MIRACLES: STAP Spectroscopy report (April 2020 – September 2021)

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General information

The MIRACLES project continues with the design phase. All CTVs (Call for Tender Verifications, i.e. ESS reviews of tenders that outsource detailed design) were passed, and now the next step is to carry out the IDRs (Intermediate Design Reviews, which are ESS reviews at a level prior to Critical Design Review, CDR, to check whether the developed design of the components comply with ESS' and instruments' requirements).

One major thing has changed with respect to the MIRACLES project schedule. The ESS is carrying out a profound rebaseline of its schedule, in collaboration with all the projects and IK partners. One of the questions that were on the table is the possibility for late instruments (which is the case of MIRACLES) of installing in-bunker components some time before the Beam On Target (BOT) milestone, during Q4-2023. The MIRACLES team has evaluated this possibility and provided a positive answer.

This means that the design, tendering and procurement planning has experienced a significant modification, prioritizing all in-bunker components (pulse shaping choppers, in-bunker guide) to reach this in-bunker installation milestone by Q4-2023. The other 2 installation slots (experimental end station + vessel, and out-of-bunker beamline) remain intact waiting for final decision from ESS.

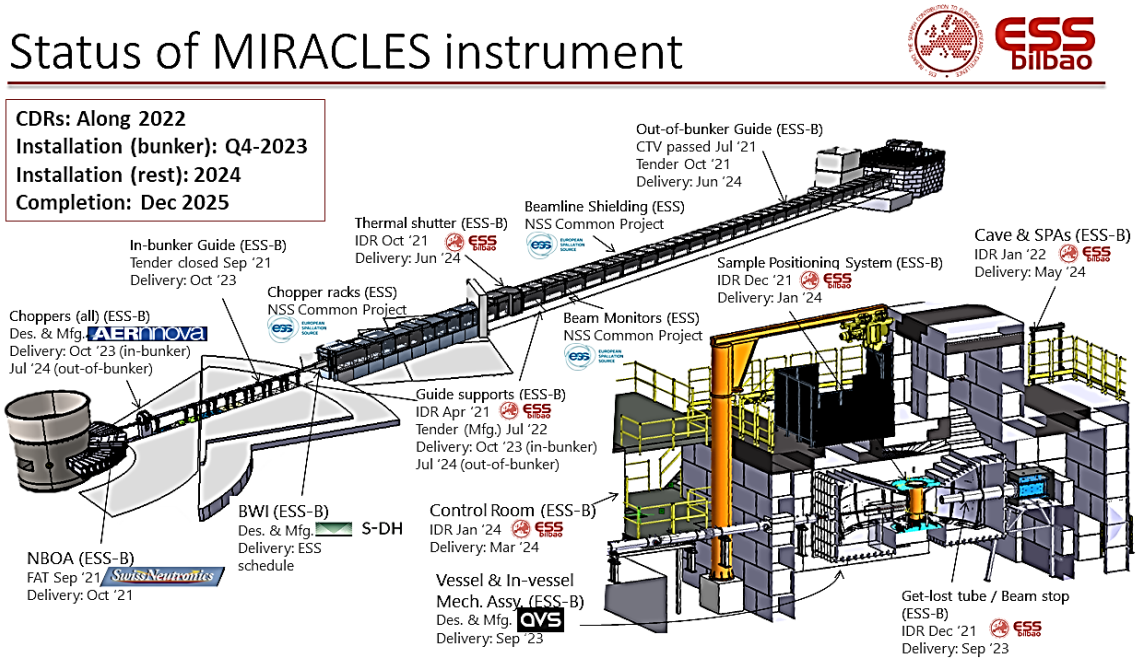

Figure 1. Illustration showing the status, providers and current milestones for the different components of MIRACLES.

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Beam transport

NBOA

The Neutron Beam Optical Assembly, NBOA, (section of the neutron beam extraction system that goes through the ESS monolith) has been manufactured by Swiss Neutronics, and the FAT were carried out. After ESS approval (Installation Readiness Review) this piece of guide, which is the first MIRACLES component to be manufactured, will be delivered to the ESS site.

