Super-FRS Status

Martin Winkler

Annual NuSTAR Meeting, GSI, Feb.29 – March 2, 2012

- **Layout Full Version**
- **Status Civil Construction**
- **Status Components**
- **Transport Concept, Installation, Timeline**
- **Summary**

Design Parameters and Layout of the Super-FRS (Full Version)

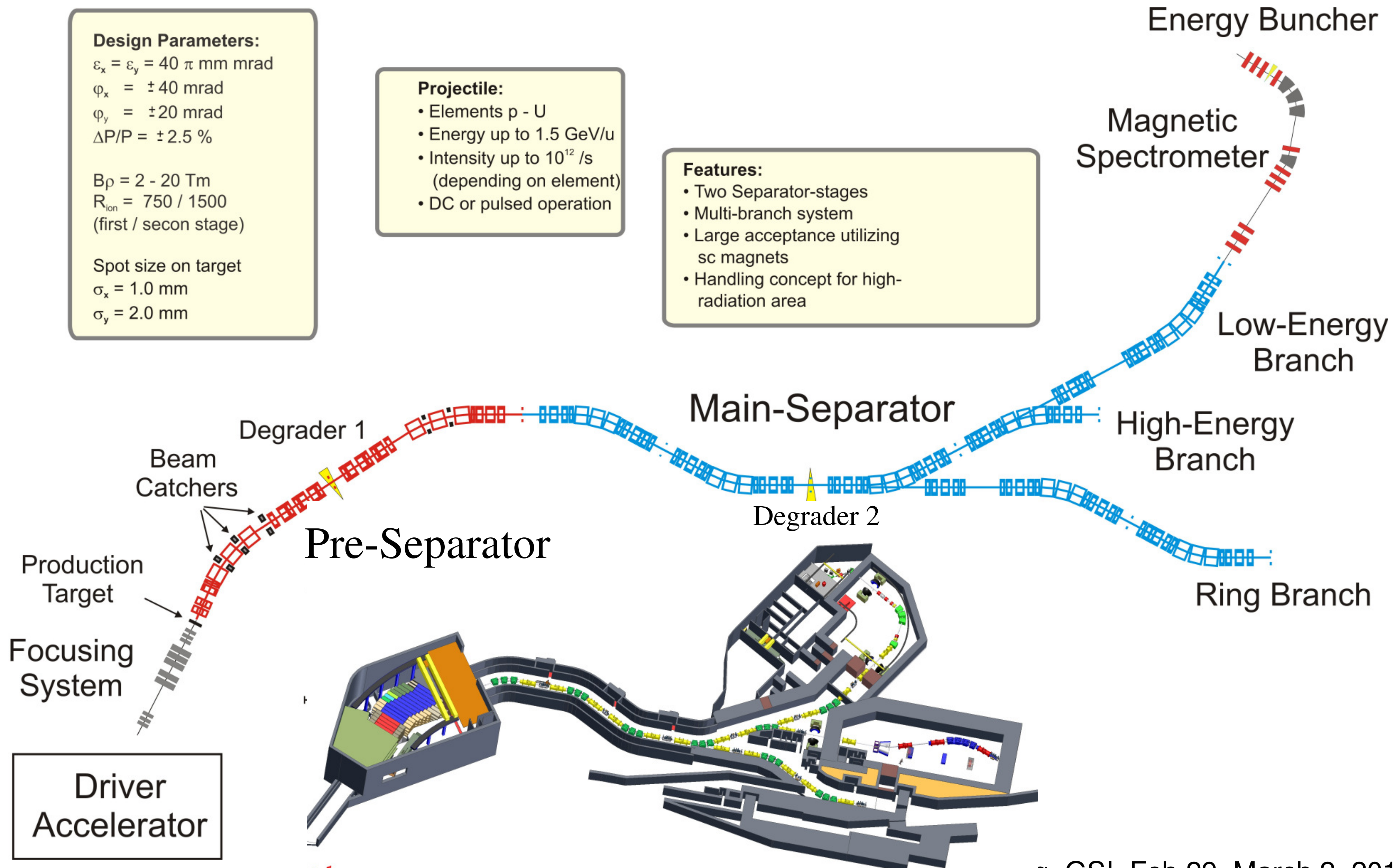
Design Parameters:
$\varepsilon_x = \varepsilon_y = 40\ \pi$ mm mrad
$\varphi_x = \pm 40$ mrad
$\varphi_y = \pm 20$ mrad
$\Delta P/P = \pm 2.5$ %

$B\rho = 2 - 20$ Tm
$R_{ion} = 750 / 1500$
(first / secon stage)

Spot size on target
$\sigma_x = 1.0$ mm
$\sigma_y = 2.0$ mm

Projectile:
- Elements p - U
- Energy up to 1.5 GeV/u
- Intensity up to 10^{12} /s (depending on element)
- DC or pulsed operation

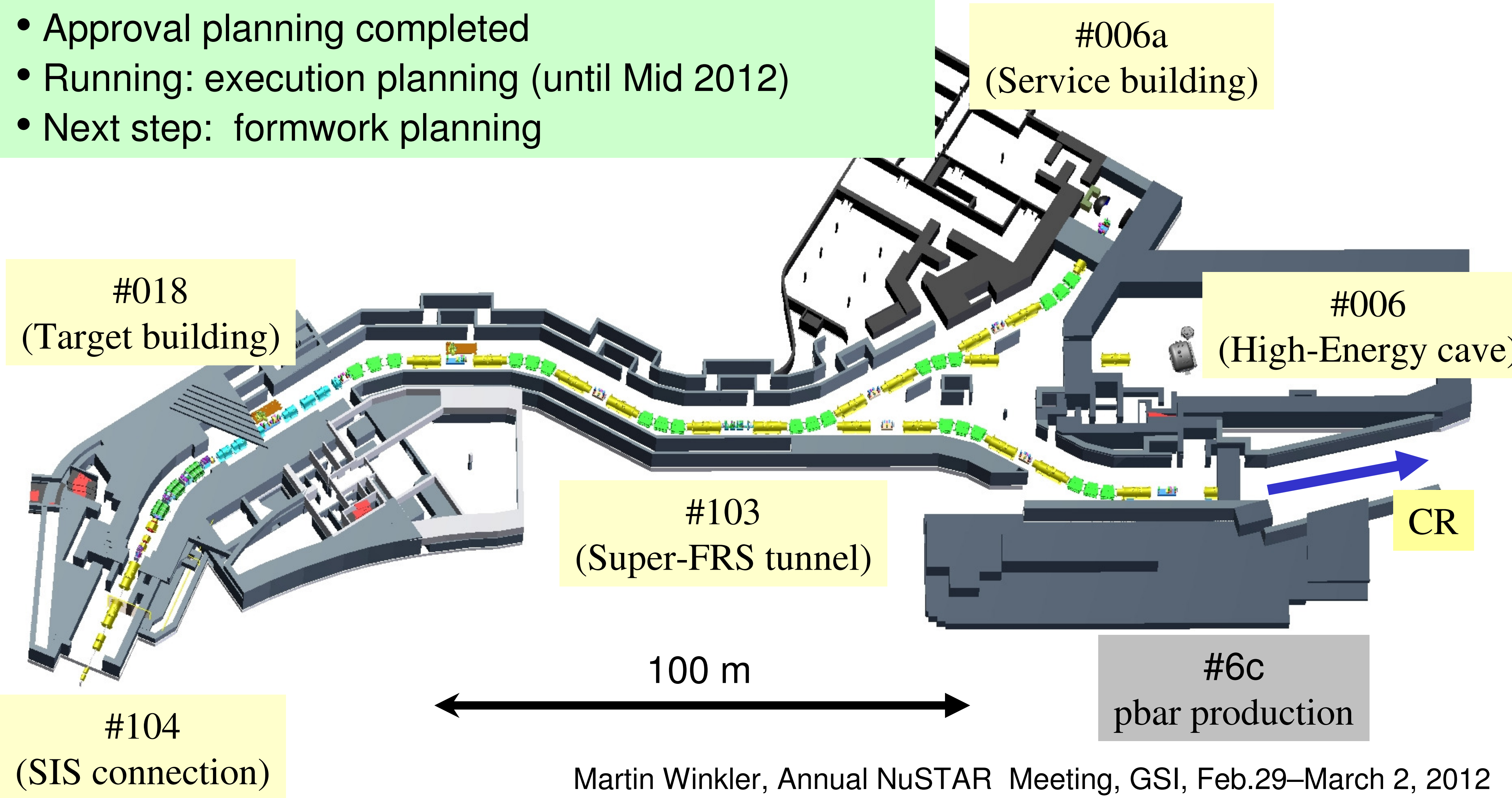
Features:
- Two Separator-stages
- Multi-branch system
- Large acceptance utilizing sc magnets
- Handling concept for high-radiation area



Super-FRS Buildings (MSV, Overview)

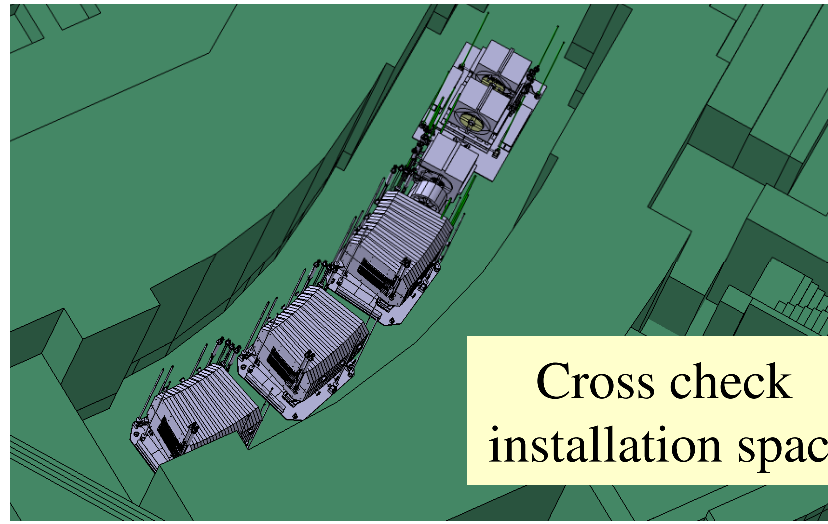
Goal: Buildings ready for Installation in 11/2016

- Basic evaluation completed
- Preliminary planning completed
- Approval planning completed
- Running: execution planning (until Mid 2012)
- Next step: formwork planning

