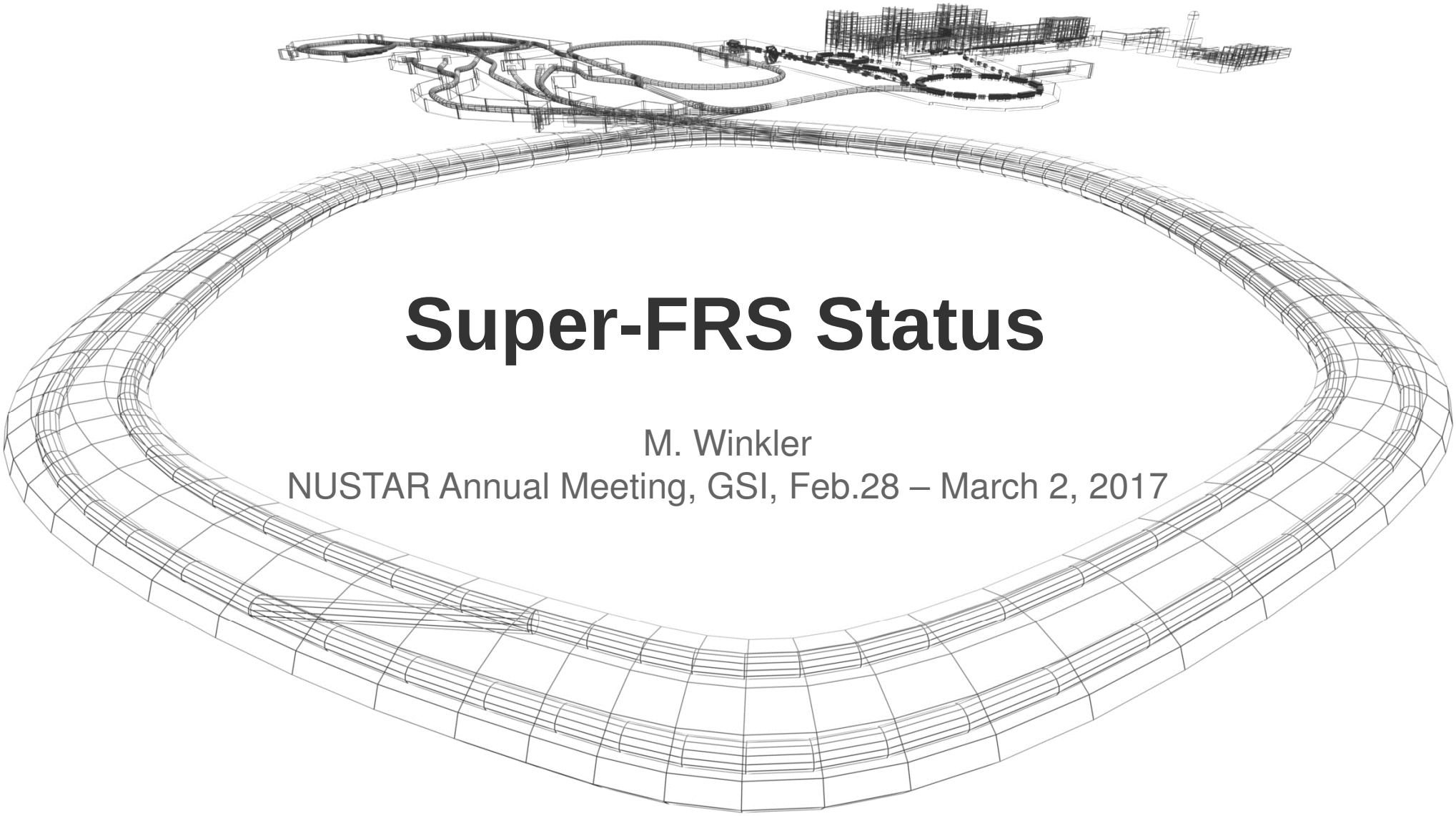


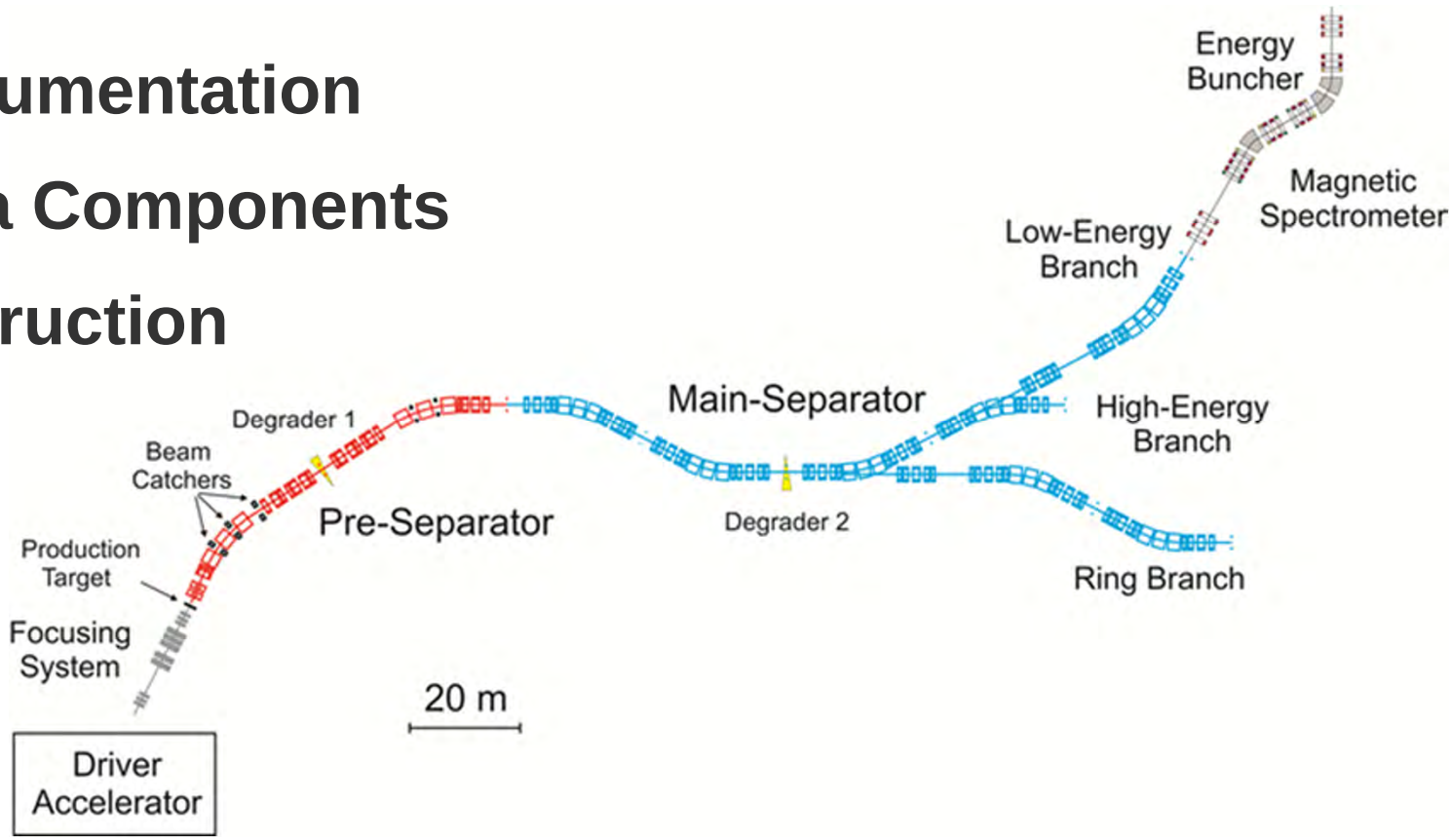
Super-FRS Status

M. Winkler

NUSTAR Annual Meeting, GSI, Feb.28 – March 2, 2017

Outline

1) Magnets and Testing
2) Local Cryogenics
3) Power Converter
4) Beam Instrumentation
5) Target Area Components
6) Civil Construction
7) Summary

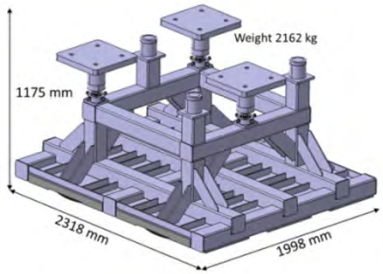


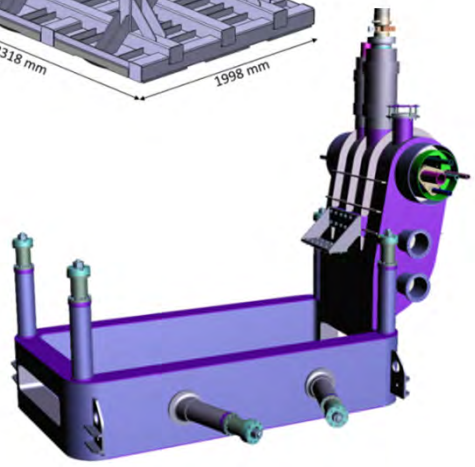
Magnets I
(Status Standard SC Dipole Magnets)

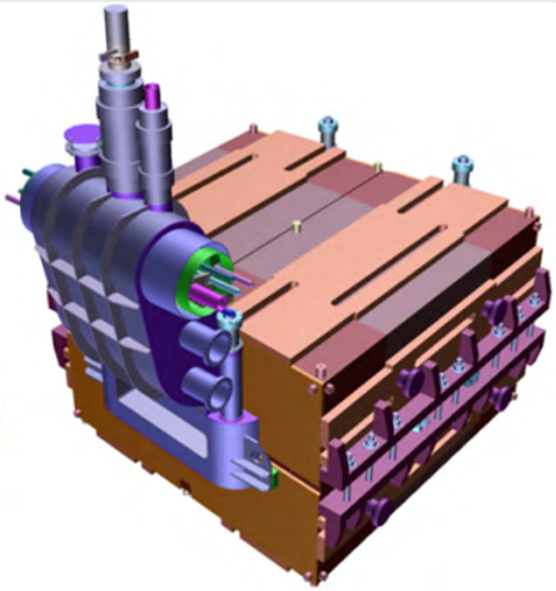
H. Müller,
E.J. Cho et al.

