# Updates for DREAM instrument (October, 2021)

The following report describes major activities of the instrument project since the last STAP meeting in April, 2021.

**Relocations to ESS**
Mikhail Feygenson (instrument scientist from FZJ) and Sylvain Desert (lead engineer from LLB) have relocated to ESS in July, 2021. The relocation of Florence Porcher (instrument scientist from LLB) to ESS next year is under discussion.

**ICEB meeting**
The forth instrument consortium executive board (ICEB) meeting for DREAM took place on June 2021, by digital means. During the meeting, schedule, progress and issues were discussed between FZJ, LLB and ESS.

**Schedule update**
According to today's planning the access for the in-bunker installation of DREAM components will be on 15$^{th}$ of August 2022. The early access to the bunker is offered in April 2022 and it will be used by the DREAM team to prepare for T0 chopper and guide installations, as well as installation of the heavy shutter. Access to the experimental hall building is on track and it is already open for installation. The first installation activities for DREAM will start in Q4 2021 with the preparation work for the installation of both experimental caves. The current planning assumes a complete installation of DREAM by December 2023, which is still before the current beam-on-target (BOT) date in March 2024. The later completion date of DREAM is driven by delay in procurement of the dedicated cryofurnace and later delivery date of the high-resolution backscattering detector. The updated project schedule was communicated to ESS for the re-baselining activities.

**In-bunker optics: NBOA and BBG**
The manufacturing of NBOA and BBG were completed by SwissNeutronics. The NBOA was delivered to ESS, while BBG was delivered to FZJ for further integration with the bi-spectral switch.

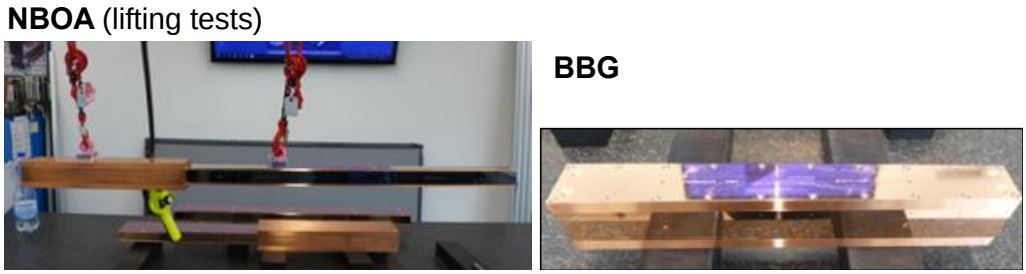


*Figure 1 Left: NBOA lifting tests. Right: BBG delivered to FZJ*

**Bi-spectral switch**
200 Si wafers coated with NiTi-supermirror (m=3) for the bi-spectral switch were manufactured by Nob Nano Optics Berlin GmbH and delivered to FZJ. The quality of NiTi-supermirror coating for selected wafers at FRM-II was cancelled due to the cold source issues. The reflectivity measurements of several wafers are now being pursued at AMOR instrument at PSI. We applied for beam time at SNS to test the assembled switch using cold TOF neutrons. Tests with thermal neutrons will be pursued at ISIS. The idea is to check the transmission and

alignment precision of the bi-spectral switch mounted on BBG. Later bunker access dates and more relaxed covid rules for external users at SNS and ISIS make such measurements feasible before start of the bi-spectral switch installation.

**Neutron guides**

The neutron guides inside and outside of the bunker have been procured as one package from SwissNeutronics, however the manufacturing was prioritized for the in-bunker guides. The intermediate design review of (IDR) of the in-bunker guides took place in June 2021, between SwissNeutronics, FZJ and ESS. The final design review (SubTG3) documentation was submitted in September 2021. The kick-off meeting for the out-of-bunker guides took place in August 2021. The last section of the guides has an interface with a polarizer and magnets array for the guiding magnetic field. The installation of the last section of the guide protruding the cave has to be coordinated with the cave installation. The installation of the in-bunker guides will be start in August 2022. The installation of the out-of-bunker guides can start after completion of both experimentally caves and the installation of the guide shielding base blocks (June 2022).

