MAGiC progress report

October 2021 STAP meeting

This report highlights the progress and changes made on the MAGiC instrument since the last meeting in April 2021.

1. Status of tenders and procurement

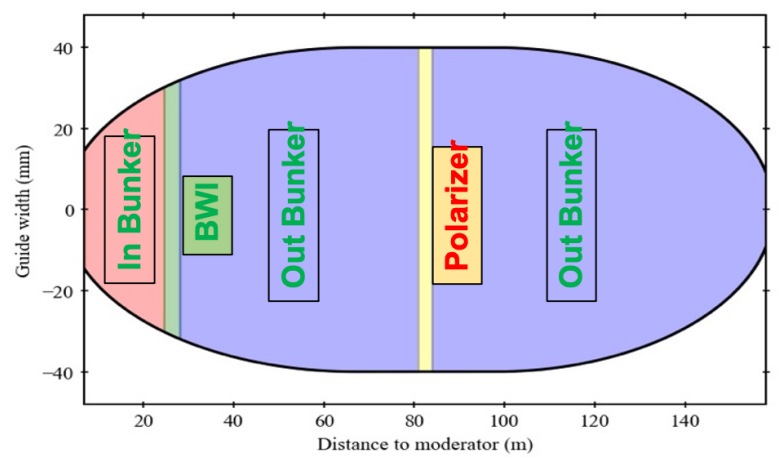
LLB

The tendering process has started at CNRS since February 2020. Two paths can be used to procure equipment :

- Above 140 k€ : open tender
- Below 140 k€ : simplified procedure

At the moment :

- Neutron guide system
    - The contracts are signed for Lots 1, 2 &3. These cover all guide elements at the exception of the thermal polarizer (3 m long section). An additional tender will be released for the polarizer.



    - The kick-off meeetings for the 3 contracts have been a success and design is in progress.
- Experimental cave : a huge effort has been made at CNRS. The deadline for the offer was the 29th of July. The tender failed as no company answered.
    - A new tender will be released in mid-October
    - Signature is expected in January
    - Installation is expected in early 2023
- Other equipments : tendering in progress at various stages

The current delivery plan is in agreement with the bunker openings and the BoT.
TG5 is expected in Mar-24 (from Jan-24).
The Hot Commissioning will be possible as soon as the BoT milestone is achieved.

JCNS

Procurement is done for most of the equipments (detectors, monitors) and everything is on track for a successful installation in 2022.

PSI

Prototype for the saturation field has been tested.

2. Meetings

ICEB

ICEB in June 21. No major decision taken.

DMSC

Quarterly meetings with DMSC (most recent one on 8th of October) with a focus on data reduction anad analysis.

3. Progress on individual components

Solid State Bender

Preparing for the ICEB, a mistake was spotted in the McStas file used for the SSB optimisation. This resulted in a degraded polarization for wavelength larger than 4A (85% at 6A). A new round of optimisation with the proper parameters has been carried out resulting in a small design change. The bender is now S-like instead of C-shaped (see figure). The increased Silicon length (+10 mm) results in a small loss of transmission (~2%).

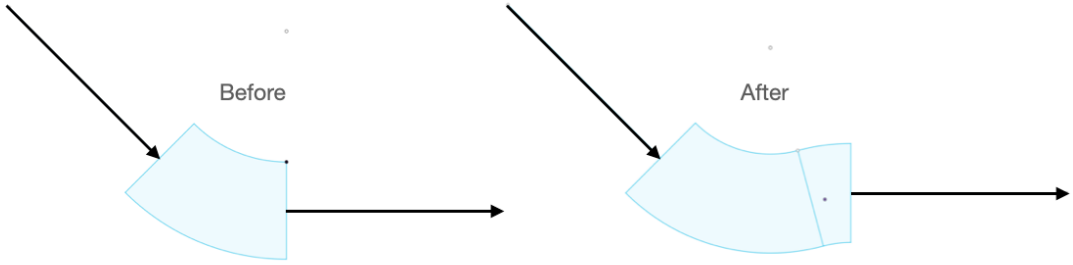
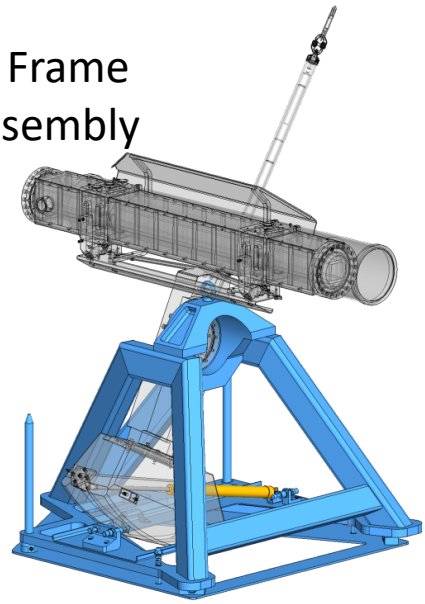


