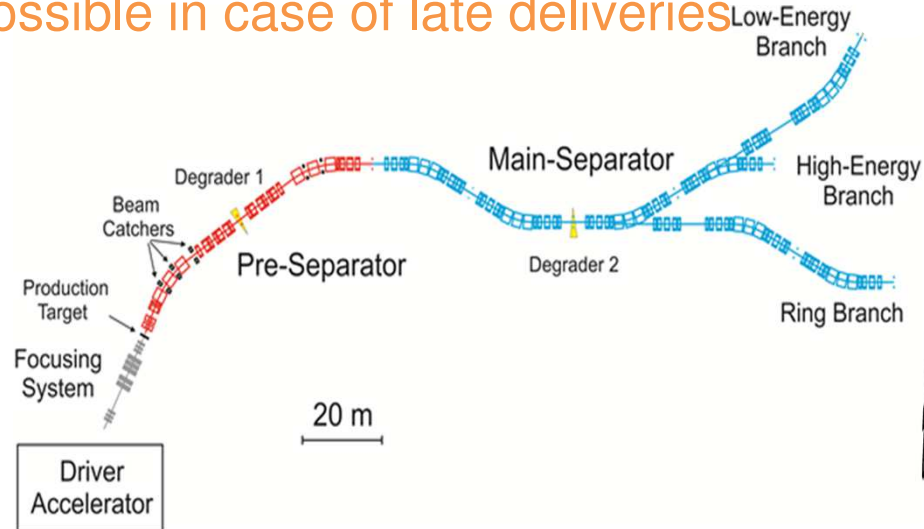
Installation Scenarios

(1st) Goal: early operation

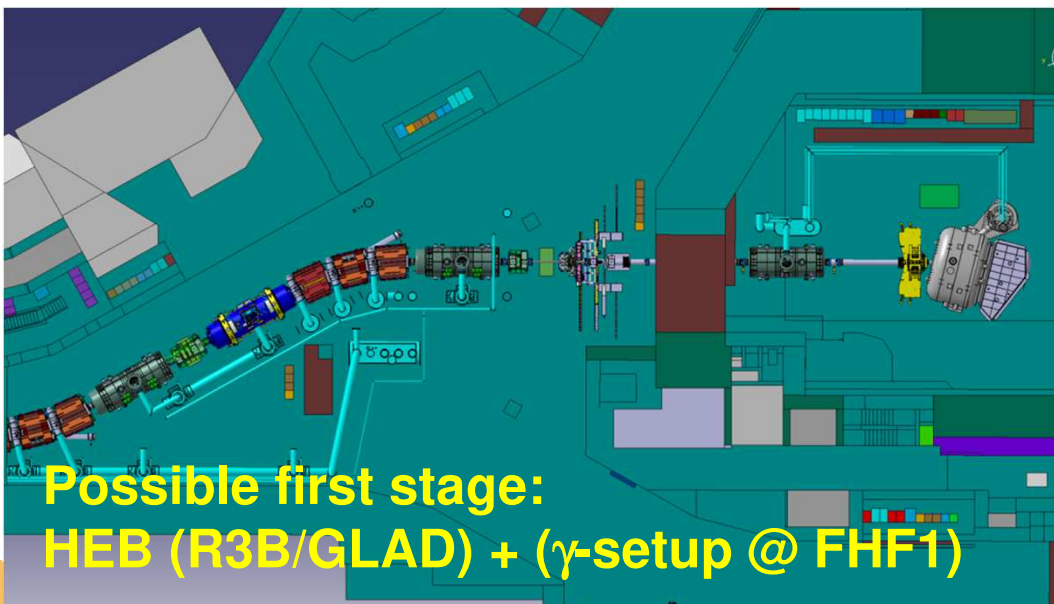
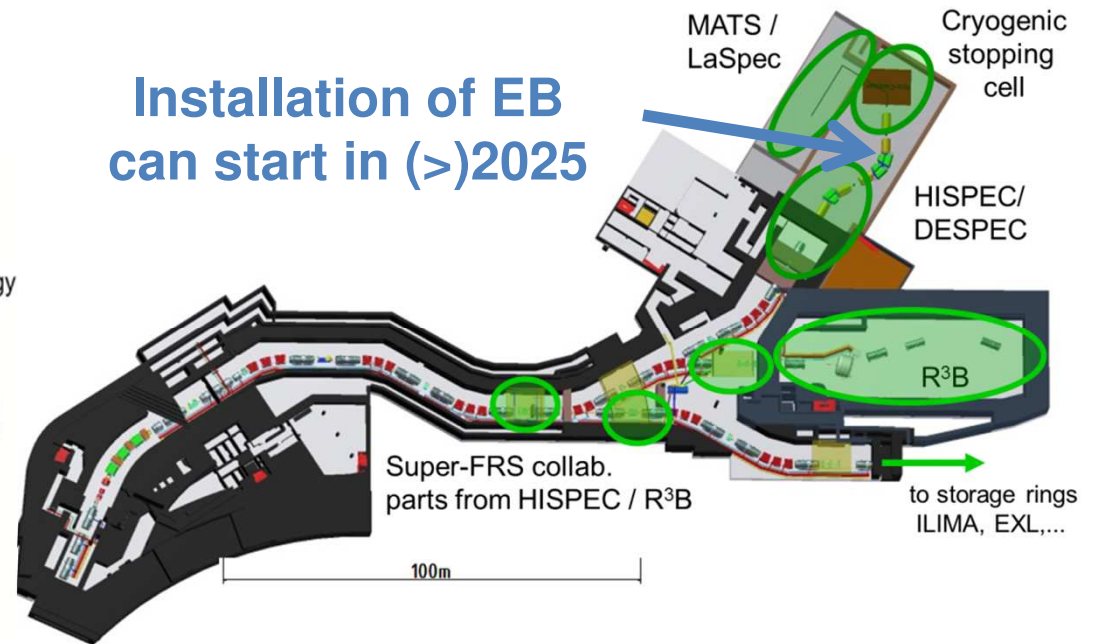
(2nd) Goal: installation of full Super-FRS from the beginning



Staged realisation of branches possible in case of late deliveries



Installation of EB can start in (>)2025



Procurement List (most critical items)

(status as of
April 2019)



	PSP-number	Component name	Country	Provider	Ordered to Provider / Sub Provider	Delivery date (Contracted/Planned)		Status
						from	until	
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.

