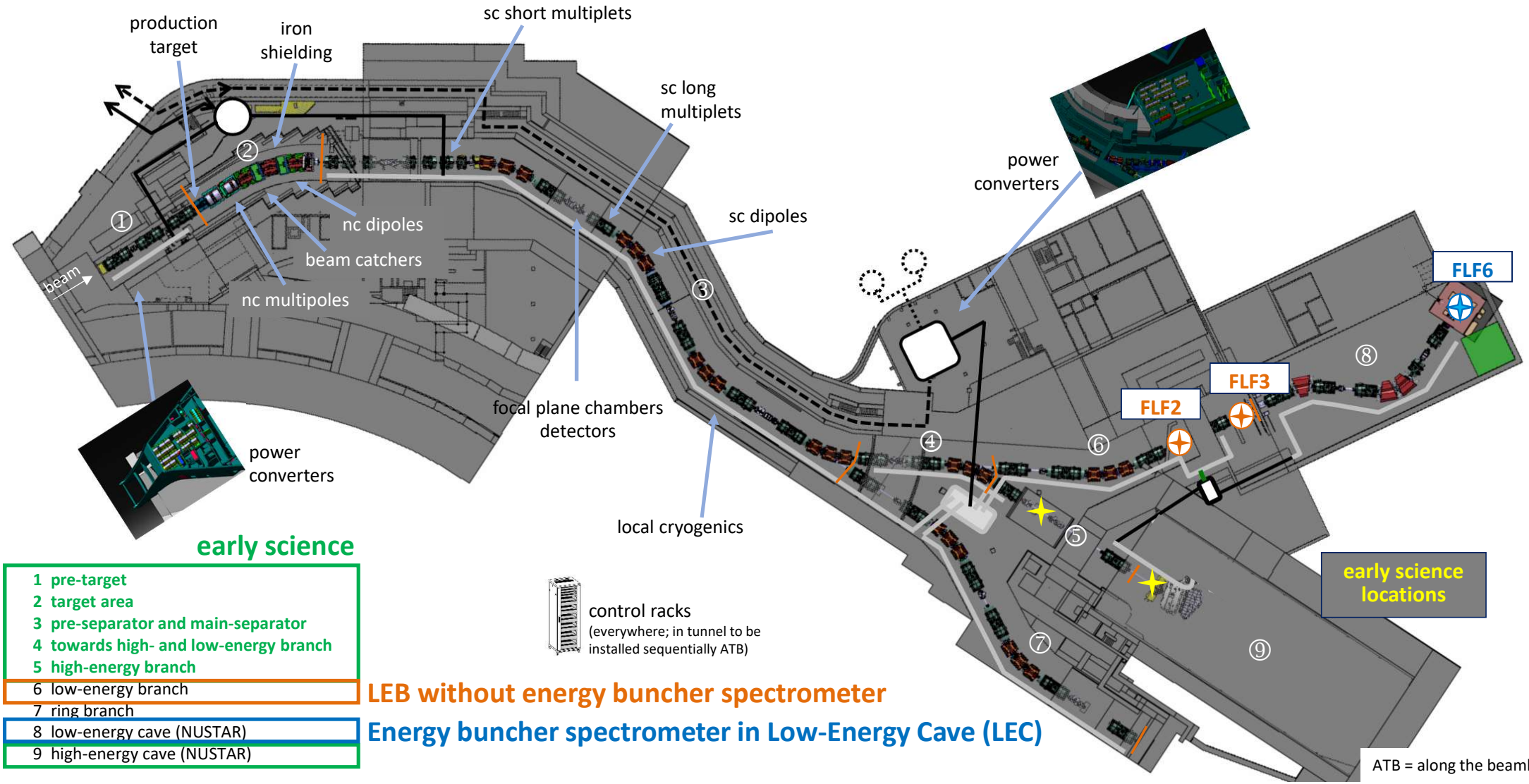
Super-FRS
Status & Opportunities

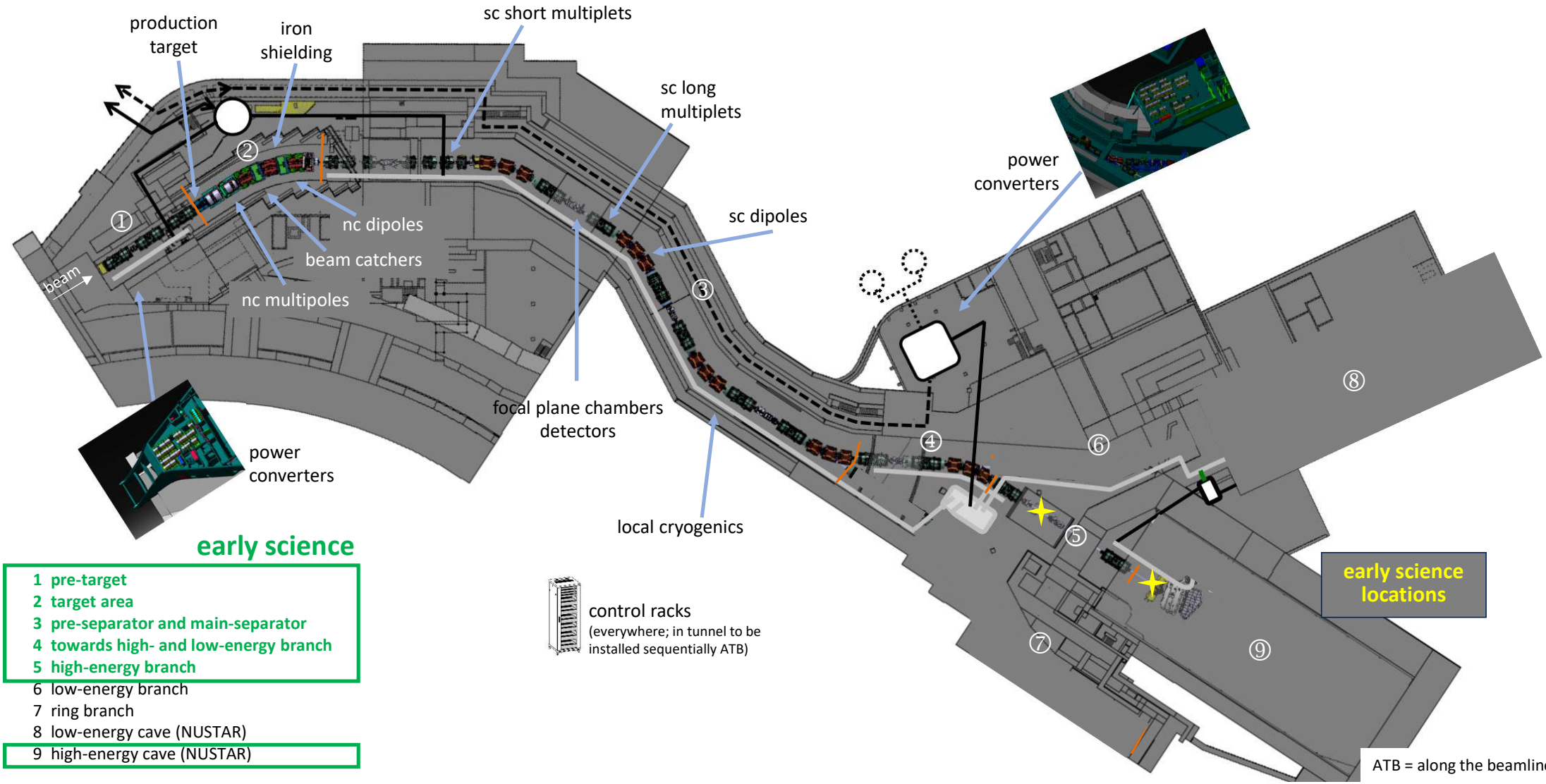
Haik Simon

Science Retreat, Bensheim, 2023-02-14/15

Original scope prior to Review Recommendation (MSV)



ES: Super-FRS main components



early science

1 pre-target
2 target area
3 pre-separator and main-separator
4 towards high- and low-energy branch
5 high-energy branch
6 low-energy branch
7 ring branch
8 low-energy cave (NUSTAR)
9 high-energy cave (NUSTAR)

Potential experimental places at the Super-FRS

Analysis: install and operate magnets for FLF2/3 instead of storage

- Power converter cost depends on availability of Indian INC
- Includes: vacuum items, special installation, infrastructure extra cost excludes: instrumentation (initially in air)
- Modified shielding wall position for FLF2/3 science location
- Freezing scenario will be presented to scrutiny group following up council decision in March

Possible science location prior to FS++