Figure 1: geometrical change of the SSB to maximize polarization at large wavelength.

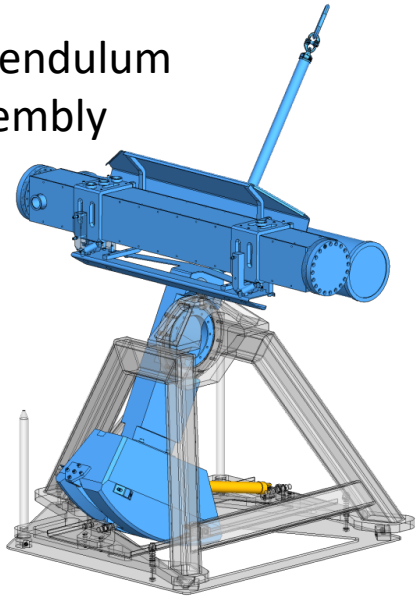
Heavy Shutter

The detailed design of the heavy shutter is now finalized. We passed CTV and are ready for manufacturing.

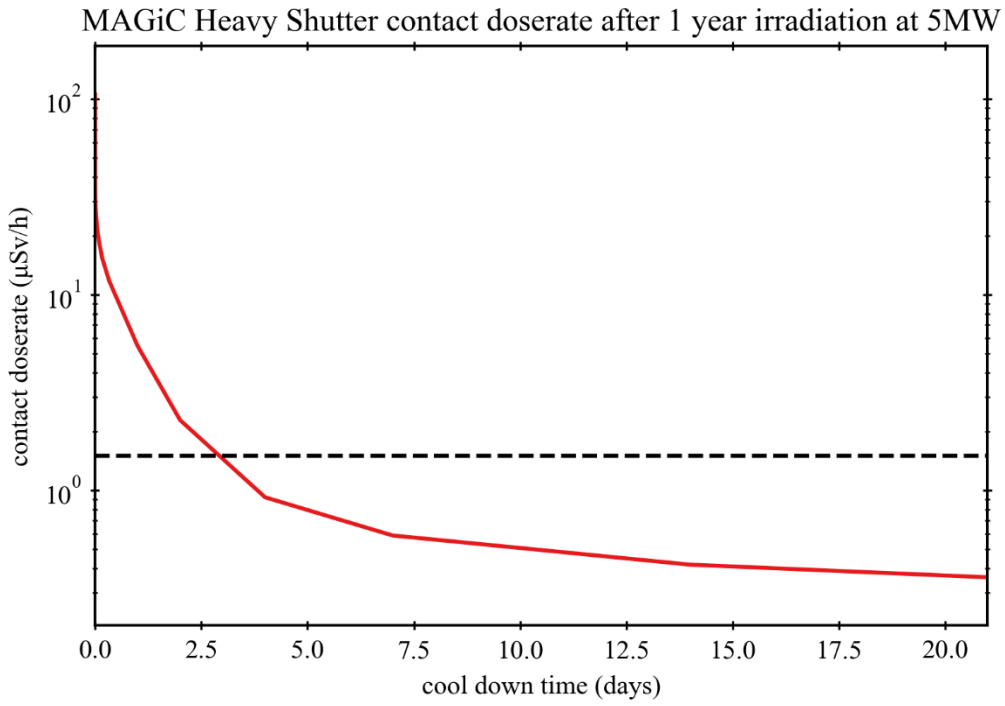
1. Frame assembly



2. Pendulum assembly



Activation calculations of the attenuating block have been performed showing no relevant activation after a cooling time of 3 days.