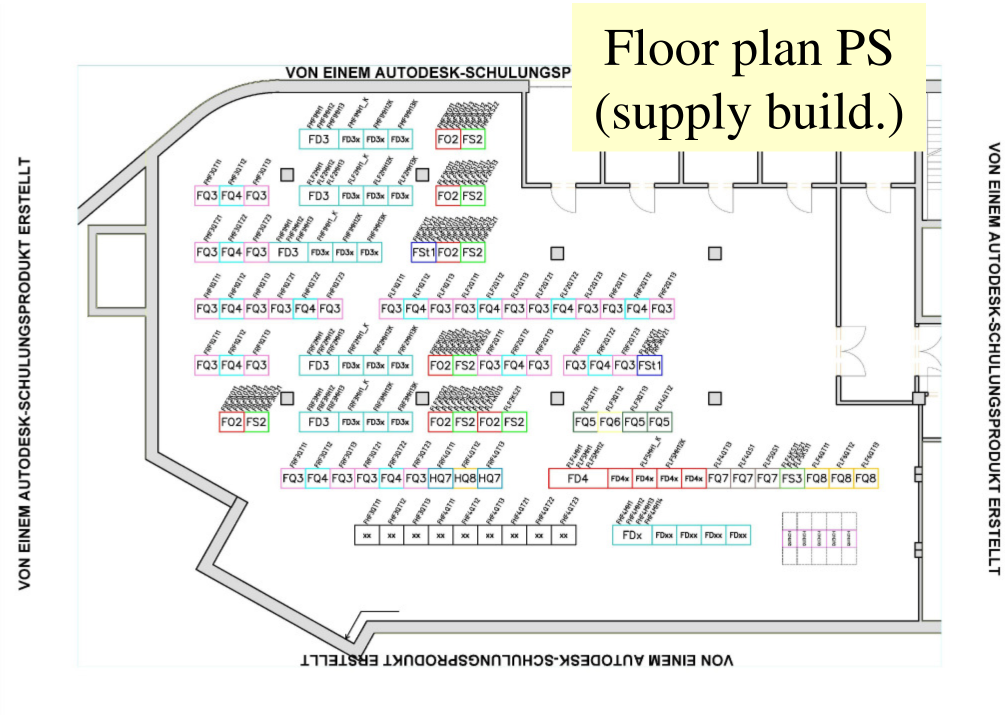


Execution Planning

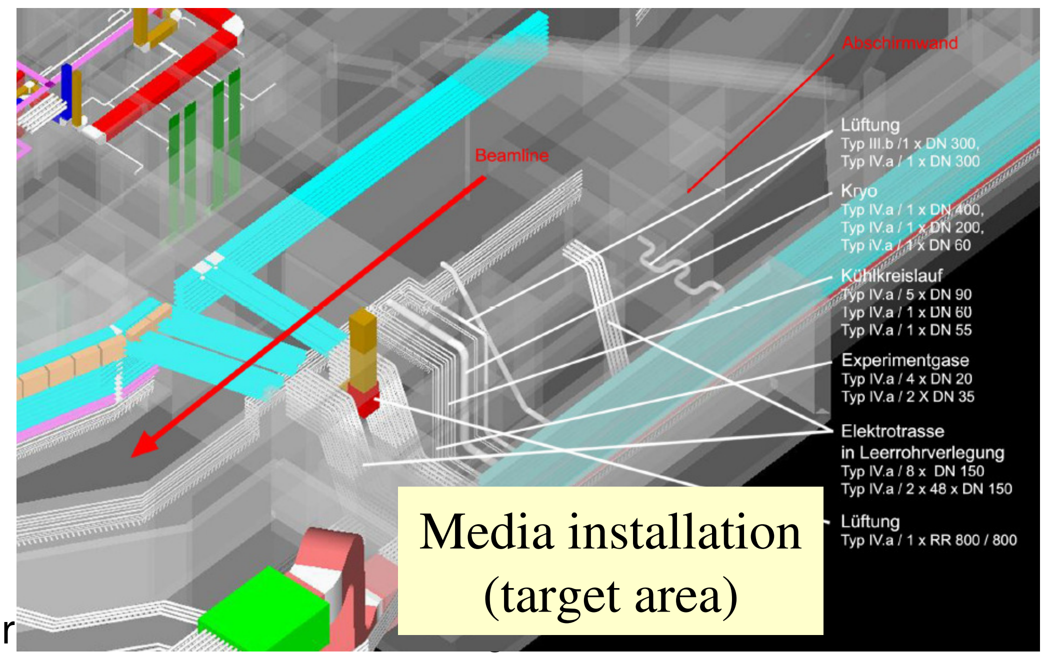
- Cross check civil construction and machine (3D, digital mock up, DMU)
- Definition of space
- Floor planning
- Cable lists, component data lists, …
- Integration of media installation and collision check



Cross check installation space

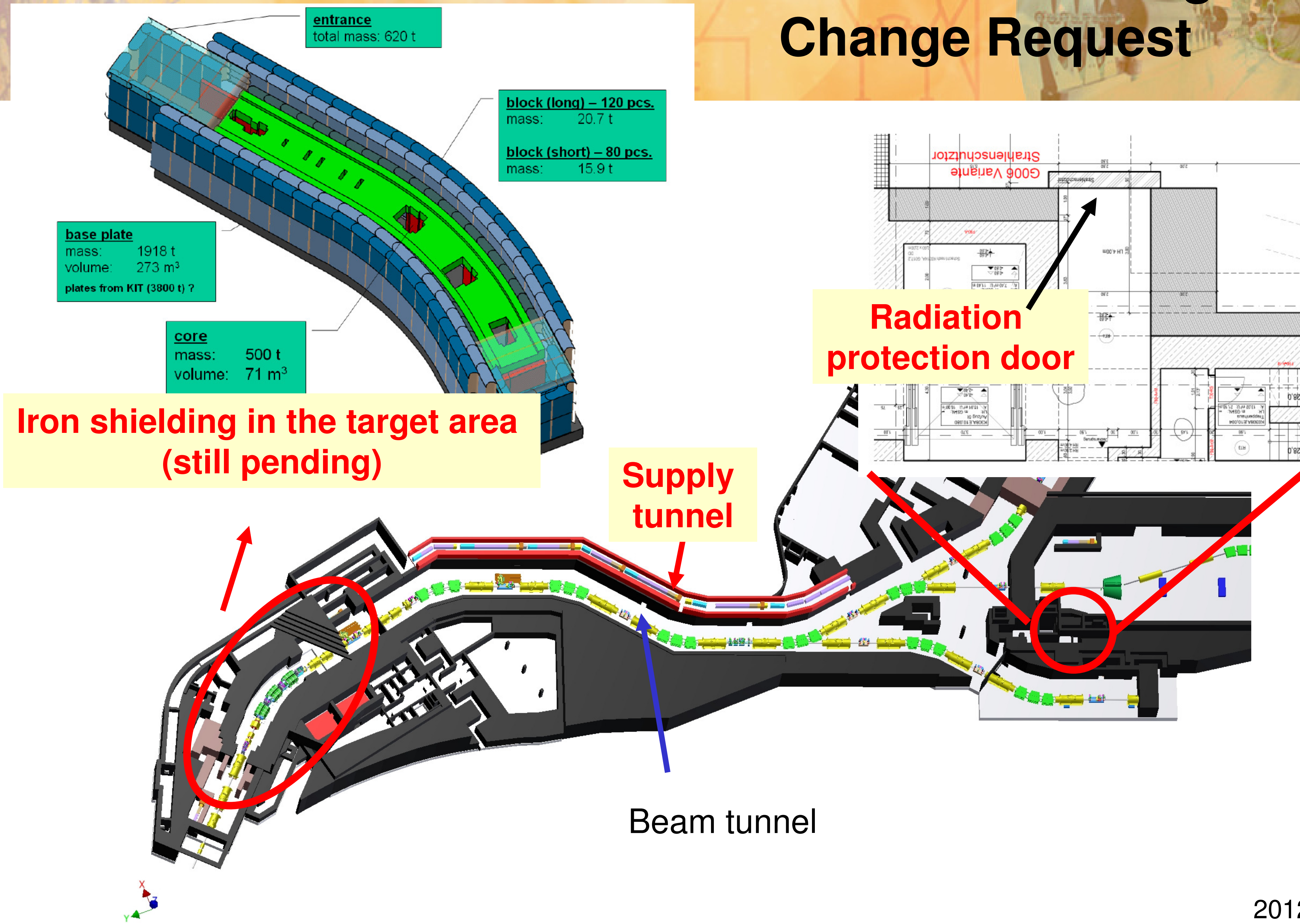


Floor plan PS (supply build.)



Media installation (target area)

Execution Planning / Change Request



C. Mühle
C. Will
P. Vobly et al.

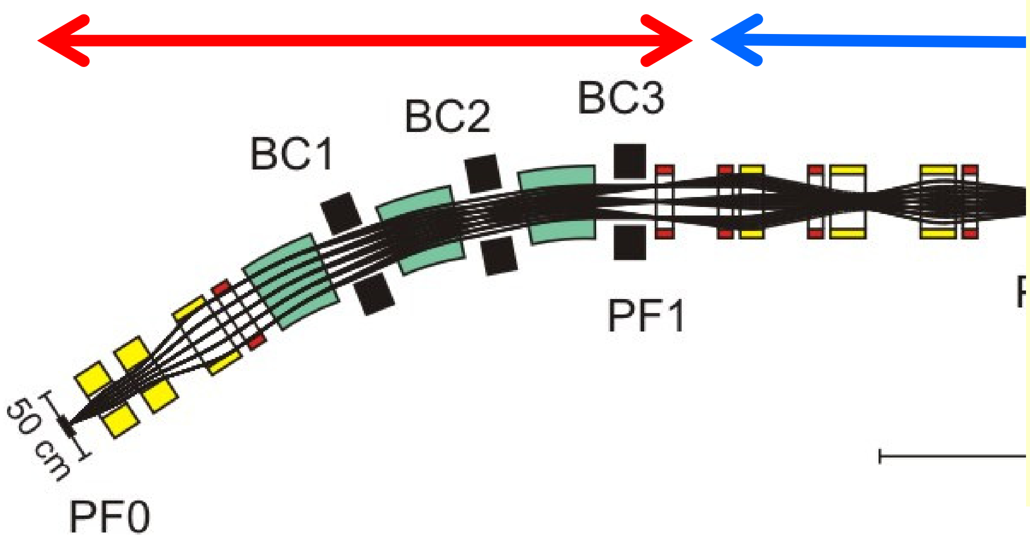
Radiation Resistant Dipole

Prototype Production

High-radiation level

→ Normal conducting

Super condu



- Developed with BINP, Novosibirsk
- Normal conducting magnets using **MIC**
- ρ = 12.5 m, ϕ = 11° , B_{max} = 1.6 T, 95 ton
- Remote connectors and alignment
- in 2010: testing, field measurement, long term stability, FAT (at BINP)
- in 2011: delivery to GSI, assembly, SAT

Financed within EU-FP6 and by GSI

C. Mühle
C. W
P. V

…ion Resistant Dipole
…rototype Production


DING
DER WOCHE

DER FRAGMENTSEPARATOR Foto Rüchel

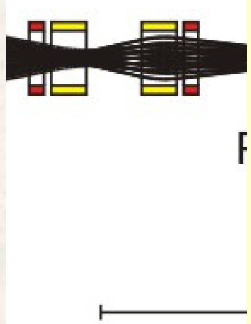
FAZ, 20.8.2011

Magnet der Extraklasse

Ein Fragmentseparator ist, wie der Name sagt, ein Gerät, das Fragmente separiert, also voneinander trennt. Ein solcher Filter steht seit einiger Zeit in der neuen Testhalle auf dem Gelände des GSI Helmholtzzentrums für Schwerionenforschung in Darmstadt.

Das Ding ist 96 Tonnen schwer, gut drei auf drei Meter groß, wurde in Russland zusammengebaut und stellt technisch einen Magneten der Extraklasse dar. Nicht nur, weil bei seinem Bau vollständig auf organische Stoffe wie etwa Exoxidharze verzichtet wurde. Seine Leistungsfähigkeit verglichen mit den Magneten, die bei der GSI bislang im Einsatz sind, liegt um den Faktor 10 000 höher, wie GSI-Magnetspezialist Carsten Mühle erläutert.