HI/DESPEC/SEC (J. Gerl)

13,600k€
CB8@2005

FLF6

Energy buncher spectrometer
in Low-Energy-Cave

FLF3

FLF2

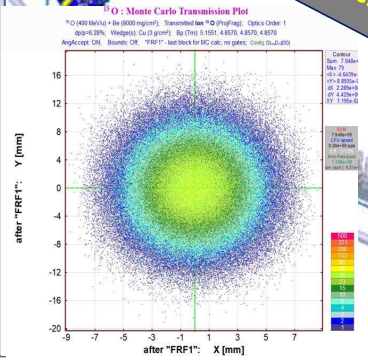
TGA ~ 10,000k€
max 10e7 pps

up to here
the LEB local-cryogenic branch (✸)
is necessary for early science

early science locations

max 10e8 pps

Possible science location for BIOMAT
Prior to FS++
(D. Severin/C Trautmann)
U (Au),^{16}O fragment,^{12}C fragment beam
180-600 AMeV
5e9 pps, few mm beam spot.
(Impact Analysis started,
2 (h) x 2 (w) x 4 (l) m^3 measurement area)
"modified beam dump"



Ring tunnel serves as storage are (avoid activation of materials)

✸ = committed and partially in production

FLF2/3@Super-FRS components procurement status

(3+1) sc multiplets

GSI in-kind
Provider: ASG superconductors, Italy
Material acquired or ordered, production running

3 sc dipoles

FAIR tender
Provider: Elytt Energy, Spain
Material acquired or ordered, production planned

Still open:

