Spectroscopy STAP, May 2022

Update on the progress of BIFROST

General progress summary

Most of our procurements are now well on track. We have signed purchase orders for the detector tubes and the ADC electronics (R5560). The full guide system is being delivered in stages, and the in-bunker guides are all at the ESS. The guide has been aligned in the bunker wall insert, and installation of the in-bunker components will comments in mid-May 2022. This is both challenging and exciting, since the space in the bunker is very tight. The sample stack has now been fully assembled, and the orange cryostat has been delivered. The base plate of the orange cryostat had not been machined, which delayed the SAT, which is yet to be done. Pictures are shown at the end of the document.

The detailed design is now pretty much done from our side. We have yet to get the detector cabling scheme and the detector electronics formally approved by the ESS, but the mechanical design is ready for procurement. The data format has been agreed with the ESS and the CEAN supplier, and the firmware is close to being finalized. We will test the detector system firmware with neutrons, including the readout chain, mitigating as much hot commissioning risk as possible, and involve the other teams in the results.

The beryllium filter TG3 is approved and the filter is in production, to be delivered in September 2022. We have tested the HOPG with neutrons on POLDI, and the results are beyond expectation. The graphite mosaicity is surprisingly uniform, and we did not have to reject a single piece. We have tested only 300 crystals out of the 1000 procured, due to beamtime constraints. We have also signed a contract for the moving cave hatch, and the project is well underway.

Regarding infrastructure, we still need final offers from the ESS, and thus electrical infrastructure, utilities and Personal Safety System (PSS) is still unbudgeted and design work has not commenced. However, the common electrical projects has finished the requirements document and are ready to issue a budget, which we will be expecting in the coming weeks.

We now have a PhD student working with Kim Lefmann, who is supposed to work on BIFROST for 2 years, in the period 2022-2026. The plan is currently to do the conceptual design of the polarization upgrade, and to simulate resolution and inelastic signals on BIFROST. While we have done the simulations of the design relevant subcomponents, a performance study, using the instrument after the detailed design process has yet to be done. Once the installation is closer to completion, this will be prioritized by me in collaboration with KU.

STAP 21 – Question 1:

“Regarding BIFROST guides in the bunker, the report states “Installation complete by June 22, ESS may need to remove installations afterwards for Target installation works”. Can this be clarified? Will it be necessary to remove BIFROST installations for ESS target installation?”

Yes, our guides near the monolith are remotely handlable, so the ESS will need to be able to take responsibility for removing the segments of guide and the PSC chopper, for NBOA installations or maintenance work. This work has luckily been foreseen, and we have designed for it. However, the bunker will be very tight and the removal and repositioning of guides and choppers near the monolith is no easy practical task.

STAP 21 – Question 2:

“We are wondering if BIFROST relies too much on Cd for thermal neutron shielding which becomes transparent above ~250 meV. We recommend this be revisited.”

The tank, including the full detector system, will be enveloped by 150 mm of borated polyethylene to thermalize and capture as many fast neutrons as possible. The inner cadmium layer serves to mop up any thermal neutron penetrating the borated polyethylene layer. During the presentation, I will show the background shielding strategy.

Below follows a comprehensive list of component status updates.

Component progress summary – from monolith to sample

- NBOA – Manufactured and Assembled. Shipped to ESS.
- BBG – Manufactured and Assembled. Shipped to ESS
- In Bunker Guides – In manufacture.
    - FAT done in February 22
    - SAT planned for March 22
    - Installation to begin in May 22 and completed by June 22
    - ESS may need to remove installations afterwards for Target installation works.
- In Bunker Choppers
    - Slow discs in manufacture
    - Fast discs CDR done
    - Spindles ordered
    - Rack SAT at ESS
    - Chopper CDR done
    - Installation of first chopper to begin in May
- Bunker Wall Insert – Received at the ESS – guide aligned
- Beam Monitors – Opted out of the common beam monitor project
    - Opted out of the common beam project, procuring beam monitors ourselves
- Out of Bunker Guides – In manufacture.
    - FAT for most systems done, last FATs due in May 22
    - SAT planned for June 22