Magnets I (SC Multiplets, Overview)

H. Müller,
E.J. Cho et al.



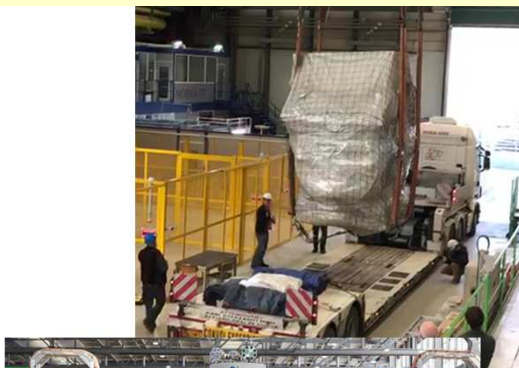
Scope:

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

Main characteristics:

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

FoS SM arrival @ CERN



Series production



FoS long production



Status / Schedule

- ✓ Contract closed 07/2015 (ASG, Genova)
- **Construction phase of FoS running**
 - ✓ FAT FoS SM 01/2019
 - ✓ shipment to CERN Feb. 20, 2019
 - **SAT FoS SM running (Q4/2019)**
- FAT FoS LM expected Q4/2019

Series production phase started

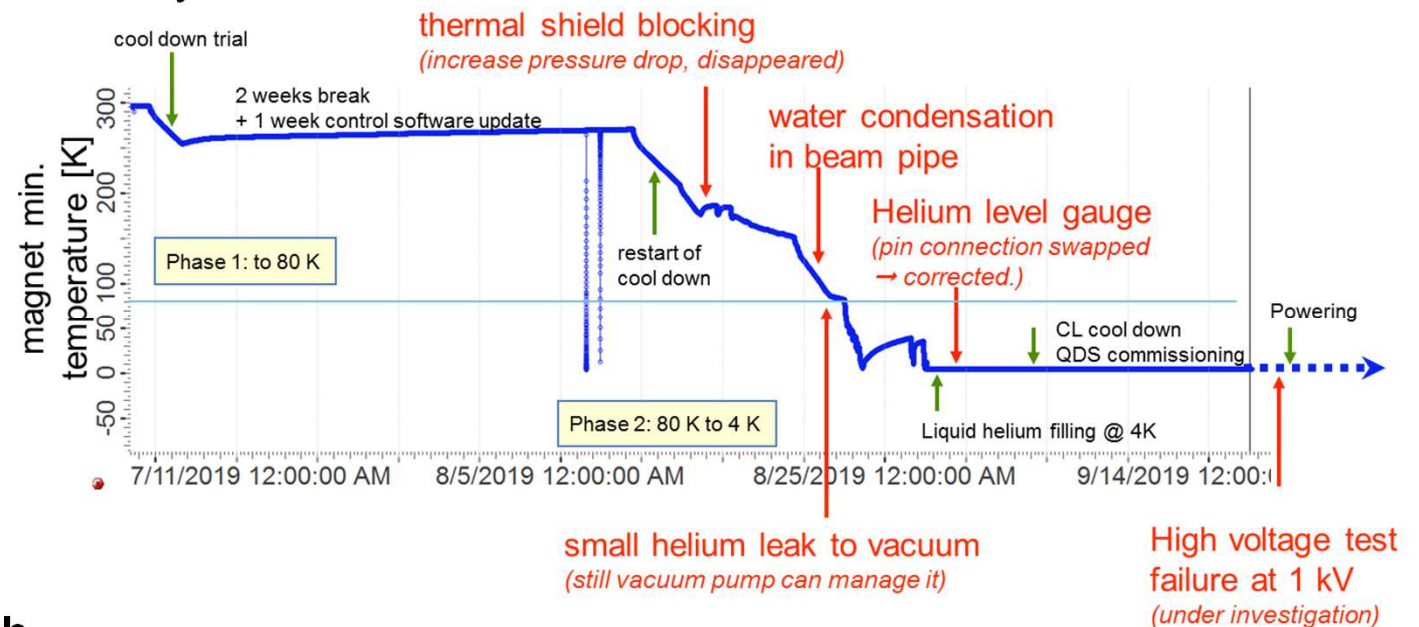
- ✓ SM #2, #3, #4 production started, FAT anticipated 04/20, 05/20, 06/20
- FAT last multiplet **Q4/2023**

Magnets (Testing@CERN, status)

K. Sugita et al.



- Collaboration between CERN and GSI
- Cold (4K) testing of the SC magnet modules at CERN
- The first short multiplet (long quadrupole and sextupole) arrived at CERN: 20. Feb
- Transport to test bench: 7. May



The first testing together with

- Commissioning of facility and devices etc.
- Training of the team
- Clarification of tasks in “gray zone” between GSI and CERN
- Cope with Non-conformities (Cryo interface, broken warm terminal temperature sensors, wrong polarities of magnet, voltage tap swap, ...)

- Cool down trial: 10. July,
- Cool down start: 9 Aug.
- Powering start: 18. Sept.

Magnet II (SC Dipoles)



CEA Saclay
H. Müller,
E.J. Cho et al.

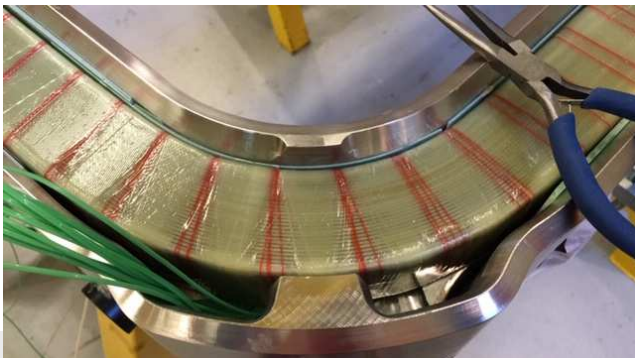


Scope

- 3 units 11° , 18 units 9.75° + support (standard)
- 3 units 9.75° + support (branched)
- **3 units 30° + support (Energy Buncher)**
- Warm iron, SC coil
- Aperture $\pm 190\text{mm} \times \pm 70\text{mm}$

Status standard sc dipole :

- ✓ Contract award Elytt (Sp) Feb. 2018
- ✓ Design verification phase
- ✓ DRR: Q2 2018, FDR: Q4 2018
- Coil mock-up running, FDR: 9 Oct. 2019
- FOS production in preparation
- FAT of FoS expected Q1/2020

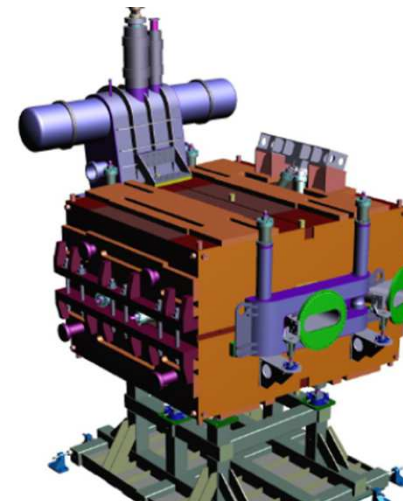


Status branched sc dipole (R&D work):

- ✓ Design phase completed
 - CDR, Spec, 3D Model released Q1/2019
 - Procurement initiated

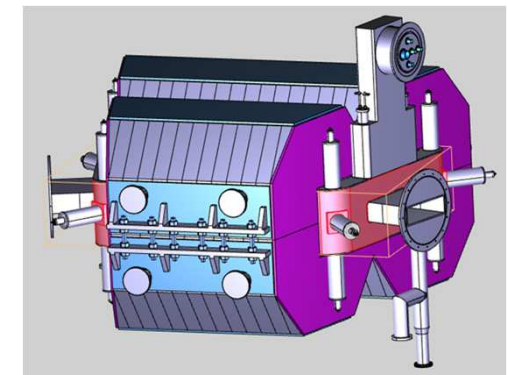
Status Energy Buncher dipole:

