

# T-REX instrument project: Report of activities for the STAP Meeting in April 2023

## 1.1 Instrument project overview

The T-REX instrument project is a collaboration between the German JCNS (75%) and the Italian CNR (25%), with a total agreed value of 16.85 M€. The project passed officially TG2 in August 2017. The Technical Annex has been signed and endorsed in January 2020.

The project of T-REX is expected to achieve completion in June 2026. The driving component for this milestone is the MG detector which should be supplied by ESS.

The agreed scope includes the delivery of a world class Direct Geometry Chopper Spectrometer (DGCS), capable to perform INS experiments for a broad user community spanning from magnetism to functional materials and functional soft matter, including the option of using polarized neutron for x-y-z neutron spin analysis. In the first-day, T-REX was planned to be equipped with about 40% of detector area, equivalent to 0.8 sr. The instrument specific SE will be a dedicated cryostat.

Currently the T-REX team is working on a cost neutral work package exchange between the partners to facilitate work on the interfaces between the components.

We here provide a brief overview of the progress in Q4-2022 and Q1-2023, in preparation of the next STAP meeting in April 2023.

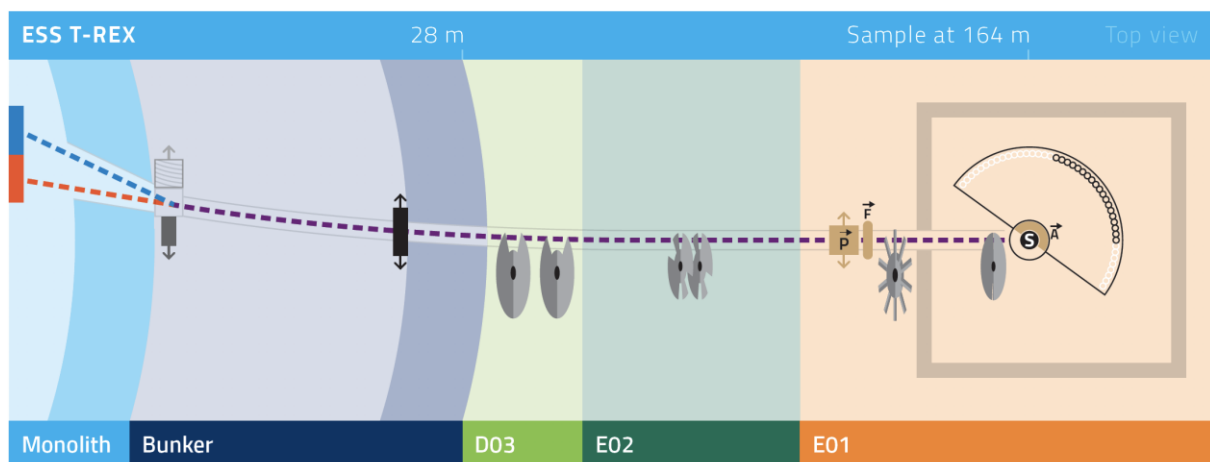


Figure 1. T-REX layout overview.

## 1.2 Beam transport system

### 1.2.1 Neutron guide

- **Neutron guide in-bunker:** SubTG3 approved (16.03.2023), manufacturing is in progress.
- **Neutron guide out-of-bunker:** contract awarded to S-DH. Design is ongoing and split into 2 portions: from bunker to FAN chopper and after FAN chopper to the end.
- **BBGOA:** Detailed design is in progress. We cannot use the standard housing provided by ESS for space reasons, but have found a good solution together with S-DH and NOB (providing the bender).

### 1.2.2 Heavy shutter

- SubTG3 has been approved (16-08-2022).
- Procurement of parts is finished, assembly is ongoing.
- Shipment to ESS is planned for autumn 2023.

### 1.2.3 Beamline Shielding

- T-REX is joining the ESS common project for this work package.
- Kick-off meeting took place (20-03-2023).