Detectors

The sub-TG3 for detector B (Polarization Analysis side) took place in December and is now validated. Production of the 8 detector B segments is in progress. The design of the interface plate is in progress. High accuracy is required as it will be shared with the polarization analyzer.

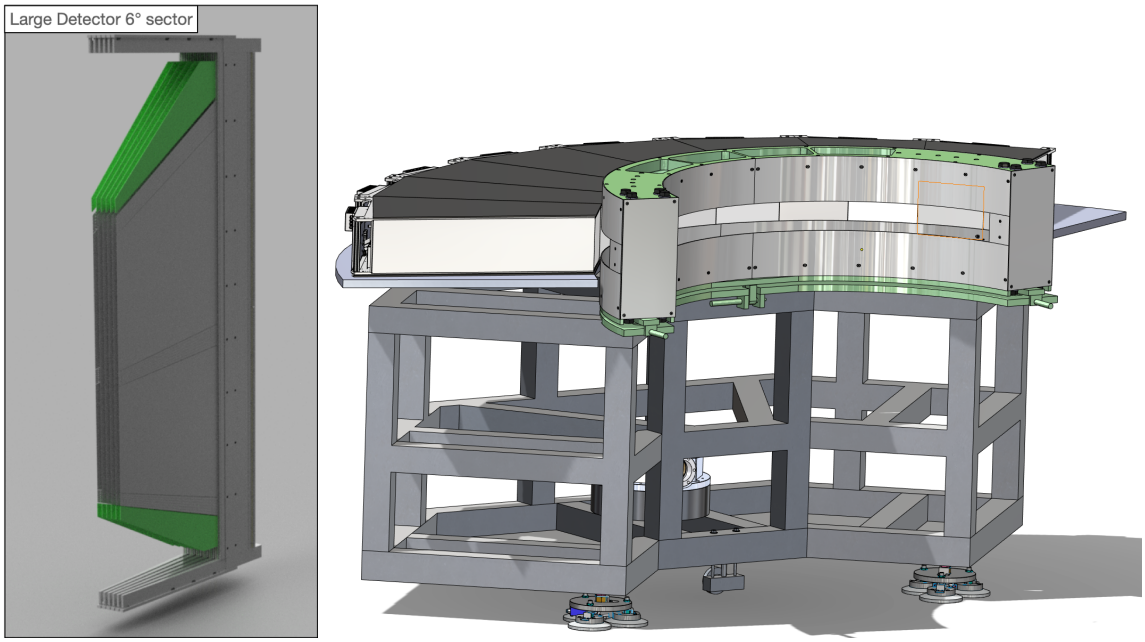


Figure 2: (left) Large detector 6° segment. (right) view of detector B mounted on the support structure with the polarization analyzer.

The sub-TG3 for detector A is scheduled for Q1 2022.

The delivery of both Detectors will be possible before the end of the Experimental Cave construction.

Monitors

sub-TG3 for Monitors has been validated.