Power Converters
Indian in-kind
IKC not yet closed – Plan-B procurement

1 (up to FLF2) or 2 (up to FLF3) Diagnostic chambers
Ex Russian in-kind, now FAIR
Still to be tendered

Various vacuum components
Partly GSI, partly FAIR, partly ex Russian in-kind
Std. Vacuum partly tendered, mostly to be procured

2022

0 not started
1 planned
2 in process
3 ready

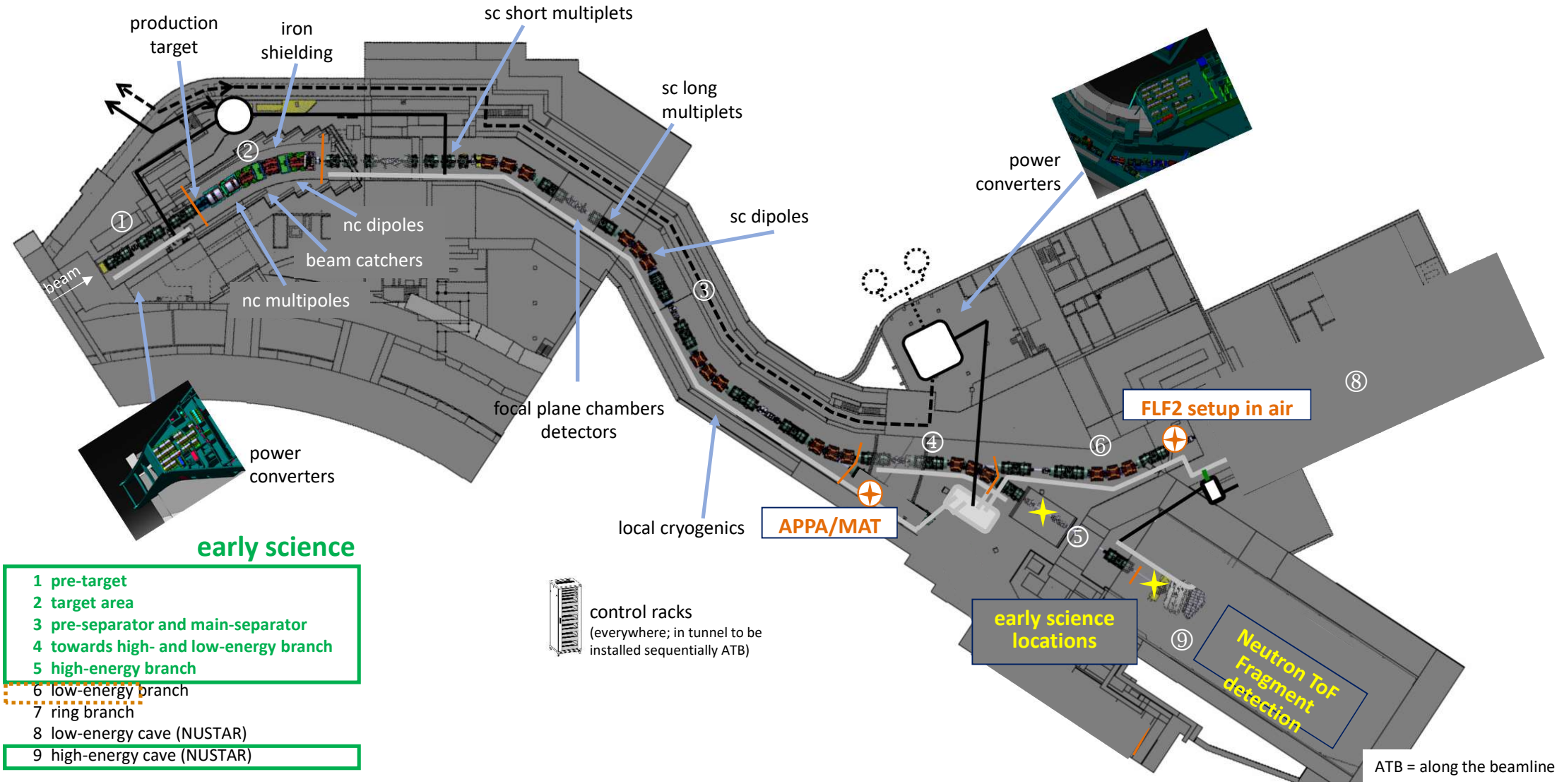
	Contracted Delivery d...	Forecast FAT date [actual date]	Drawings: Design: 3D Modell	2D	Procurement status: magnet steel	SC cable	He-vessel incl. inner pl...	thermal shield	vacuum vessel	beam pipe	current leads	Tie rod	AMI Level seonsors	T-sensors/Heaters	MLI	Support Rings	Retainer	Safety devices	Insrumentation /Quench bo...	alignment feet	Support frame	Productions Status: Production: Laminations	yokes	coils	magnets	cold mass	Thermal shield	multiplet
FLF1YMQ11		23/05/2024	3	3	2	3	2	1	2	3	1	2	2	2	2	2	3	2	3	2	1	3	1	1	1	1	1	1
FLF2YMQ11		20/10/2024	3	3	2	2	2	1	2	3	1	2	2	2	2	2	2	2	3	2	1	3	1	1	1	1	1	1
FLF2YMQ21		29/06/2023	3	3	3	3	3	1	3	3	1	3	3	3	2	2	3	2	3	2	1	3	3	3	3	2	1	1
FLF3YMQ11		12/12/2024	3	3	2	2	2	1	2	3	1	2	2	2	2	2	2	2	3	2	1	3	1	1	1	1	1	1