- VECC returned EOI, 12/2018
 - CDR and 3D Model provided
- Discussion with CEA on HOAI part
- Tender expected in 2021



CDR branched
dipole, CEA

CDR EB, VECC, Q2/19
partly to be redesigned



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

F. Wamers
Y. Xiang et al.



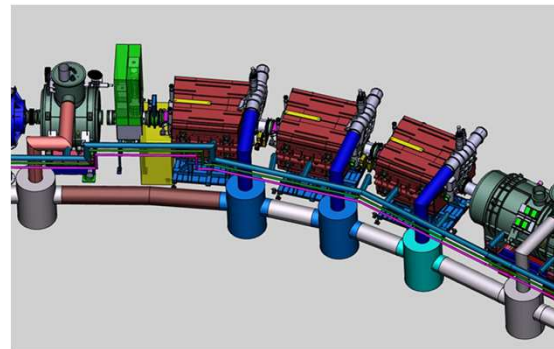
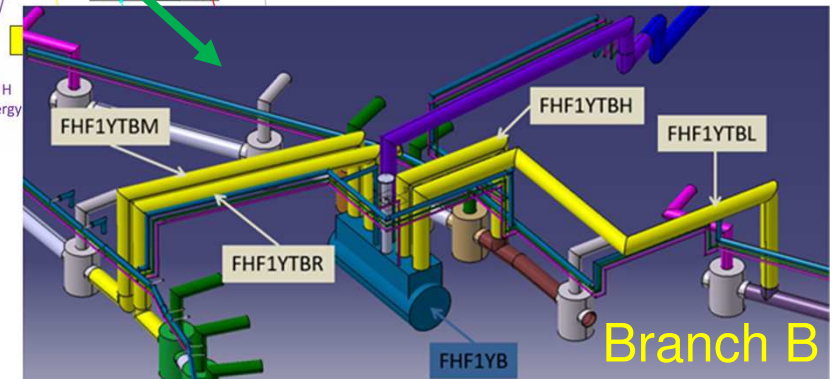
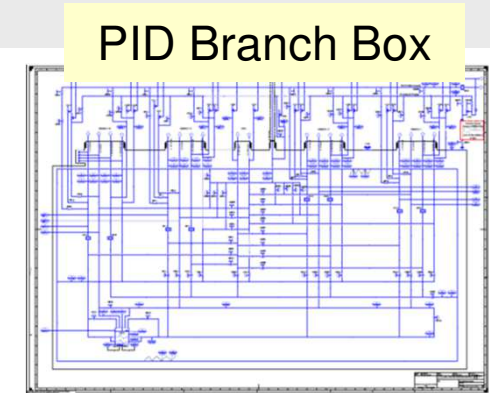
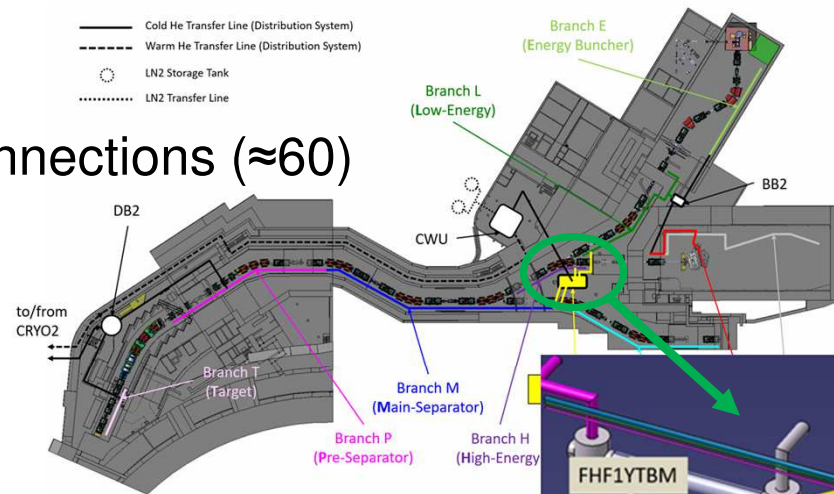
Super-FRS Local Cryogenics

Scope:

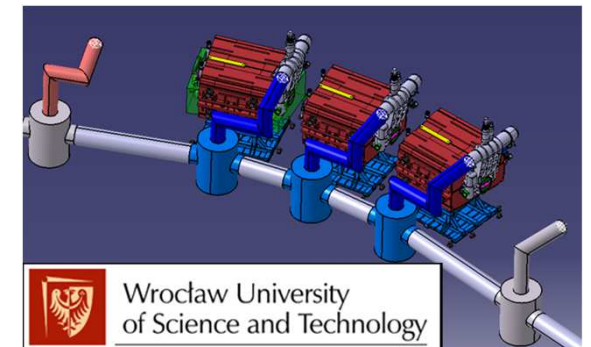
- 1 large Branch Box
 - Feedboxes plus Jumper connections (≈ 60)
 - End Boxes (7)
 - Transferlines (≈ 300 m)
 - ≈ 1.5 km Warm-Gas Piping
-

Status / Schedule

- ✓ DMU / Branch concept ready
- ✓ CS released (= **scope definition**)
- ✓ DS on sub-componets released or in review process
- IKC draft in Poland for review , design work started by WUST
- ✓ Additional in-kind partner: BINP will develop Branch Box, further contribution to be agreed