…per condu…



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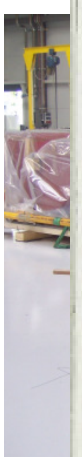


June 2011


July 2011

C. Mühle
C. Will
P. Vobly et al.

Radiation Resistant Dipole
Prototype Production

High-radiation level

→ Normal conducting   Super condu

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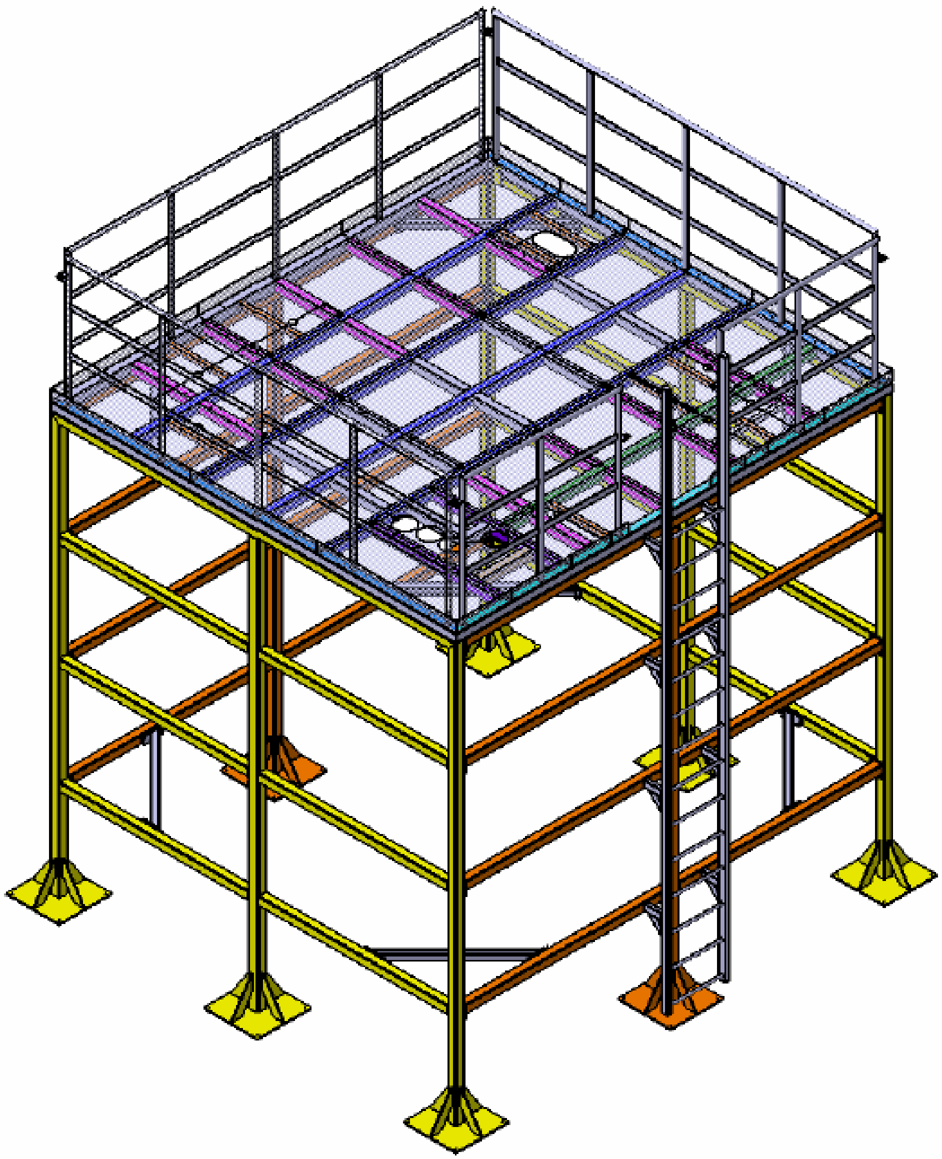
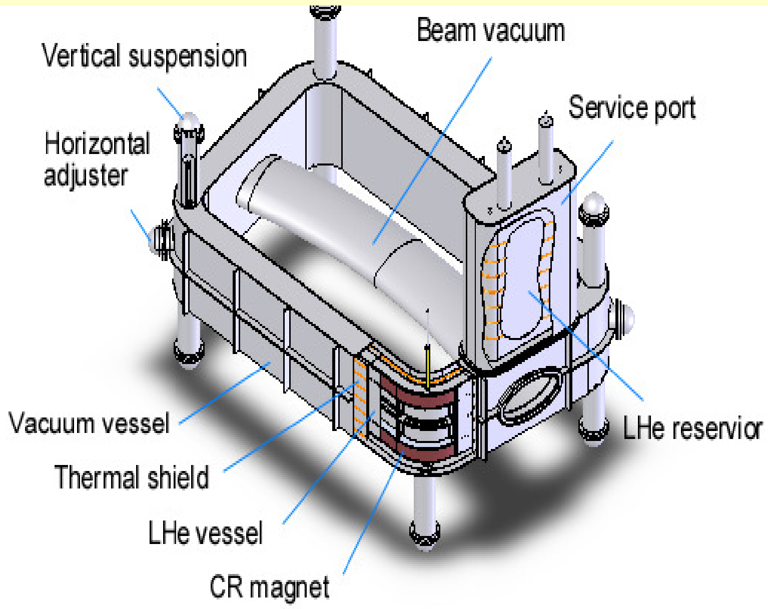
- Remote connectors and alignment
- in 2010: testing, field measurement, long term stability, FAT (at BINP)
- in 2011: delivery to GSI, assembly, SAT
- **next step: simulate 'tunnel installation'**

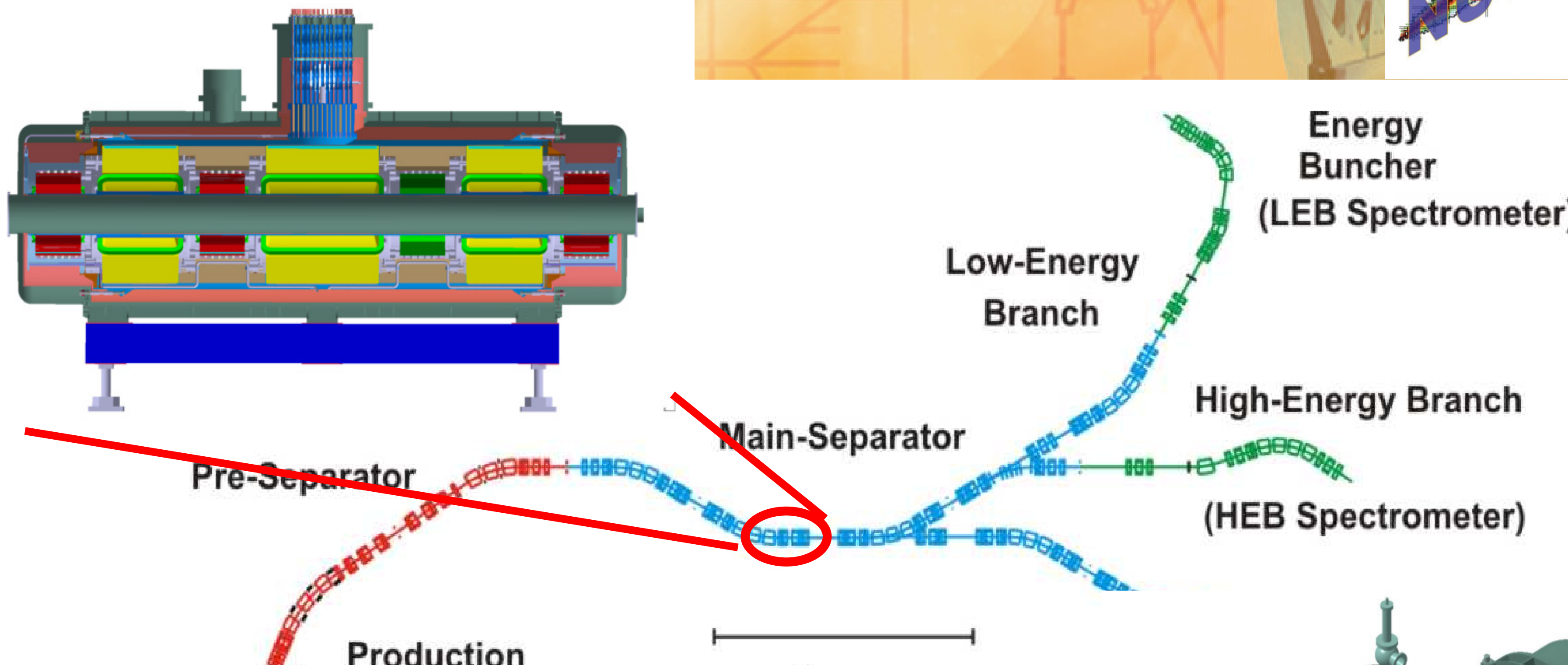


Superferric Dipole for the Super-FRS

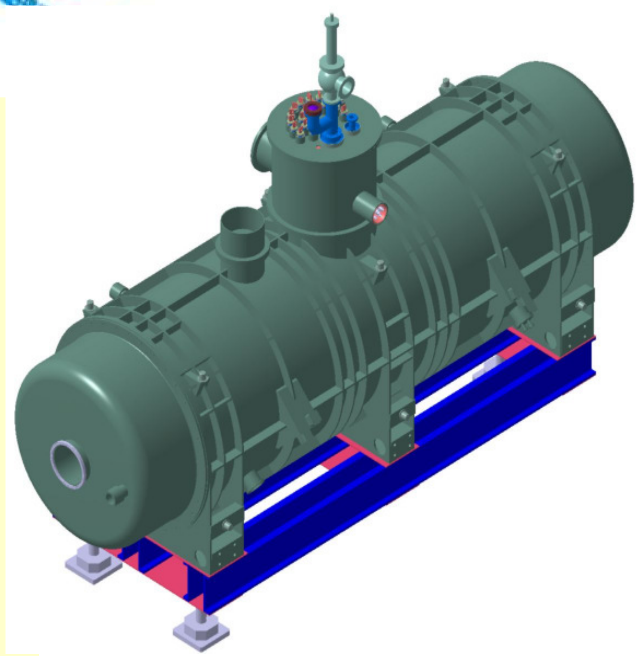
- 24 dipole units are required
- Iron dominated, warm iron, SC coil
- Large aperture ±190mm x ±70mm; 50 ton
- Prototype built and tested by FAIR China Group
- Some small modifications are required for the series
- Advanced negotiation with France (CEA, Saclay) as contributor
- Spain (CIEMAT, Madrid) indicated interested, but so far no concrete proposal
- First series dipole expected for 2014



Superferric Multiplets for the Super-FRS



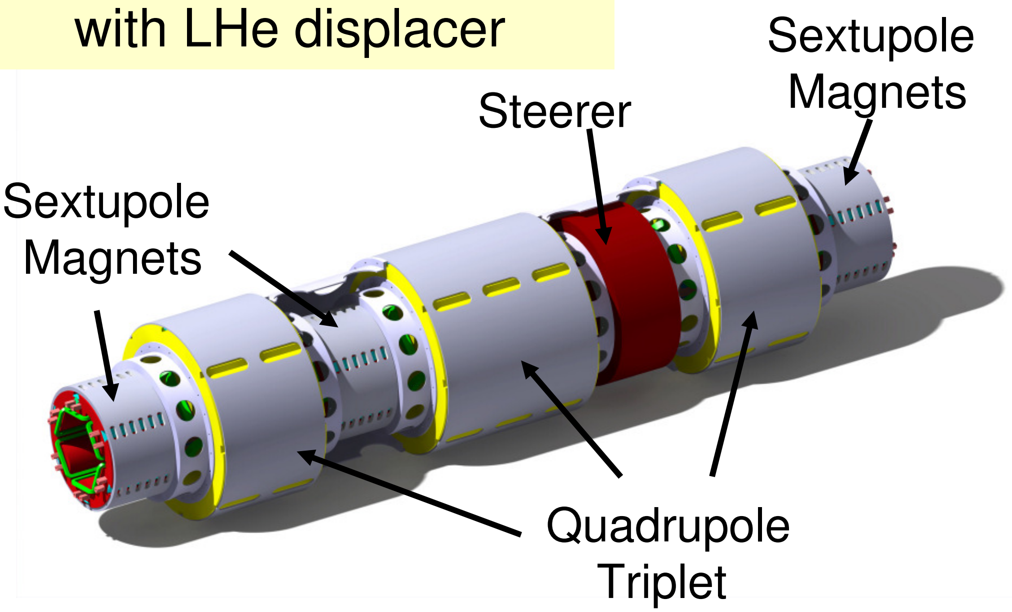
- 31 SC Multiplets (+ 2 spare Multiplets)
- iron dominated, cold iron, warm beam pipe
- up to 9 magnets in one cryostat, L_{Max}=7 m, M_{Max}=50 ton
- large aperture, Ø 380 mm, high gradients (e.g. 10 T/m)
- presented as German in-kind contribution at IKRB and approved by FAIR council
- Preparation of specification and tendering documents
- Negotiation with CERN concerning magnet testing/mapping