### 1.2.4 Choppers

- **Bandwidth choppers:** pending decision on procurement through the common chopper project or alternative options. Calculations and simulations allow the use of smaller discs (700 mm instead of 1200 mm) to save cost. All offers (Common project, mirrortron and Airbus) are still over budget. Discussions are ongoing.
- **P- and M- choppers:** the sub-project is on the way with the engineering department at FZJ (ZEA-1). IDR passed on 22.02.2023, with permission for early procurement of the chopper discs. This is necessary because of long lead time for the discs. FZJ spindels are chosen over SKF for these choppers.

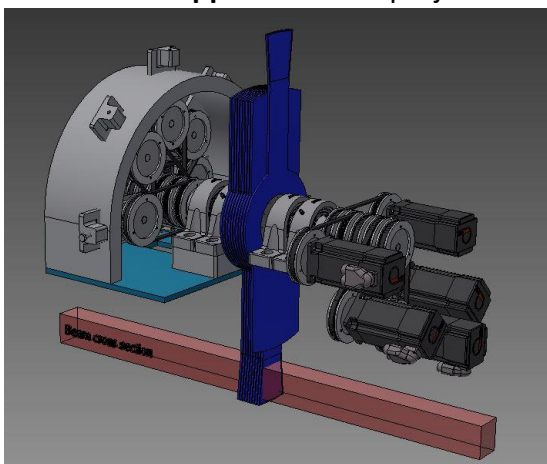


Figure 2: CAD model of the FAN chopper for T-REX

- **FAN chopper:** A kick-off meeting with the ESS chopper group took place on 27.03.2023, where our inhouse design (FZJ-JCNS) was presented. We are now approaching IDR level for this component.

### 1.2.5 Primary collimator

- The problem with the deformation of the vacuum vessel is solved by decoupling the primary collimator assembly from the vacuum vessel. It now has its own support pillar.
- Mechanical design is finished.
- Currently discussions with Thomas Gahl (ESS) on selection of motors, encoders and resolvers.

### 1.2.6 Polarization

This is a complex work package with many interfaces to other WPs, e.g. the M-chopper. Also components such as the thermal polarizer or spin flipper are not commercially available and must be developed according to the instrument needs and constraints. We are in contact with Hal Lee (Polarisation group ESS).

- **Cold neutrons polarizer:** in production at SNAG, SubTG3 planned for 04/23, SAT 09/25.
- **Thermal neutrons polarizer:** currently preparing documentation for design review.
- **Spin flipper:** We are currently designing a broadband neutron spin flipper for the use with cold and thermal neutrons.
- **Guide field (spin transport):** magnetic field calculations in progress, necessary components identified. Guide fields after the M-chopper fixed.
- **Adiabatic field (spin rotation):** magnetic field calculations in progress, necessary components identified.
- **Guide/polarizer exchange unit:** Preliminary design finished, waiting for final design of the thermal polarizer.
- **PASTIS set-up:** not yet started.

## 1.3 Scattering characterization system

### 1.3.1 Detector vacuum vessel

- Contract is awarded to the company AVS, cutting of raw materials is in progress, FAT is foreseen for end 2023.
- A pre-installation phase (agreed with ESS at T-REX review late 2022) in Jülich in 2024 will be used to integrate equipment such as the gate valve, radial collimator etc. Vacuum test with the full assembly will also be done. Delivery to ESS is foreseen for early 2025.
- Detector support structure and alignment tool are in production in Jülich, along with the elevated floor for the vessel.



Figure 3: Raw material for the detector vessel at AVS

### 1.3.2 Detectors Integration box

Manufacturing of the prototype of the detectors integration box is ongoing. The company Kress is testing a new tool for the manufacturing of the main body, which will improve the manufacturing quality of the detector box.

The pedestal for detector installation into the chamber in Jülich is almost finished, as well as the transport trolleys for the detector boxes.

### 1.3.3 MG-Detector

The detector remains the highest risk for the T-REX project. The instrument depends on the Multi-Grid technology, mainly for the high expected count rate at thermal energies and budget reasons. The detector box prototype and detector floor are already in production, as further delays are not acceptable for the project. ESS has given green light for this.