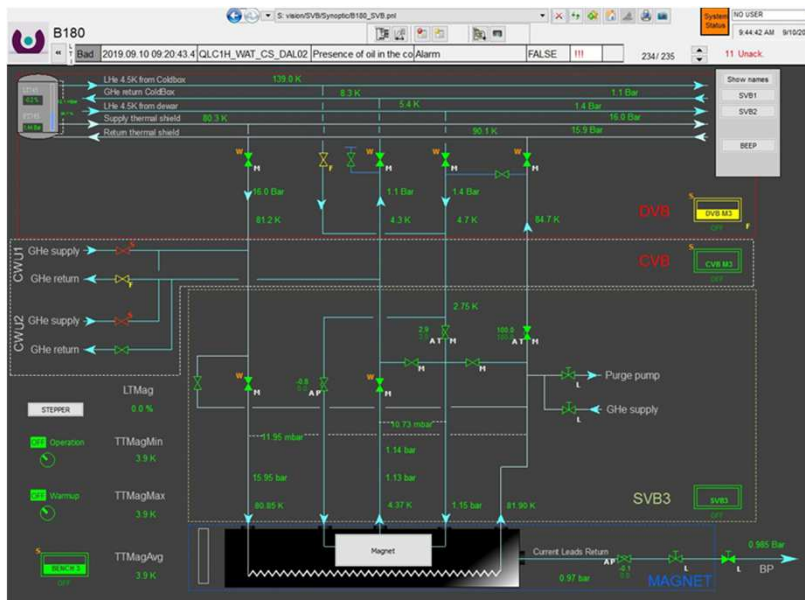
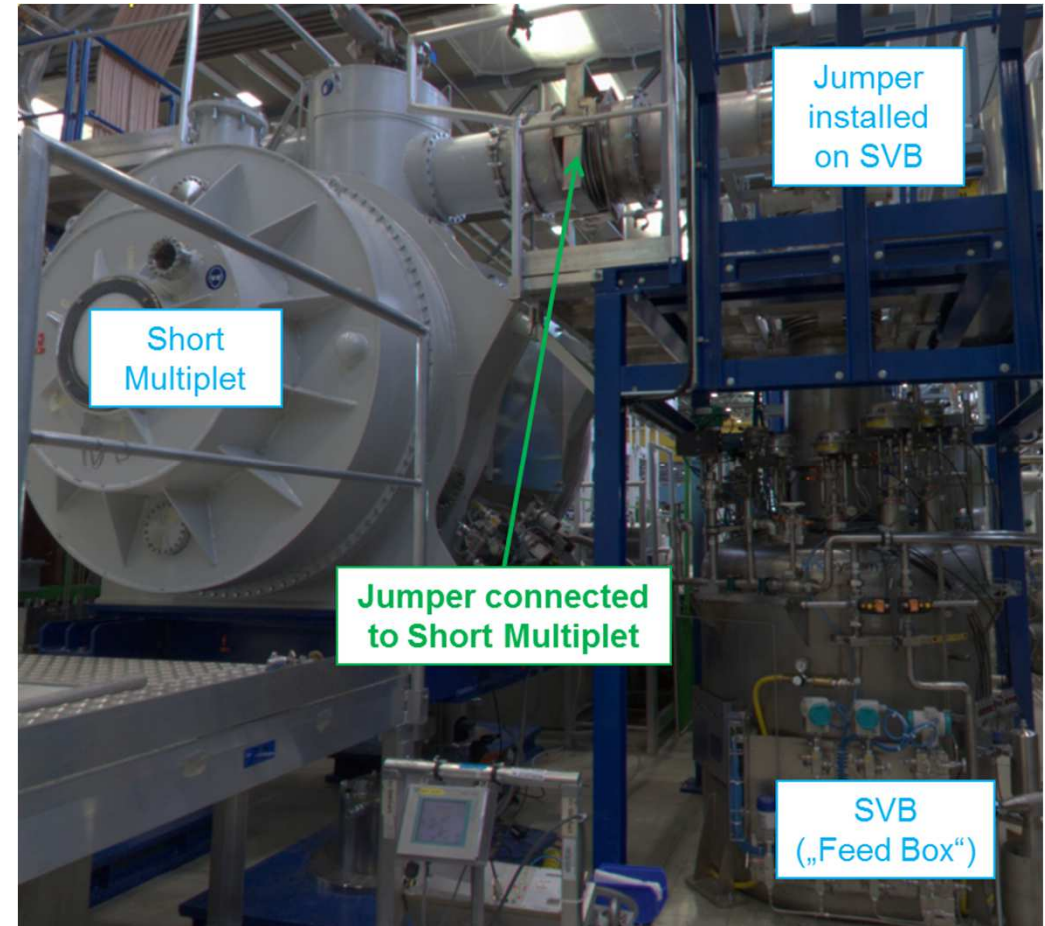
old dipole FB concept:
following Jumper interface



WUST proposal: *FB*
following magnet symmetry

Super-FRS Local Cryogenics (Cryo Facility @ CERN)

F. Wamers
Y. Xiang et al.



- SAT of Jumpers without magnets (warm and cold performance tests) successful.
- B180 control system operational. Further tests of Jumpers (without magnet) possible if needed.

Magnets IV

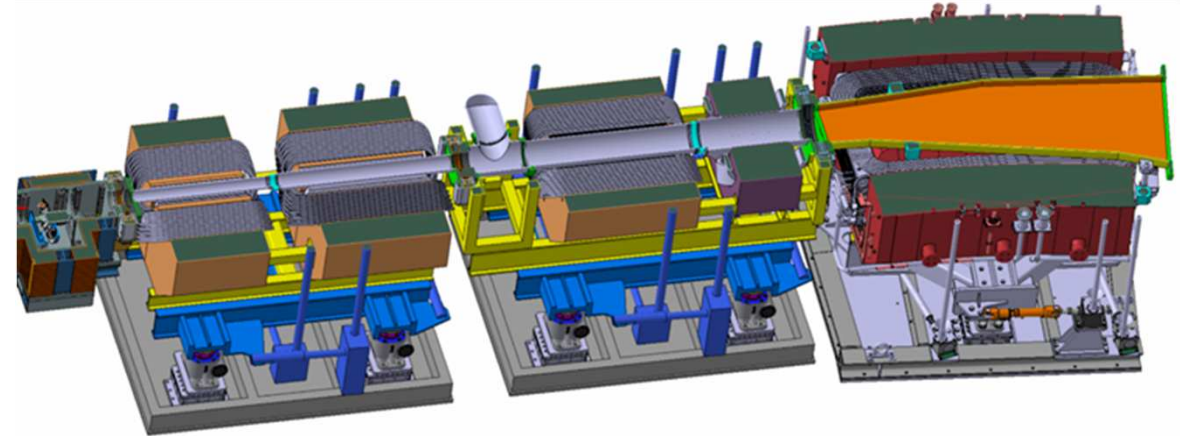
(Radiation Resistant Magnets)

H. Leibrock,
T. Blatz et al.



Scope:

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



Status / Schedule

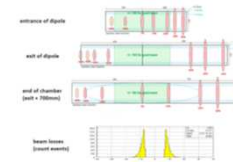
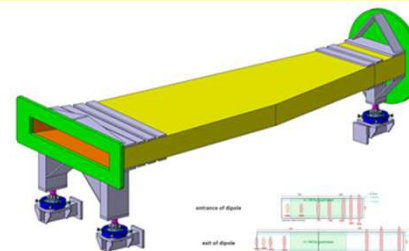
- ✓ WP1: CC signed 04/2019;
- ✓ MIC procured, in-house
- CDR scheduled for CW 48/19 at BINP
- research contract on dipole chamber development signed 09/2019
- ✓ WP2: BINP will conduct R&D phase
 - ✓ research contract signed 09/2019
 - conceptual design expected 03/2020;
 - decision on IKC expected for Q1/2019