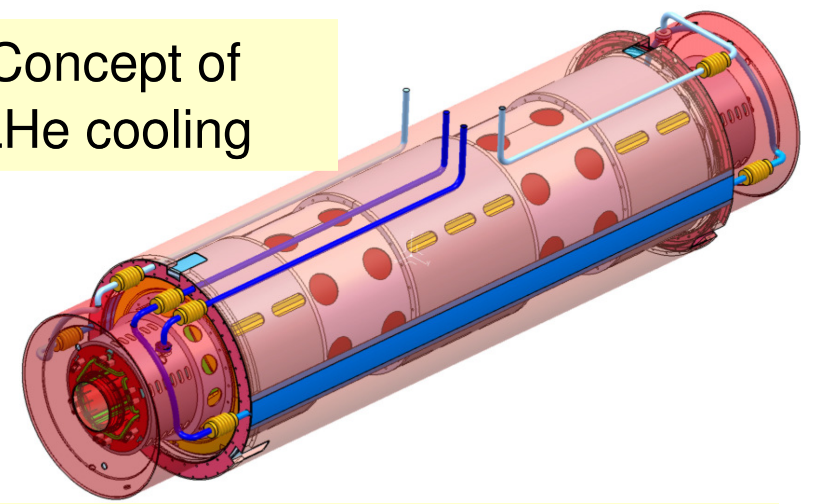
Most time critical component

Establishing the Specification
(Modular System)

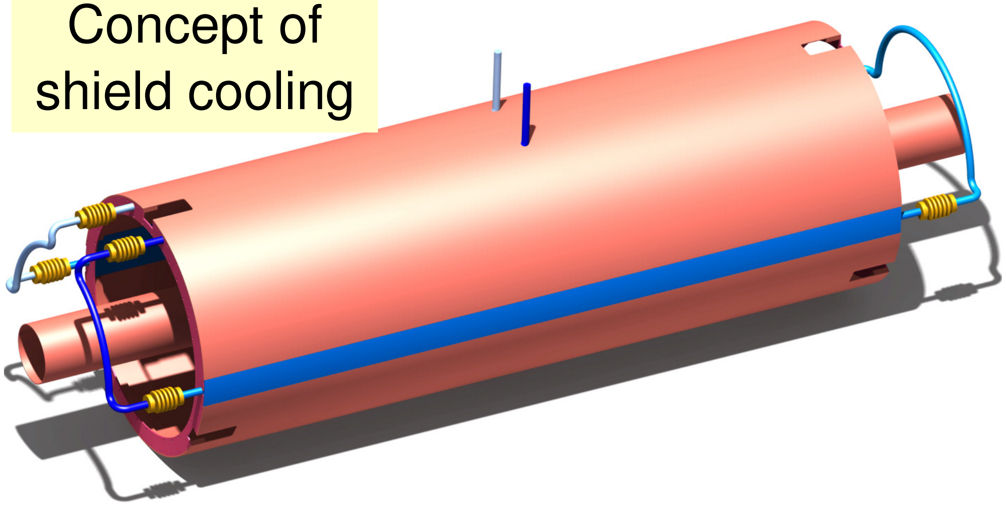
Concept of cold mass with LHe displacer



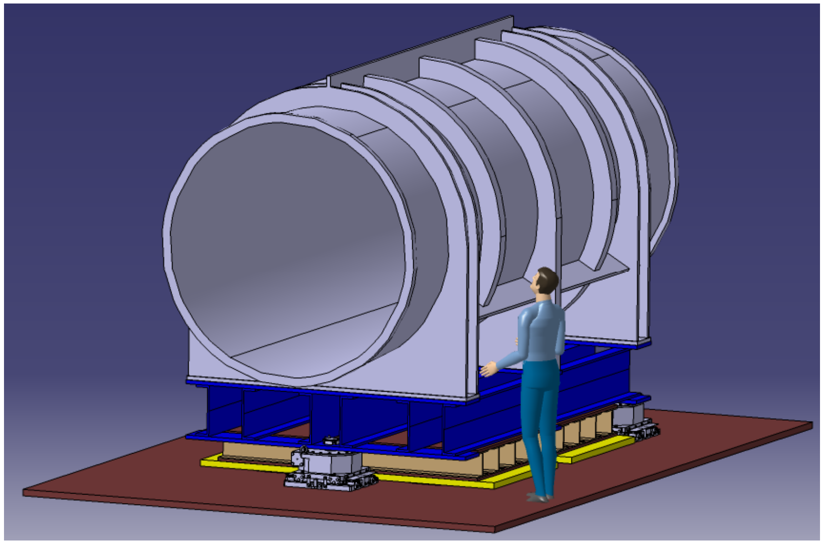
Concept of LHe cooling



Concept of shield cooling

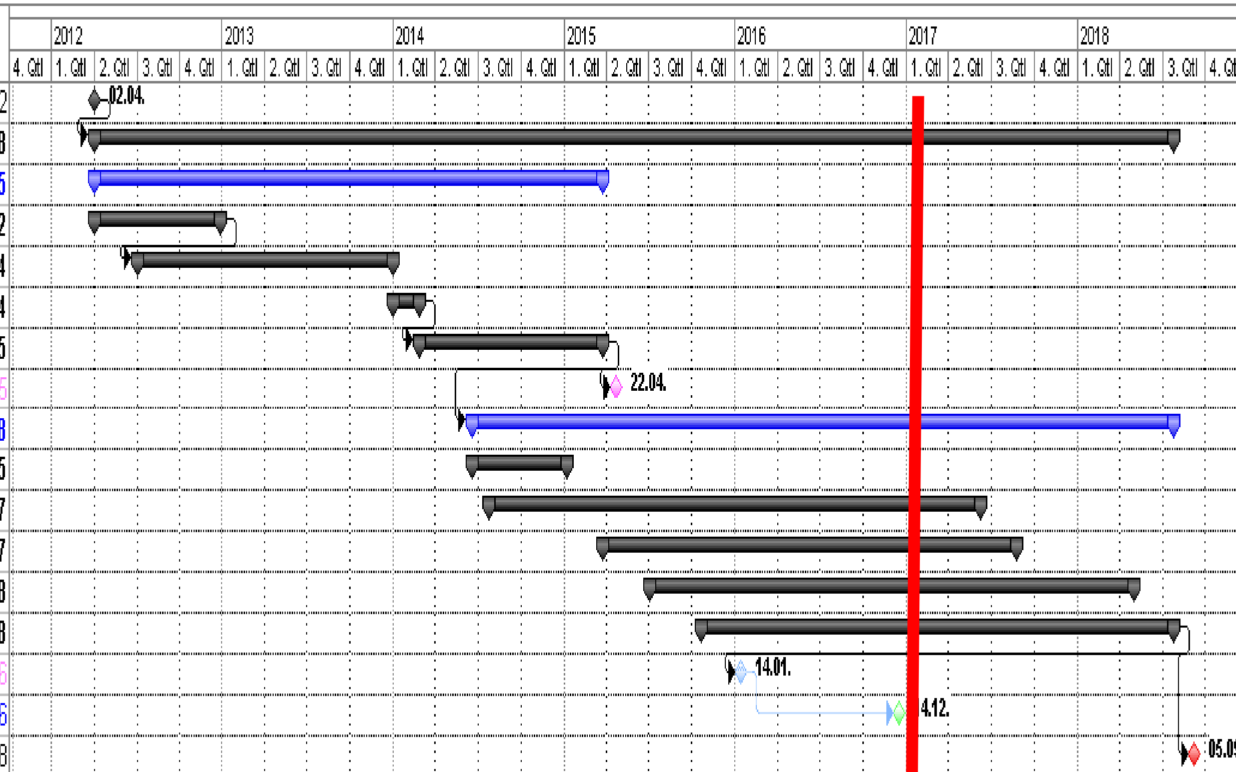


Concept of transport in tunnel



Timeline SC Multiplets

Nr.		Vorgangsname	Dauer	Anfang	Ende
1		Contracting	0 Tage	Mo 02.04.12	Mo 02.04.12
2		Multiplet	1648 Tage	Mo 02.04.12	Mi 25.07.18
3		1st Multiplet	778 Tage	Mo 02.04.12	Mi 25.03.15
4		Design 1st Multiplet	195 Tage	Mo 02.04.12	Fr 28.12.12
18		Production 1st Multiplet	393 Tage	Mo 02.07.12	Mi 01.01.14
56		Assembling multiplet	40 Tage	Do 02.01.14	Mi 26.02.14
58		Test 1st multiplet	280 Tage	Do 27.02.14	Mi 25.03.15
63		Delivery 1st multiplet	0 Tage	Mi 22.04.15	Mi 22.04.15
64		Series	1070 Tage	Do 19.06.14	Mi 25.07.18
65		Construktion (additional configurationen)	145 Tage	Do 19.06.14	Mi 07.01.15
68		Material procurement	750 Tage	Do 24.07.14	Mi 07.06.17
72		Production series	630 Tage	Do 26.03.15	Mi 23.08.17
90		Assembly Series	740 Tage	Do 02.07.15	Mi 02.05.18
94		Test eries	720 Tage	Do 22.10.15	Mi 25.07.18
96		Delivery 2nd Multiplet	0 Tage	Do 14.01.16	Do 14.01.16
97		Delivery 12th multiplet (Pre-Separator completed)	0 Tage	Mi 14.12.16	Mi 14.12.16
98		Delivery last multiplet	0 Tage	Mi 05.09.18	Mi 05.09.18



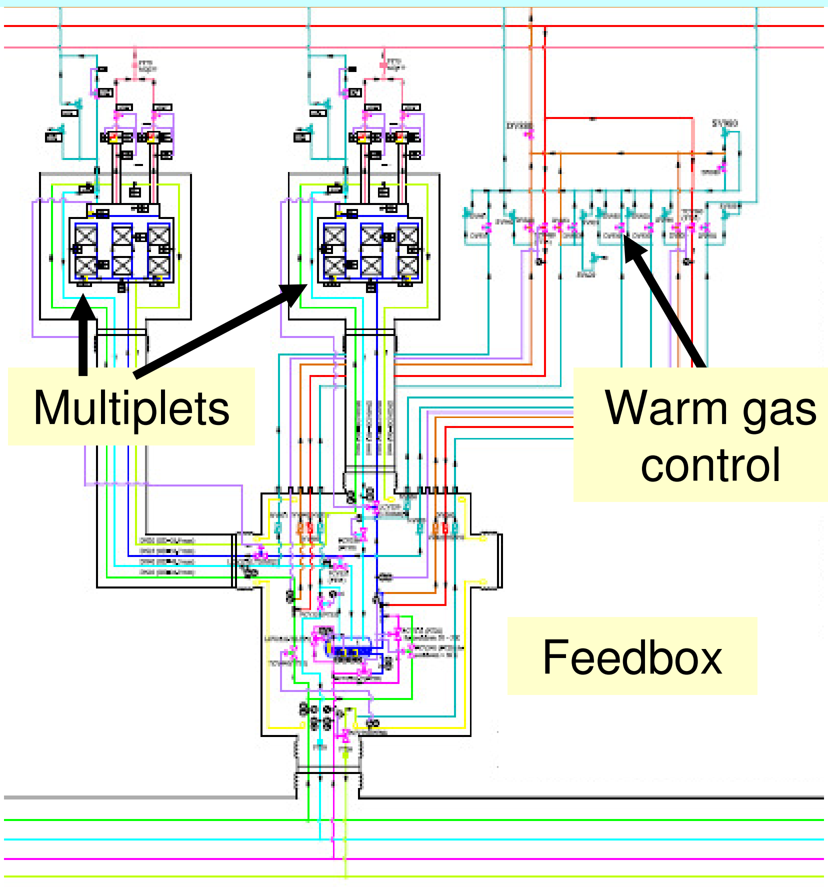
Series production:
we expect roughly 1 multiplet to be delivered per month

