

FAIR



Outline

- Work Package
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- 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

Multiplet production

WPL: Eun Jung (Melanie) Cho



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 🗔 🚟 🎞



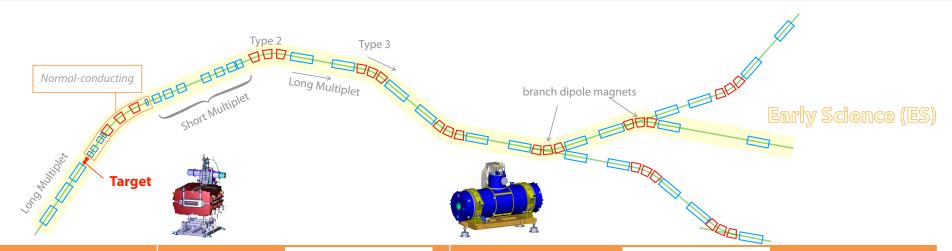
incoming inspections

preparation and interface setup for installation, storage





S-FRS magnets overview

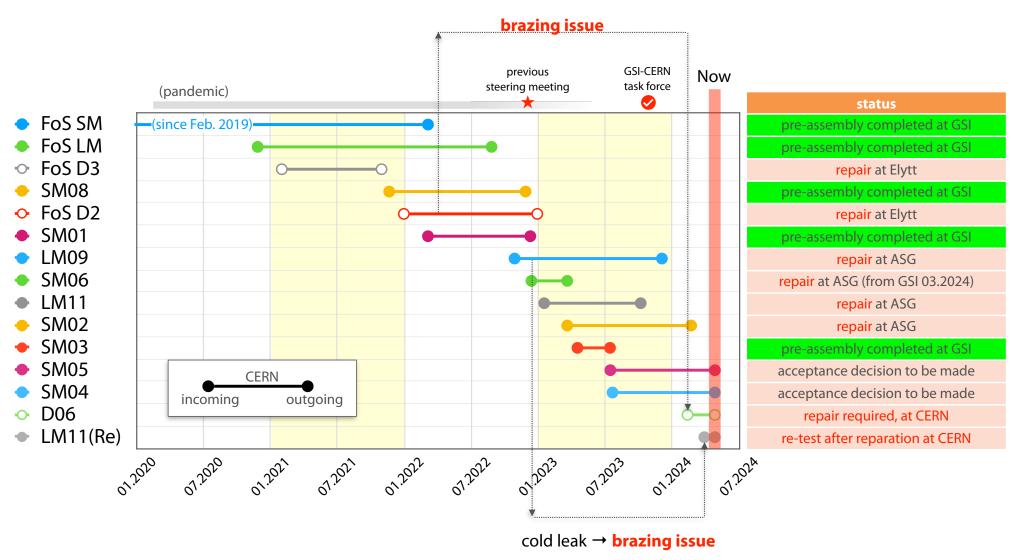


	Dipole magn	et ELY	TT ENERGY	Multipl	ets	ASC SUPERCONDUCTO	7 RS					
	Type 2	Type 3	Branch	24 different configurations								
total quantity	3	18	3		7	short + 23 long	g					
for ES	3	10	2		7 shor	t + 13 long (16	types)					
length [m]	3.3	3.0	3.0			2.7 to 7.0						
height [m]	4.4	4.4	4.4			4.3						
weight [ton]	52	55	49	27 to 65								
LHe volume [L]	50	50	50	900 to 1350								
aperture [mm]	170×794	170×794	170×794			380						
				Short Quadrupole	Long Quadrupole	Sextupole	Steering Dipole	Octupole (in SQ)				
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



in total 14+1 magnet modules received





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

Short term (next half year):

- Updated monthly
- Based on the tentative plans from the magnet manufacturers
- Adjusted to the real situation (progress of reparation/production, transport coordination)