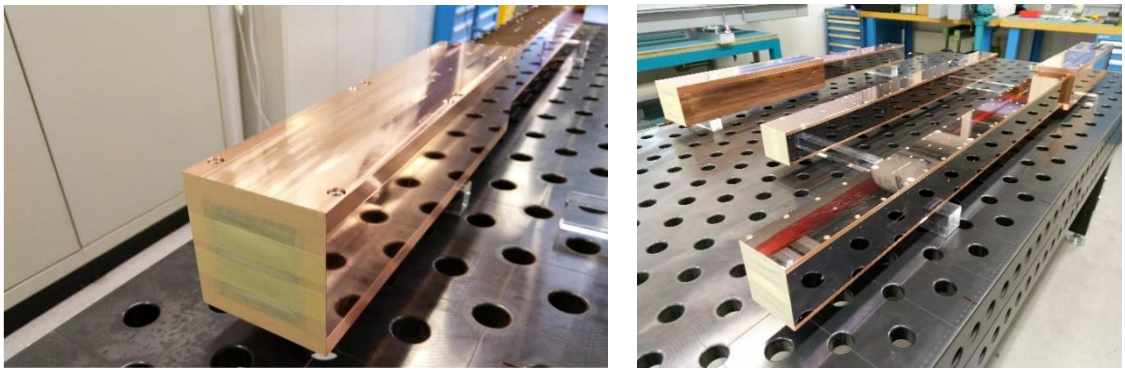

Figure 2. The MIRACLES NBOA.

BWI

The Bunker Wall Insert, BWI (section of the beamline that goes through the bunker wall) developed by S-DH, has experienced a significant advance in the design concept. The next step will be to incorporate the strategy for horizontal handling (in case of dismounting and reinstallation) which affects to the upstream flange (in-bunker).

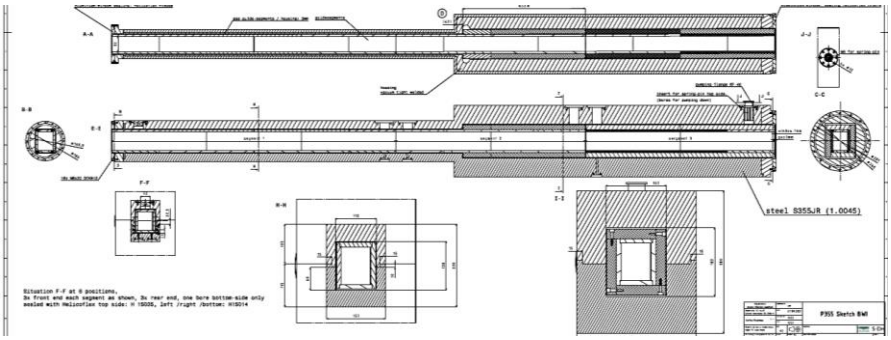

Figure 3. The MIRACLES BWI: preliminary drawings.

In-bunker guide

The tender for the in-bunker guide is ongoing. The bids are being evaluated right now and it will be awarded the 8th of October.

Out-of-bunker guide

The tender for the out-of-bunker guide is under preparation (after approval of the CTV this summer) and will be launched end of October.

Guide supports and housing alignment system

This component, developed in-house at ESS-Bilbao, after having an IDR last spring, is preparing for the development of a prototype to test the alignment concept. In any case, feedback from future guide providers is required to give final shape to the housing-support interface.

Beam stoppers (shutter, get-lost tube/beam stop)

ESS-Bilbao is developing a compact concept for the thermal shutter (see figure) located at L=52 m from the moderator. A 5 mm B4C/7 mm Pb shutter block will be driven by linear mechanism provided with a double-acting pneumatic actuator SMC Cylinder. An IDR will be conducted in October.

Additionally, ESS-Bilbao is developing a modular concept for the get-lost tube / beam stop assembly, which provides an easy installation. The transmitted beam will be captured by a B4C disk at the end of the get-lost tube, surrounded by steel and concrete.

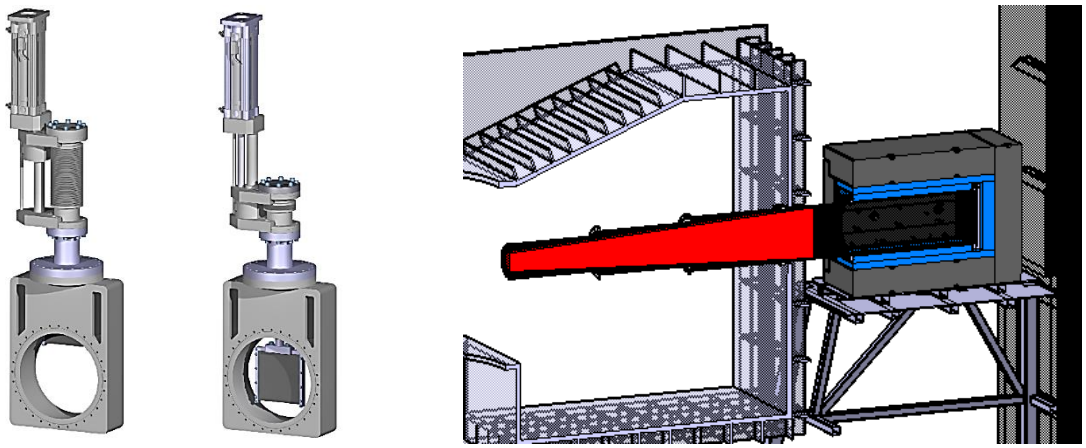

Figure 4. Designs of the thermal shutter and the get-lost tube / beam stop assembly..