2022

0 not started
1 planned
2 in process
3 ready

Designation/ Benennung	...very dat...	FAT date [actual d...	Drawings: Design: 3D Modell	2D	Procurement status: magnet steel	SC cable	Cryostat	thermal shield	current leads	CW Support	AMI Level sensors	T-sensors/ Heaters	MLI	Safety Devices	Insrumentation/ Quench box	Power cable box	alignment feet	Stand	Productions Status: Production: Laminations	yokes	coils	cold mass	Thermal shield	Vacuum Vessel	magnets
FLF2MH1		16/06/2025	3	3	1	3	1	1	3	1	3	3	3	3	3	3	3	3	1	1	1	1	1	1	1
FLF2MH12		26/02/2025	3	3	1	3	1	1	1	1	3	3	3	3	3	3	3	3	1	1	1	1	1	1	1
FLF2MH13		20/10/2025	3	3	1	3	1	1	1	1	3	3	3	3	3	3	3	3	1	1	1	1	1	1	1

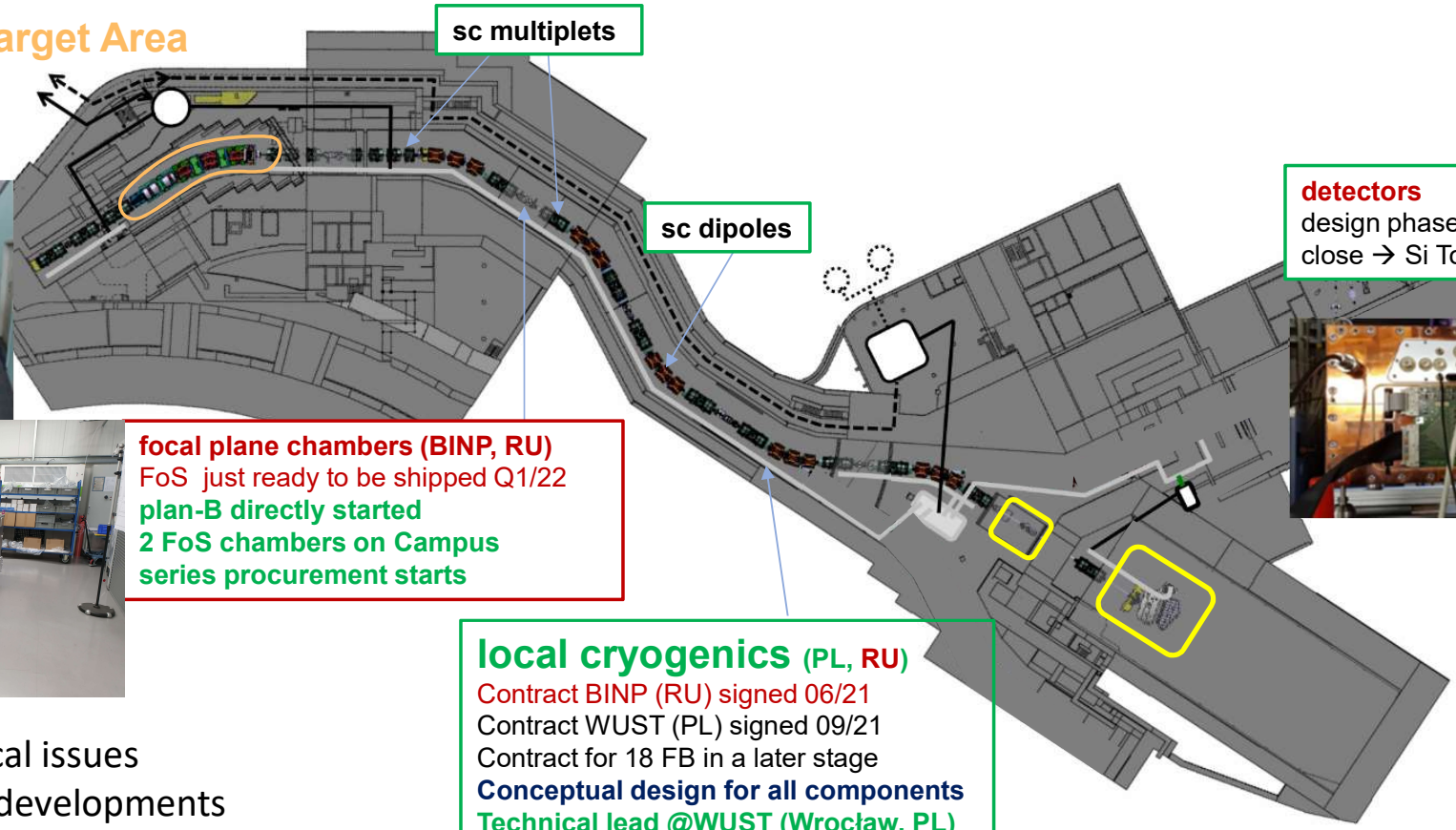
ES: Proposed partial unfreeze

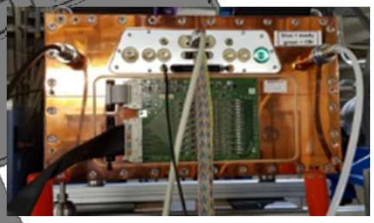


early science

1 pre-target
2 target area
3 pre-separator and main-separator
4 towards high- and low-energy branch
5 high-energy branch
6 low-energy branch
7 ring branch
8 low-energy cave (NUSTAR)