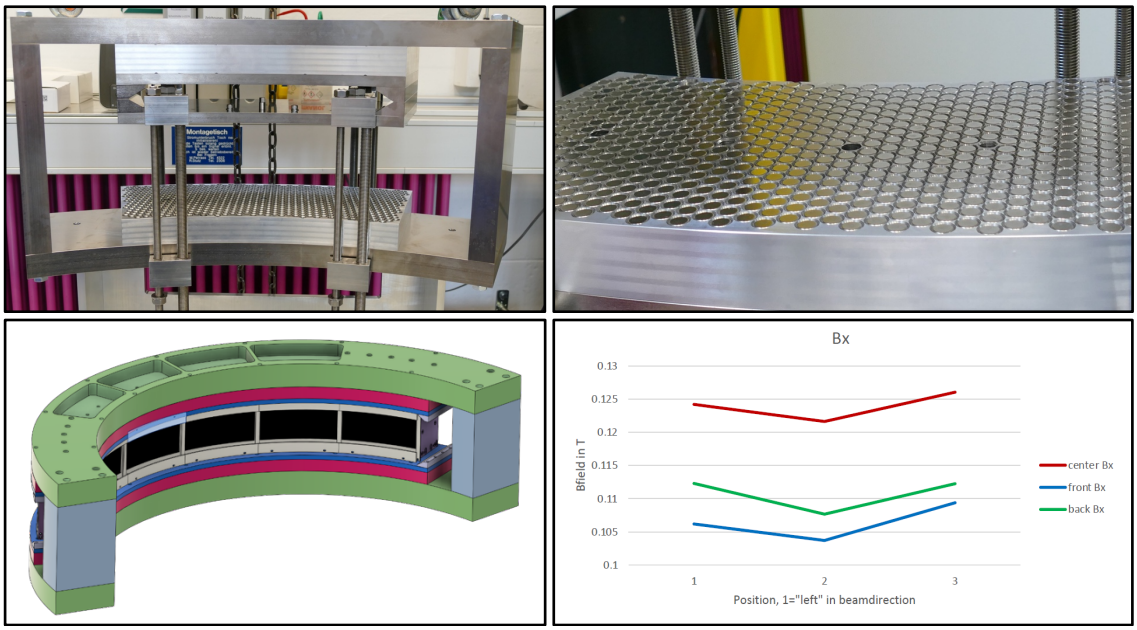
Analyzer

An alternative design is explored :

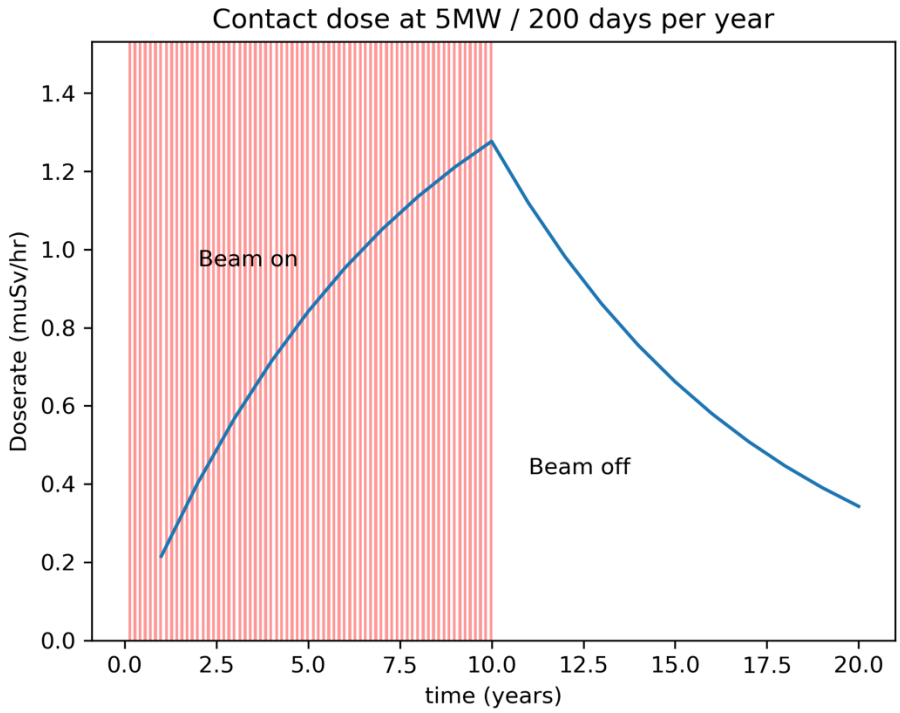
- Switch from solid state to air gap design
- Switch from Si to Glass substrate
- Switch from FeSi to FeCo-V coating

This will allow delivery of the analyzer in time and in budget at the cost of ~30% in efficiency and a potential loss in homogeneity of the Polarization Analysis along the Analyzer span. The full scienctific scope of the instrument can be achieved with the new design if sufficient homogeneity can be achieved.

A strong saturating magnetic field (1000 G) has been design increasing robustness against stray fields and eliminating the need for a remagnetization device. This will dramatically simplify maintenance and operation. A prototype module (19°, glass, coating and magnetic field) is in development to validate the new design.



The switch from FeSi to FeCo-V is backed up by activation calculations showing a limited doserate at contact in the worst case scenario of an irradiation of the analyzer by a 5 MW beam for 200 days a year over 10 years.



In parallel, a solid state stack with FeSi coating has been tested at PSI (AMOR beamline). Detailed analysis of data is in progress.

Cryostat

A reduction of the vacuum tail diameter from 160 mm to 120 mm has been validated.

XYZ field / guide field at sample position

The polarization analyzer and its magnetic field will determine the final design.
For the incident beam, a simplification of the design is possible using the Halbach design made for DREAM by E. Babcock.