MIC cable procured
stored at GSI
ready for delivery to BINP



NC dipole
kick-off



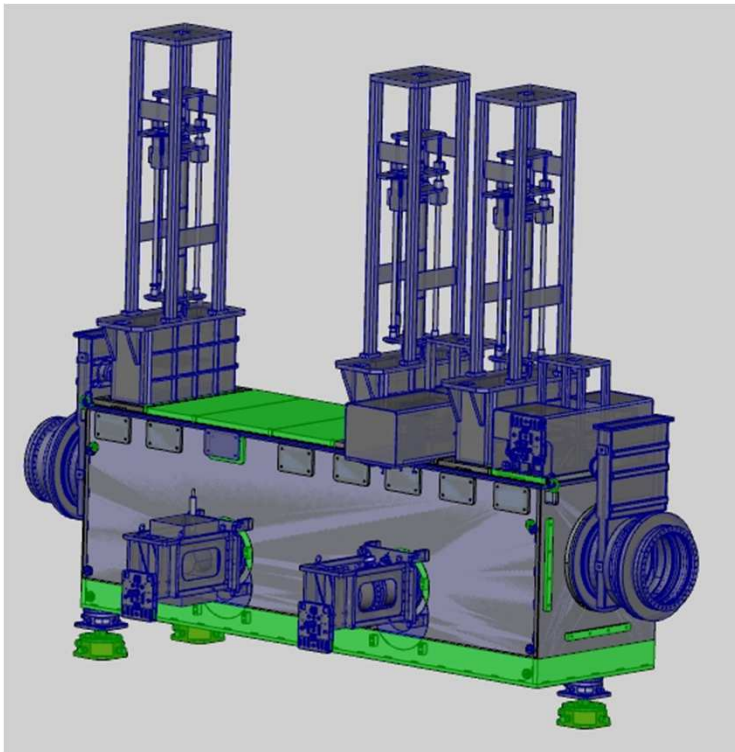
➤ otherwise tender required

Vacuum System

- vacuum standard: centralized buying GSI
- **main in-kind provider is BINP**

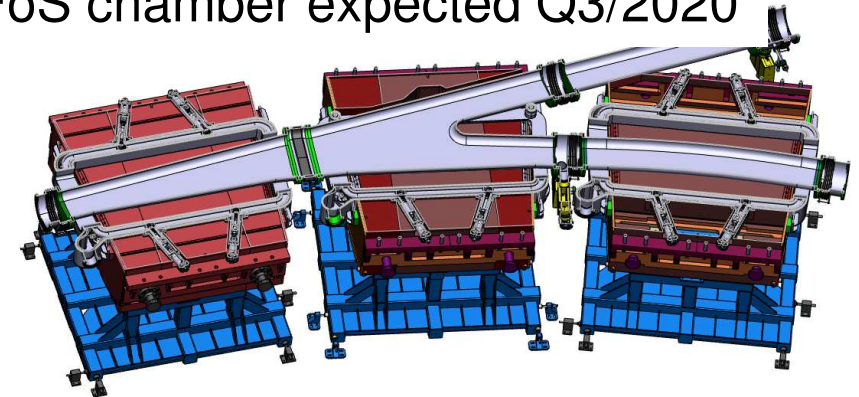
Focal planes chambers

- ✓ Contract signed 04/2019,
(21 chambers)
- ✓ FoS CDR released 09/2019
- FoS chamber expected Q2/2020



SC Dipole vacuum chambers

- ✓ Contract Signed (straight exit)
- ✓ kick-off done, 09/2019
- FoS chamber expected Q3/2020



Under negotiation with BINP

- NC magnet chambers (research contract for NC dipole chamber signed)
- SC Dipole vacuum chambers (Branching)
- Pumping chamber
- Beam pipes (specs still missing)
- Energy Buncher dipoles chambers
- Adapter flanges
- Window Flange
- Supports for vacuum elements

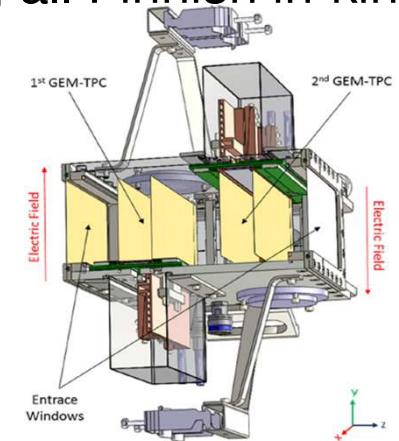
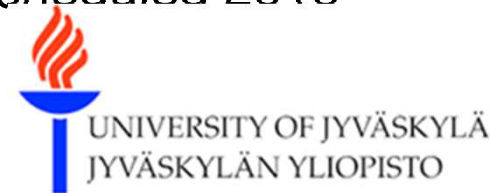
Beam Instrumentation

PID Detectors

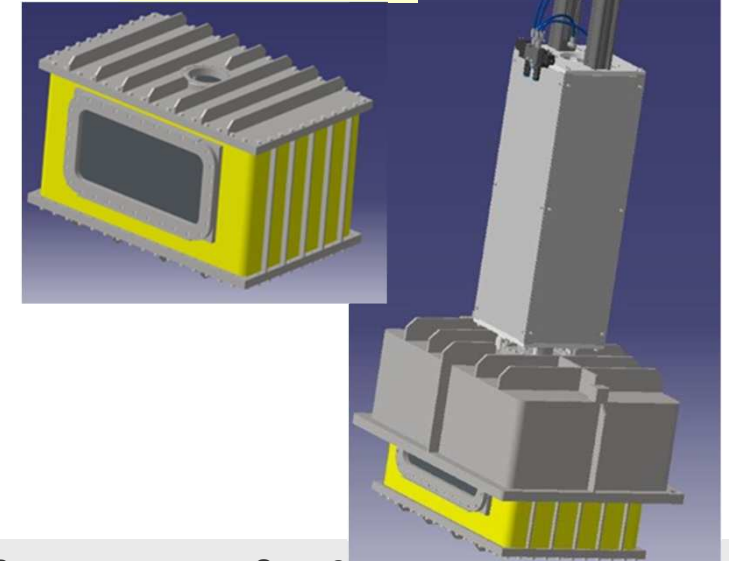
C. Nociforo
B. Voss
O. Kisselev et al.



- Drive unit with SEM Grid (profile monitor) and GEM-TPC (tracking) , all Finnish in-kind
 - ✓ IKC for SEM Grid signed, design running
 - ✓ IKC for drive signed ? kick-off scheduled Oct.7, 2019, **32 units**
 - ✓ IKC for GEM TPC drafted, beamtime test scheduled 2019
- MUSIC (energy-loss), Finnish in-kind, 4 units
 - ✓ IKC signed (12/2017)
 - ✓ CDR done (11/2018), design phase running
 - New PreAmps development by Mesytech
- ToF (Silicon based), Russian in-kind, 4 units
 - ✓ Detailed Spec ready since **Nov. 2016**
 - IKC negotiation ongoing (last meeting: last Monday)
 - FAIR needs to take care on mechanics and DAQ
- Plastic scintillators, Swedish in-kind, 6 units
 - ✓ IKC drafted , waiting for signature from Sweden