9 high-energy cave (NUSTAR)

Status & Challenges: Russian in-kind: replacement strategy necessary





focal plane chambers (BINP, RU)
FoS just ready to be shipped Q1/22
plan-B directly started
2 FoS chambers on Campus
series procurement starts

detectors
design phase about to close → Si ToF alternative

local cryogenics (PL, RU)
Contract BINP (RU) signed 06/21
Contract WUST (PL) signed 09/21
Contract for 18 FB in a later stage
Conceptual design for all components
Technical lead @WUST (Wrocław, PL)
Reprocurement of Branch Box running

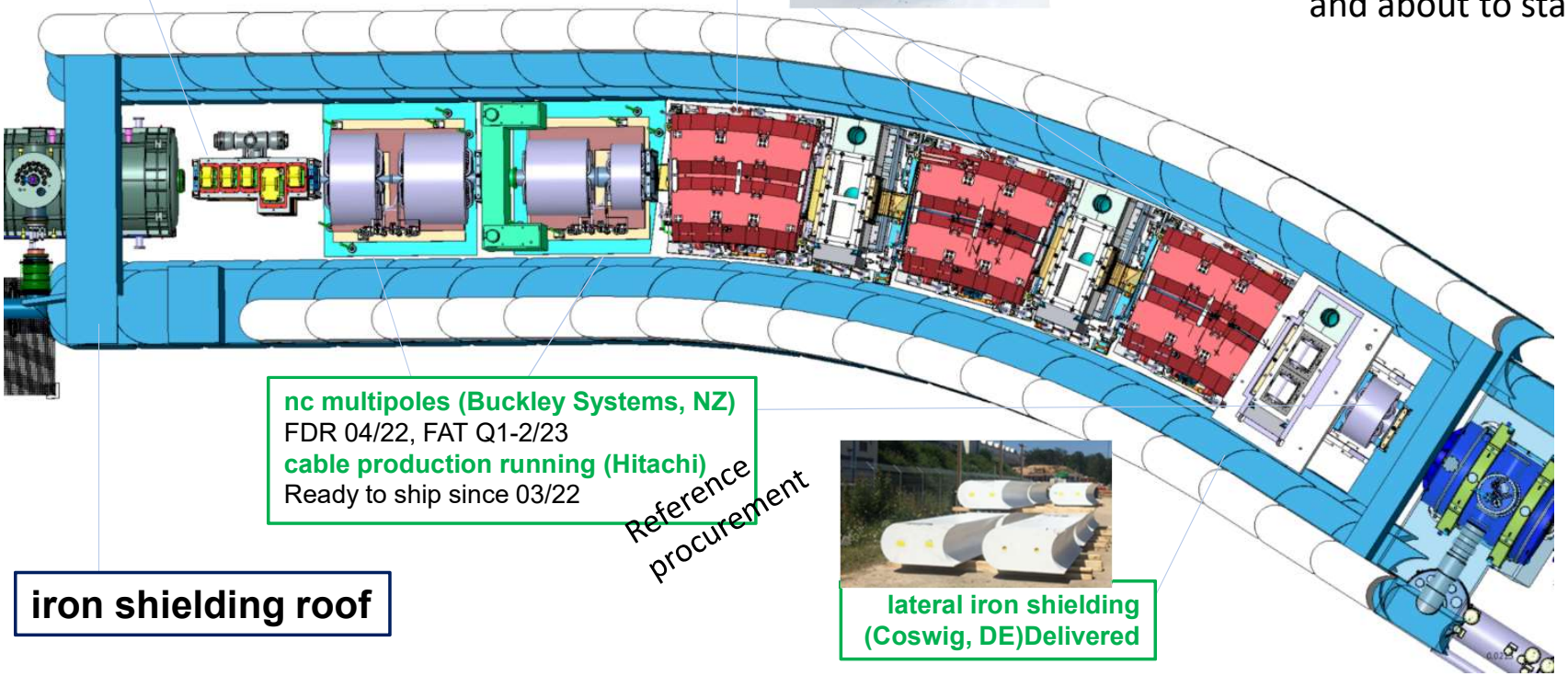
- No technical issues
- No critical developments
- Reprocurements prepared

Status & Challenges: Russian in-kind: replacement strategy necessary

Target Area

Target chamber

nc dipoles (2 of 3 BINP)
FoK dipole on campus 1/3
FDR yoke ready
cable delivered on site
Tender starts asap 02/23



nc multipoles (Buckley Systems, NZ)
FDR 04/22, FAT Q1-2/23
cable production running (Hitachi)
Ready to ship since 03/22

