MIRACLES: STAP Spectroscopy report (April 2022 – October 2022)

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General information and management

The MIRACLES instrument continues with steady progress with the detailed design in the last six months. For 2022, three SubTG3 reviews are planned (one already held, with review process ongoing):

- BTCS† In-bunker: documentation submitted in August (in review).
- BTCS† Out-of-bunker (Part I: BWI, FO chopper, shutter): submission of documentation scheduled by mid-November.
- SCS‡ (+ beam stop): submission of documentation expected by December.

A general overview of the status of the main work packages, and providers of the detailed design at this stage are depicted in Fig. 1:

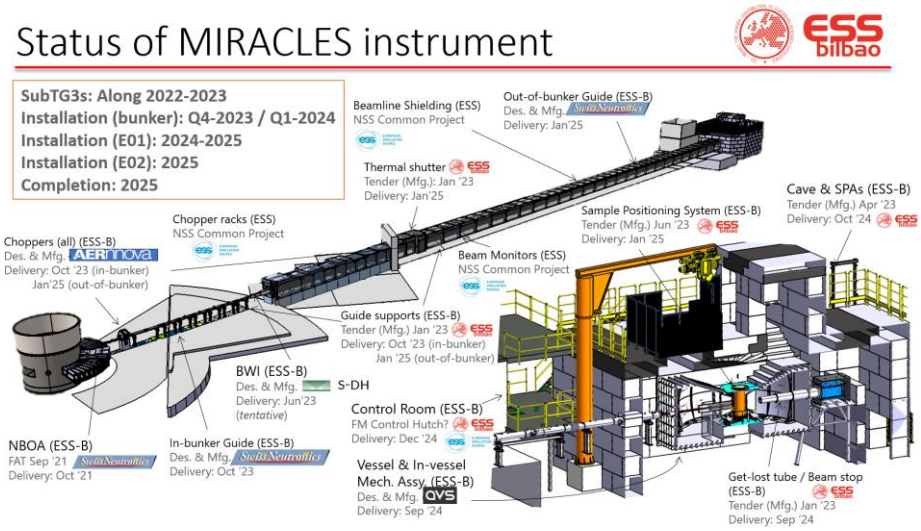

Figure 1. Illustration showing status, providers, and milestones for the different components of MIRACLES.

Integration of the MIRACLES instrument with the ESS facility (design, common projects, etc…) and other interactions with ESS will be described in the corresponding section.

Beamline (Beam Transport and Conditioning System)

<u>NBOA</u>

The Neutron Beam Optical Assembly, NBOA, arrived at ESS site in October 2021. The Neutron Beam Port Insert (housing of this guide segment) passed successfully its TG3 (CDR) this Spring and is being manufactured. Installation is scheduled by 2023.

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† BTCS: Beam Transport and Conditioning System

‡ SCS: Scattering Characterization System

In-bunker components

The final design and documentation of the in-bunker components (guide, supports and choppers), except the beam monitor, was submitted for SubTG3 review in August. During the review process, we have realized that there is a clash of our guide housing alignment system with MAGIC choppers. This has compelled us to find a customized solution for the first guide section (after the ESS light shutter). A solution is proposed to the NSS Integration Team and the ESS Survey, Alignment and Metrology Group.

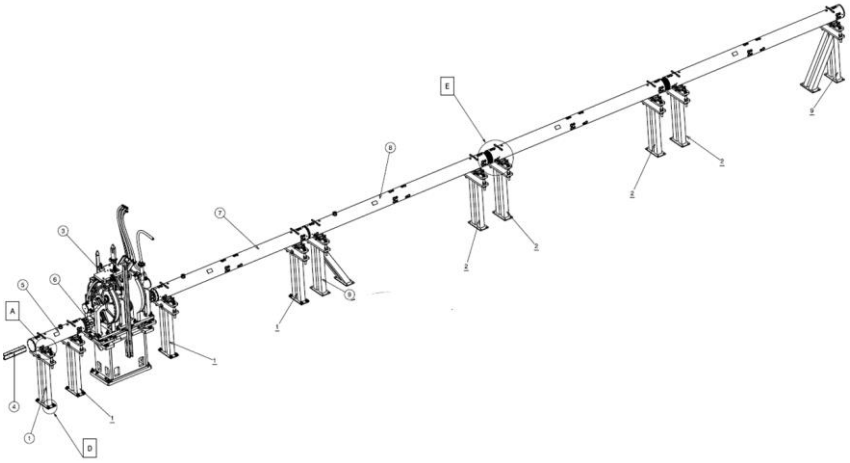

Figure 2. Mechanical assembly drawing showing all the in-bunker components.