Choppers

The MIRACLES choppers will be developed by Aernnova. Prior to the detailed design for the MIRACLES choppers, the company developed a prototype of a fast CFRP chopper and run tests at the SKF premises, provider of the chopper motors, in Calgary at above the speeds of the MIRACLES pulse shaping choppers. An IDR will be held by November.

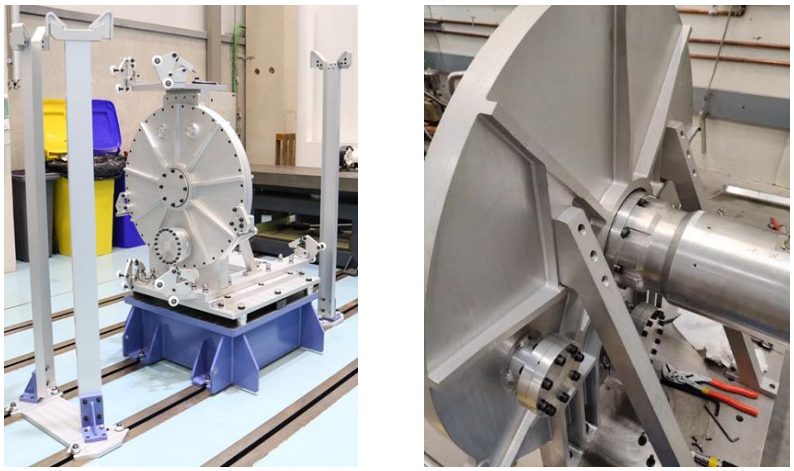

Figure 5. Fast chopper prototype developed by Aernnova (left) and test carried out at SKF premises.

Secondary Spectrometer

The vessel and in-vessel mechanical assemblies were tendered and awarded to AVS. A preliminary design is on track. The first task for the vessel is to give shape to the sample loading area, in which a trade-off between structural robustness of the vessel and ergonomics for realization of experiments is required. The first task for the in-vessel mechanical assemblies was the design of the motion, alignment and fixation of the analyzer.

The IDR is expected to take place in December.

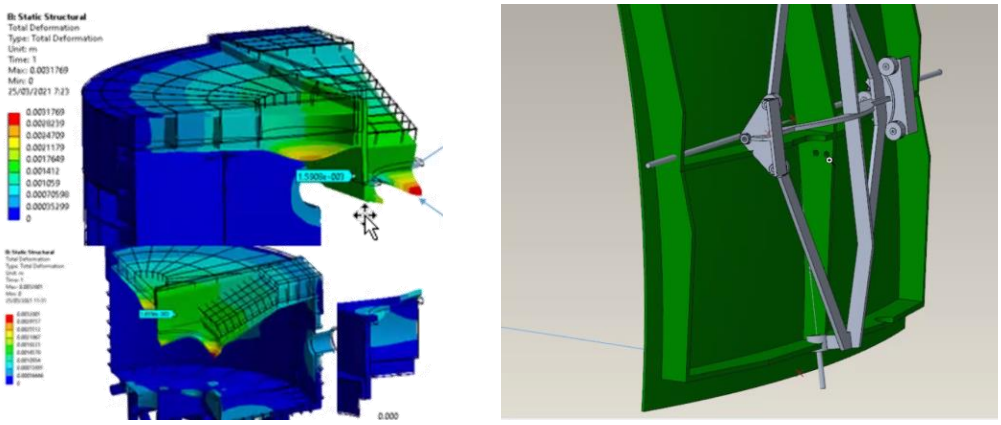

Figure 6. Structural analysis of the vessel, focusing on deflections around the sample area (left) and preliminary alignment mechanism of an analyzer panel (right).

Experimental End Station

Currently, ESS-Bilbao is carrying out the design of the cave. First contacts with providers of the concrete blocks are ongoing. On the other hand, the MIRACLES team is working on the design and motion of the sliding slab for the sample hatch (sample loading area), and in the utilities distribution for the sample preparation areas. An IDR is scheduled by January.