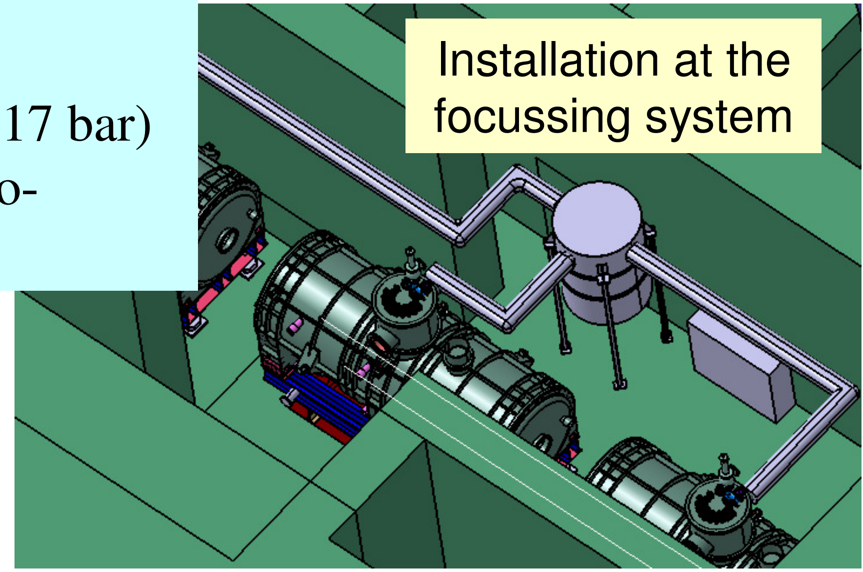
At that point all SC multipletts necessary for the Pre-Separator should be available on site

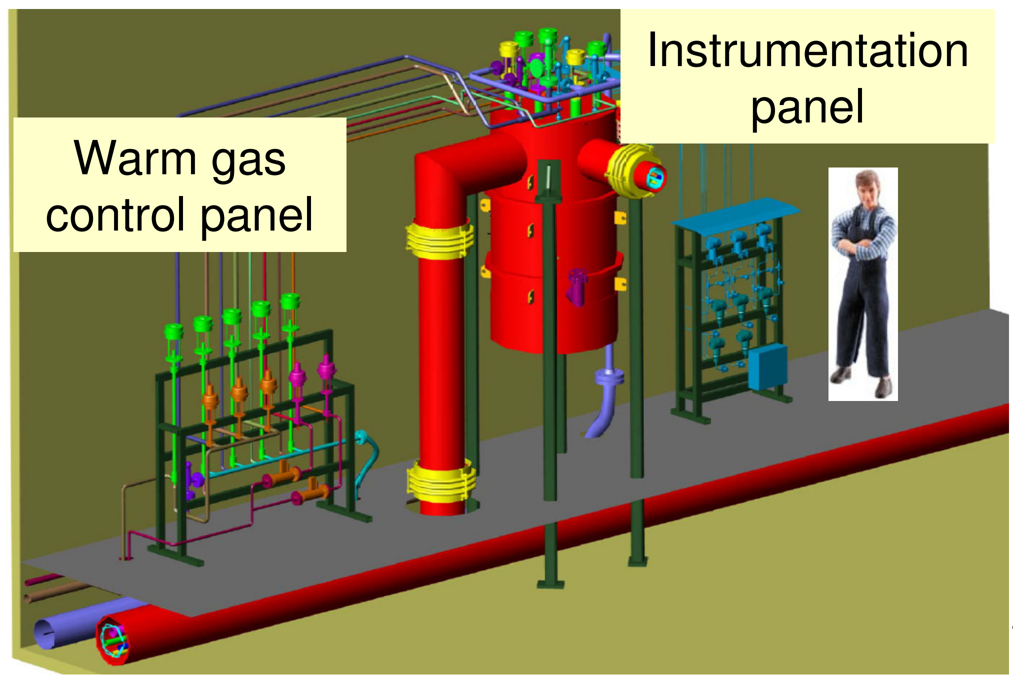
Y. Xiang
A. Breidert et al.

Local Cryogenics for Super-F

- Method: bath cooling
- Rather high LHe inventory (1.500 l/multiplet)
- Grouping of several cryostats using one feedbox
- Feedboxes provide: 1-5K LHe (3 bar), 4-50K He gas (17 bar)
- Poland will contribute as in-kind to feedboxes and cryo-transferline



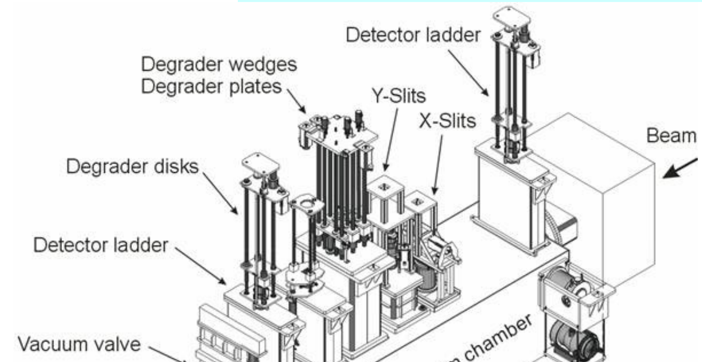


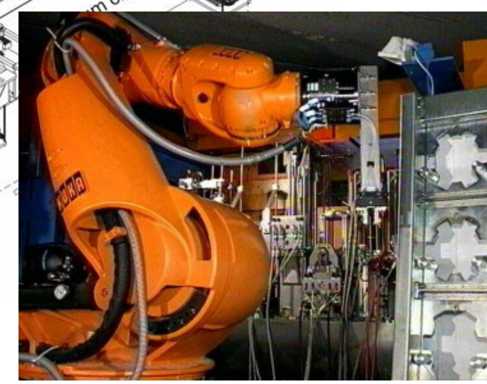


Vacuum System and Components

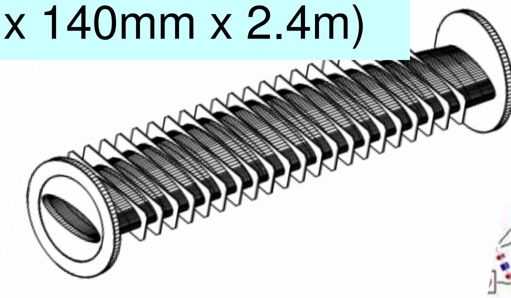
- Goal: vacuum in the 10^{-7} mbar range
- Large and very large size chambers (target, beam catcher, magnet chambers, focal plane chambers)
- Remote handling capability in the target area (e.g. pillow seals) and at the Pre-Separator (e.g. robotic)
- German in-kind for standard vacuum components

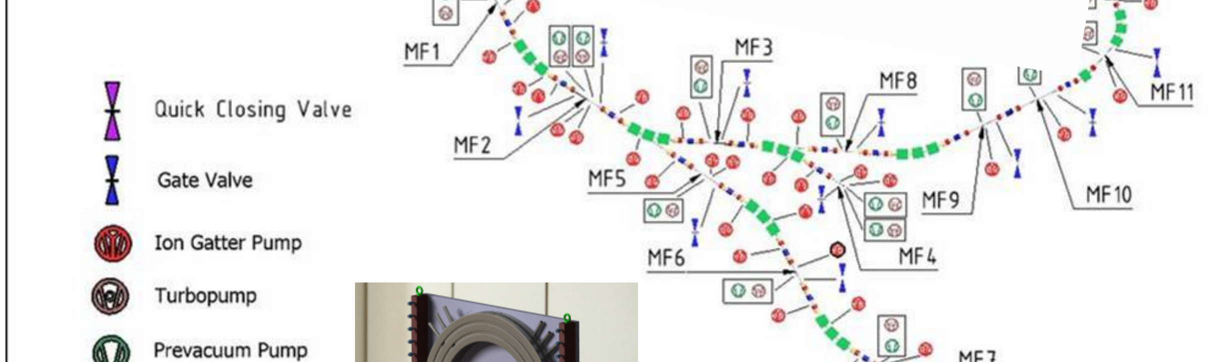
Remote handling capability at the Pre-Separator



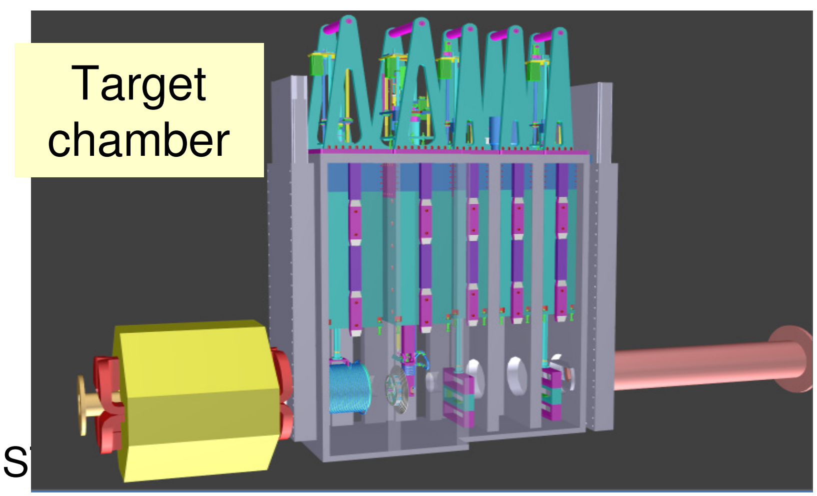


SC Dipole chambers (Size 400mm x 140mm x 2.4m)