Reference procurement

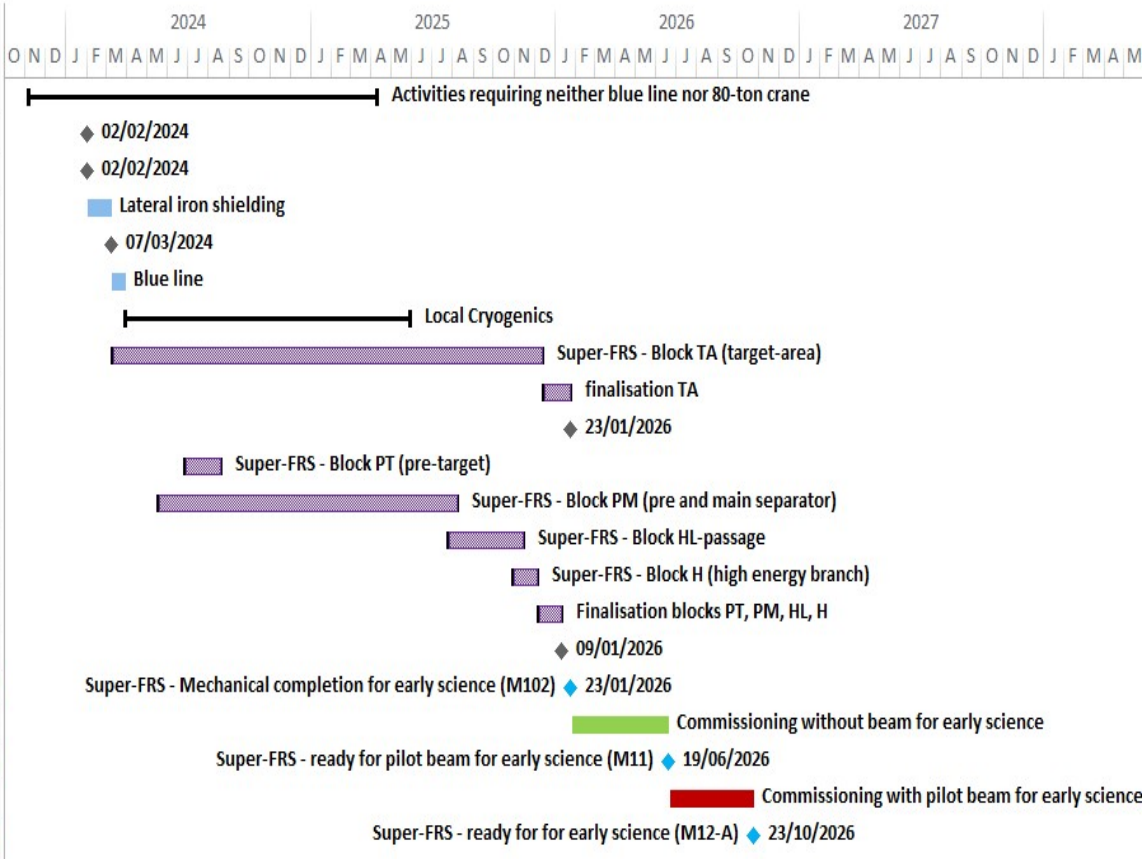
lateral iron shielding (Coswig, DE)Delivered

iron shielding roof

- No technical issues
- No critical developments
- Reprocurements prepared and about to start.

Super-FRS actual installation schedule: overview

Task Name	Duration	Start	Finish
Activities requiring neither blue line nor 80-ton crane	**74.4 wks**	**07/11/2023**	**10/04/2025**
80-ton crane in G018 ready	0 wks	02/02/2024	02/02/2024
Preliminary "red line" for lateral-iron-shielding ready	0 wks	02/02/2024	02/02/2024
Lateral iron shielding	5 wks	02/02/2024	07/03/2024
Floar coating in G018/E10 (tunnel) ready	0 wks	07/03/2024	07/03/2024
Blue line	3 wks	08/03/2024	28/03/2024
Local Cryogenics	**61 wks**	**28/03/2024**	**29/05/2025**
Super-FRS - Block TA (target-area)	**92 wks**	**11/03/2024**	**12/12/2025**
finalisation TA	**6 wks**	**15/12/2025**	**23/01/2026**
Block TA (target area) installation completed	0 wks	23/01/2026	23/01/2026
Super-FRS - Block PT (pre-target)	**7.4 wks**	**27/06/2024**	**19/08/2024**
Super-FRS - Block PM (pre and main separator)	**63.8 wks**	**17/05/2024**	**07/08/2025**
Super-FRS - Block HL-passage	**16 wks**	**24/07/2025**	**13/11/2025**
Super-FRS - Block H (high energy branch)	**5.2 wks**	**30/10/2025**	**05/12/2025**
Finalisation blocks PT, PM, HL, H	**5 wks**	**08/12/2025**	**09/01/2026**
Blocks PT, PM, HL, H installation completed	0 wks	09/01/2026	09/01/2026
Super-FRS - Mechanical completion for early science (M102)	0 wks	23/01/2026	23/01/2026
Commissioning without beam for early science	21 wks	26/01/2026	19/06/2026
Super-FRS - ready for pilot beam for early science (M11)	0 wks	19/06/2026	19/06/2026
Commissioning with pilot beam for early science	18 wks	22/06/2026	23/10/2026
Super-FRS - ready for for early science (M12-A)	0 wks	23/10/2026	23/10/2026