**Status of neutron guide shielding**

DREAM team has accepted the offer resulting from the ESS Common Shielding project. The SubTG3 review has taken place. No major problems were found with the proposed design. After resolving some of the minor issues with using a proper composition of concrete for neutronic simulations, the manufacturing of blocks has begun in Hungary.

**Chopper system**

The housing and base of pulse-shape and band-control choppers are undergoing final manufacturing steps and tests at Jülich Chopper group workshop at FZJ. The disks were manufactured by Airbus and delivered to FZJ. After leak tests are completed, the housing and disks will be shipped to Canada to the spindle manufacturer SKF in October 2021. The choppers will be assembled at SKF and undergo factory acceptance tests.

DREAM instrument will use T0 chopper prototype manufactured for the ESS chopper group. The factory acceptance test was completed in September 2021. The chopper will be shipped to ESS in October 2021. The chopper will be available for installation within the bunker access dates.


*Figure 2 Left: remote handling test of band-control chopper housing; right: remote handling rails for the pulse-shaping chopper.*

**Heavy shutter**

The ESS solution for the heavy shutter based on neutronics simulations provided by the DREAM team was accepted. The shutter mechanics itself was designed and manufactured by the external company Kinetic and FAT has been completed in August. The support frame is designed and manufactured by ESS. The shielding block is being procured.

**Detectors**

The first modules of mantle detector were tested with neutrons at TRIGA reactor in November 2020. Raw data and first analysis show very good results. One issue was found in the mechanical stability of these long elements resulting in short cuts. This has been analyzed, and the manufacturing can be improved for safe performance. The report is being finalized. The final version of the manual for mantel detectors was delivered by CDT, after feedback from DREAM team and ESS Detector group was received.

The serial production of mantle and endcap detectors is ongoing at CDT GmbH. The high-resolution backscattering and nm-SANS (RAC funded) detectors design is complete. Both detectors use the same $^{10}$B-techology as mantle and endcap detectors, however they have different modular structure consisting of the interchangeable cuboids arranged around a neutron beam axis. Both detectors will offer a high efficiency and resolution, with nm-SANS detector being optimized for longer wavelengths (>2Å). The installation of the detectors will take place after the caves and detector support structure are installed. The newer date for finishing the detector installation is in November 2023.

**Detector support structure**

The installation of the detector support structure is in the final stage at FZJ. The mounting plates for the end-cap detectors were installed and precision was verified using a laser tracker system. The vacuum cones for the sample vessel were installed and leak tested according to ESS standards. The mantle detector assemble unit, which will be used for maintenance of the mantle detector, is at final stage of construction (Fig. 3). The final assembly and tests of the detector support structure, sample vessel and sample vessel support are planned for January 2022.

*Figure 3 Mantle detector assembly unit at FZJ*

**Experimental caves**

The tender to design and manufacture two experimental caves was awarded to MICO company. The same company will be manufacturing the experimental hutch and sample preparation lab. It allows a certain flexibility during the installation of both caves and hutches.

The design of the caves is being finalized. SubTG3 documentation was submitted in August 2021, after IDR meeting in June. We are currently finalizing design and location of electrical panels and utilities. The requirements for the ESS common electrical and utilities projects are being finalized as well. Together with ESS PSS team we are developing methods of access to various parts of the caves. The preparation work for the cave installation will start at the end of this year. According to the current schedule both caves will be erected by June 2022. The outfit of the first sample cave will be completed in August 2022.