4. Common projects

Choppers

The choppers project is well advanced and the disks have been manufactured. A small deviation from specifications, that will not affect the scientific output, is noted and accepted.
Installation of the FE choppers is aligned with the bunker opening. Installation of the BC chopper can occur as soon as June 22 in the E02 building.

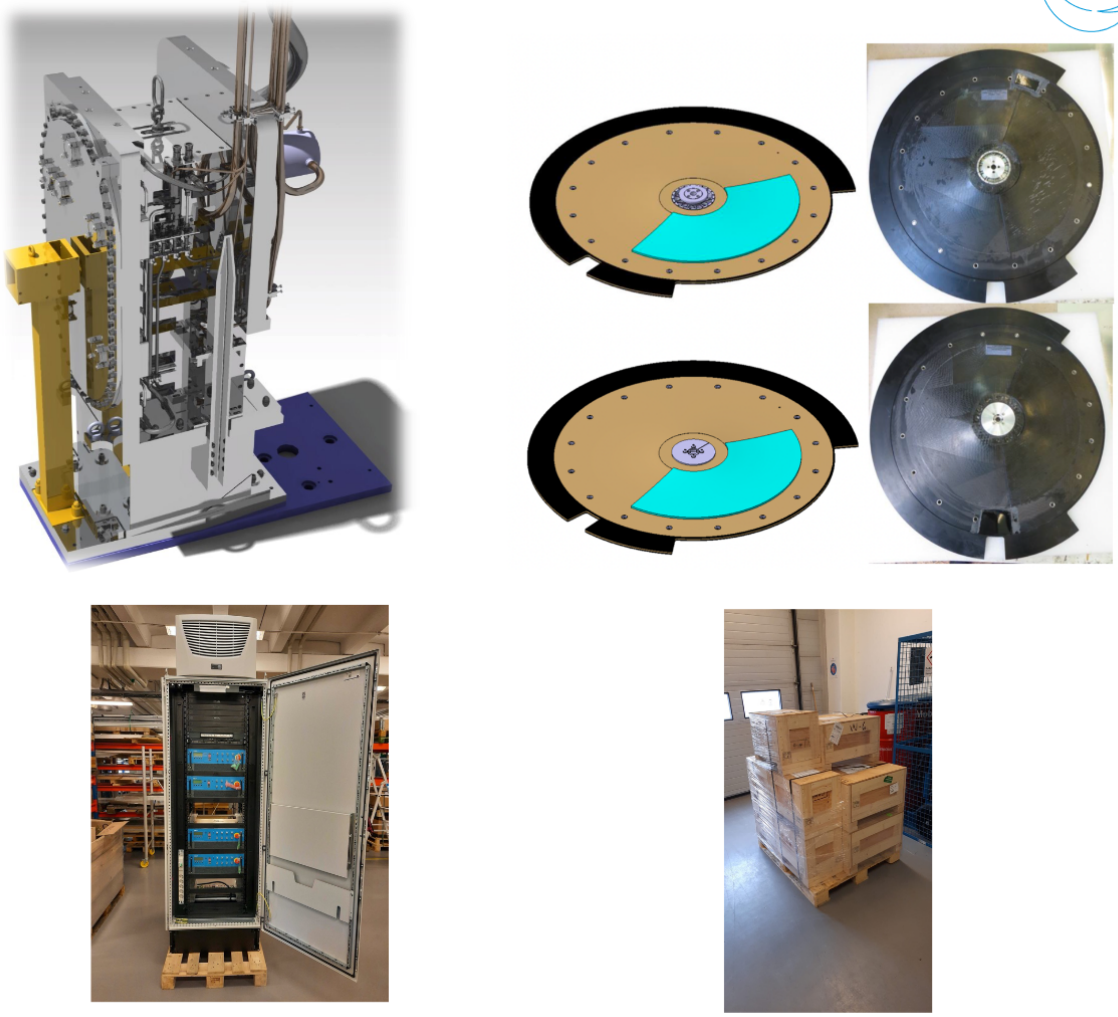
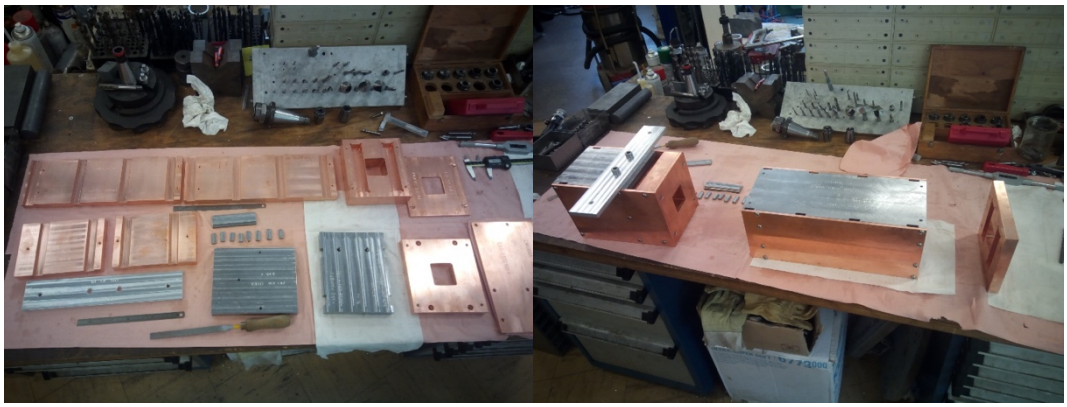