Out-of-bunker components

The Bunker Wall Insert, BWI, out-of-bunker FO chopper and the shutter have also a final design, and we are updating the documentation following the feedback from IDR reviews. The three components will be ready as well for their SubTG3 scheduled in November.

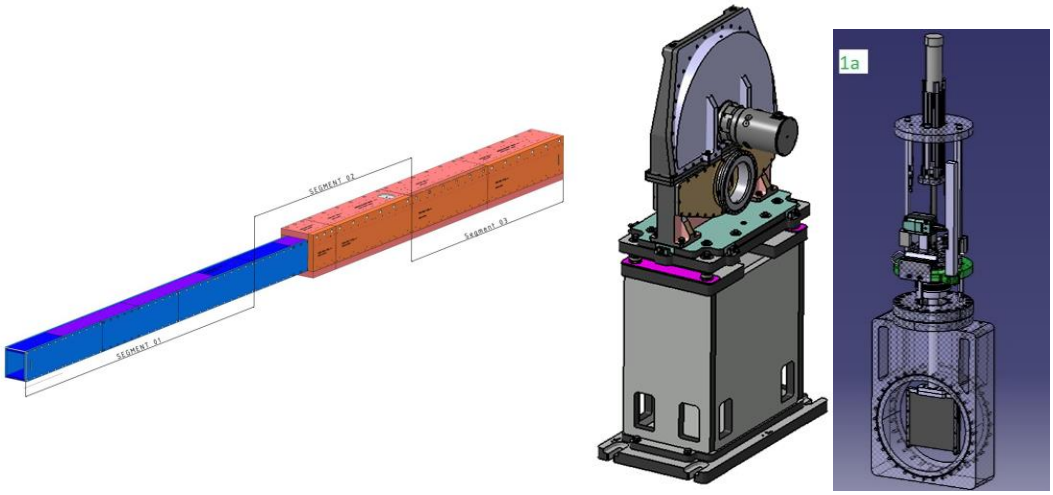

Figure 3. Bunker Wall Insert, FO out-of-bunker chopper and thermal shutter.

Finally, out of bunker guide was awarded in May to Swiss Neutronics. They are working in the preliminary design.

Chopper racks

Chopper racks, provided by the NSS Common Chopper Project, have arrived at ESS.

Beamline shielding

A first meeting to set the line of action for the NSS Common Shielding Project is scheduled Friday 21st October, along with T-REX, HEIMDAL and VESPA.

Scattering System

Vessel

The design of the vessel has been completed (see Fig. 4). Both engineering models and documentation are ready for the SubTG3 this year.