Scope

- 3 units 11°, 18 units 9.75° + support
- Warm iron, SC coil
- Aperture ±190mm x ±70mm
- Weight: 50 to 60 ton







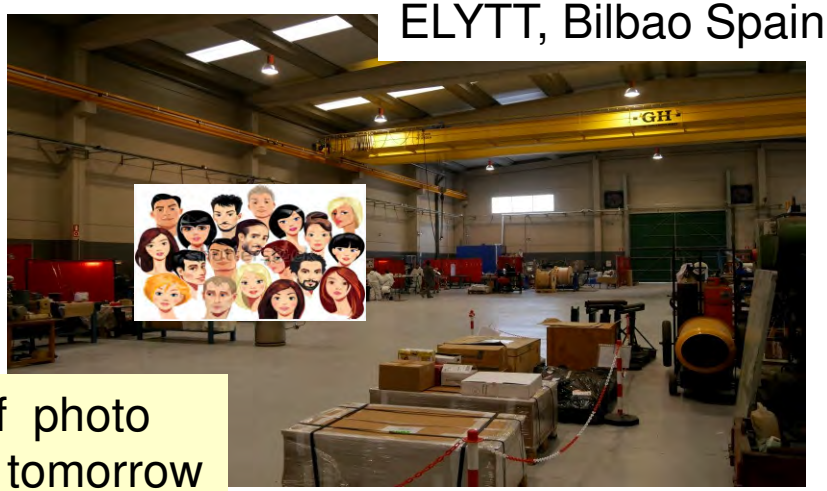
Collaboration with CEA, Saclay:

✓ TCC signed , includes:
- ➢ Detailed design, CDR, Spec, 3D Model
- ➢ Technical follow-up

Tender Status :

✓ Announcement published April 2017
✓ Qualifying submission closed mid May 2017
✓ Offers received by mid July 2017
✓ 1st round negotiation closed mid November 2017
✓ 2nd round negotiation closed Jan. 22, 2018
✓ **Contract award Feb. 8, 2018**
- **Kick-off: March, 1, 2018**
- FDR expected Q3/2018
- FAT of FoS expected Q2/2019

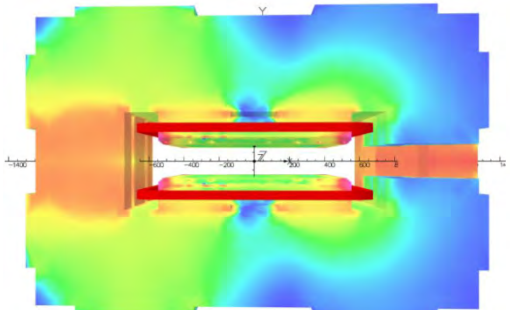
manufacturing plant
ELYTT, Bilbao Spain

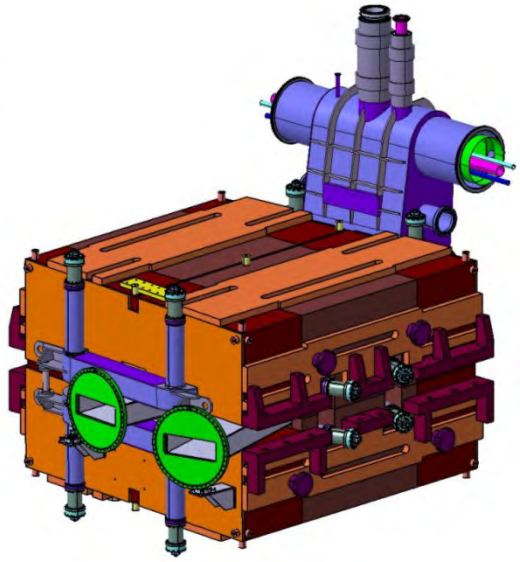


Kick-off photo follows tomorrow

Magnets II
(R&D Branching Dipole Magnets)

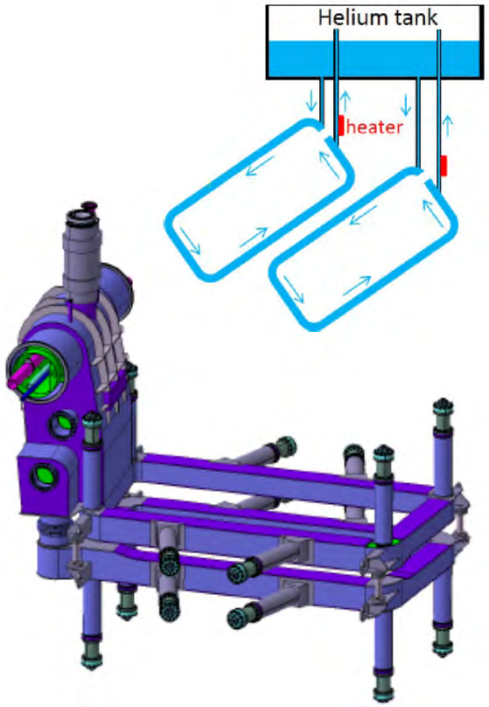
H. Müller,
E.J. Cho et al.

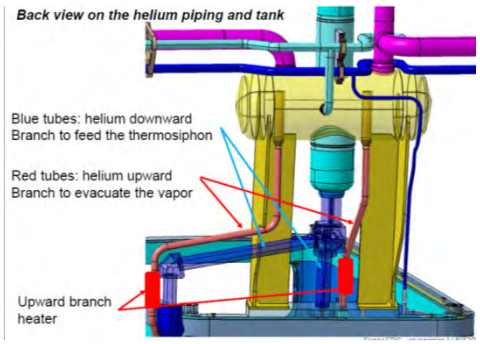


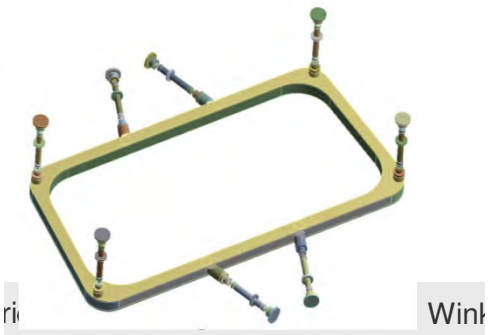


Schedule (R&D work):

- ✓ Collaboration agreement with CEA/Saclay
  - ➢ Detailed design, CDR, Spec, 3D Model
- ✓ Kick-off meeting 06/2017
- ✓ PDR 12/2017
- • FDR 05/2018
- • Final Report, DS 06/2018
- ➢ FAIR tender afterwards







PDR status

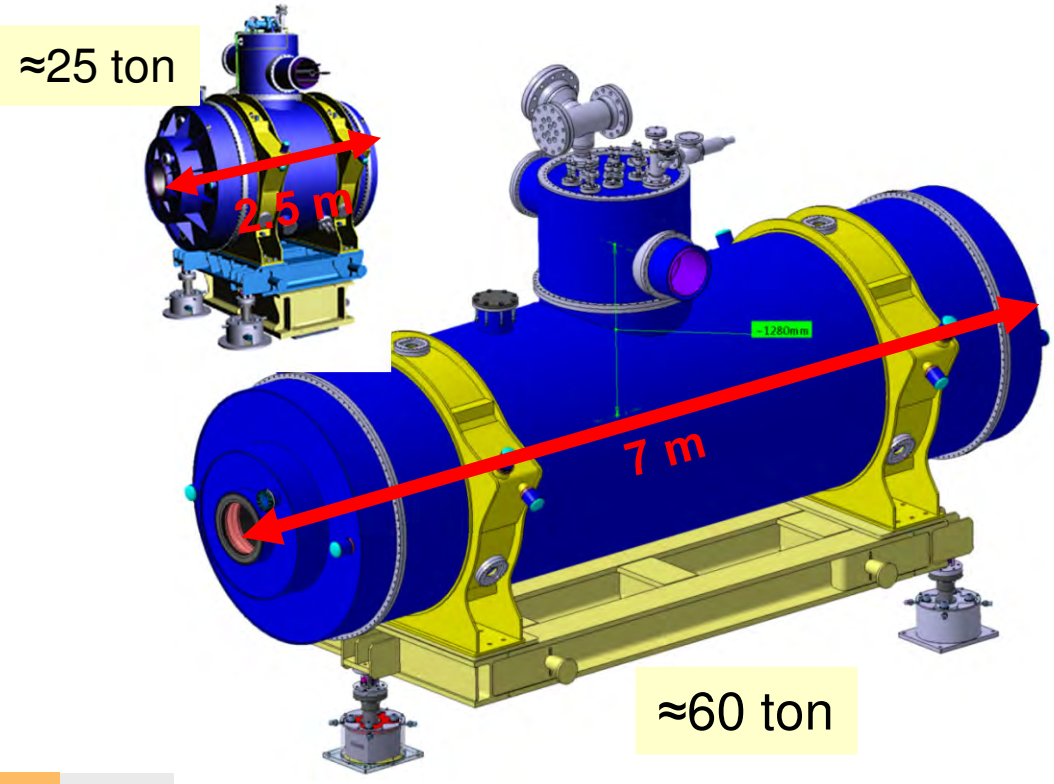
- • Geometry (yoke, coil, cryostat)
  - ➢ ∫Bdl achieved, I adopted
  - ➢ magnetic field quality, chamfers included
- • Assembly Scenario
- • Thermal behavior after cool -down
- • Magnetic forces after energizing
  - ➢ various configuration of CTWS
  - ➢ including cryo-stopper
  - ➢ pole corner radius
- • 2 active thermosiphon loops
  - ➢ use heaters to force flow direction
  - ➢ design modification done
  - ➢ thermal budget simulated
  - ➢ thermosiphon experimental mock-up

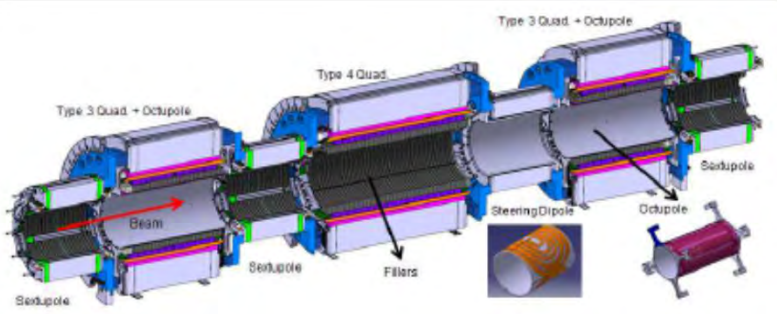
Magnets III
(SC Multiplets, Overview)

H. Müller,
E.J. Cho et al.

Scope:

- 8 short multiplets (PS)
  - ➢ QS configuration
- 25 long multiplets (mainly MS)
  - ➢ Quadrupol triplet
- include corrector elements & steerer





Main characteristics:

- iron dominated, cold iron (up to 37 tons)
- common helium bath
- warm beam pipe (38 cm inner diameter)
- individual powering, max. current <300A