Figure 3: front end chopper set (PSC+SC) render

The magnetic guide field assembly guiding cold neutrons polarization has been manufactured at LLB and will be sent to ESS for integration with the FE choppers after Ni and Cd plating.



Electrical

No news from the Electrical project. Priority is on the first 3 instruments. NSS confirmed that they will provide their part of the project to the MAGiC instrument in time for installation. The location and installation sequence of the Instrument Electrical Board in E02 has been validated by the instrument team in April 21.

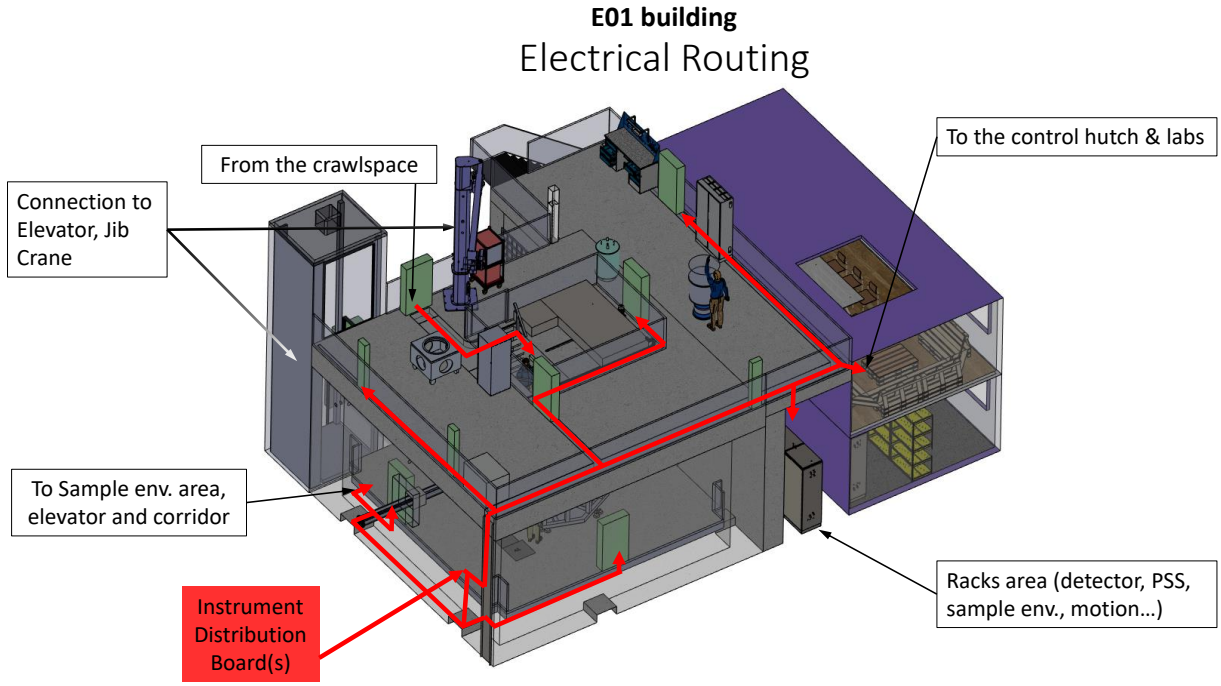


Figure 4: simplified layout of experimental cave electrical routing.