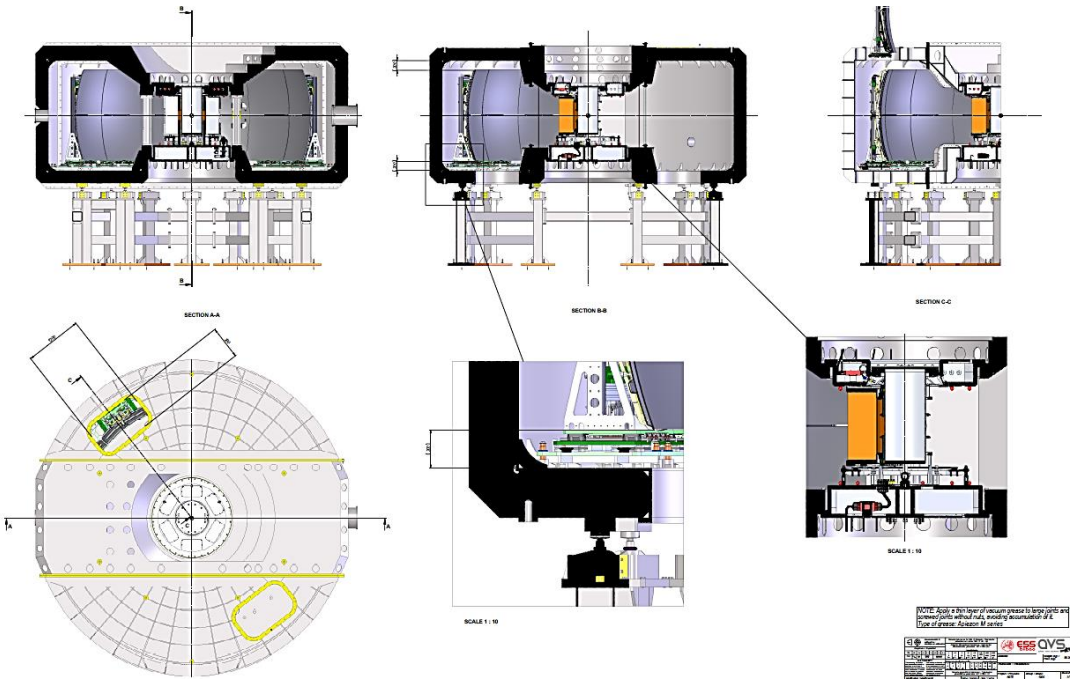

Figure 4. Assembly drawing of the MIRACLES vessel and in-vessel mechanical assemblies.

Radial collimator

The mechanical design and motion control of the collimator is in its final form, and also ready for the SubTG3.

Analyzer

The mechanical assembly of the analyzer is in its final design, ready for the SubTG3. On the other hand, the review carried out by the NSS Integration Team aiming at the early purchase and manufacturing of the panels received a positive response, and thus the carbon fiber was already purchased, and ready for manufacturing.

The optical assembly (Si crystals and Gd paint) shows also some progress (see Fig. 5). Documentation for the design and integration and assembly plans has been drafted.

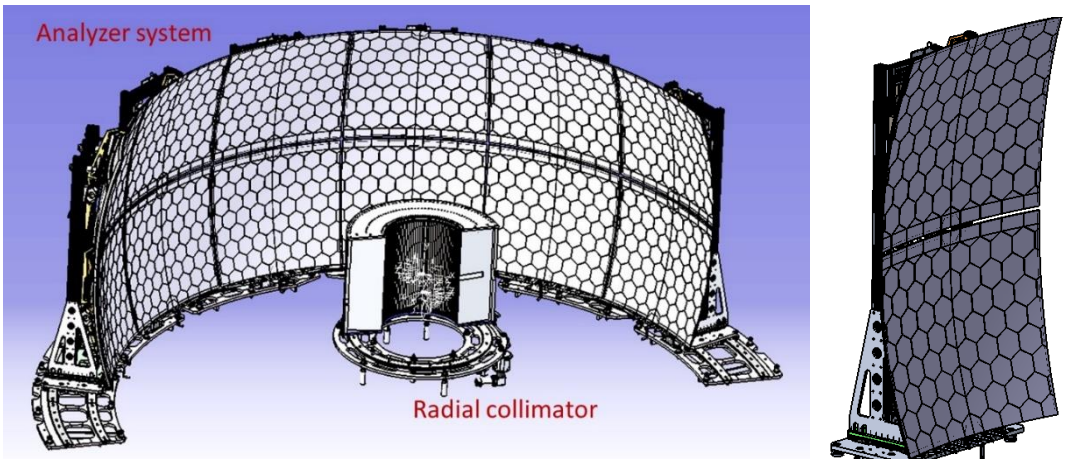

Figure 5. MIRACLES analyzer.

Additionally, two prototypes for the analyzer, dedicated to a systematic study in collaboration with the staff at IN16B (ILL) of different fabrication conditions (method, etching) and thickness for the Si(111) crystal reflectors, are being designed (see Fig. 6) by AVS. The plan is to start manufacturing of this prototypes at the end of the year and carry out the tests during the Spring of 2023.