Installation of magnets FLF2/3 takes about 3 months (⑥, shutdown work)

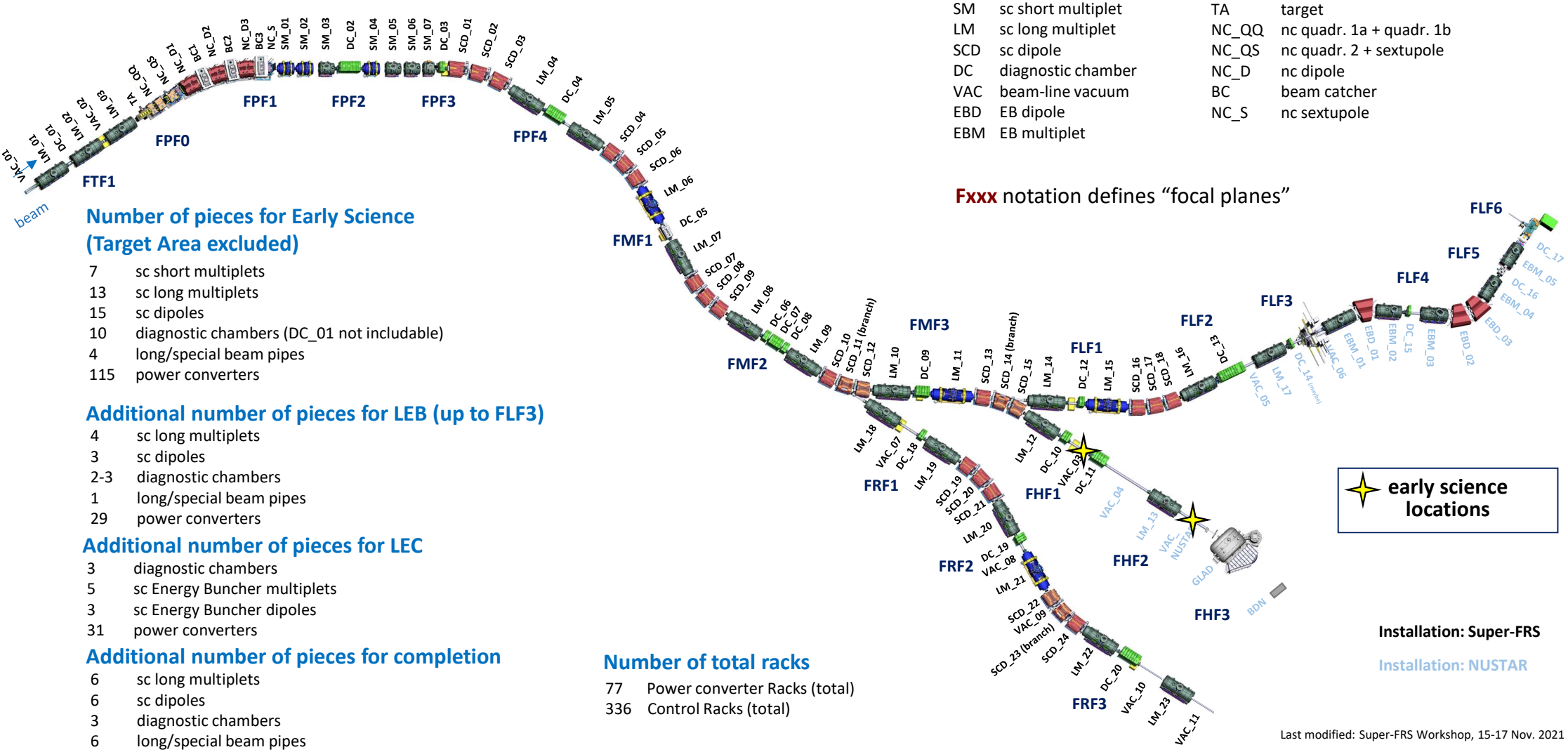
Thank you

Assembly Units along the beam line

Assembly Units' names

SM	sc short multiplet	TA	target
LM	sc long multiplet	NC_QQ	nc quadr. 1a + quadr. 1b
SCD	sc dipole	NC_QS	nc quadr. 2 + sextupole
DC	diagnostic chamber	NC_D	nc dipole
VAC	beam-line vacuum	BC	beam catcher
EBD	EB dipole	NC_S	nc sextupole
EBM	EB multiplet		

Fxxx notation defines "focal planes"



Number of pieces for Early Science (Target Area excluded)

7	sc short multiplets
13	sc long multiplets
15	sc dipoles
10	diagnostic chambers (DC_01 not includable)
4	long/special beam pipes
115	power converters