MUSIC:
CDR design

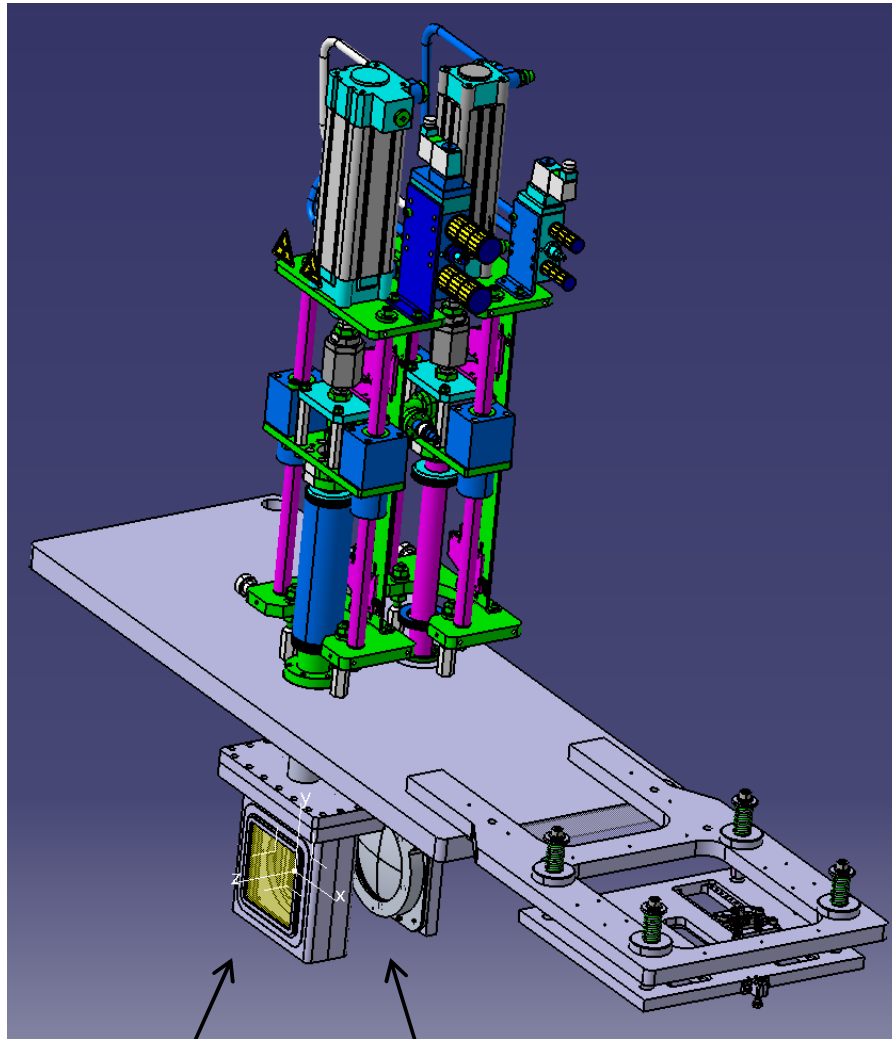


Beam Instrumentation Intensity Monitor (PDC)

C. Nociforo
F. Schirru
T. Blatz et al.

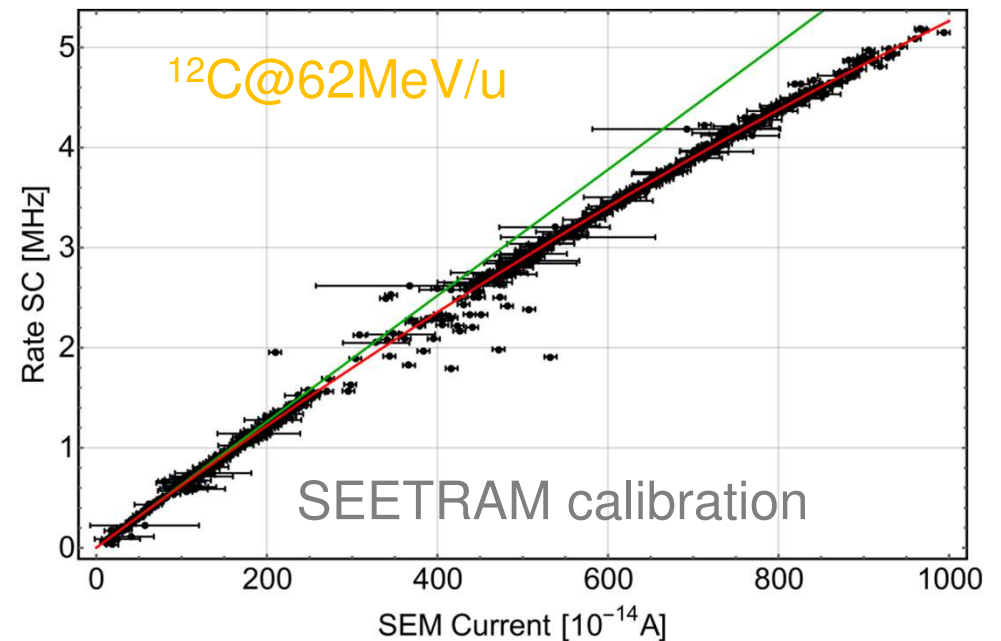


- 2 stations (target area & FPF4)
- detectors: SEETRAM, IC, diamond
- FAIR procurement
- PDC drive designed (FPF4, 1 flange, 2 drives)
- SEETRAM design (\varnothing 100 mm, 3-Al foils, 24 μ m) ready and tested in 2018



IC

SEETRAM



- IC under design
- Counting particle detector (diamond) mounted on a different flange (Ru in-kind)

Target Area

Target chamber:

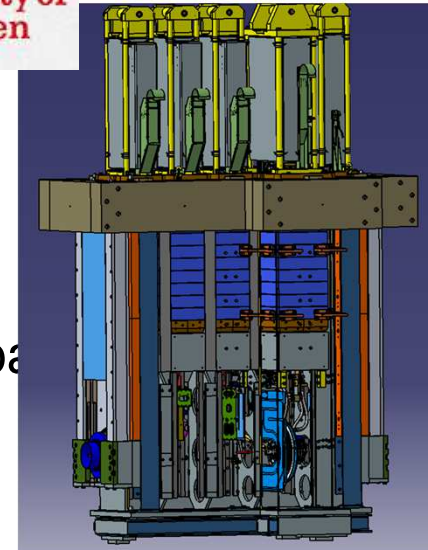
- Collaboration Contract with KVI-CART (design chamber & plugs)
- Plug mock-up built , plug guidance verified
- CDR March 2019, not released, revision in preparation
 - detector plug cooling, gas supply for IC
- FDR expected Q2/2020
- Afterwards: tender on manufacturing by GSI (due to reorganization of KVI-CART)

Beam Catchers:

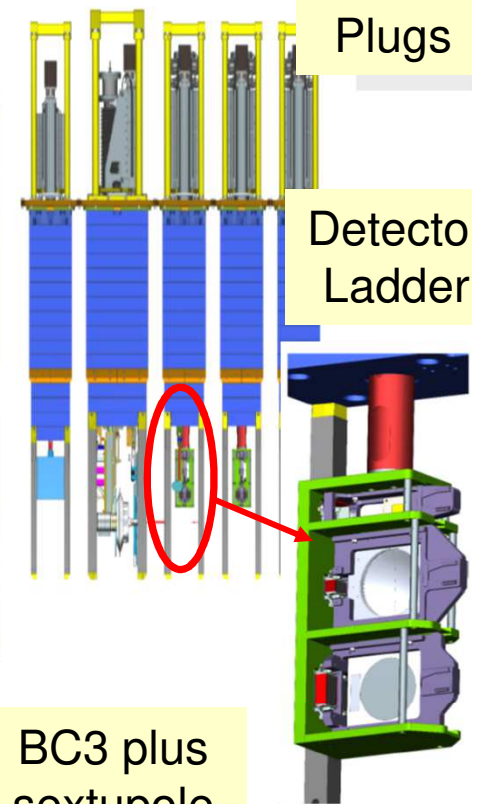
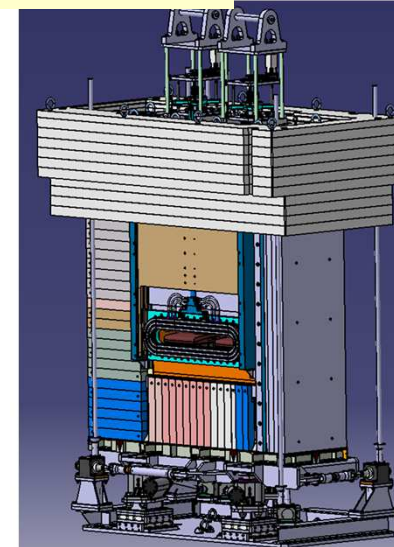
- ✓ DS released, IKC drafted (approval process)
- Design by CMERI , Interfaces defined
- ✓ CDR done, FDR approaching
 - some quality issue with technical drawings
 - absorber mock-up in preparation
- Tender (manufacturing) by India (after IKC closed)