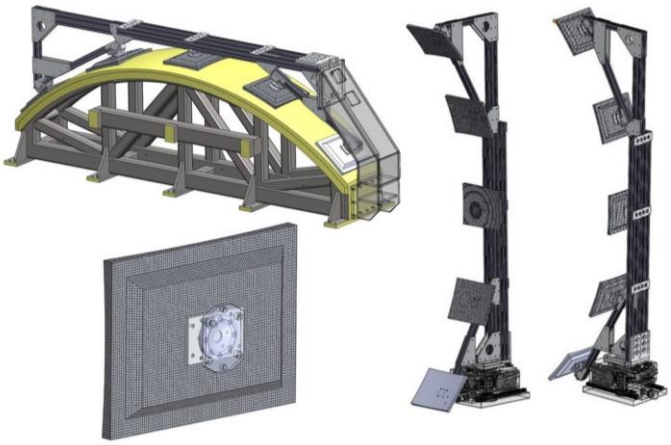

Figure 6. Panel prototypes for the analyzer, for the tests in IN16B (ILL)

Detectors, beam monitors and readout

Detectors

Experiments devoted to test the ^{3}He tubes U-shaped serial connection developed by Reuter-Stokes and the integration with the CAEN electronics (preamplifier + digitizer) were carried out using the Am/Be source available at the Universidad Politécnica of Madrid (UPM). Preliminary results confirm that the signal provided has room for improvement, revealing some issues with the customized connections of the electronics and the gain; future experiments working with CAEN are ongoing in the search of a proper choice for the preamplifier.

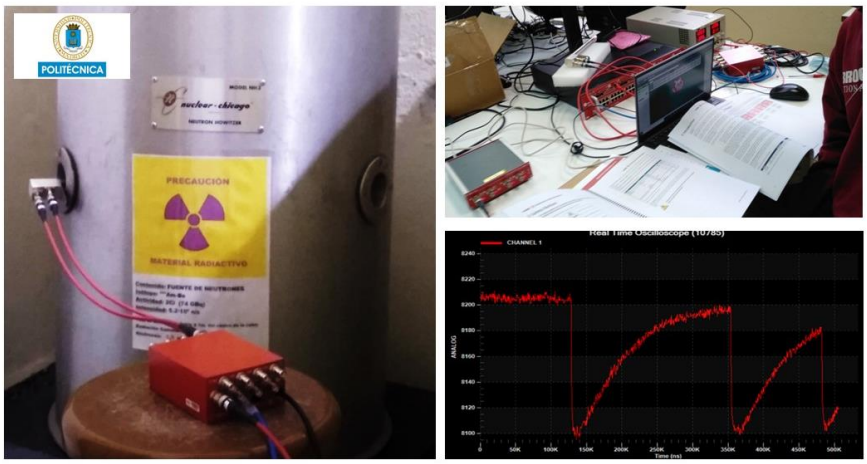

Figure 7. Pictures from the experimental tests carried out at the UPM and analog signal from the preamp, showing neutron collection; however, further improvement is sought.

Readout

There is some progress in the discussion on defining an interface between the MIRACLES detector readout and DMSC (thanks to the NSS ECDC group). After setting the local geometry and the ring allocation (see Fig. 8), the next steps were focused on constructing the digital mapping and to allocate memory for the data format. Multi-byte values are stored in little-endian format. Each packet contains one packet header and one or more data sections. Each data section contains one or more readouts. We are taking advantage from the fact that, using the same digitizer, the data format for MIRACLES readout is suggested to be identical to that of BIFROST.

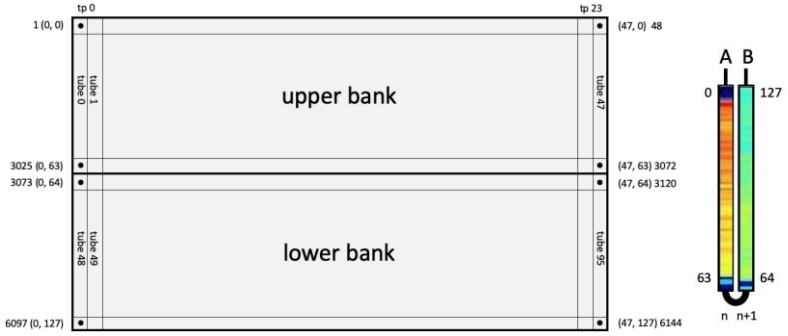

Figure 8. Logical geometry and pixel identification of MIRACLES detector banks

Ring	tube-pair	A	B	Tubes
0/1	0			0/1
0/1	1			2/3
0/1	2	...	...	4/5
...	...			...
0/1	11			22/23
2/3	0			24/25
2/3	1			26/27
2/3	2	...	...	28/29
...	...			...
2/3	11			46/47
4/5	0			48/49
4/5	1	...	...	50/51
...	...			...
6/7	11			94/95