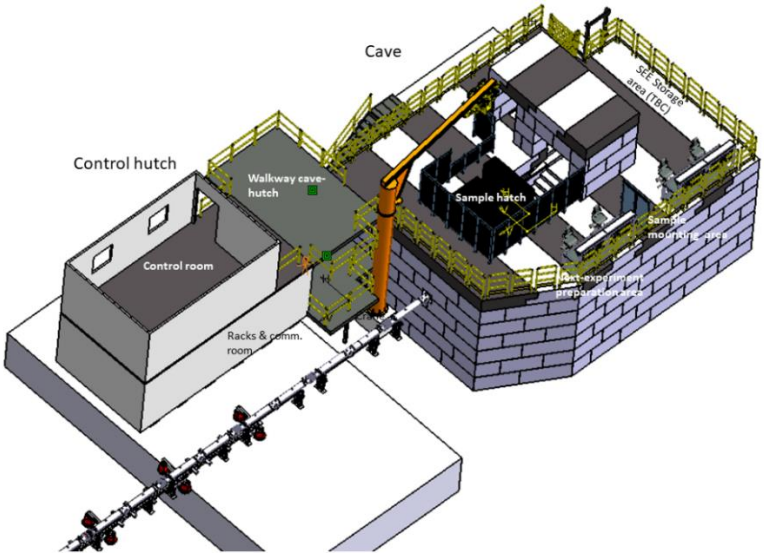

Figure 7. MIRACLES experimental end station.

Detectors and Beam Monitors

There is little advance with respect to last STAP. The ^{3}He tubes with the U-shape connection designed by Reuter Stokes and the front-end electronics (CAEN 8-channel A1422 preamp and R5560B digitizer) were ordered and the items are expected to arrive along October- November.

From there, several tests will be carried out before the end of the year. And the final tests to integrate the front-end electronics with the ESS backend readout electronics is expected to take place by 2022, after BIFROST integration tests.

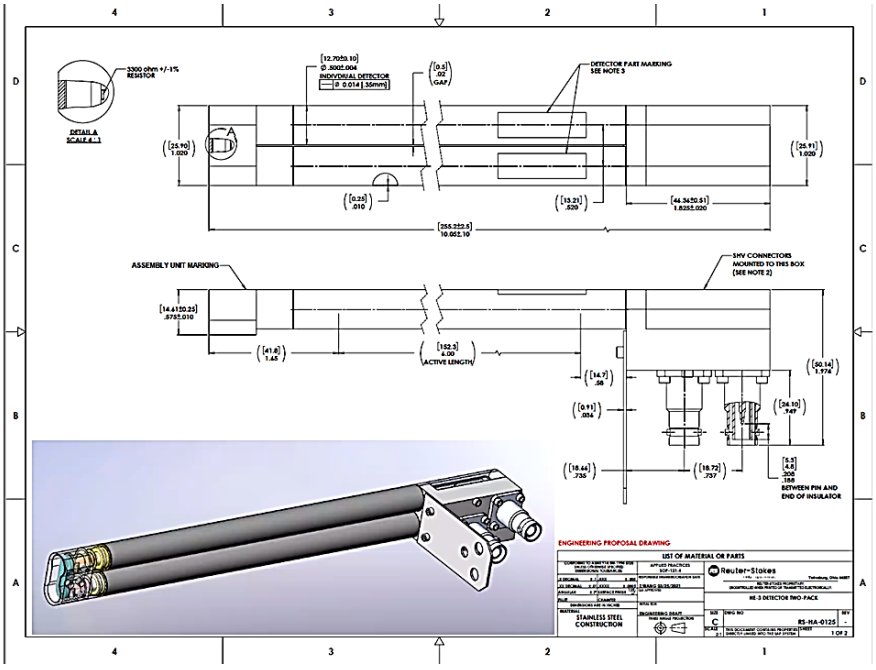

Figure 8. Design concept of serial connection of 3He tubes for MIRACLES (from Reuter Stokes).

Finally, MIRACLES has formally agreed to participate in the ESS Beam Monitor Common Project.

BM	purpose in experiment	integrated intensity (n/s) HF/HT	peak intensity (n/s) HF/HT	pulse length (ms) HF/HT	out of LOS	technology
1	monolith flux monitoring & PWD, PS chopper diagnostics	6e10/6e8	1.19e12/1.6e11	5.2/0.37	no	fission chamber/ I-BM
2	BW, FO chopper diagnostics	4.2e10/4.4e8	1.37e11/1.9e9	31/28	yes	GEM
3	normalisation	3e10/3.2e8	3e10/4.2e8	72/54	yes	MWPC
4	sample position determination	2.7e10/2.9e8	2.7e10/2.9e8	N/A	yes	MWPC (MultiTube)

Table 1: Performance requirements for the MIRACLES beam monitors at 2 MW for the high flux (HF) and high time (HT) resolution scenarios.