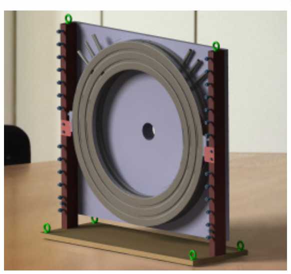




Target chamber



Pillow seals

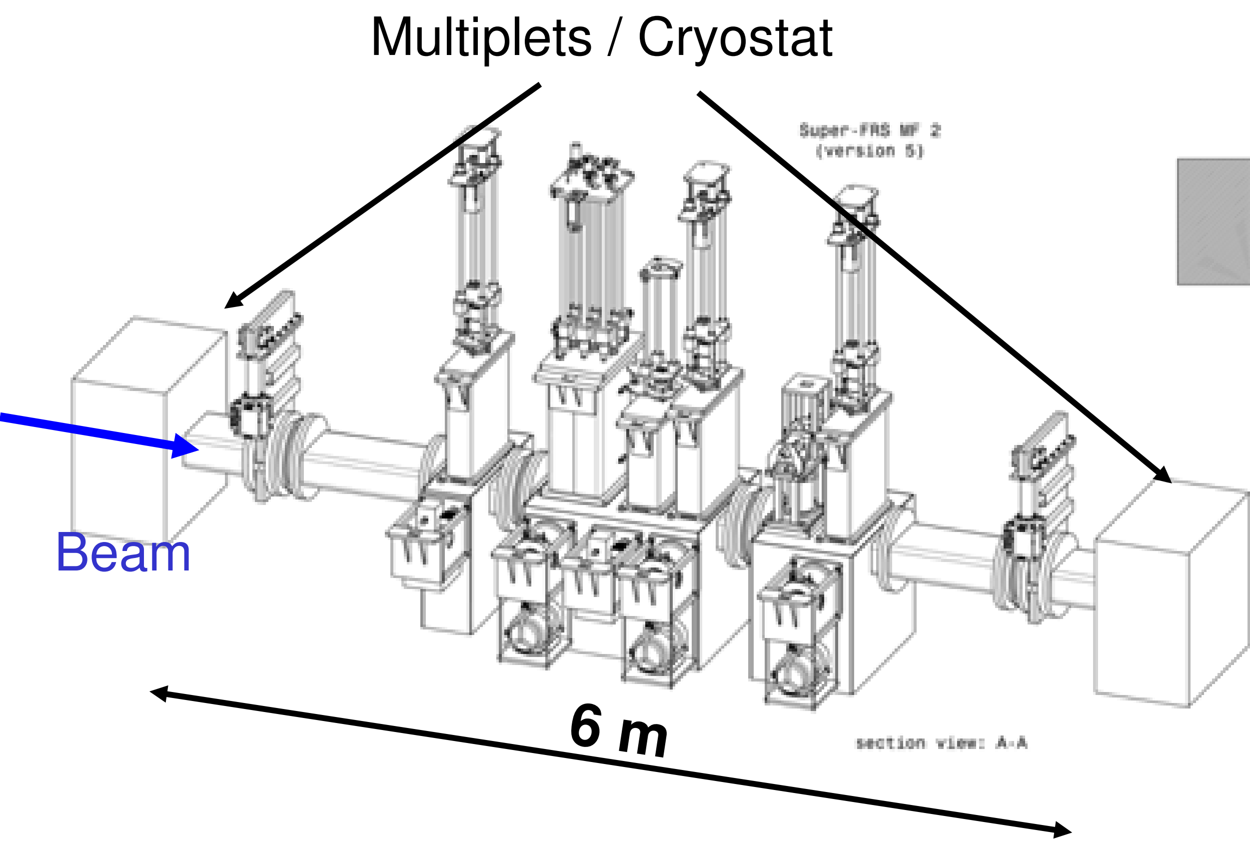


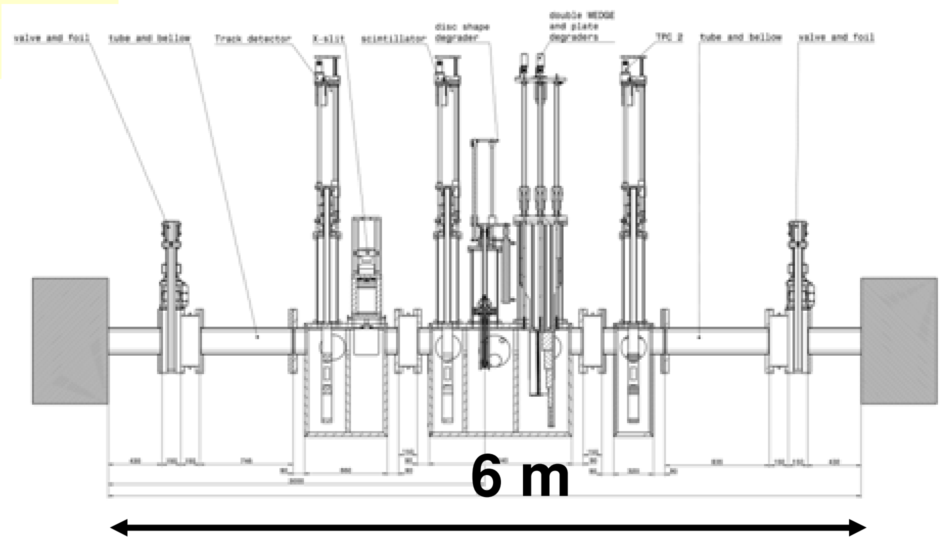
I. Mukha et al.

Focal Plane Chambers

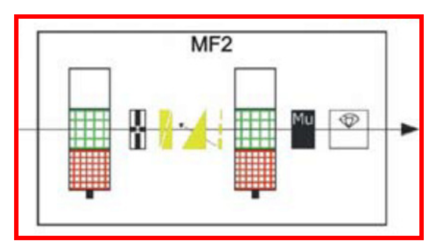
(example: mid-plane of the Main-Separator, FMF2)

- Sufficient space at focal planes foreseen
- Keep **Flexibility** to set-up different equipment
- Russia (BINP) indicated interest to apply for in-kind contribution for all Super-FRS focal plane chambers (including support frames)



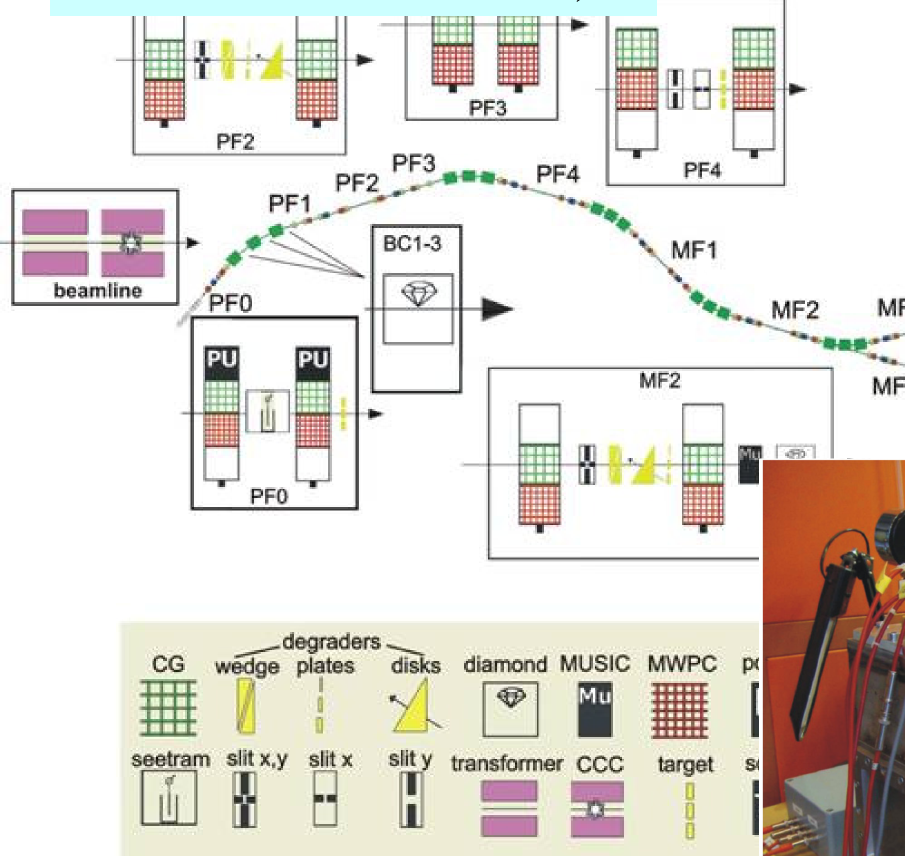


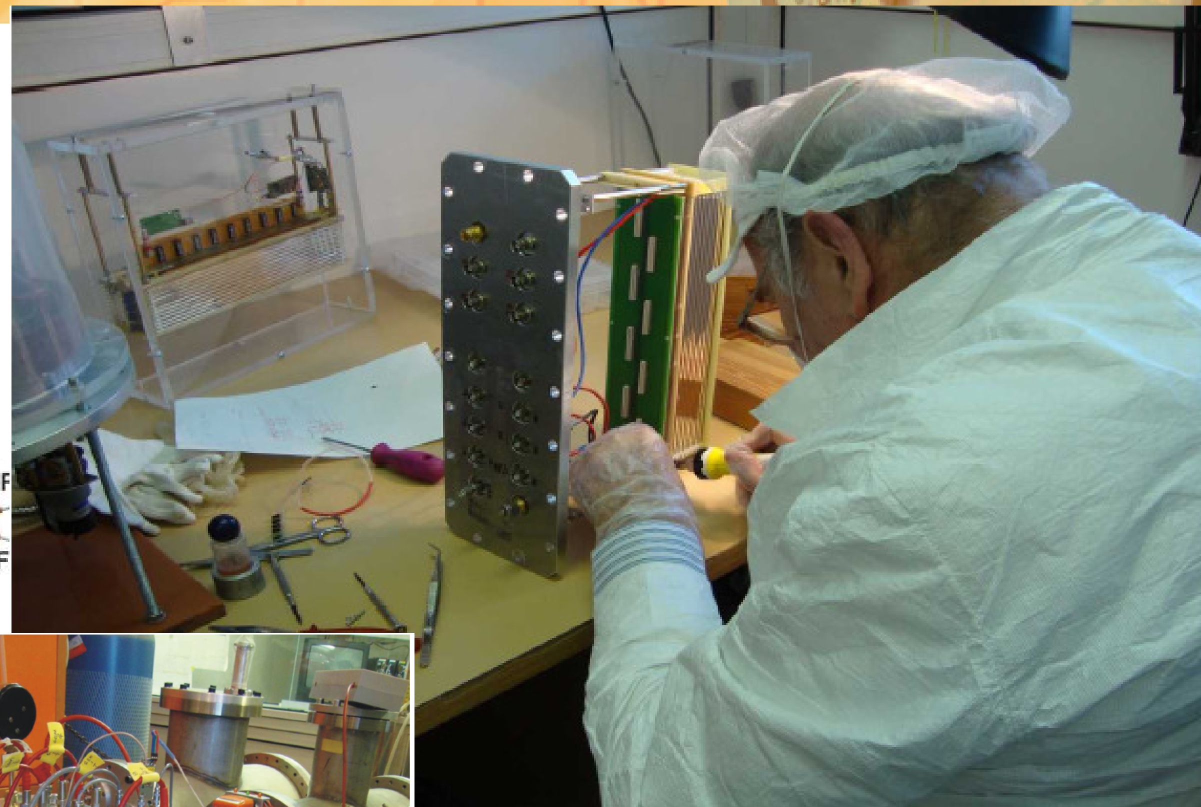
Equipment

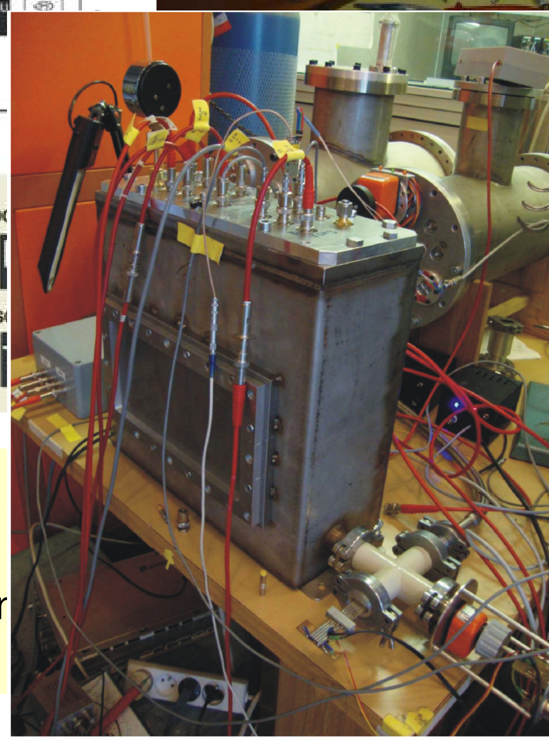


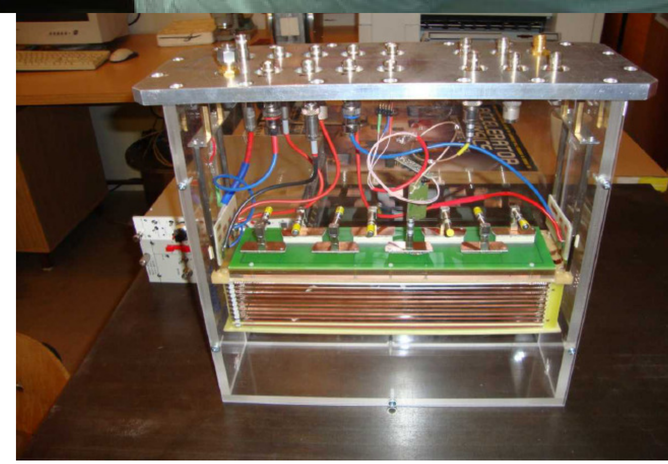
GEM TPC development

GEM TPC Prototype
(F. García et al., Helsinki /
B. Sitar et al., Bratislava)