0	1	2	3	byte/address
Padding			Version	0 - 3
0x00	0x00	0x00	0	
Cookie			Type / SubType	4 - 7
'E'	'S'	'S'		
Length		OQ ID	TimeSrc	8 - 11
Pulse time HI				12 - 15
Pulse time LO				16 - 19
Prev. Pulse time HI				20 - 23
Prev. Pulse time LO				24 - 27
Sequence Number				28 - 31

Figure 9. Left: Digital mappings for MIRACLES (values supplied by the readout system, ESS backend from Detector Group, are in purple, and the ones ECDC uses internally, in blue. Right: Packet header

Beam monitors

The Beam Monitor Common Project is frozen.

Experimental station

Cave

The cave continues with the design works towards detailed design. Last updates are devoted to improving the cave structure, and the feedthroughs for utilities.

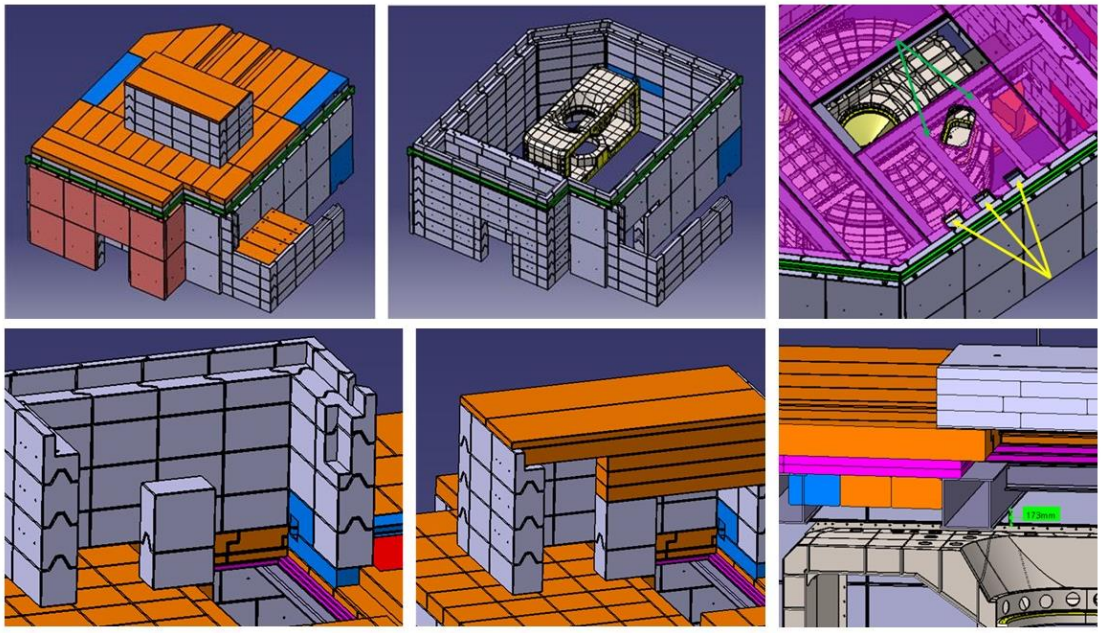

Figure 10. MIRACLES cave: design details.

Get-lost tube / Beam stop assembly

The design of this component is now ready for the SubTG3, that will take place together with the Scattering Characterization System.

Control hutch

We have no updates since our first meetings with ESS Facility Management related to the potential delivery of the Control Hutch by ESS. Some feedback is expected by November.

Polarization analysis

The MIRACLES team has resumed conversations with the ESS Polarization Analysis Project. The first topics for discussion were devoted to secure space for the future implementation of PA equipment (polarizer, Hallbach array, Helmholtz coils and ^{3}He cell). Recently, some progress has been shown in the calculations for the polarizer and the beamline magnet array; all this is still in the conceptual design but progressing steadily.

Infrastructure and other NSS projects

Utilities

The MIRACLES Team has started first discussions with the NSS Common Utilities Project in order to join such common project. A document with technical specifications has been drafted, to serve as a starting point for the discussions. Results of this interaction will come out in the following weeks.

Electrical

Due to prioritization of Target works, the ESS Management has decided to move temporarily the NSS Electrical Team to the Target Division. Hopefully, the group can return to NSS in 2023, so we can start conversations about the involvement of MIRACLES in the Common Electrical Project.