CSPEC STAP report October 2024

D. Noferini, W. Lohstroh, S. Longeville, F. Moreira, M. Campos, M. Olsson, G. Tucker.

CSPEC is the cold chopper spectrometer at the ESS. CSPEC TG5 (final ESS internal review, corresponding to the end of construction phase with relative documentation and licensing) is currently planned in August 2027. The science case for CSPEC is very broad and will satisfy many different communities such as magnetism, soft matter, energy materials, life science. CSPEC has a strong focus on small samples, in situ and operando, kinetics etc.
Most recent CSPEC paper: Rev Sci Instrum. 2021 Oct 1;92(10):105104. DOI: 10.1063/5.0059907
In this STAP report, we provide an overview of the status of the main components.

Guides and housings

NBOA and BBG (first guide elements): installed. BWF (bunker wall feedthroughs) installed. TUM guides: ca 90 m of out-of-bunker guides are on site; ca 58 m are produced/in production, 2 pieces needed resputtering (ongoing); ca 2 m are currently under design. An installation test is scheduled in October, with start of installation campaigns in December 2024, spring and summer 2025. All the out-of-bunker housings and supports have been produced, delivered and accepted. The in-bunker housings and supports successfully passed the factory acceptance test (FAT) and will be delivered at end of October.

Figure 1 In-bunker supports and guide housings at Nortemecanica

Shutter

A prototype was produced and tested. Some corrections are needed and we expect to finish the installation in September 2026. A temporary shutter will be installed in 2025.

Shielding (common project)

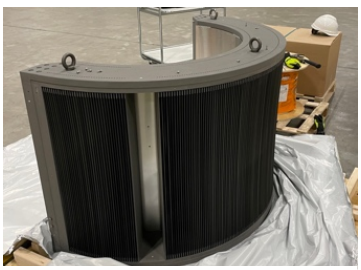
All the shielding blocks for the primary spectrometer have been produced.

Choppers

All the disks are manufactured and tested. There were some technical problems for the hubs and we accepted some delays to allow the most robust fix and an extended testing period. The new spiral hub has passed the tests so far. In bunker choppers will be delivered in December, out of bunker choppers in May 2025.

Figure 2 CSPEC choppers at Airbus

Radial oscillating collimator



The collimator is completely manufactured and arrived at the ESS. The collimator drive is currently under design (CSPEC team). We expect the component to be finalised in May 2025.

Figure 3 CSPEC radial collimator

Cave and control cabin

The subTG3 meeting was done in September. The installation will begin at the end of October, the main structure will be finished in the second week of December, in order to allow the installation of the tank.

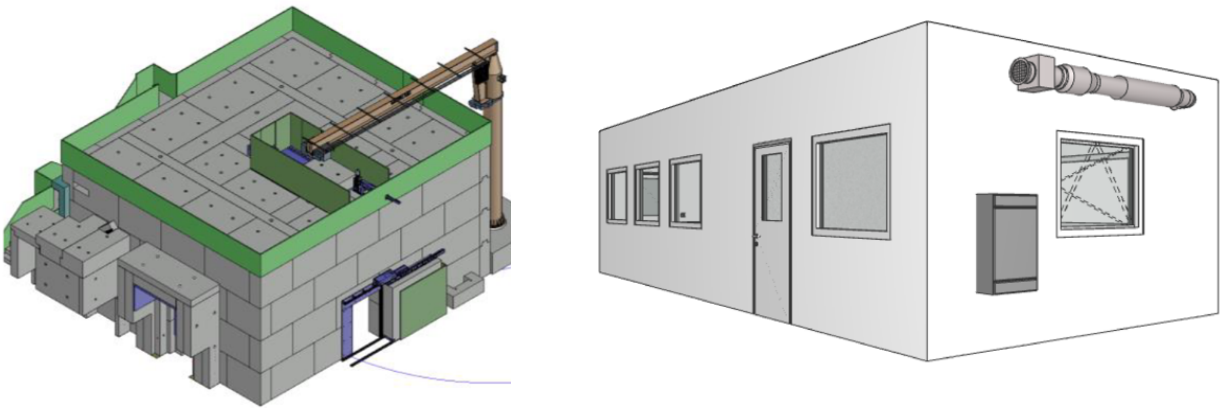


Figure 4 Detailed design of the cave (left) and control cabin (right) by MShield.

Electrical installation and utilities installation (common projects)

Detailed design for utilities and electricity is ongoing. The priority is on the bunker, for which plans have been made. The out of bunker detailed design will start after the cave installation.

Sample environment

The tender for the cryofurnace is to be published shortly. Preliminary work for the 12-14 T spectroscopy magnet to be used on CSPEC and TREX is ongoing. For the hot commissioning we plan to have ready the cryofurnace and the rotation stage.

Detector tank

The detector tank is expected on site in December. The procurement of the cadmium sheets and polyethylene blocks for the bottom part is ongoing. The design of the polyethylene blocks for the sides and the top part is ongoing.