Utilities

As for the Electrical project, priorirty is on the first 3 instruments. NSS confirmed that they will provide their part of the project to the MAGiC instrument in time for installation.

We have initiated contact with the project leader to start the work on cost estimate asap. A complete list of the experimental cave utility panels and their location has been transmitted.

UTILITIES FOR MAGIC

15/07/2020

SES Supply For each subset	Main characteristic	No's	ESS Main Connection	Connector type	Valve/ regulator/ IP class	Meter, control NEUS-PLC[a]	General	Panel 1	Panel 2	Panel 3	Panel 4	Panel 5	Panel 6	Panel 7	Panel 8	Panel 9	Panel 10	Panel 11	Panel 12	Panel 13 Specific	Panel 14	Elevator	Hutch & Lab	Racks Area
Cooling water	5°C	0					Main cooling loop															Specific electrical board (provided by supplier)	Specific electrical board (provided by supplier)	Specific electrical board (to be defined)
	14°C TBD	3	D40	Defined	Y/N	Yes	Secondary loop Capacity 20kW	YES	YES			YES	YES					YES						
Pwr. Conn. Sum	230V / 400V (16A;32A)	8/2/2	Wires	CEE	IP44[b]		Slow fuses			YES		YES			YES			YES			YES			
Box #1 Mennekes 950004	230V / 400V (16A;32A)/RJ45	2/1/1/4	Wires 5x25mm²	CEE	IP44[b]		Slow fuses	YES	YES	YES	YES	YES		YES	YES		YES	YES	YES		YES			
Box #2 Mennekes 940018	230V / 400V (16A;32A)	6/1/1	Wires 5x25mm²	CEE	IP44[b]		Slow fuses	YES		YES	YES	YES	YES, 2		YES	YES		YES	YES	2 sockets 230V	YES			
Box #3 Mennekes 920003	230V / 3x10A/15min	3	Wires 5x10mm²	CEE	IP44[b]		UPS			YES		YES			YES			YES			YES			
Gases	CO2 / Argon Mix for detector	2	Cylinder		Y/Y	Yes	ESS supply, independent extraction points			YES	YES	YES												
	Nitrogen 4.6	2	D25 <=8bar		Y/Y	Yes	ESS supply, independent extraction points																	
	Helium 4.6	2	Cylinder		Y/Y	Yes	ESS supply, independent extraction points	YES		YES		YES	YES		YES			YES		1 connector				
	Compressed air	3	D25 <=8bar		Y/Y	Yes	ESS supply, independent extraction points	YES		YES	YES	YES	YES		YES			YES	YES		YES			
	Exhaust	2	D100 ?		Y/N		Needs special consideration see ref [5]				YES ?	YES ?												
	He Recovery	3	KF DN 25	KF DN 25	Y/N		Ref. TEFI	YES					YES		YES			YES						
Communication/patch panel[c]	RS232, sensors plugs, etc.	1		Dsub 9	-	-	Serial communication																	
	General comm.	5		Dsub 25			Contact and serial																	
	Ethernet conn Data, USB	15		Cat6, RJ45			Network compatible connectors					YES	YES							1 connector	YES			
	4 Pin connector Temp, Heater	20		Lemo / Fischer			Thermometer, SE Process signal																	
	General signal	10		BNC			Contact and small low power, low voltage signals																	
	General signal	5 pair		4 mm "Banana"			Contact and small low power, low voltage signals																	
Power Câble Length (m)								17.6	23	21.4	12.4	11.4	25	15	12.6	16.3	20	16	18.7	21.4	22	15	16	19

Figure 5: list of all utility panels and the associated outlets/plugs

Shielding

Thermal neutrons capture by super-mirrors are now modelized. A simplified shielding structure can be used as the need for steel in the first 70 m of the neutron guide is not necessary. This leads to an easier shielding structure and cost reduction. A hot point has been found at the 92 m mark which corresponds to the location of Al Windows.
The effort is now on the modelization of the fast neutrons and gammas from the moderator. The STEP model of all components in monolith, is used.
The sub-TG3 for shielding is now scheduled for October 20th 2021.