    - Installation complete by August 22
- Beamline Shielding
    - Certain D03 blocks installed to allow further installations
    - E02 side blocks installed
    - All E01 blocks installed
    - All blocks installed (or ready to install) by mid 22
- Thermal Shutter – Assembled at ESS
    - PSS information has changed so modifications needed
    - Base to be installed in June
    - Still awaiting control box and PSS inputs
- E02 Chopper
    - Slow discs in manufacture
    - Spindles ordered
    - Rack SAT at ESS
    - CDR concluded in July
    - Planned installation Q2 22
- Cave – Installed and complete
- Divergence Slits – SAT complete and awaiting installation in Q3 22
- Sample Stack
    - Rotation Stage Installed
    - Mechanics installed, including goniometer, but awaiting cabling
- Orange Cryostat delivered at SAT to be done in May 22
- Tank – Installed and complete
- Background Shielding
    - Cadmium at ESS and awaiting installation during Q2 22
    - Cross Talk Shielding at ESS and awaiting installation during Q2 22
    - Borated Polyethylene at ESS or in manufacture. Install Q3 22
- Beryllium Filter
    - Beryllium ordered
    - CDR in October
    - Planned delivery in August 22
- Detectors – In design
    - Tube contract signed.
    - Mechanical design complete. Sub-TG3 done
    - Electronics design almost complete
    - Planned assembly Q4 22
- Beam Stop – Installed and complete
- Crane – Installed and complete
- Hutch – Installed and complete
- Electrical Design – No progress – Waiting for ESS common project resource
- Utilities Design – No progress – Waiting for ESS common project resource
- PSS Design – No progress – Waiting for ESS common project resource

Financial status:

The major risk is still the unbudgeted common ESS projects, that stand to have considerable cost. We hope and believe that our current budget is sufficient.

Risks:

Given the estimated BoT date, we see few relevant schedule risks. The major project & scientific risks are the following:

- Component breakage during installation
- Loss of key ESS or partner personnel for component integration and fulfillment of the common project responsibilities (especially detectors)
- Lack of ressource availabity.

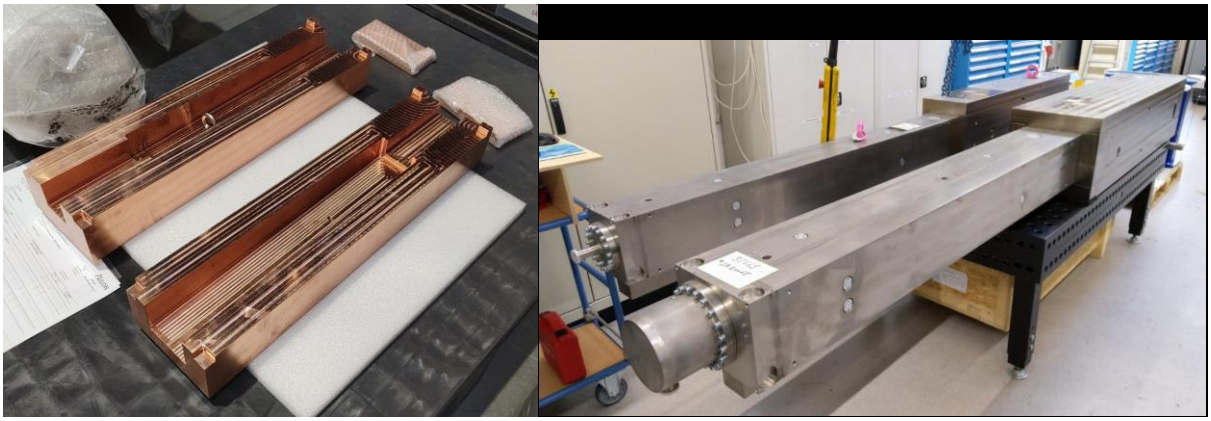

Figure 1 – (left) In-bunker copper collimator. (right) Two bunker wall inserts, BIFROST is the one to the left