Additional number of pieces for LEB (up to FLF3)

4	sc long multiplets
3	sc dipoles
2-3	diagnostic chambers
1	long/special beam pipes
29	power converters

Additional number of pieces for LEC

3	diagnostic chambers
5	sc Energy Buncher multiplets
3	sc Energy Buncher dipoles
31	power converters

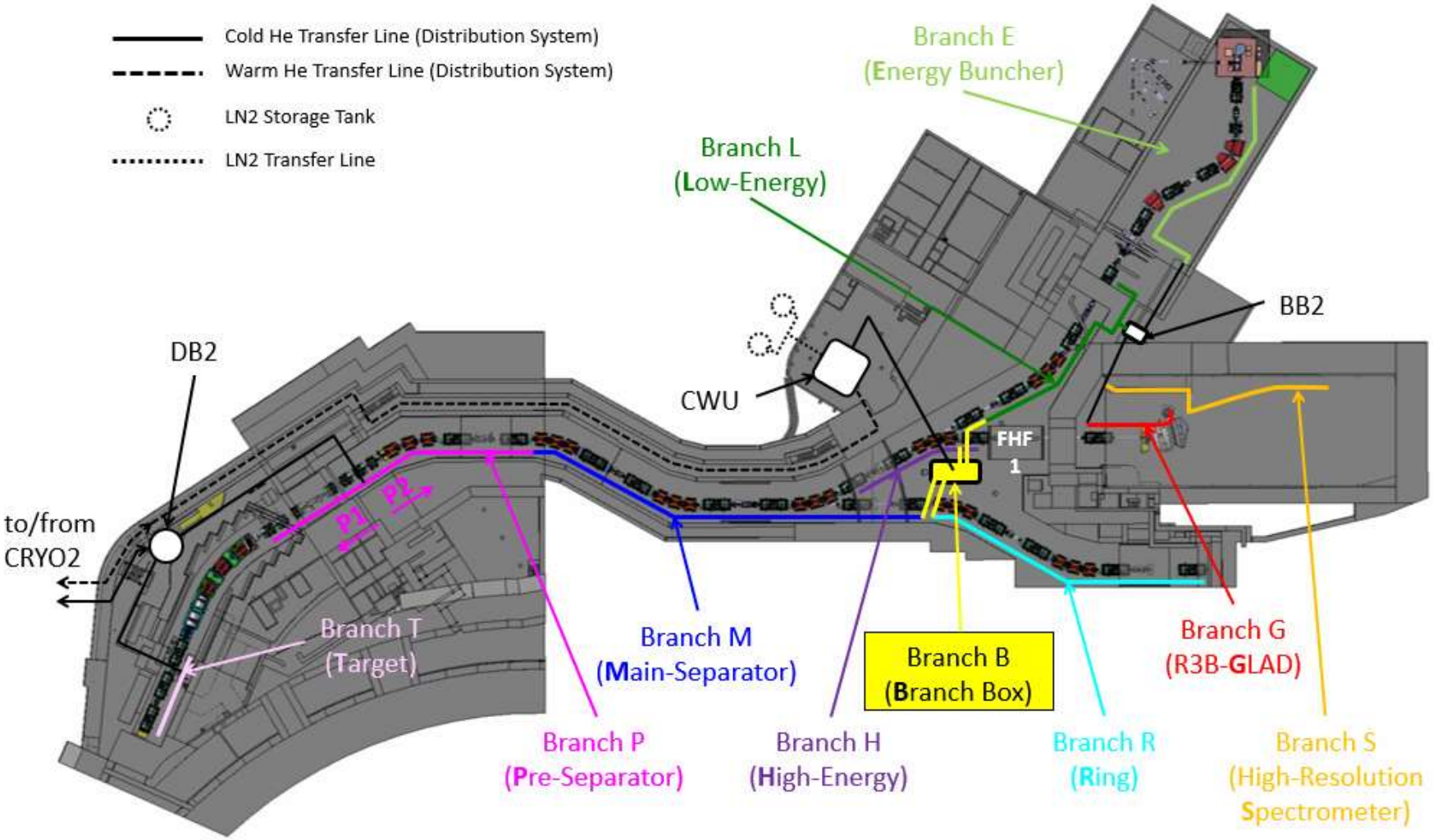
Additional number of pieces for completion

6	sc long multiplets
6	sc dipoles
3	diagnostic chambers
6	long/special beam pipes
46	power converters

Number of total racks

77	Power converter Racks (total)
336	Control Racks (total)

Last modified: Super-FRS Workshop, 15-17 Nov. 2021


Cold He Transfer Line (Distribution System)
Warm He Transfer Line (Distribution System)
LN2 Storage Tank
LN2 Transfer Line
Branch E
(Energy Buncher)
Branch L
(Low-Energy)
BB2
DB2
CWU
FHF
1
to/from
CRYO2
P1
P2
Branch T
(Target)
Branch M
(Main-Separator)
Branch B
(Branch Box)
Branch G
(R3B-GLAD)
Branch P
(Pre-Separator)
Branch H
(High-Energy)
Branch R
(Ring)
Branch S
(High-Resolution
Spectrometer)