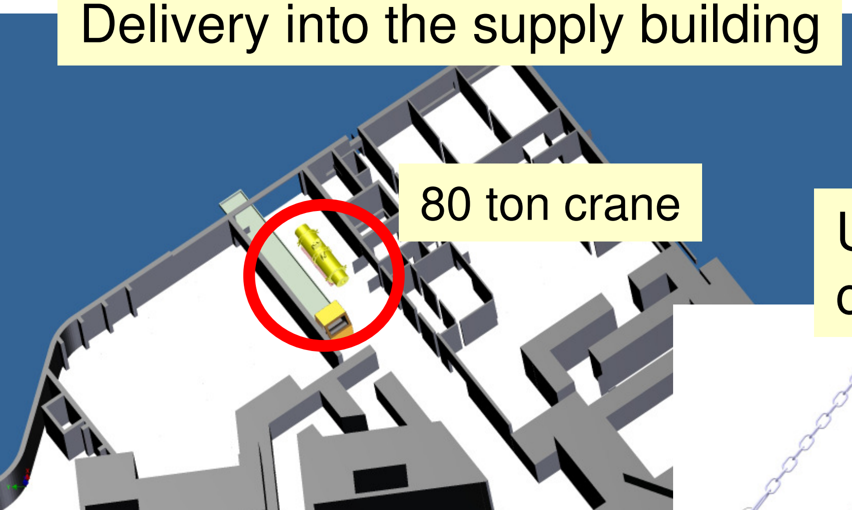
Full isotope identification
- x, y: position measurements→ Bρ
- x', y': corresponding angle measuremer
- ΔE and TOF for particle identification

Beam time at FRS000 in April/May

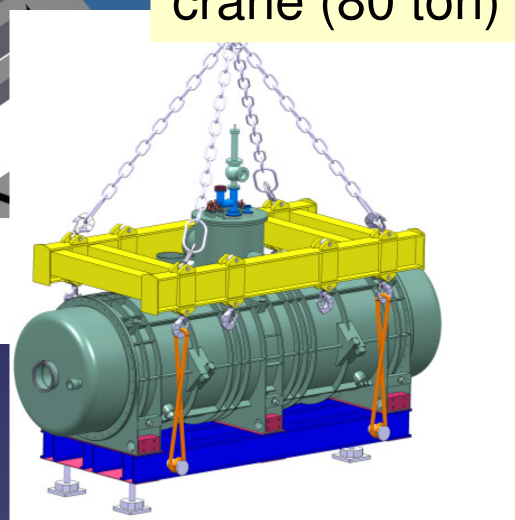
Rudo Janik

Transport Concept I (Tunnel)

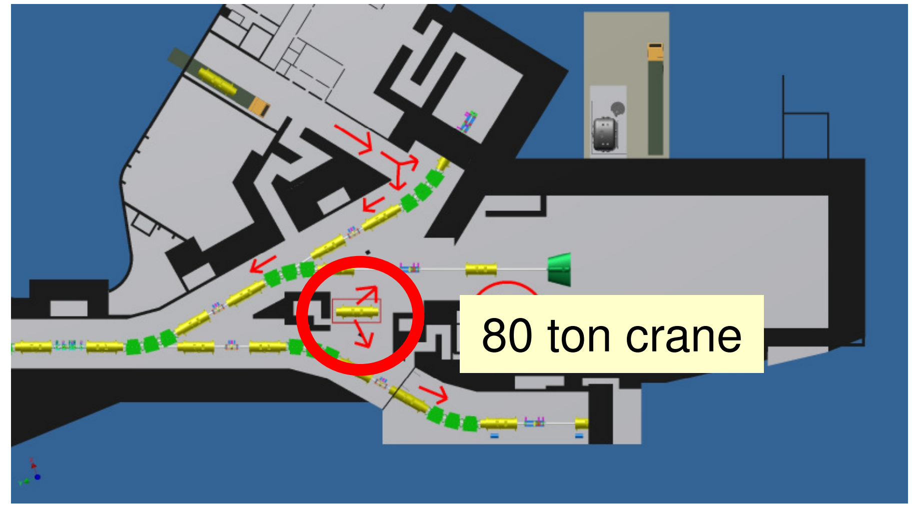
Delivery into the supply building



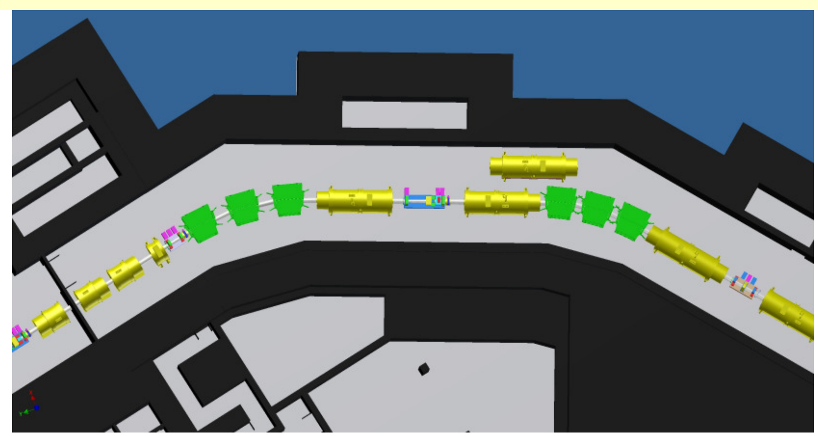
Uploading by crane (80 ton)

