



Status of harmonised schedule

Kei Sugita

Work-package leader (Interim)

on behalf of collaboration: **Super-FRS magnet testing at CERN**

CERN-GSI Collaboration Steering Board Meeting - 26 Feb 2024

Outline

- Work Package
- Super-FRS magnet overview
- Testing status
- Project schedule
- Summary

Work packages



Dipole magnet production

WPL: Hans Müller

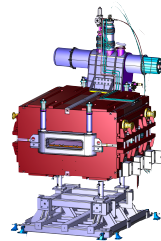
Technical follow-up by CEA



Production & Factory acceptance test (FAT)

FAT acceptance

Transport permission to CERN



Magnet testing at CERN

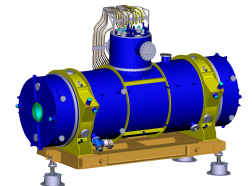
WPL: Kei Sugita (interim)

Collaboration with CERN



five colleagues from GSI (two to be refilled soon.)

Site Acceptance Test (SAT)



SAT acceptance

Transport permission to GSI

SAT acceptance

Transport permission to GSI

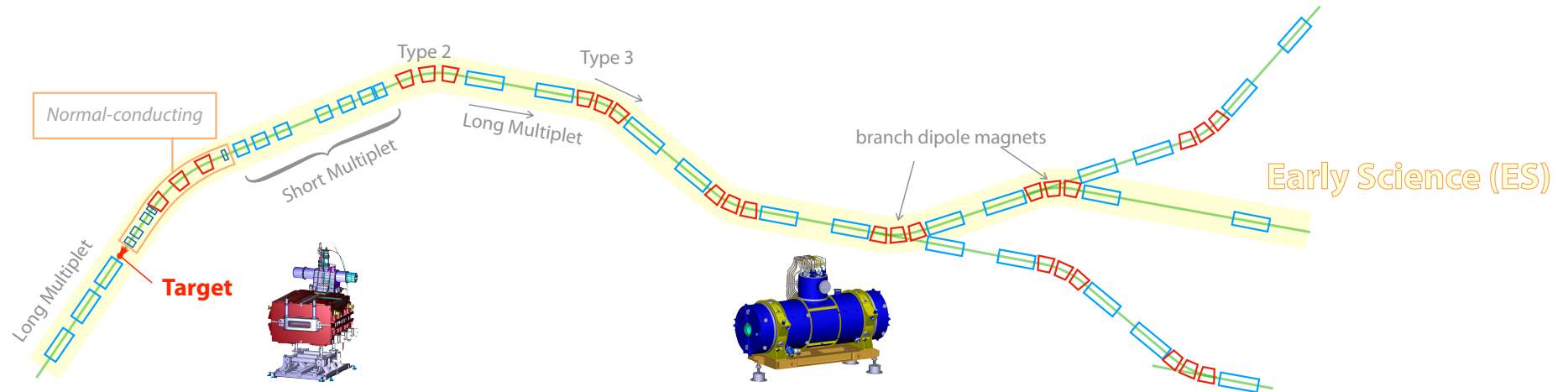
Pre-assembly

responsible: Vasileios Velonas

incoming inspections

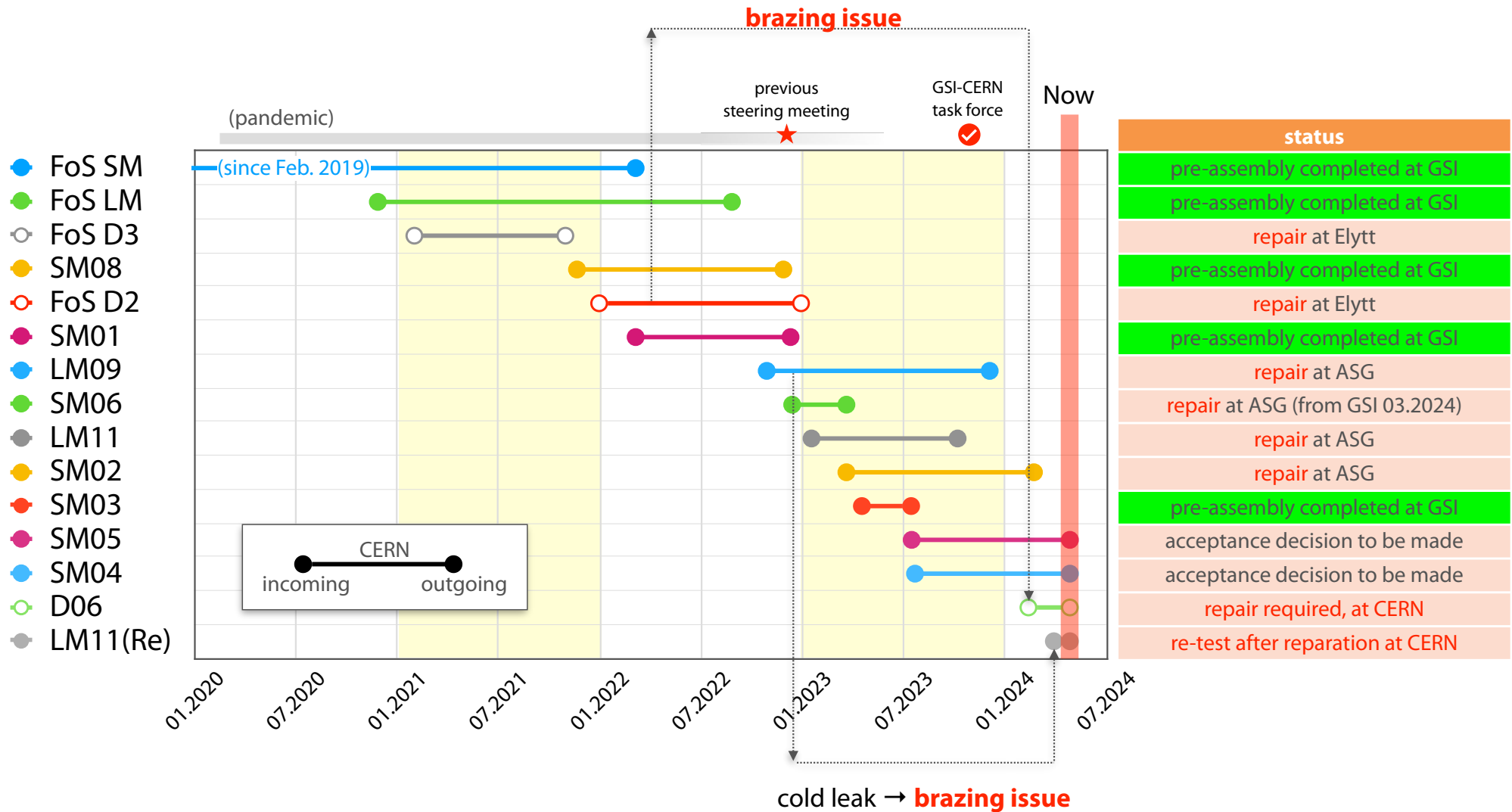
preparation and interface setup for installation, storage

S-FRS magnets overview



	Dipole magnet			Multiplets				
	Type 2	Type 3	Branch	Short Quadrupole	Long Quadrupole	Sextupole	Steering Dipole	Octupole (in SQ)
	Type 2	Type 3	Branch	24 different configurations				
total quantity for ES	3	18	3	7 short + 23 long				
length [m]	3.3	3.0	3.0	2.7 to 7.0				
height [m]	4.4	4.4	4.4	4.3				
weight [ton]	52	55	49	27 to 65				
LHe volume [L]	50	50	50	900 to 1350				
aperture [mm]	170x794	170x794	170x794	380				
number of magnets	3	18	3	44	34	41	14	42
max. current [A]	260	260	308	330	330	320	308	176
inductance [H]	26	23	23	30	42	1.04	0.07	0.1
stored energy [MJ]	0.5	0.5	0.7	0.77	1.1	0.037	0.0026	0.0013