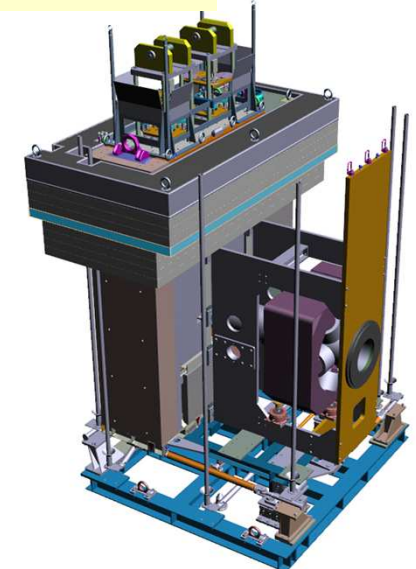
university of
 groningen



BC1 / BC2
station



BC3 plus
sextupole

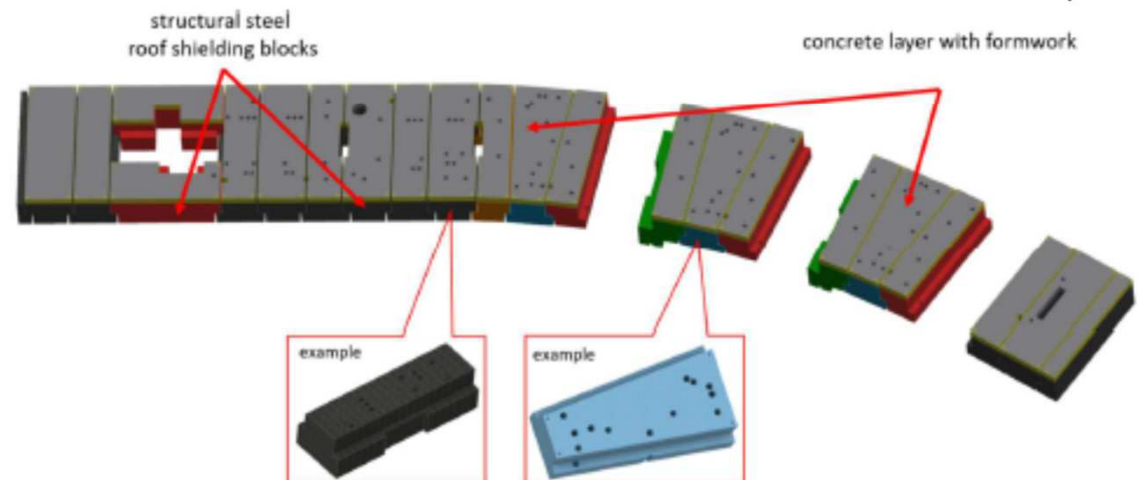
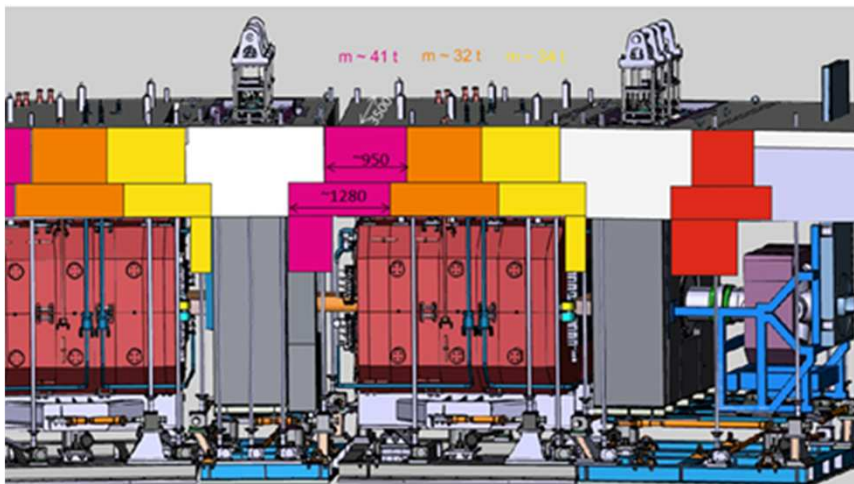
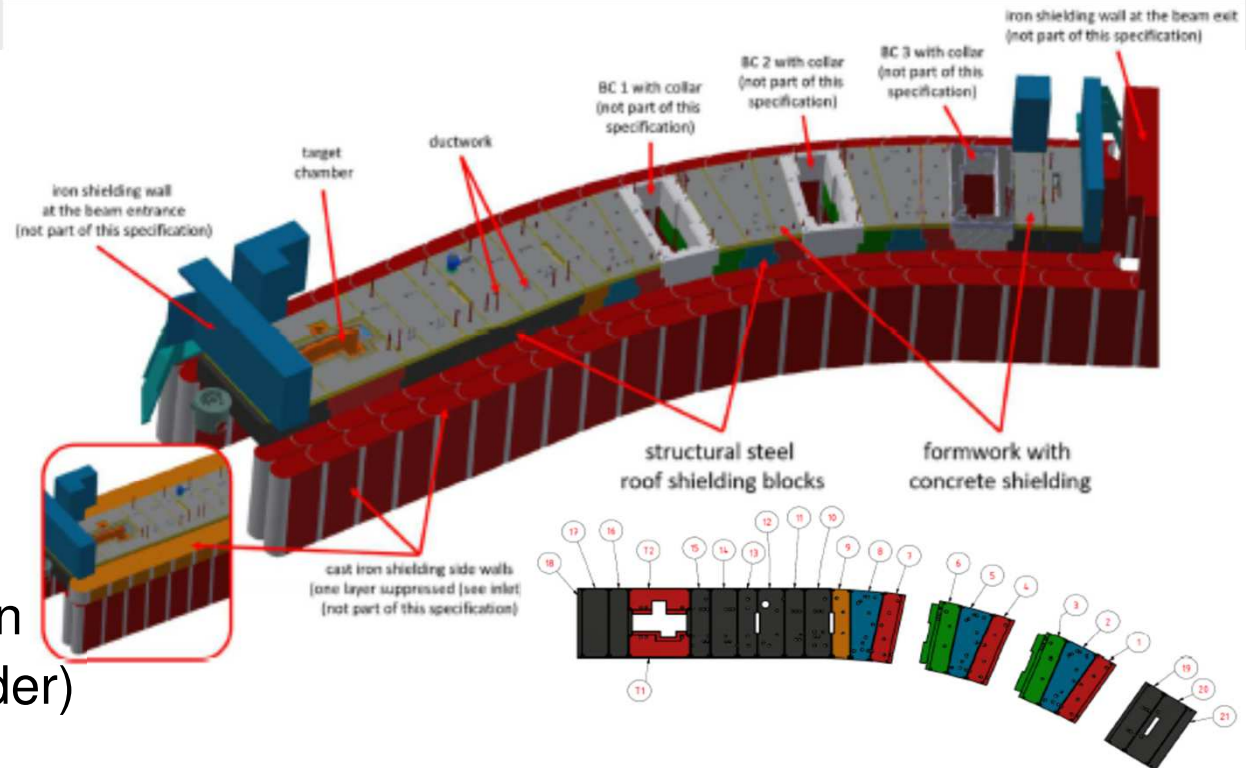