Schedule FoS SC multiplets

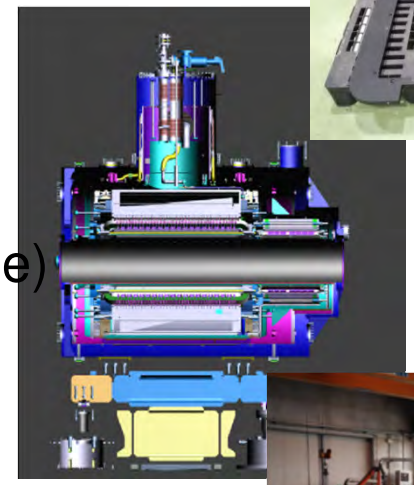
- ✓ Contract closed 07/2015 (ASG, Genova)
- ✓ Design phase for SM and LM done
  - ✓ FDR 12/16
  - ✓ PRR SM 07/17
  - ✓ PRR LM 12/17
- Construction phase for FoS running
  - ➢ FAT FoS SM 06/18
  - ➢ shipment CERN, SAT FoS SM 12/18

Magnets IV
(FoS SM Production)

- All coils produced (quadrupol, sextupol)
  - ➢ vacuum impregnated
  - ➢ electrical integrity tests
- Laminations punched (sub-provider)
- Yoke assembly tool manufactured
- Yoke assembled (short quad, sextupole)
- CL prototype qualified (20 bar, M&W)

➢ CL for FoS SM under production
➢ Thermal shield manufactured
➢ LHe vessel manufactured
➢ Vacuum vessel manufactured
➢ Assembly bench manufactured (subprovider)
➢ Connectors for instrumentation under qualification










Magets V
(Testing@CERN, status)

K. Sugita et al.

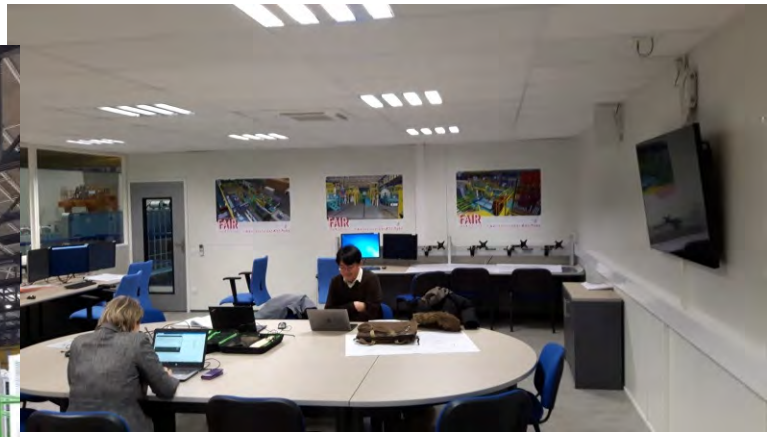
- Collaboration between CERN and GSI
  - ➢ CERN Build. 180: Infrastructures, renovation
- Cold (4K) testing of the SC dipoles and multiplets
  - ➢ 3 test benches,
  - ➢ incl. magnetic field measurements
- Addendum to the collaboration agreement
  - Covering operation phase 5.5 years
  - ✓ **Signed January 2018**
- Facility commissioning ongoing
  - ➢ FoS multiplet expected for 06/18

✓ Personnel deployment ongoing (4 FTE from GSI)

- still missing: cryo jumper

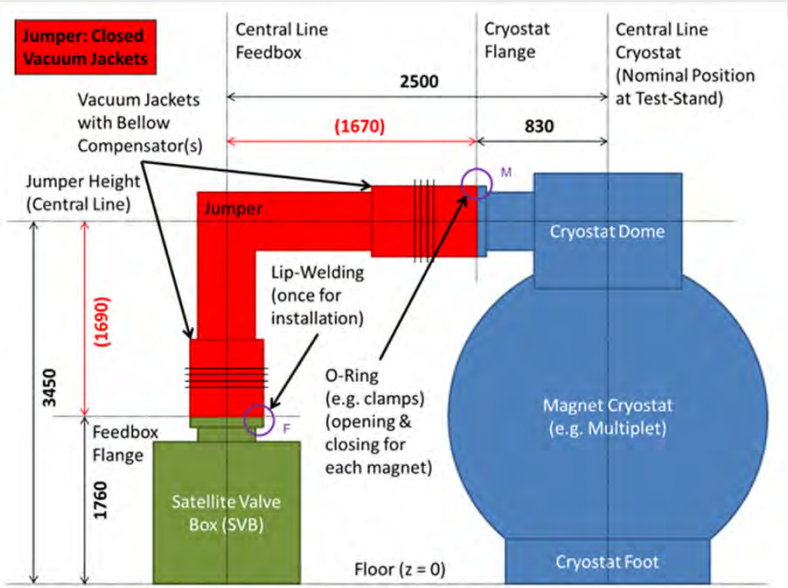
Magets VI
(Testing@CERN impressions)

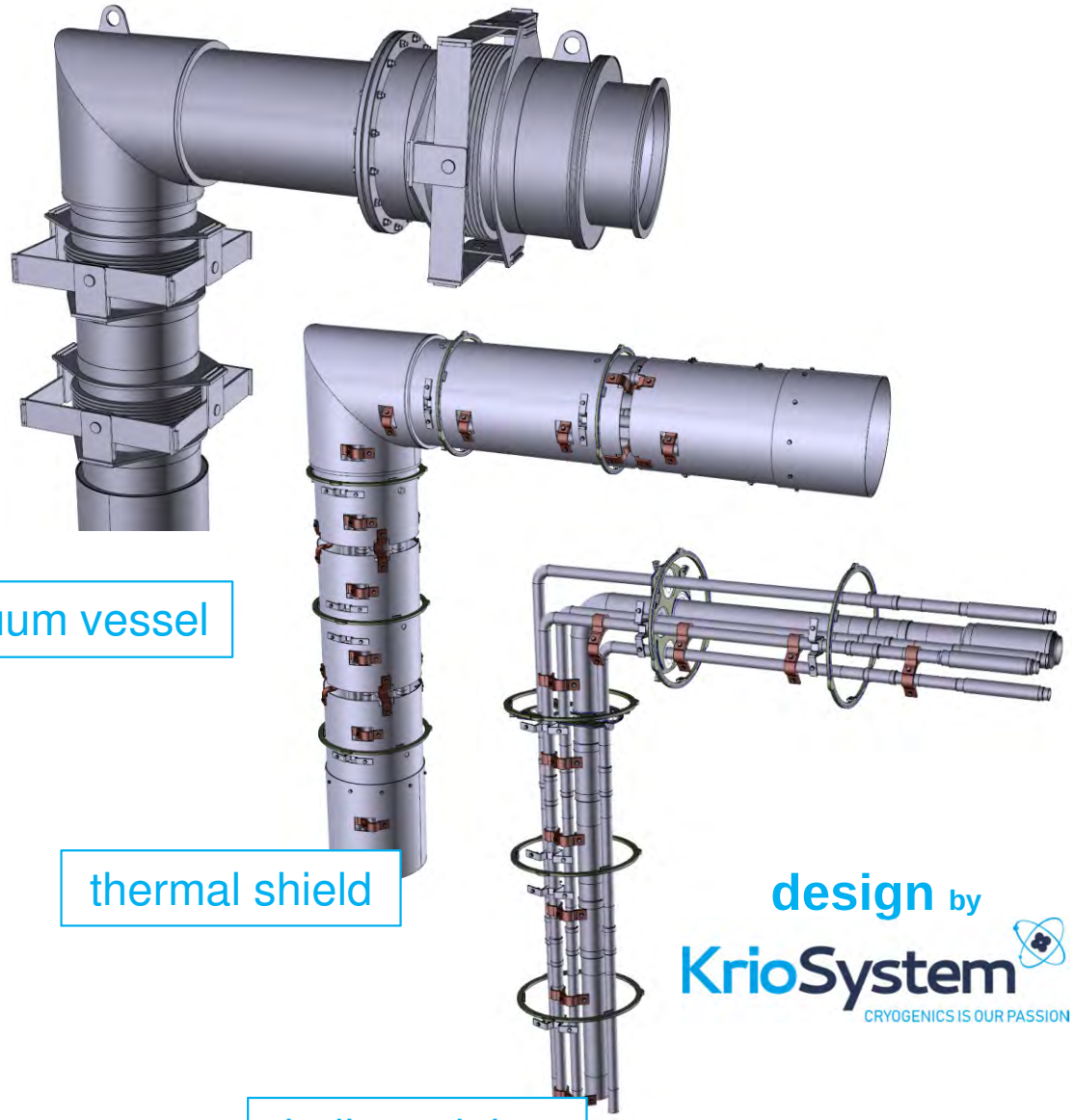
K. Sugita et al.



Magnets VII
(Testing@CERN Cryo Jumpers)

F. Wamers,
M. Chesi,
Y. Xiang et al.





- ✓ Spec Released: 18th Nov 2016
- ✓ Tendering Started: 21st Feb 2017
- ✓ Contract Awarded: 15th May 2017
- ✓ Kick-Off Meeting: 31st May 2017
- ✓ PDR: 7th Dec 2017
- ✓ FDR: 21st Feb 2018
- • **Manufacturing: Feb-May 2018**
- • FAT: May 2018
- • Delivery to CERN: May 2018
- • Installation & SAT: May-June 2018
- • Ready for Ops: June 2018 - ...