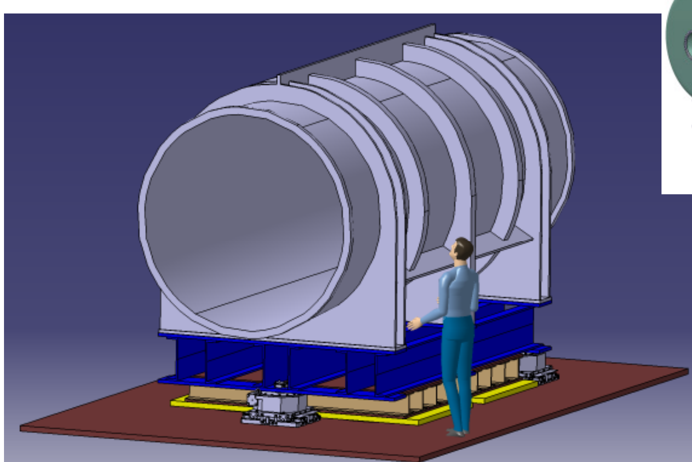


Component distribution



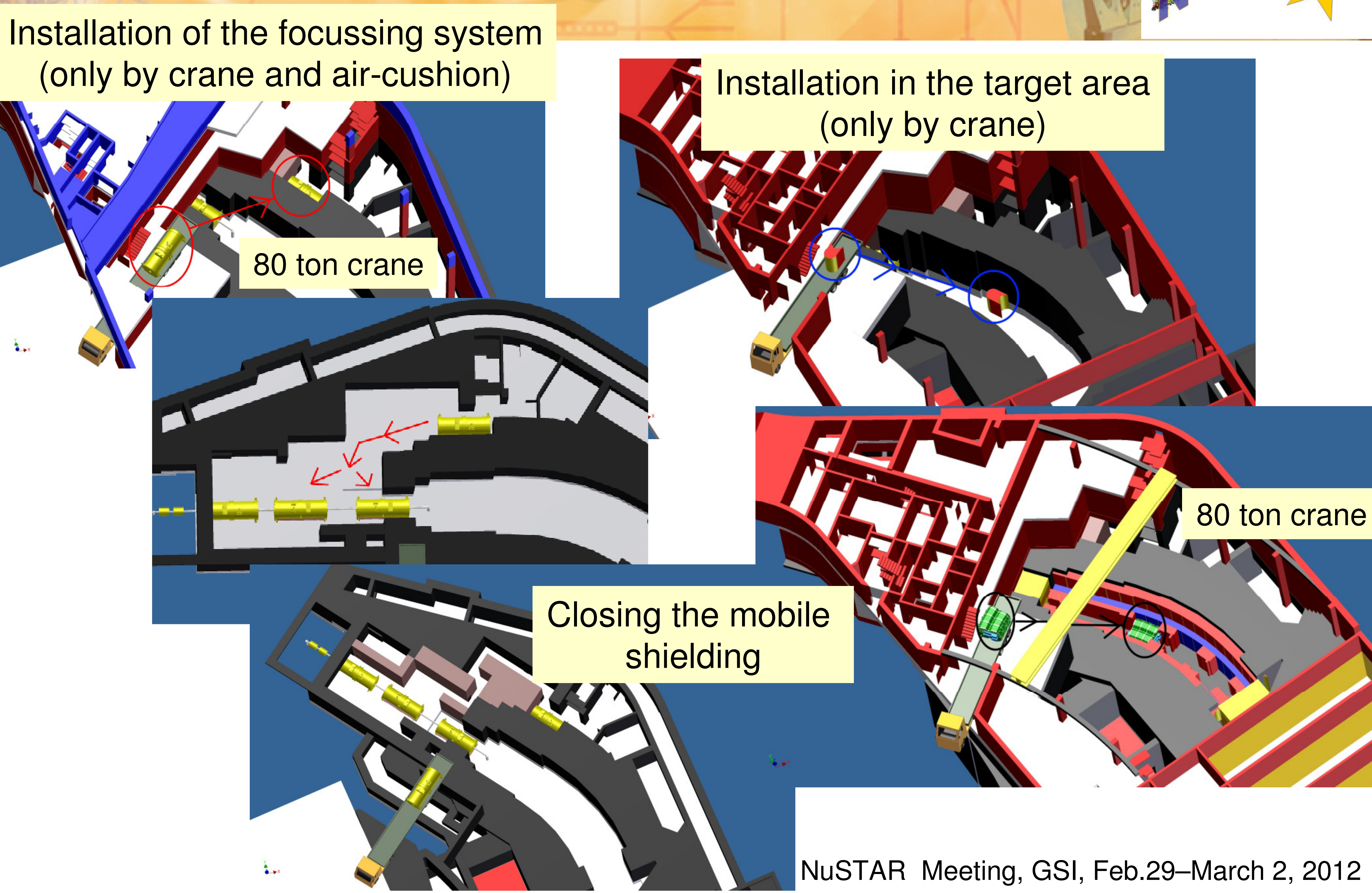
Transport on left side in the tunnel



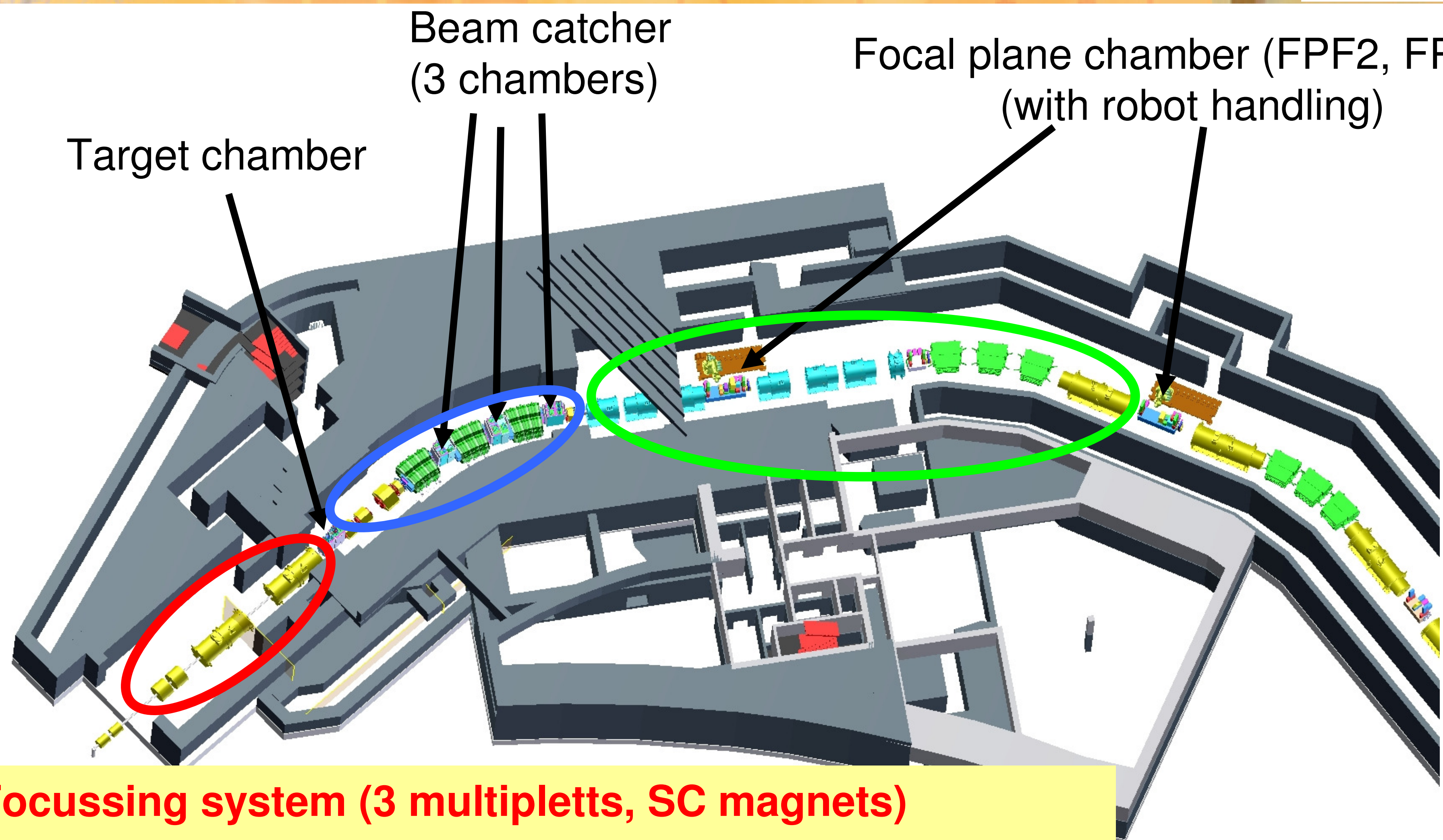


Air-cushion transport

Transport Concept II (Target Building

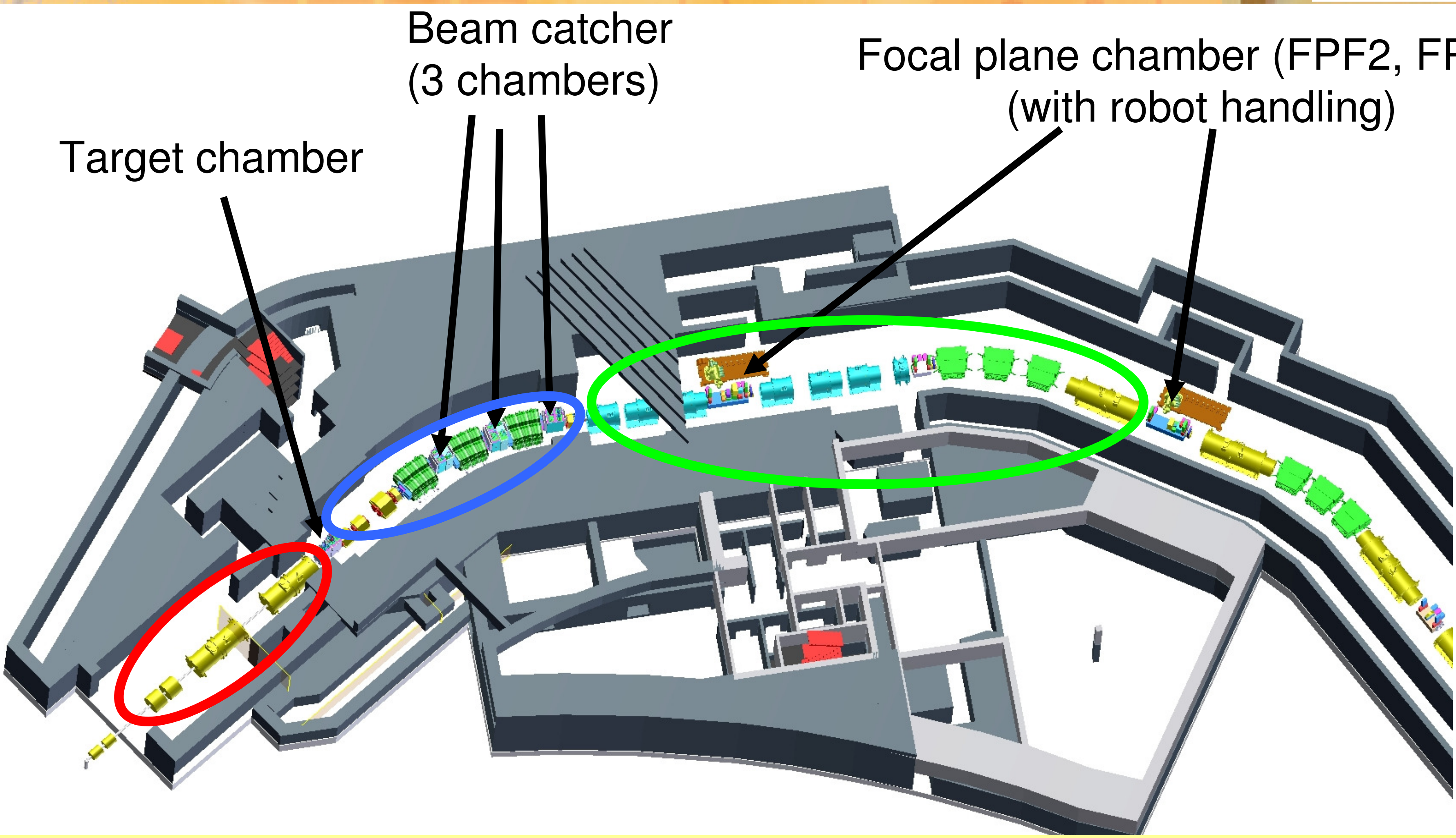


Installation of the Pre-Separator



1) Focussing system (3 multipletts, SC magnets)
2) Target chamber (1)
3) Radiation resistant magnets (NC magnets)
4) Beam catcher chamber (3)
5) Separator dipole magnets and multipletts (SC magnets)

Installation of the Pre-Separator

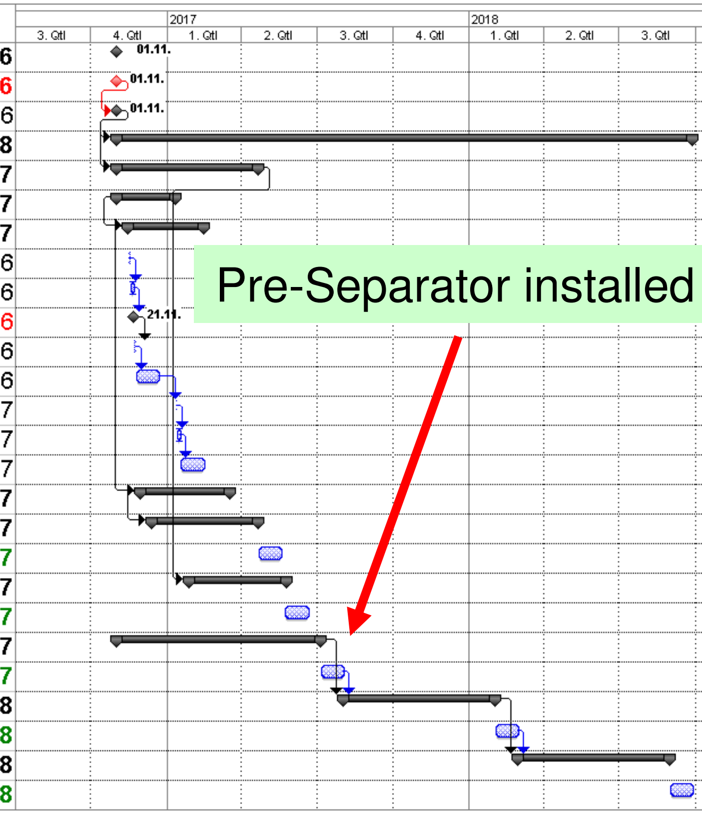


Almost all equipment is used at least once

Timeline Super-FRS Installation

(preliminary)

Nr.	PSP Code	Vorgangsname	Dauer	Anfang	Ende
8		FAIR Civil Construction	0 M	Di 01.11.16	Di 01.11.16
9		building ready for installation SFRS	0 M	Di 01.11.16	Di 01.11.16
10		Start of Super-FRS Installation	0 M	Di 01.11.16	Di 01.11.16
11	2.14.14.11	Installation Super-FRS	24,9 M	Di 01.11.16	Do 27.09.18
12	2.14.14.11.1a	Focussing system / Pre Separator	6,15 M	Di 01.11.16	Do 20.04.17
13		Cryo feedbox, diagnostic, vacuum chambers	2,55 M	Di 01.11.16	Di 10.01.17
22		SC multiplet (6m, 50t) no1	3,25 M	Di 15.11.16	Mo 13.02.17
23		delivery, unloading	2 t	Di 15.11.16	Mi 16.11.16
24		mechanical acceptance test (MAT)	3 t	Do 17.11.16	Mo 21.11.16
25		magnet testing (if necessary)	0 M	Mo 21.11.16	Mo 21.11.16
26		internal transport	2 t	Di 22.11.16	Mi 23.11.16
27		preparation for installation	20 t	Do 24.11.16	Mi 21.12.16
28		transport to SFRS building	2 t	Mi 11.01.17	Do 12.01.17
29		air cushion transport to installation location	2 t	Fr 13.01.17	Mo 16.01.17
30		installation and adjustment at SFRS	20 t	Di 17.01.17	Mo 13.02.17
31		SC multiplet (6m, 50t) no2	3,95 M	Di 29.11.16	Fr 17.03.17
40		SC multiplet (6m, 50t) no3	4,65 M	Di 13.12.16	Do 20.04.17
49		final installation work, connection to media	20 t	Fr 21.04.17	Do 18.05.17
50	2.14.14.11.1b	Targetchamber, quadrupoles, dipoles, beam catcher	4,2 M	Fr 27.01.17	Mi 24.05.17
155		final installation work, connection to media, testing	20 t	Di 23.05.17	Mo 19.06.17
156	2.14.14.11.1c	SC multiplets, FPFs, robotics, dipoles	8,8 M	Di 01.11.16	Di 04.07.17
319		final installation work, connection to media, testing	20 t	Mi 05.07.17	Di 01.08.17
320	2.14.14.11.2	Main-Separator (1st half)	6,55 M	Mi 02.08.17	Mi 31.01.18
465		final installation work, connection to media, testing	20 t	Do 01.02.18	Mi 28.02.18
466	2.14.14.11.3	Main-Separator (2nd half)	6,55 M	Do 01.03.18	Do 30.08.18
620		final installation work, connection to media, testing	20 t	Fr 31.08.18	Do 27.09.18



Summary

- Civil Construction is progressing fast
- First Super-FRS magnet assembled at GSI (Testinghalle)
- Preparation to procure SC magnets under way (time critical line)
- Installation and commissioning by sections from end 2016 on

Thank You !