April			01-2	024			02-2	024			03-2	2024			04-2	2024			05-2	024			06-2	024	
	PA-in							SCD_06						LM11(Re)						LM09(Re)	LM09(Re)				
	PA-in																Steering me	eting							
	PA-in																at CERN								
	TB1	SM05	SM05	SM05	SM05										LM11(Re)	LM11(Re)	LM11(Re)	LM11(Re)	LM11(Re)	LM11(Re)	LM11(Re)	LM11(Re)	LM11(Re)	LM11(Re)	LM11(Re)
	status															CD	CD	PM	WU	WU	CD				
	TB2								SCD_06	SCD_06	SCD_06	SCD_06	SCD_06	SCD_06	SCD_06	SCD_06	SCD_06	SCD_06	SCD_06	SCD_06	SCD_06	SCD_06	SCD_06	SCD_06	SCD_06
	status								dust ir	pipes			leak issue, i	1				CD	CD	PM	WU				
	TB3	SM04				Sample T.	Sample T.	Sample T.	Sample T.							LM09(Re)	LM09(Re)	LM09(Re)	LM09(Re)						
	status																								
	PA-out					SM05	SM05	SM05	SM05	SM05	SM05	SM05	SM05	SM05	SM05	SM05	SM05	SM05	SM05	SM05	SM05				
	PA-out	SM02	SM02					waiting a	decision																
	PA-out								SM04	SM04	SM04	SM04	SM04	SM04	SM04	SM04	SM04	SM04	SM04	SM04	SM04				

	07-2	024			08-2	024			09-2	024			10-2	024			11-2	024			12-2	024	
				SM02(Re)	SM02(Re)		SCD_05	SCD_05				SCD_04	SCD_04				SCD_02	SCD_02		SCD_03	SCD_03	SCD_03	SCD_03
		LM10	LM10						LM16	LM16				LM18	LM18					LM21	LM21	LM21	LM21
	SM06(Re)						LM20	LM20															
LM11(Re)	LM11(Re)	LM11(Re)		LM10	SM06(Re)	SM06(Re)	SM06(Re)	SM06(Re)	SM06(Re)	LM18	LM18	LM18	LM18	LM18	LM18	LM18	LM18						
CD	WU				CD	CD	PM	WU	WU			CD	PM	WU			CD	CD	PM	WU	WU		
SCD_06	SCD_05	SCD_05	SCD_05	SCD_05	SCD_05	SCD_04	SCD_04	SCD_04	SCD_04	SCD_04	SCD_02	SCD_02	SCD_02	SCD_02	SCD_02								
CD	PM	PM	F	PM	PM	PM	WU			CD	PM	WU			CD	PM	CD						
LM09(Re)	LM09(Re)	LM09(Re)	LM09(Re)	LM09(Re)	LM09(Re)	SM02(Re)	SM02(Re)	SM02(Re)	SM02(Re)	SM02(Re)	LM16	LM20	LM20	LM20	LM20	LM20	LM20						
	CD	CD	PM	WU	WU		CD	PM	WU			CD	CD	PM	WU	WU			CD	CD			
						LM09(Re)	LM09(Re)				SM02(Re)	SM02(Re)		SCD_05	SCD_05				SCD_04	SCD_04			
											LM10	LM10					_	LM16	LM16				
			LM11(re)	LM11(re)					SCD_06	SCD_06						SM06(Re)	SM06(Re)						

CD = cool-down

PM = powering and magnetic measurement

WU = warm-up

F = Floating







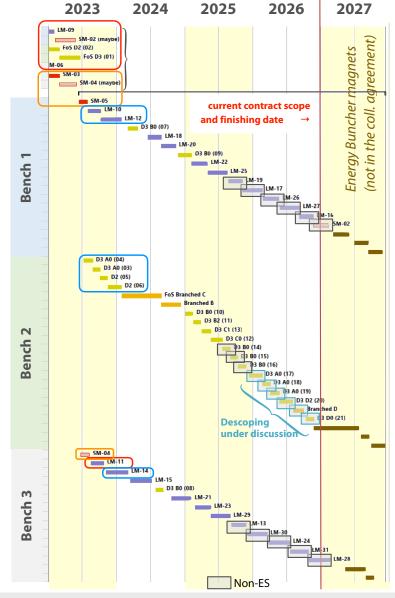
Project schedule

Long term (til end of the project):

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

	current collaboration	meeting	as of today April 2024									
Name	addendum	Nov. 2022										
End of ES magent		Q3 2025	Q1 2027									
End of full scope	Q4 2026	Q1 2027	Q3 2028									
End incl. EB	-	Q4 2027	Q2 2029									
			1									
	at least 13 magnet modules (1.5 years) behin											
		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											

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







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)

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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

ot in the current addendum)

full scope of current agreement





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