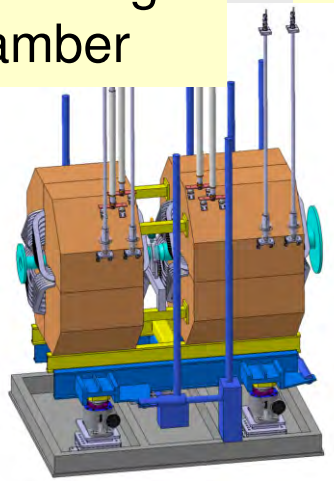
Magnets VIII
(Radiation Resistant Magnets)

H. Leibrock,
T. Blatz, et al.

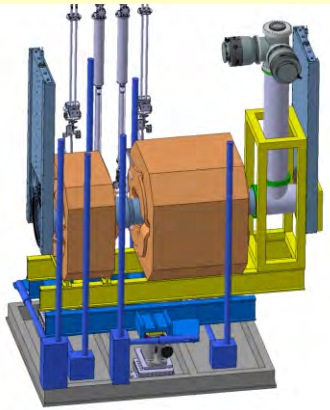
- 3 dipole, 3 quadrupole, and 2 sextupole
- Normal conducting magnets using MIC cable
- Remote connectors and alignment

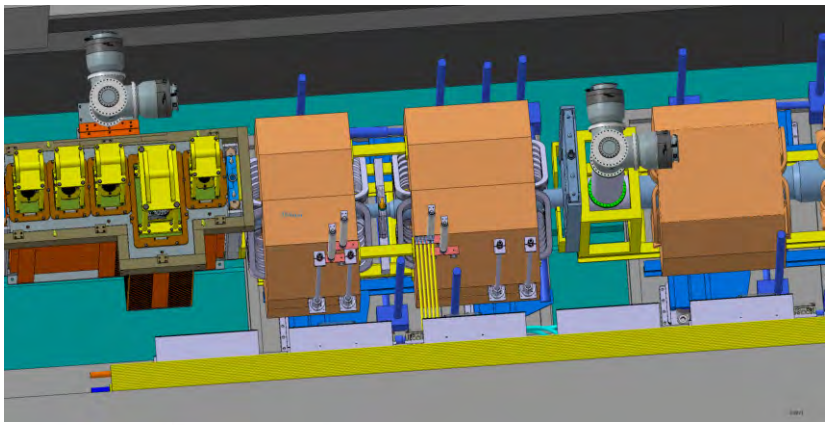
✓ Prototype dipole built and tested by BINP
✓ Dedicated support structure constructed
✓ Dipole: specification released
  - ➢ FAIR procurement
    - tender not yet started, under discussion with RU
- Two further specification in preparation
  - ➢ DS for QQ (Q2/17)
  - ➢ DS for QS, includes pump port (Q3/17)

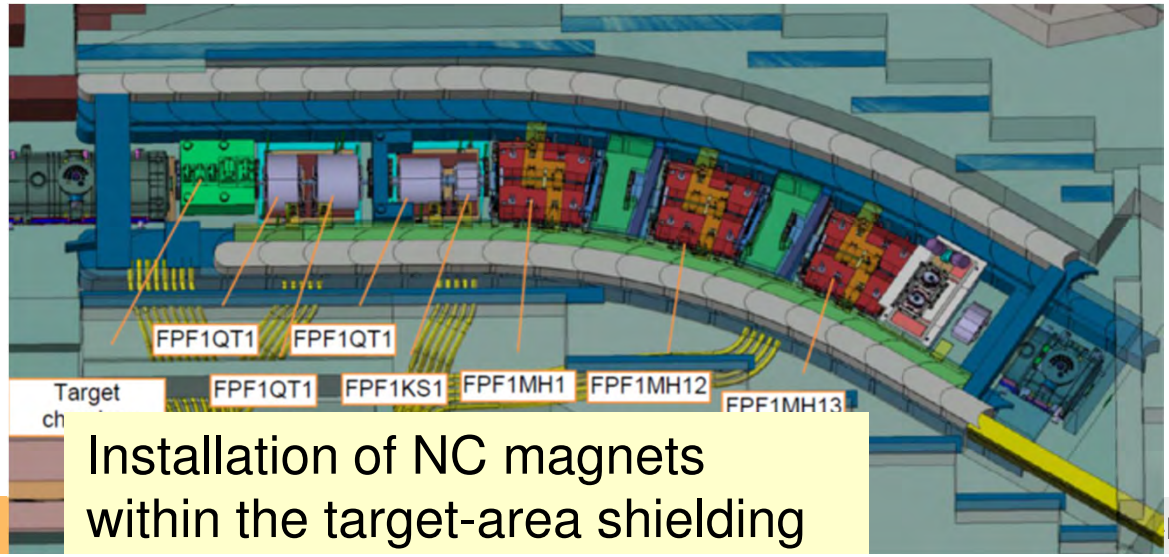
QQ after target chamber



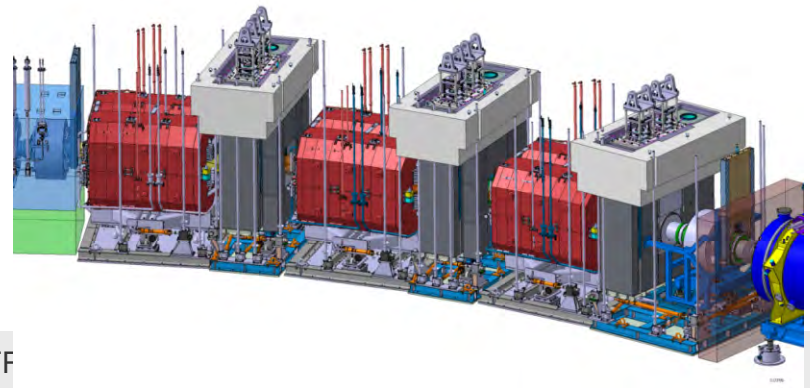
QS plus pump port







Installation of NC magnets within the target-area shielding



Local Cryogenics (Installation Planning)

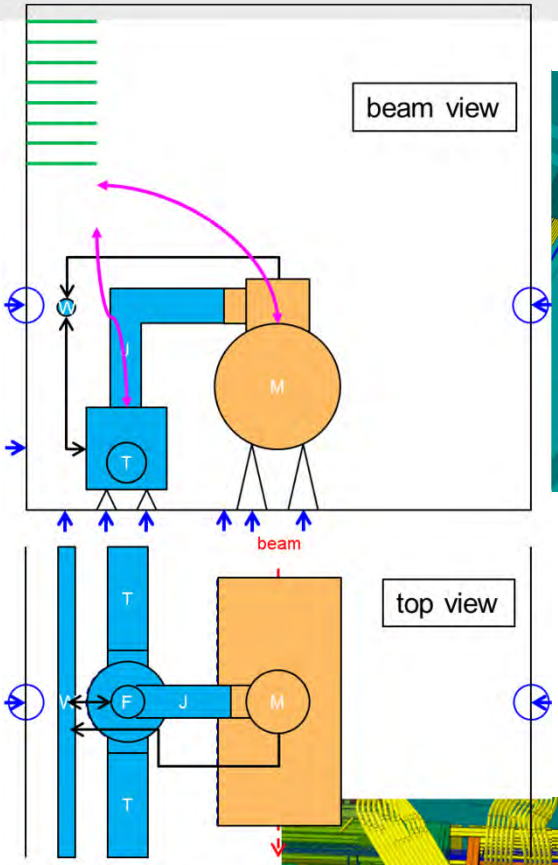
F. Wamers,
Y. Xiang et al.

Planning driven by installation and commissioning logistics; basically

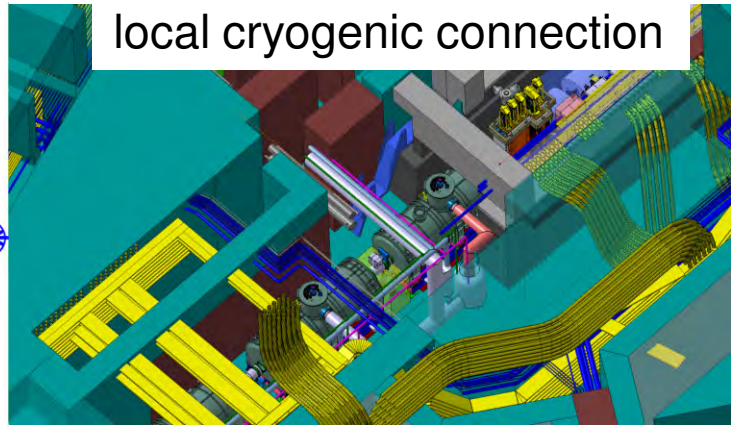
1. survey mesh required
2. technical services (TGA)
3. local cryogenics
4. magnet installation

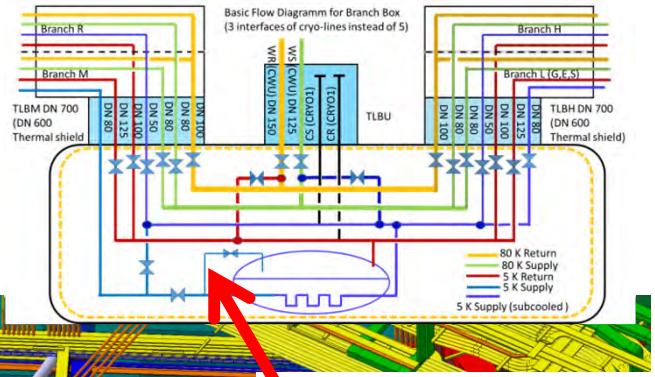
To be defined:

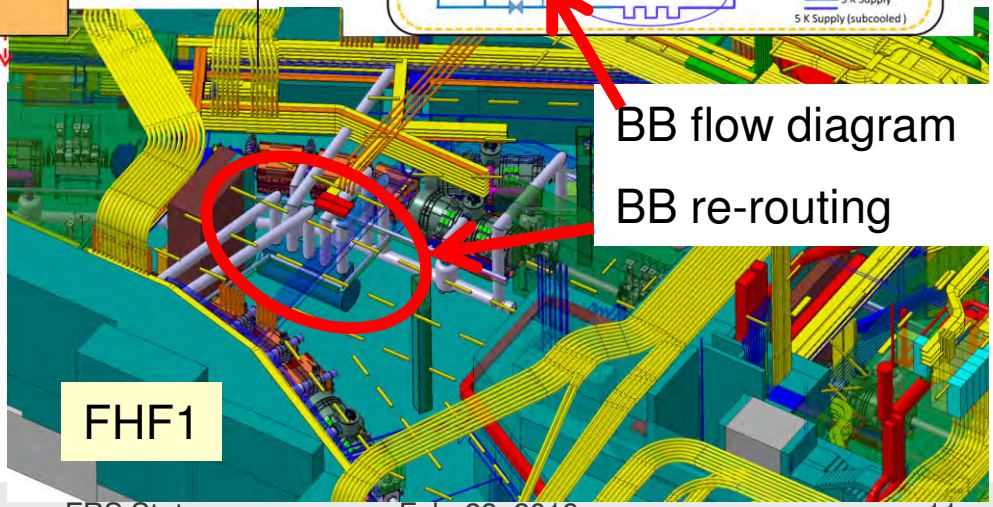
- detailed planning,
- order of checks & tests,
- cold tests before magnets (?),
- order of branches, ...