During the last ICB meeting, ESS has announced that no personnel will be assigned to this project in 2023 since T-REX is a tranche 3 instrument. No plan was given to further develop this component. The detector is on the critical path for the project and pushing our TG5.

### 1.3.4 Oscillating collimator

The magnetic bearing and most parts for the drive of the collimator have arrived in Jülich. With these, the test setup will be completed and operation can be tested with test weights

and ensure smooth operation. The collimator itself is part of the work package exchange between FZJ and CNR. We have asked for updated offers from suppliers.

## 1.4 Experimental cave

The instrument team discovered some possibilities to improve the cave design towards a better usability for instrument scientists and users, e.g. easier access to the sample position. The new design has also shorter distances from the experimental hutch to the instrument while retaining the space for setting up a subsequent experiment. The instrument team is working hard to finish the CTV documents before the ESS summer break. Weekly meetings monitor the progress. A potential risk is the drastic increase in cost which was reported by other instruments.

The finalization of these documents and its approval is essential for the timeline of instrument installation since the elevated floor is a part of this work package and the delivery of the detector vessel can only be done after the construction of the elevated floor.

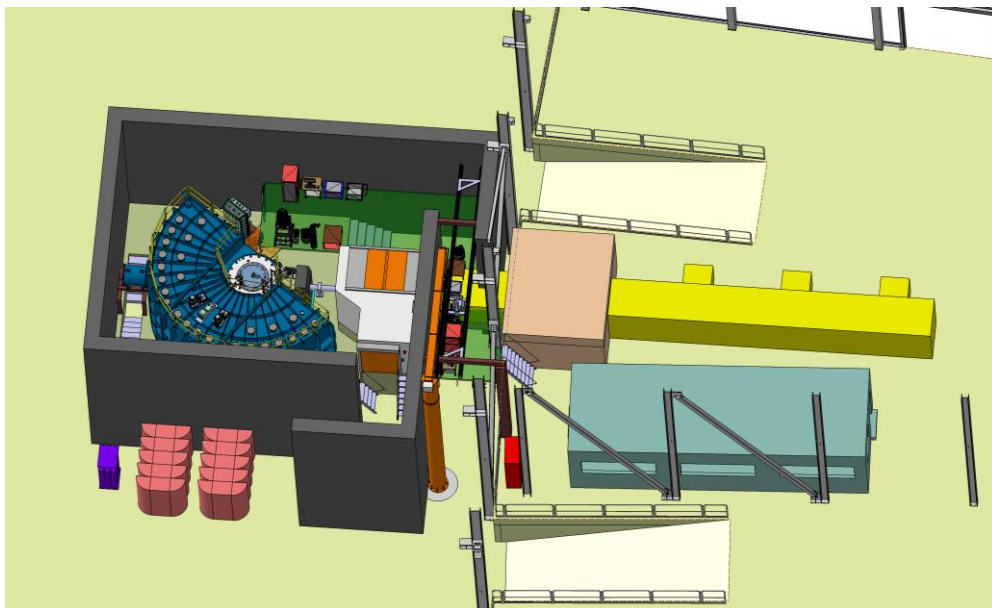


Figure 4: One of the preliminary concepts for the T-REX cave

## 1.5 Safety systems

Nothing to report on this.

## 1.6 Project Risks

Top 5 Risks				
Title	Rating	Category	Partner	Treatment
Detector performance requirements may not be met	25	Quality	ESS	Avoid
Mult-Grid Detector not ready for hot commissioning	25	Schedule	ESS	Avoid
Increasing costs of materials (Experimental cave)	25	Cost	CNR	Reduce
Guide suppliers working at capacity	10	Cost	FZJ	Observe
Final TG3 delayed	9	Schedule	FZJ	Observe

## 1.7 Staffing

FZJ:

- No changes

CNR:

- Alessio Laloni has joined the team as a technician and designer. Alessio was part of the ESS detector group before moving to CNR, and is therefore already very experienced with ESS.

ESS:

- The partners are considering hiring an engineer on site.