CSIR - CMERI

सी एस आई आर - केन्द्रीय यांत्रिक अभियांत्रिकी अनुसंधान संस्थान
CSIR - Central Mechanical Engineering Research Institute

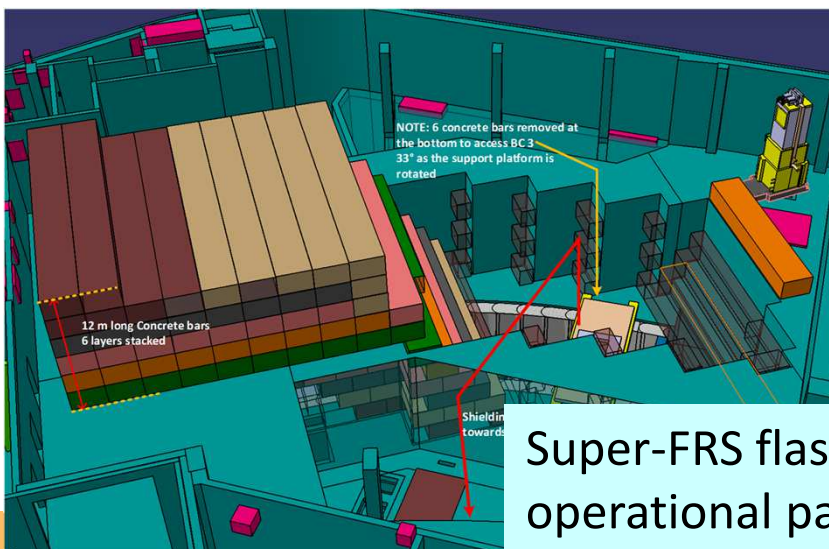
Target Shielding (Iron)

- Funding secured CBWG 2018
- Negotiation with potential in-kind partner failed
- DS for lateral shielding released
- Tender for lateral iron shielding started (**early installation!**)
- DS for roof shielding drafted
- Ru announced interested; decision expected Q4/2019 (otherwise tender)



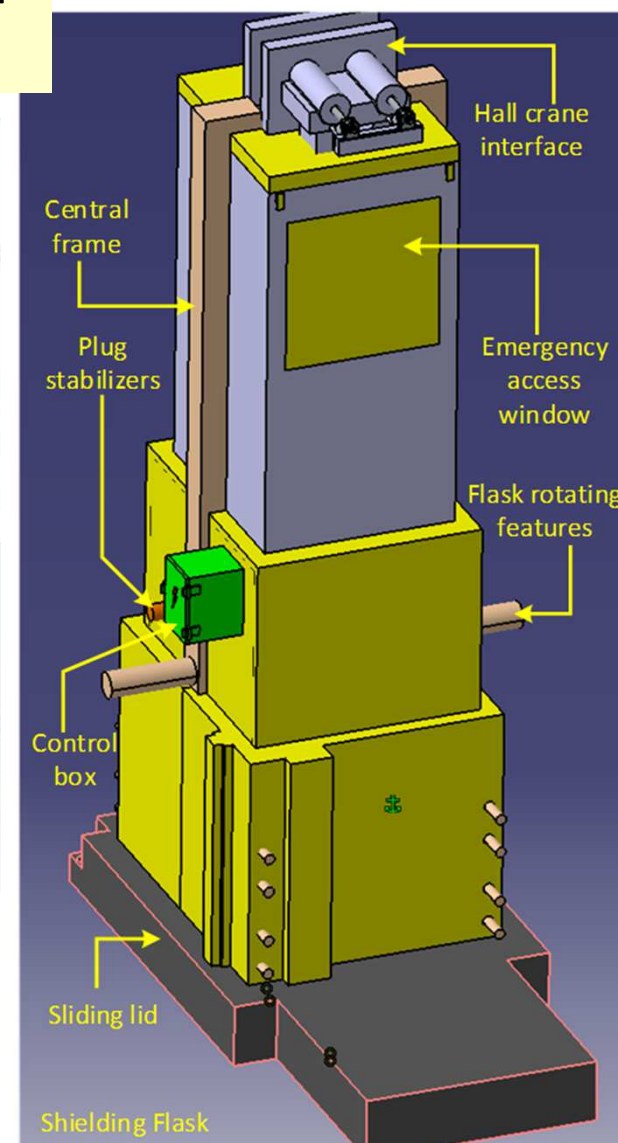
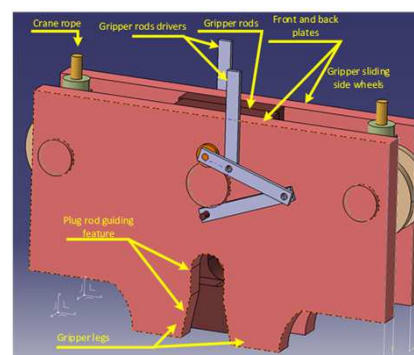
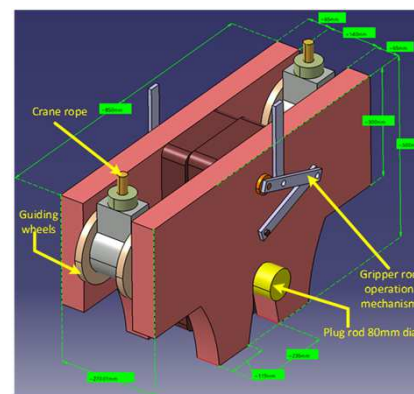
Shielding Flask

- ✓ DS in released
- ✓ IKC (Finland) drafted
- Similar Flask required for pbar, Swedish in-kind
- Joint procurement intended in preparation with IOP and Partners
- Radiation protection operational plan sent to authority for approval and for TÜV certification requirements
- Contact with ESS remote handling team established



Super-FRS flask in target building:
operational parameters assessment

Gripper conceptual design



Summary

- Super-FRS can be ready for operation in 2025
- Time schedule: ambitious but realistic
 - Staged realisation of branches possible (in case of late deliveries)
- Civil Construction main topic:
 - Tender FAIR CC south on market
 - Building services planning running
- (Time) critical items identified
 - SC Multiplets: FoS SM delivered to CERN, SAT running
 - Local cryogenics: IKC (Poland) negotiation running; BINP is new collaborator
 - Collaboration Contract for NC multipole development closed with BINP
 - Tender for (lateral) iron shielding on market

Thank you for your attention !