T-branch
local cryogenic connection







BB flow diagram

BB re-routing

FHF1

➢ Information & experience exchange with experts at other labs:

- Visit & Workshop at ESS (09/ 17)
- Visit & Workshop at DESY (12/17)

Big issue: In-kind with Poland missing ☹

Power Converter

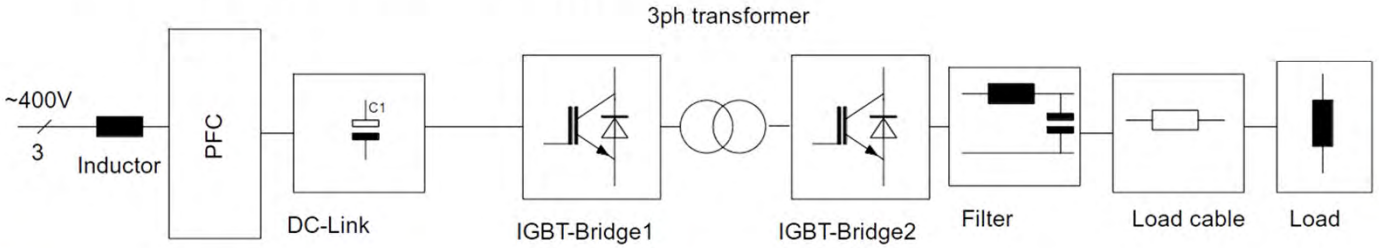
A. Wiest,
W. Freisleben et al.

Scope

- in sum ~250 PC required
  - 9 PC with high-power (up to 500 kW)
  - other PC medium-power for SC magnets
- Voltage range: from 30V to 745V
- Current range: from 15A to 1.480A

Features

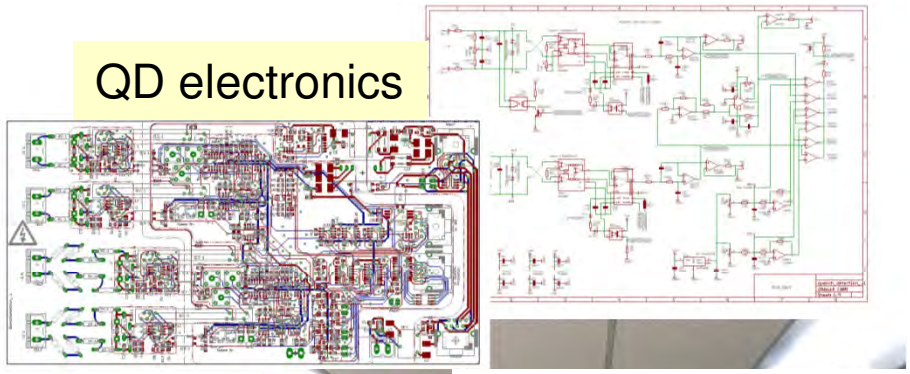
- common topology proposed
- energy recovery system
- all PC are bipolar
- PC include Active Power Correction Factor
- Two different DC voltages for ramp and flat-top
- **QD electronics integrated within the PC rack**
- Output filter , switching frequency up to 90kHz
  - very small current ripple



Status

- ✓ in-kind (Council) of India
- ✓ Specifications released (2017)
- Prototype PC under construction
  - FAT expected Q3/2017
  - SAT 12/2018 (?), at CERN FoS SM
- In-kind contract 12/2018
  - India signed for ~600 PC (FAIR)

QD electronics

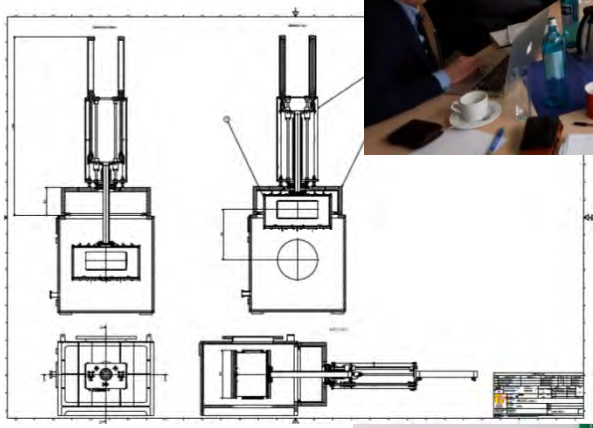


assembly area ECIL

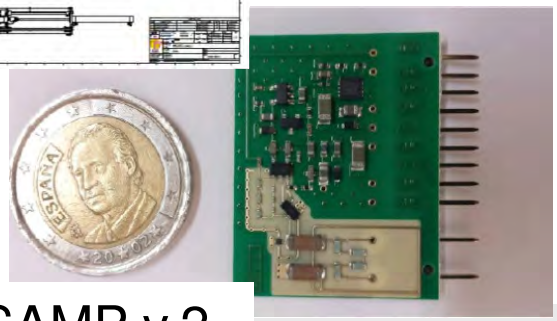
Beam Instrumentation I
(ΔE and ToF)

C. Nociforo
B. Voss,
O. Kiselev, et al.

- MUSIC (energy-loss, Finnish in-kind)
  - ✓ Specification approved Q1/2017
  - ✓ **1st IKC for Super-FRS signed !**
    - ➢ Field cage subcontracted to GSI
  - ✓ Kick-off meeting done
    - ➢ schematic design presented
    - ➢ schedule for design phase and FoS development agreed (ready Q3/19 → beam test if possible)
  - o PreAmps by CEA Bruyeres
    - ➢ successfully tested at beam time in 2016
    - ➢ contract waiting for signature (CEA)



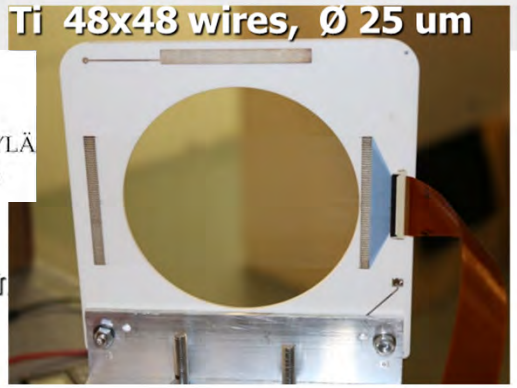
- Time-of-Flight (Russian in-kind, IOFFE StP)
  - ✓ Specification approved Q3/2016
  - ✓ IKC drafted Q3/2017
  - ➢ Response from IOFFE 02/17, many proposed changes, still under negotiation
  - R&D on diamond and silicon ongoing



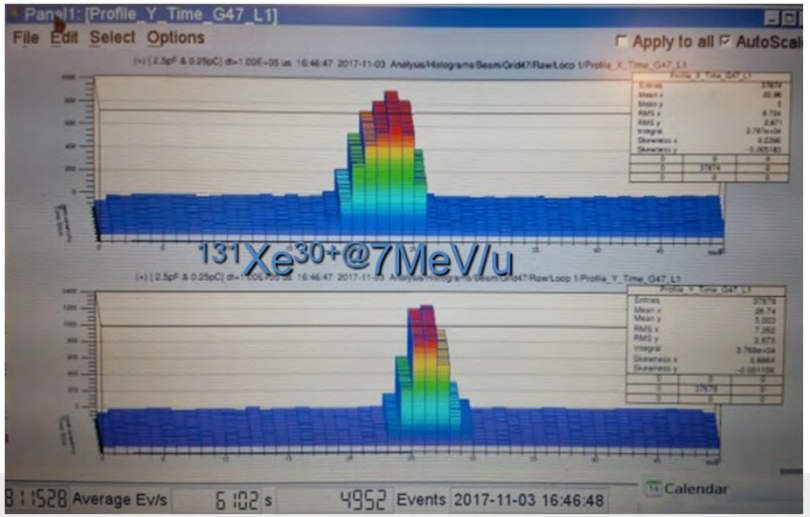
MUSAMP v.2

Beam Instrumentation II
(Position Detectors)

C. Nociforo,
A. Prochazka,
C. Caesar, et al.



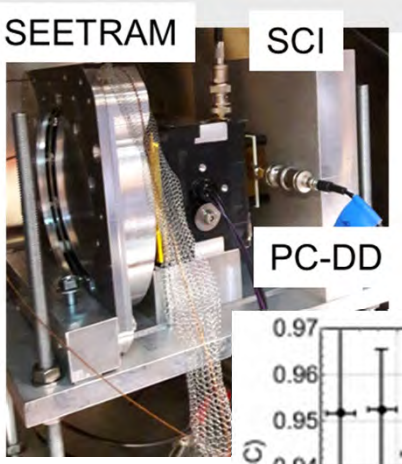
- SEM Grid (profile monitor), Finnish In-kind
  - ✓ Specifications released
  - ✓ Beam test at JYFL 11/2017
    - ➢ C and Ti sample (FERMILAB),
    - ➢ W sample (GSI)
    - ➢ FEE POLAND
  - IKC in preparation
    - ➢ Fi continuing design → adopt dimensions
- GEM-TPC (tracking), Finnish in-kind
  - ✓ Specîfication released
  - IKC in preparation
  - – issue: GMX_2NX board high production wastage
  - Beam test at GSI 2018 planned
    - ➢ test PADI and clock-TDC combination
- Position drive, Finnish in-kind
  - ➢ combined with SEM on a common drive
  - ➢ Specification in preparation



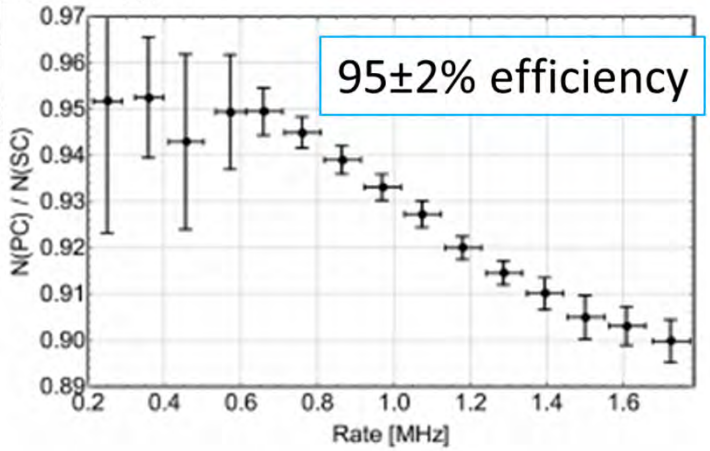
Beam Instrumentation III
(Beam Monitors)