Figure 5 CSPEC tank manufacturing at SDMS.

Detectors

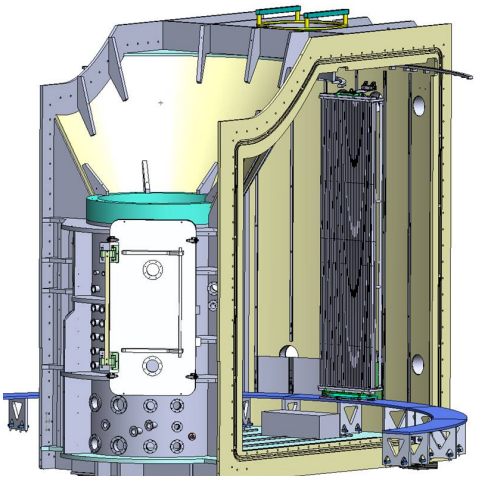


Figure 6 Cut of the tank with a MT module.

The collaboration agreement with the ILL to deliver 12+1 MultiTube (MT) modules was signed in July 2024. This date sets the T0 for the delivery of the MT modules as:

- T0 + 28 months: modules 1-4. → These modules are considered to be sufficient to start hot commissioning at the instrument.
- T0 + 34 months: modules 5-8.
- T0 + 40 months: modules 9-13.

The amount of gas available for day 1 on CSPEC is planned to be sufficient to ensure 2.5 bar in 7 modules, hence providing the efficiency (60% or more at 4 Å) and the horizontal angular coverage (ca 58%) agreed at the scope setting meeting. The gas can be distributed in different ways among the 12 modules (e.g., all the 12 modules can be filled, or a smaller angular range etc). However, this will obviously affect the pressure in each module and hence the detector efficiency.

A rescoping document (ESS-5355413) was submitted in order to increase the amount of available ^{3}He gas, to reach full horizontal coverage with 2.5 bar (initial upgrade) and 5 bar (optimal upgrade). A further upgrade can be realised by filling the region below and above the beam stop with small modules (ca 18 tubes with 1-inch diameter and 1.25 m height).

Beam Monitors (common project)

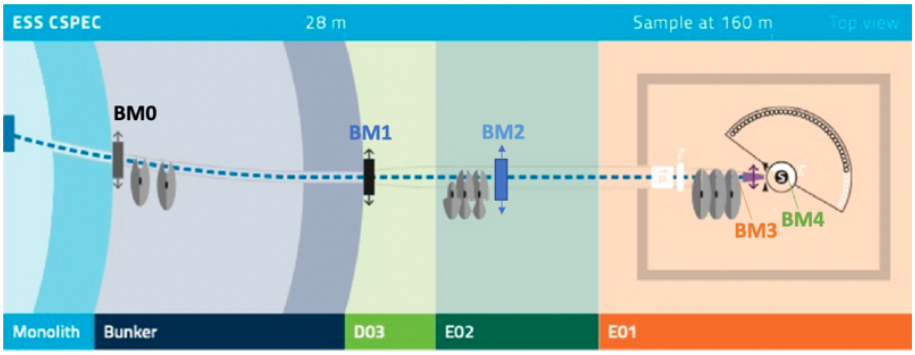


Figure 7 Sketch of the locations of the beam monitors

The solutions currently envisaged for CSPEC beam monitors (BM) within the common project are:
BM0 (in-bunker, fixed): ionisation beam monitor (IBM), CDT Germany. Not CSPEC scope
BM1 (removable): IBM or micromegas (MM), CEA, France
BM2 (removable) and BM3 (fixed): MM
BM4 (after sample): neutron camera. A monitor from the common pool will be used for commissioning and maintenance.
Plans for a fixed transmission monitor for polarisation analysis (not day 1).

Instrument control, data acquisition, transformation and analysis

The control of the instrument will be via NICOS. A set of requirements have been discussed, but the work on a specific version for CSPEC has not yet started. The data acquisition will strongly profit from the work on BIFROST: as the digitisers and firmware are the same (or only slightly different), the Event Formation Unit will be based on BIFROST one. We are working together with DMSC and DetG to a new Detector Interface Control Document. The data transformation will be done via SCIPP. A specific workflow for CSPEC is not under active development yet, but it will partially use the work for BIFROST and some specific first requirements have been discussed. Data analysis is advancing also thanks to the addition of Henrik Jacobsen to the DMSC DRAM group. Henrik is working with the CSPEC team to implement the data analysis software EASYdynamics.

Hot commissioning and first science

The hot commissioning time will be strongly driven by the source performance. The CSPEC team will profit from the experience of the first instruments, and especially BIFROST. Plans are ongoing to ensure the participation of the CSPEC scientists to the hot commissioning on BIFROST. The CSPEC team expect to profit also from the support and experience of the in-kind partners.