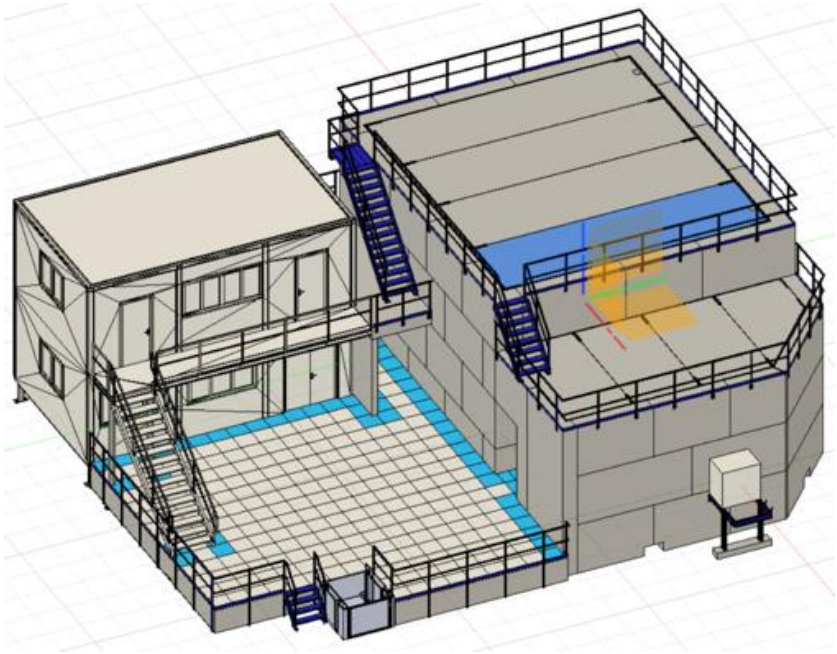

*Figure 4 Layout of the experimental caves and control hutch with the sample preparation laboratory.*

**Control hutch and sample preparation lab**

MICO company will also design and construct the DREAM control hutch and sample preparation lab. Again, the interface with ESS common projects was considered. After IDR meeting in June, the design of hutches was changed to full pre-cast solution due to stricter requirements of ESS for the fire safety. Redesign has no impact on the cost and delivery schedule for the hutches. The SubTG3 documentation for the hutches will be submitted in October 2021. The hutch will be built a month later after completion of both caves, i.e. in July 2022.

**Development of personnel safety system (PSS)**

We note a good progress with ESS developments of PSS for DREAM. We now have regular meetings with PSS team to review the PSS concept of operations. Procedures for accessing sample position from ground and upper floors are being discussed. The PSS will be developed for the first cave only, with the reservations made for the second experimental cave.

**Sample vessel**
The milling of the sample vessel is complete (Fig.5).

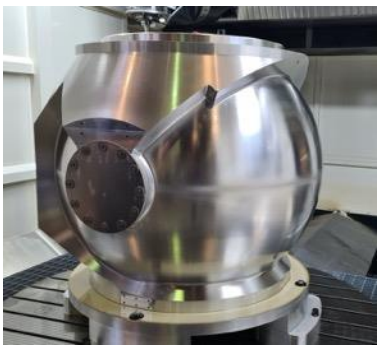

*Figure 5 Sample vessel after milling process*

The thickness of 2.2 mm along the neutron scattering flight pass was verified. The sample has been shipped to Switzerland for galvanizing. After pre-assembly and leak tests at FZJ, the sample vessel will be delivered to ESS in August 2022 for installation. The sample vessel cover made of plexi glass was manufactured. It will be used during the transportation and for storage.

**Sample vessel support**
The design was updated to accommodate the most recent change in the type of kinematic mounts imposed by ESS. The sample vessel support is undergoing final modifications. The sample vessel support will be shipped from LLB to FZJ by the end of this year for the pre-installation with the sample vessel and detector support structure at FZJ.

**Sample environment**
There was a significant administrative delay with the publishing of new call for tender for DREAM cryofurnace since last STAP meeting. The new tender with reduced requirements (discussed in the previous STAP report) was published in September 2021. According to the proposed schedule in call for tender the cryofurnace should be available before BOT.

**Instrument control software development**
DREAM team has provided the requirements for the instrument and experiment control to DMSC. The requirements were agreed with other diffraction instruments. DREAM team has monthly meetings with members of DMSC, which are responsible for implementing the requirements using NICOS interface.

**Data reduction workflow document**
This document is still a work in progress. It was decided to provide the requirements for the 1D Rietveld data reduction first. SANS and PDF workflows will be added after that.

**Development of polarizer setup**
We continue working on the implementation of the cold polarizer ($^3$He cell) into the last section of the neutron guide. The design of the magic box setup is ongoing based on the setup used at POLI and T-REX instruments. Due to cold source issues at FRM-II, the tests of guiding field assembly cannot be performed this year. We are looking into alternative tests at Delft University reactor in Netherlands.