C. Nociforo,
F. Schirru,
S. Schlemme et al.

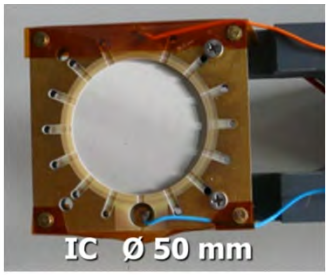
- PDC
  - o combined particle rate detectors (diamond) and beam current monitors (IC, SEETRAM) designed at GSI
  - ✓ Prototypes in-beam test INFN-LNS 05/2017 C12 @ 62MeV/u
  - ➢ Specification in approval process
- Diamond (intensity monitor, Ru in-kind)
  - ✓ pcCVD/scCVD sensors by GSI-DL
  - ✓ PA-20 preamps 20dB (1.5 GHz) tested
  - ✓ Specification released
  - ➢ IKC ready for preparation
- SEETRAM
  - ✓ 3-Al foils (24 μm) produced by GSI tested and calibrated with DIA
  - ✓ radiation-hard multi-pin self-aligned connectors tested (RH)



PC-DD 20x20x0.3 mm
SEETRAM Ø 100 mm
SCint 100x100x0.25 mm³



PDC test:
IC calibration



self-aligned connectors

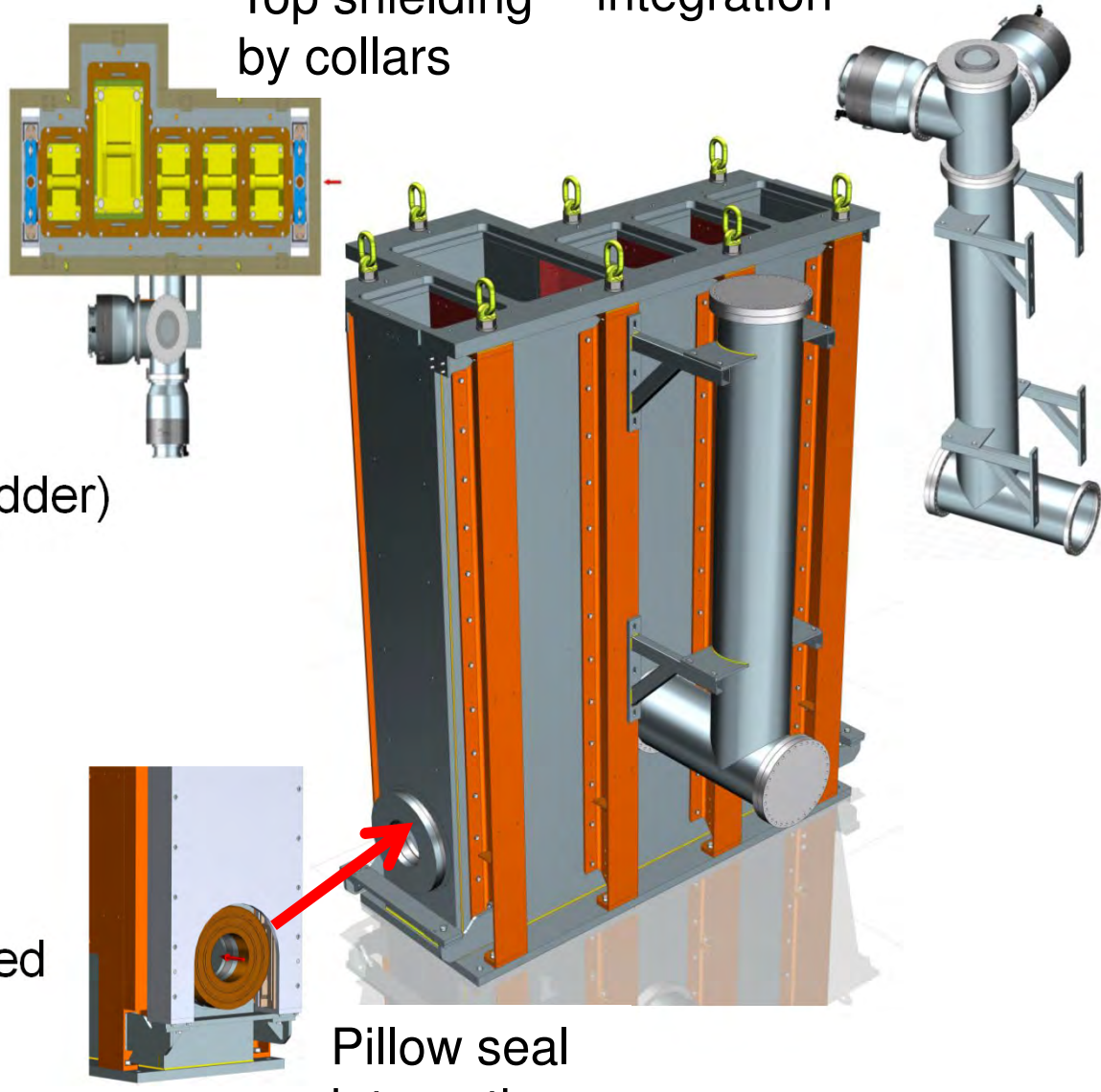
PA-20 preamps by IFJ (Cracow)

Target Area I (Target Chamber)

H. Weick,
C. Karagiannis

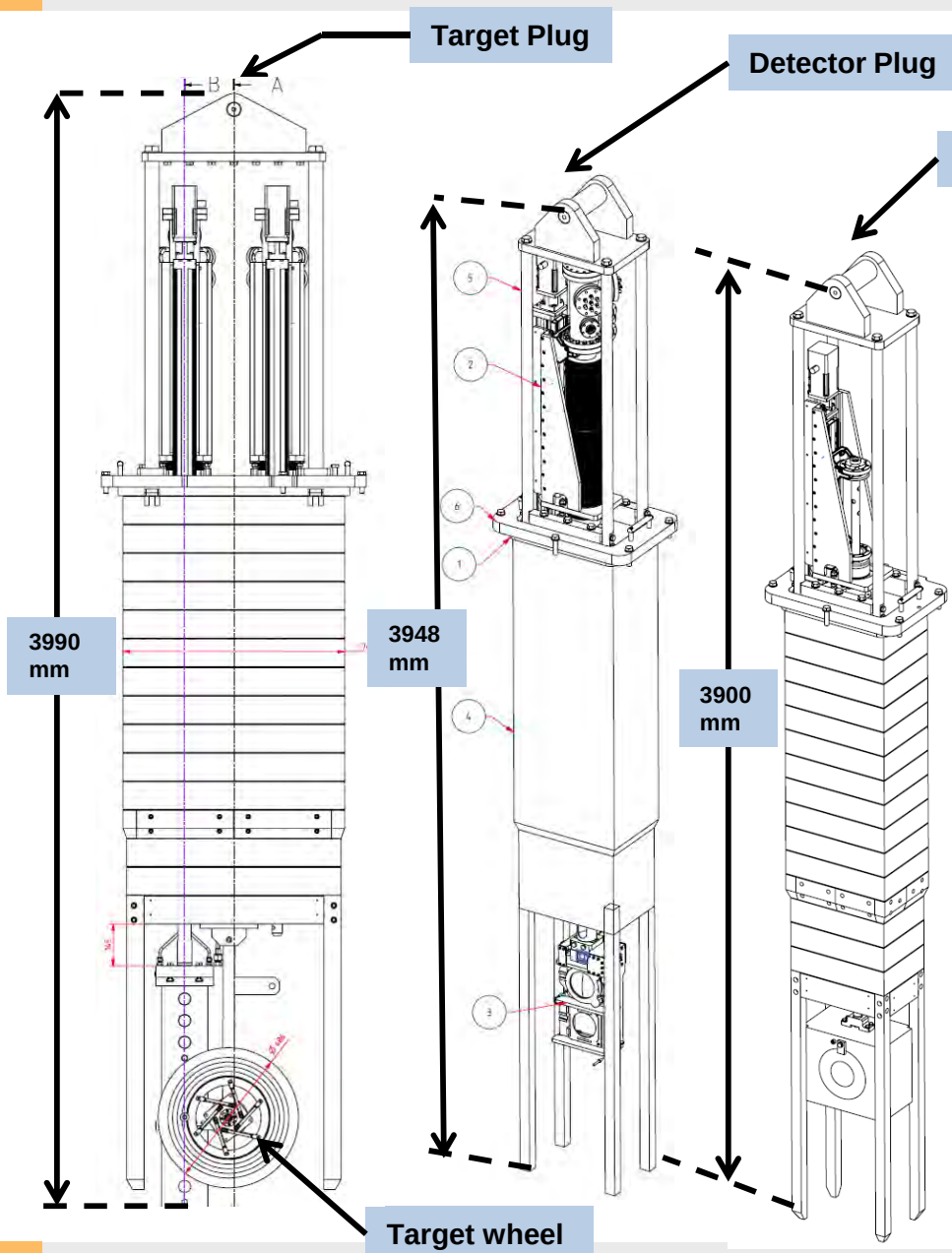
Status:

- ✓ Specification released
- ✓ Collab. Contract with KVI-CART
- ➢ Design phase running, includes:
  - chamber design
  - including 5 plugs
    - o 3 detector plugs
    - o target wheel plug (2nd target ladder)
    - o collimator plug
  - ➢ pillow seal integration
  - ➢ vacuum system integration
  - ➢ beam spot diagnostic on target
- ✓ CDR report established
- ✓ 1:1 plug model built;
  - ✓ plug guidance successfully verified



Target Area II (Plug System)

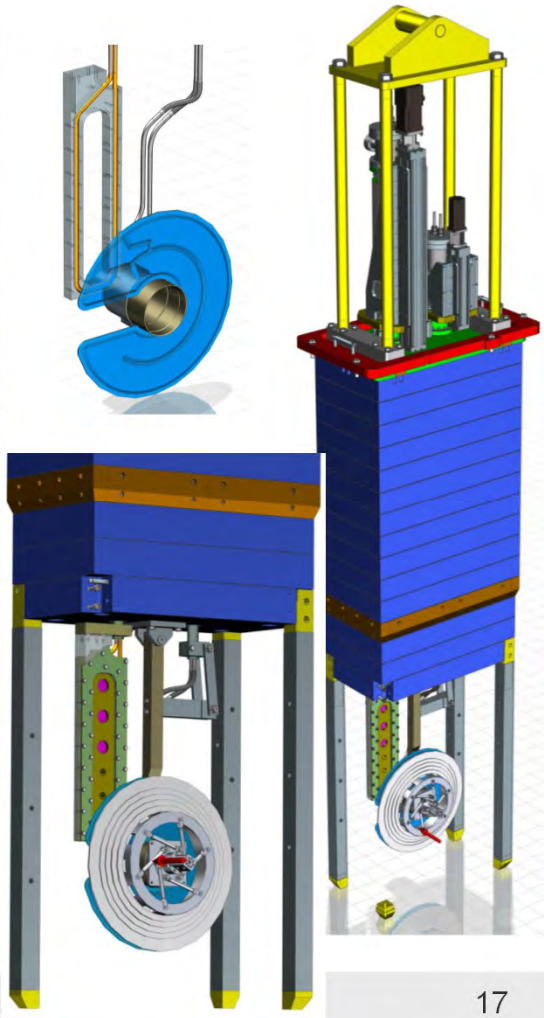
H. Weick,
C. Karagiannis



Target wheel plug (details)