CERN testing status



GSI-CERN task force

- focus on the brazing
 - both dipole magnets and multiplets have **copper pipe and brazing** on the thermal shield, causing a leak.
 - multiplets
 - leak investigations
 - FEM analysis, x-ray, tomography, metallography, chemical analysis, tensile test, thermal cycle and leak test with and by **CERN experts**.
 - root cause of leak (LM11):
bad quality of brazing joint, possible damage associated with the high stress
 - improvement on the design and quality control
 - partly replaced to “**stainless steel and welding**”
 - FEM simulations, 100% x-ray inspection, sample tests
 - **presence of GSI colleague at the manufacture’s workshop every week**
 - dipole magnet will follow it

Project schedule

Long term (til end of the project):

- only tentative plan from the manufacturers
- delay is estimated from known information

the plan from the previous meeting (**Nov. 2022**) with **updates**

Name	current collaboration addendum	previous meeting Nov. 2022	(preliminary) as of today April 2024
End of ES magnet		Q3 2025	Q1 2027
End of full scope	Q4 2026	Q1 2027	Q3 2028
End incl. EB	-	Q4 2027	Q2 2029

at least 13 magnet modules (1.5 years) behind

Re-test

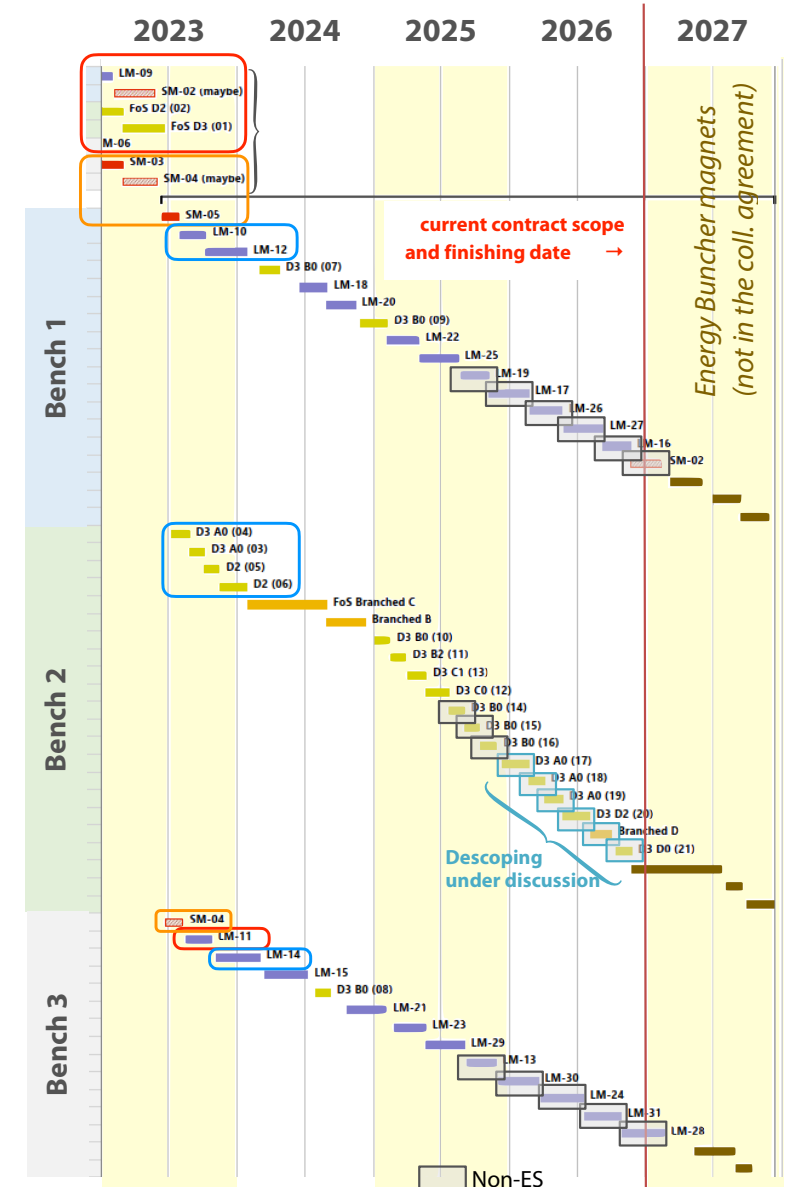
LM11, LM09, SM02, SM06
FoS D3, FoS D2

not-yet-tested until April 2024

LM10, LM12, LM14
D02, D03, D04, D05

Potential reparation and re-test (under discussion) + 0.5 years

SM01, SM03, SM04, SM05, SM08

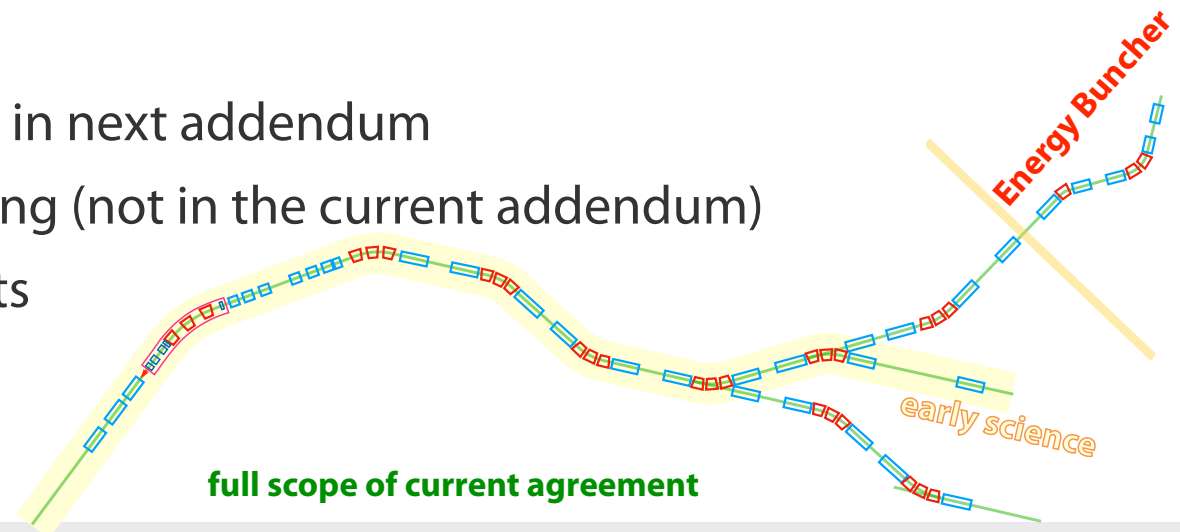