5. Updated timeline

The instrument timeline has been strongly impacted by :

- Delay in Bunker access to December 2022 and extended opening period
- Delay in guide elements delivery up to August 2023
- Delay in Experimental Cave procurement

As such, TG5 is now expected in March 2024 corresponding to a one year delay. In the meantime, BoT has been shifted from July 2022 to an undefined date in 2025.
The instrument will be ready for beam on target. A hot commissioning phase of one year will then be possible while ramping up the accelerator.
To achieve this, cold commissioning will be performed in parallel with installation to benefit from any downtime in handling activities.

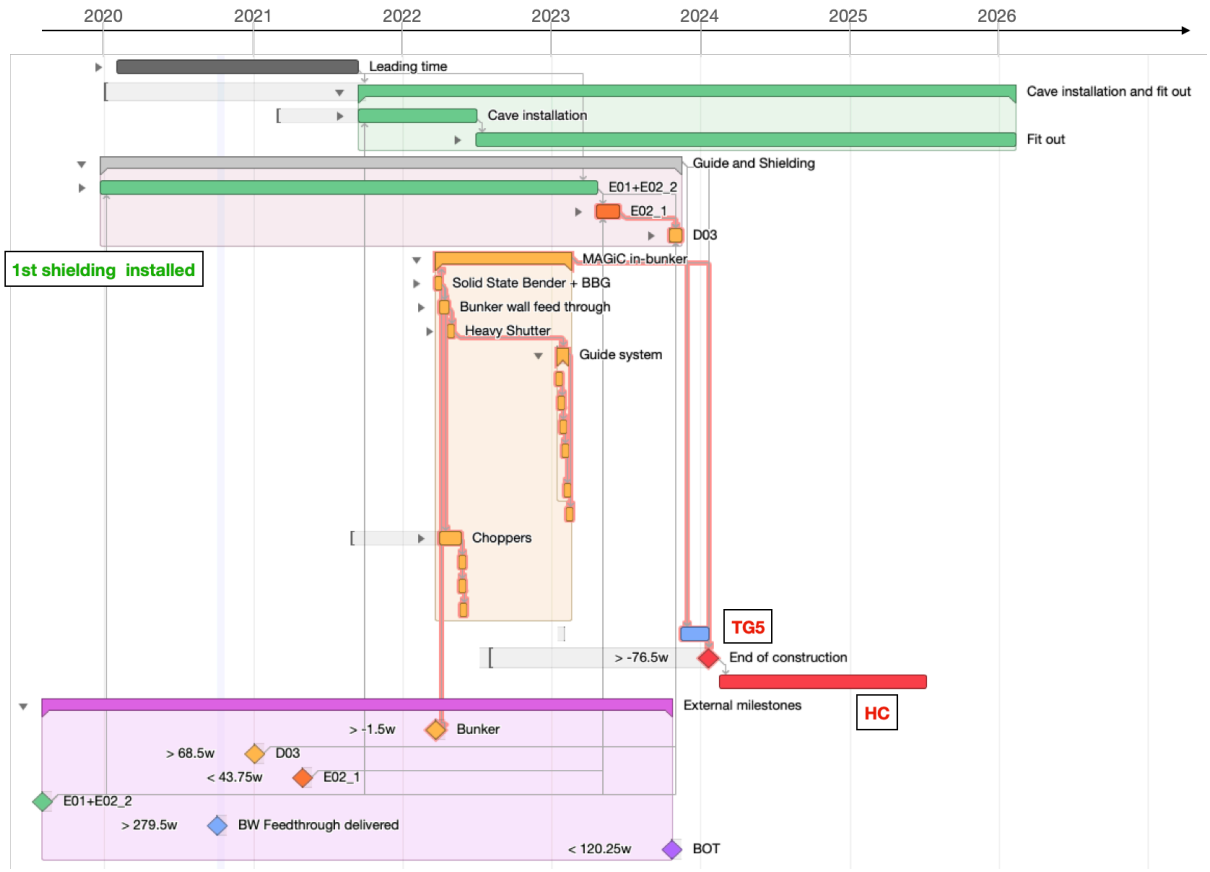


Figure 6: updated MAGiC's installation plan