- 4.2 ton (heaviest plug)
- includes target ladder (6 position)
- 2 linear drives + TW motor
- active cooling

Plug test setup

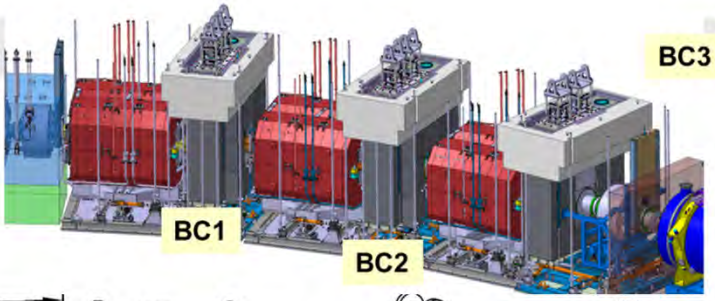


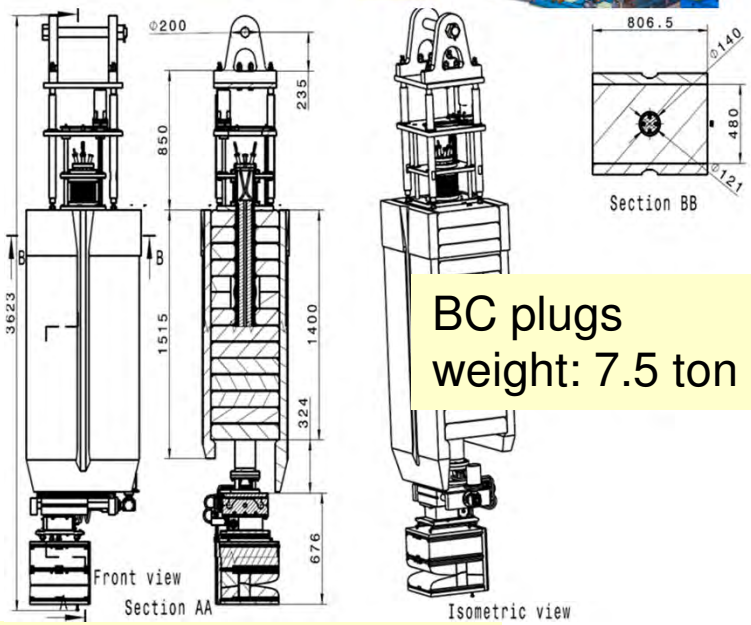
Target Area III
(Beam Catcher Plugs)

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

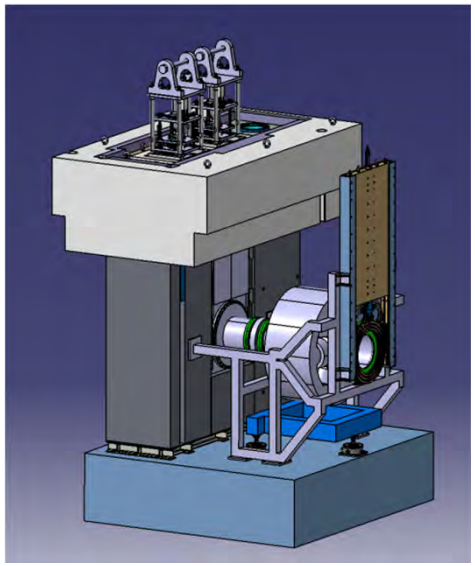
FAIR GSI

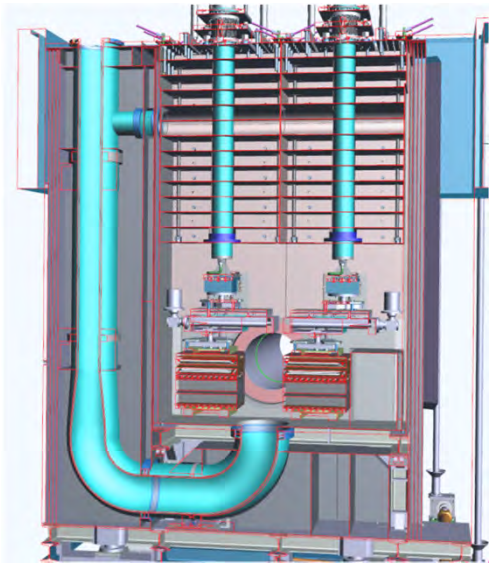
- 3 BC station equipped with two absorber each
- Indian in-kind, Collaborator: **CMERI Durgapur**
- Design running, based on definition report
  - ➢ absorber geometry optimized
  - ➢ use C/Cu (fast/slow extraction) → avoid Be
- ✓ CDR released 12/17
  - ➢ build a absorber mock-up verify RH capability
  - ➢ DS in preparation (Q2/2018)
  - ➢ in-contract preparation (Q4/2018)
- ▪ India started company qualifying phase (Q4/2018)



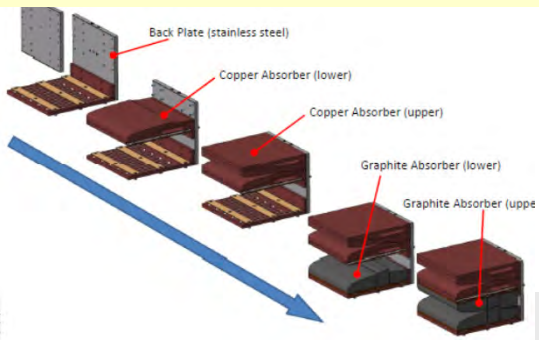


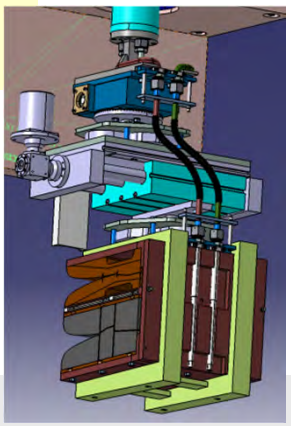
BC plugs
weight: 7.5 ton





absorber and
assembly sequence (RH)

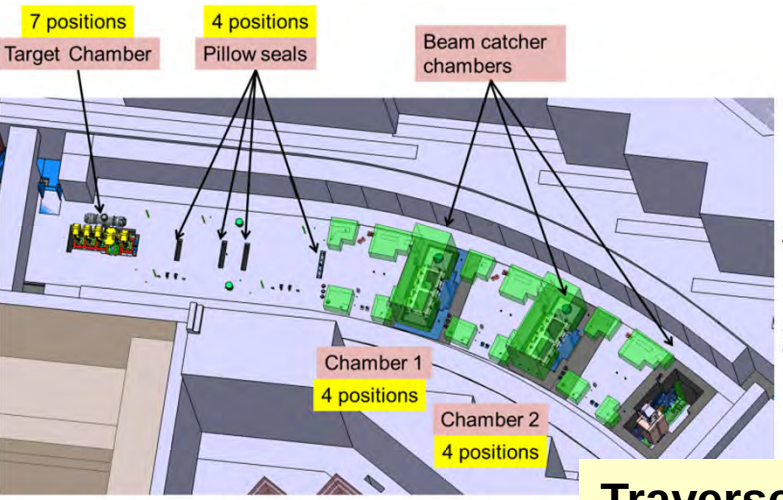


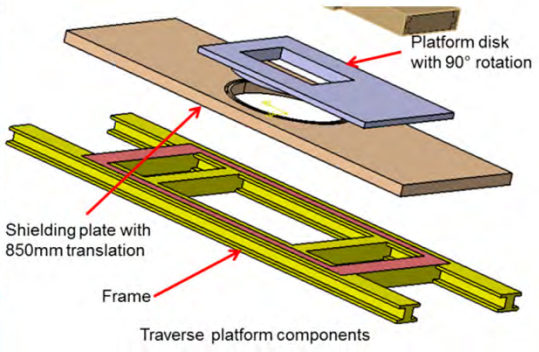


Target Area IV
(Shielding Flask)

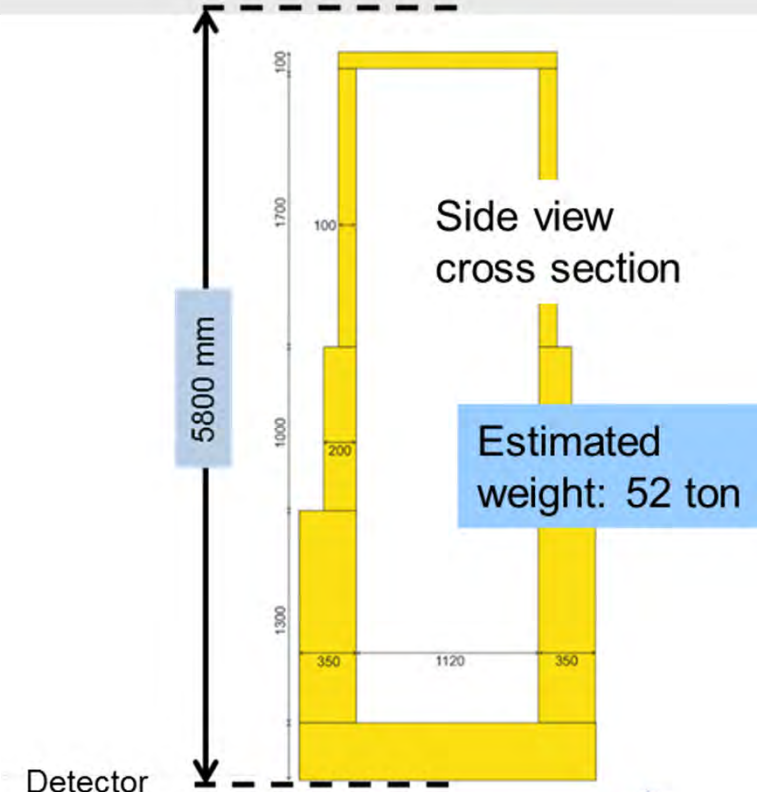
F. Amjad,
H. Weick et al.