Figure 2: (left) Chopper housings for BIFROST. (Right) Chopper control racks

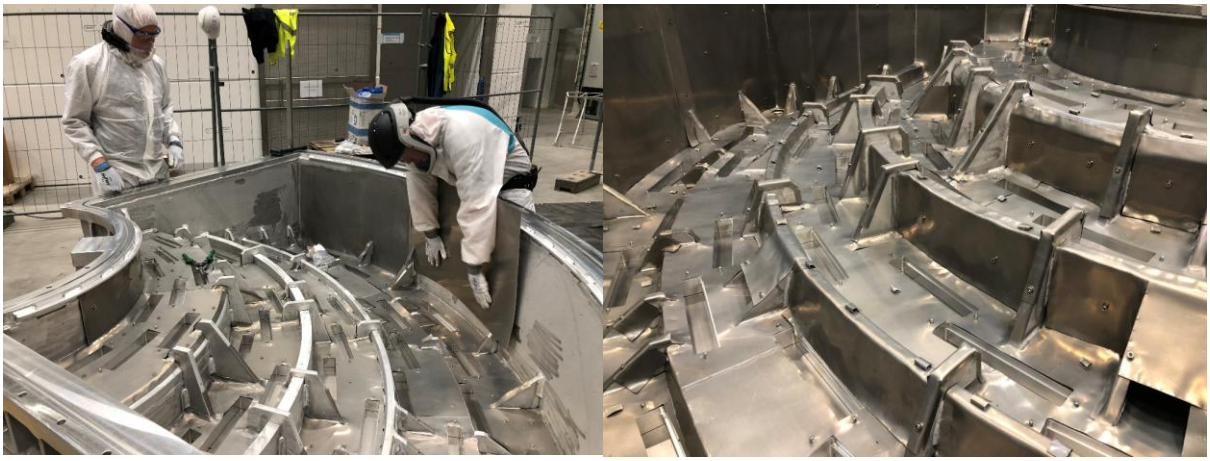

Figure 3:(Left) Two safe technicians mounting cadmium plates. (Right) Cadmium covered on the spectrometer tank floor

Figure 4:(Left) Sample stack assembly. (Right) Orange cryostat base including goniometer

Figure 5: (Left) NBOA guide pieces delivered. (Right) Orange cryostat delivered

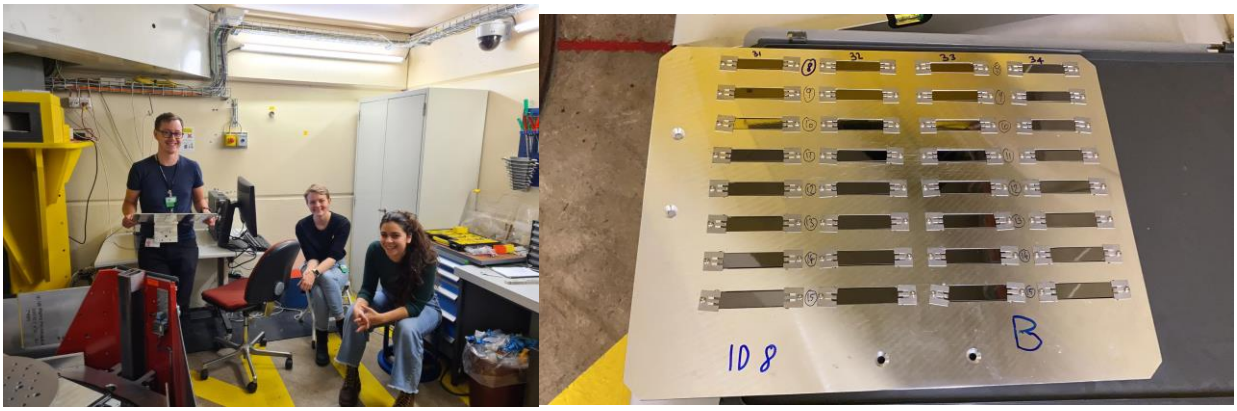

Figure 6 (Left) Happy young scientists before fully knowing what they agreed to. (Right) HOPG crystals mounted on plate for neutron test

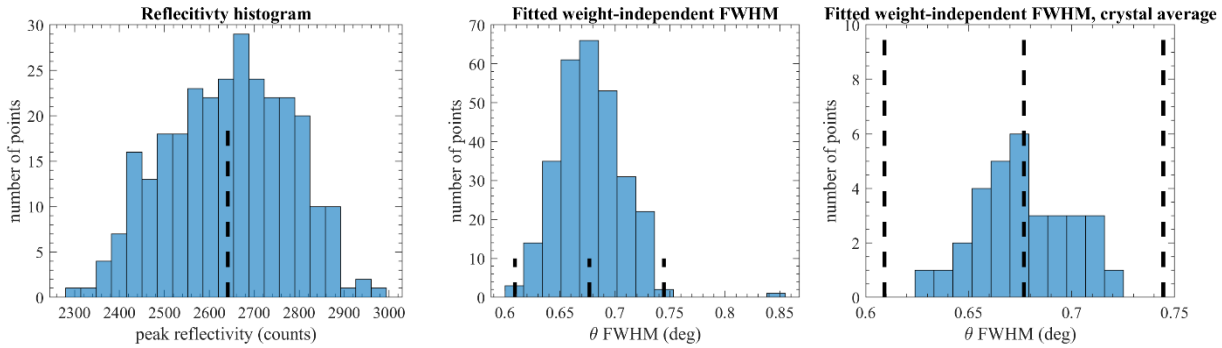

Figure 7:Example of data from a single plate of crystals