Mitigations

- **tighter quality control at the manufacturers**
 - increase **presence of GSI** at the factories at ASG, Elytt
 - support from the **GSI-CERN task-force experts**
- **flexibility of facility**
 - 2nd platform for the dipole magnet (**prepared**)
 - larger preparation area (**prepared**)
 - consolidation of cryo facility (**completed**)
- **speed-up of the testing** (discussion ongoing)
 - parallel operation
 - reviewing the test contents
 - relax non-critical parameters (80 K waiting time, etc.)
 - possibly increasing resource, two shift operation(?)
- **smooth logistics** (transport to/from CERN)

Summary

- **15 magnet modules** have been delivered and **critical technical issues** were identified at CERN testing
- with **broad support from CERN experts**, the magnet production is now **heading to the right way**
- in 2024, **repaired and improved magnet** testing to be done
 - intensive testing required (two thermal cycles etc.)
- the testing may become **bottleneck of the project** in future
 - collecting ideas to facilitate the testing, discussion ongoing
- **open points for future**
 - extension of project duration in next addendum
 - energy buncher magnet testing (not in the current addendum)
 - 3 dipoles and 5 multiplets



Many thanks

to collaboration management from CERN side,
to CERN experts for extensive and flexible supports

*Our technical challenges continue
under the fruitful collaborations!*

Thank you for your attention