- ✓ Specification ready for approval
  - all dimensions finalized → interface HC finalized
  - internal crane with automatic gripper; load 9 ton
  - shielding: design goal is 10µSv/h on surface
  - includes traverse platform with shielding plate
    - ➢ allows for 90° rotation for position adjust
- MoU between Finland, KVI, PS, GSI in preparation
  - ➢ to be signed Q2/2018
- ✓ in-kind contract with Finland to be established





Traverse platform:
dim: 8.700mm x 3.000mm x 300mm
weight: 19.5 ton



Civil Construction I
(Overview)

Build. 018
(Target building)

100 m

Build. 006a
(Service building)

Tunnel 103

Build. 006b
(LEB cave)

Build. 006
(HE cave)

To CR

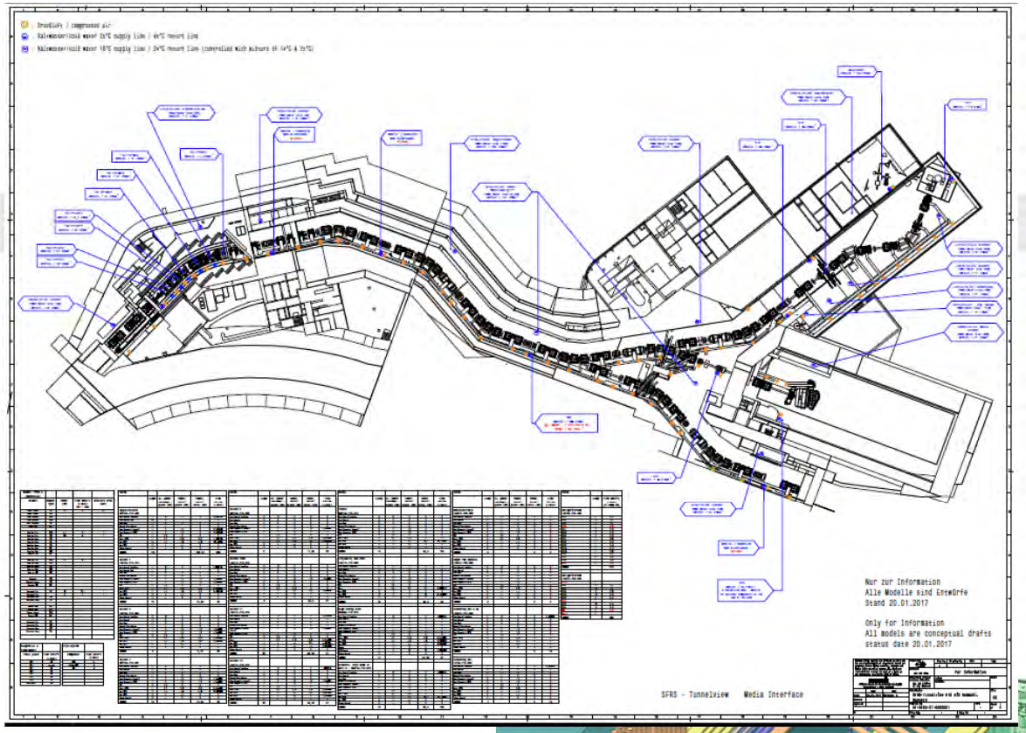
CC planning Phase 1-4 done
- ✓ equivalent to LP5 (execution planning)
- ✓ LEB cave integrated to full extend
- ✓ interfaces to 'machine' defined

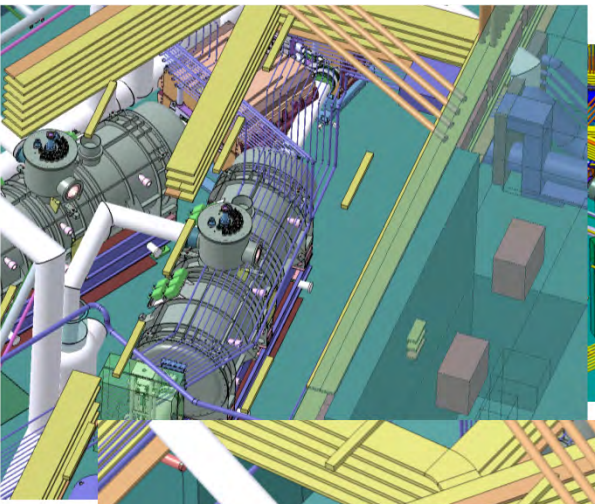
Logistic planning & Installation planning running

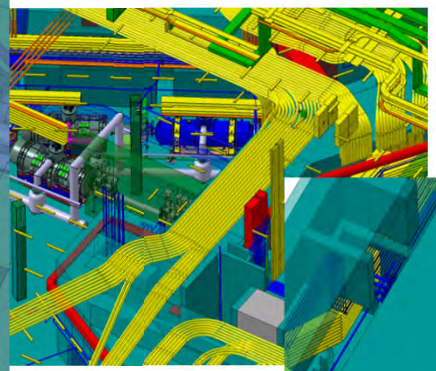
Construction area south (NUSTAR and other):
- Preparation of tender documents running
- ➢ review of contract specifications announced for 04/18
- ✓ partly tender already running (e.g. conveyor technique)

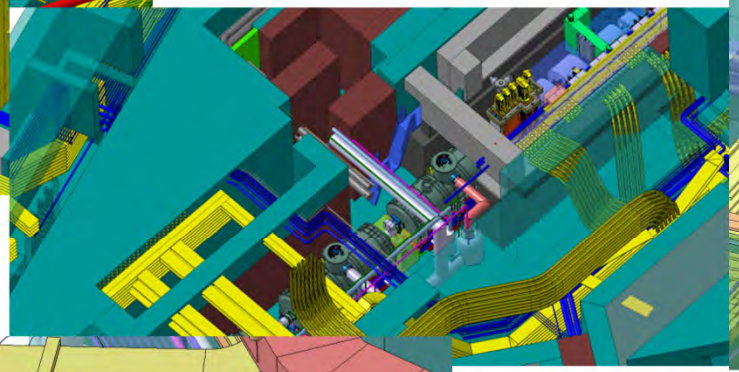
Civil Construction II
(Building services)

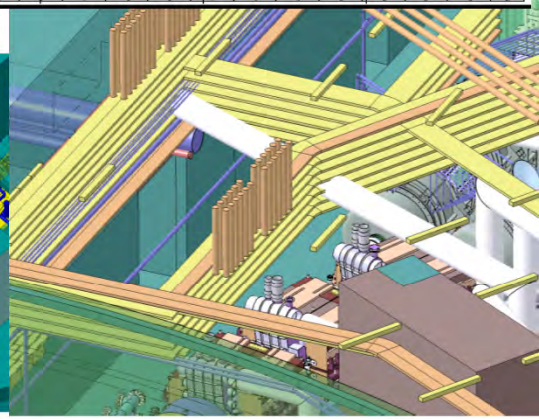
- ✓ Technical services (TGA)
  - ➢ Cable data base updated 09/17
  - ➢ Power & ventilation planning
  - ➢ 1st collision check 01/18

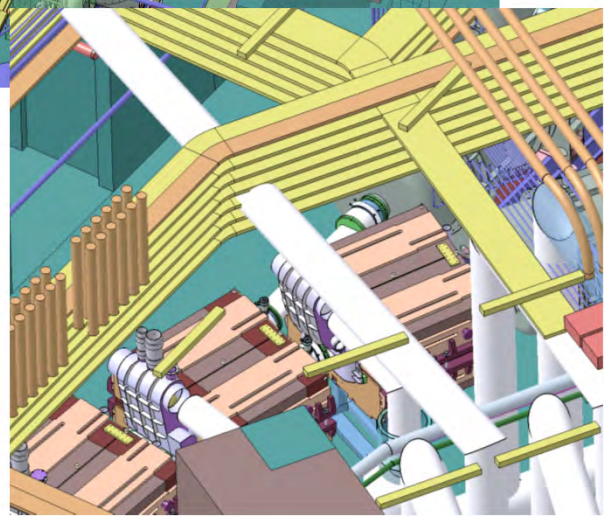


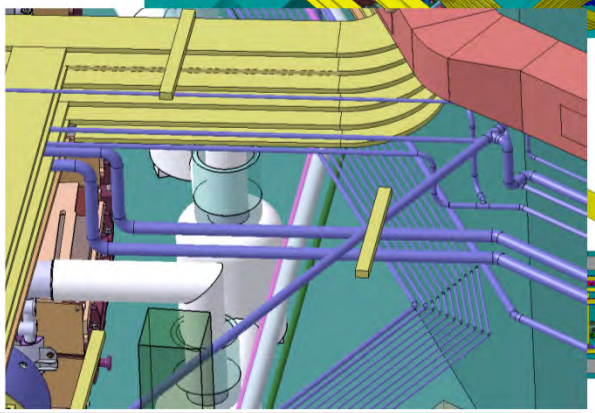


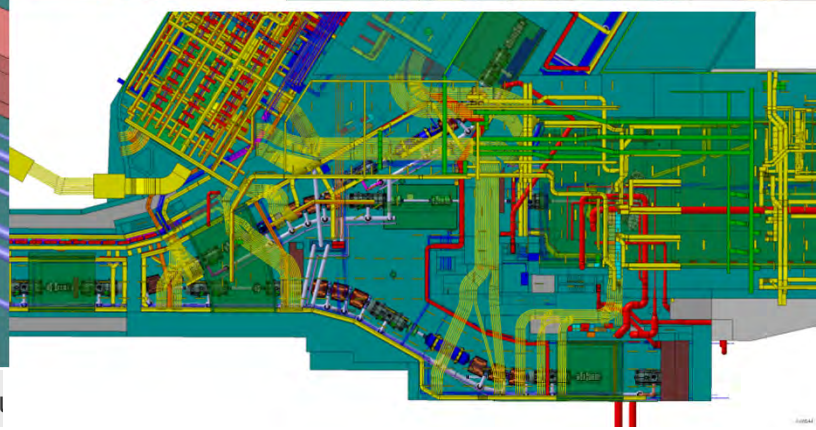












Summary

- SC Magnets & Testing (most time critical items):
  - Standard dipoles: contract awarded Feb 2018
  - Multiplets: design phase done; manufacturing of FoS SM under way
  - Testing@CERN: contract addendum signed, commissioning of cryo-facility running, procurement of last components running; FoS SM expected in 06/2018
- Development and procurement of various other components under way
  - PC specification released; prototype PC under development
  - First IKC for MUSIC detectors signed; kick-off with provider done
  - Specification of various other beam instrumentation components released and corresponding IKC in preparation (R&D is ongoing
  - Target chamber and plug systems ready for CDR
  - CDR of beam-catcher system done; DS and IKC expected in 2018
  - Shielding flask: specifications ready for approval; MoU between collaborating parties in preparation
- Civil Construction execution planning finalized; tender documentation in preparation, building services planning running

Thank you for you attention !