



**EUROPEAN
SPALLATION
SOURCE**



ESS Target System development and corrective maintenance

PRESENTED BY ULF ODÉN

2022-09-14

Agenda



- 1 General overview Target System
- 2 Target Wheel
- 3 Monolith Vessel Inner Shielding
- 4 ESS supplier experience



Future needs ESS Target Station

Representative examples

Target System

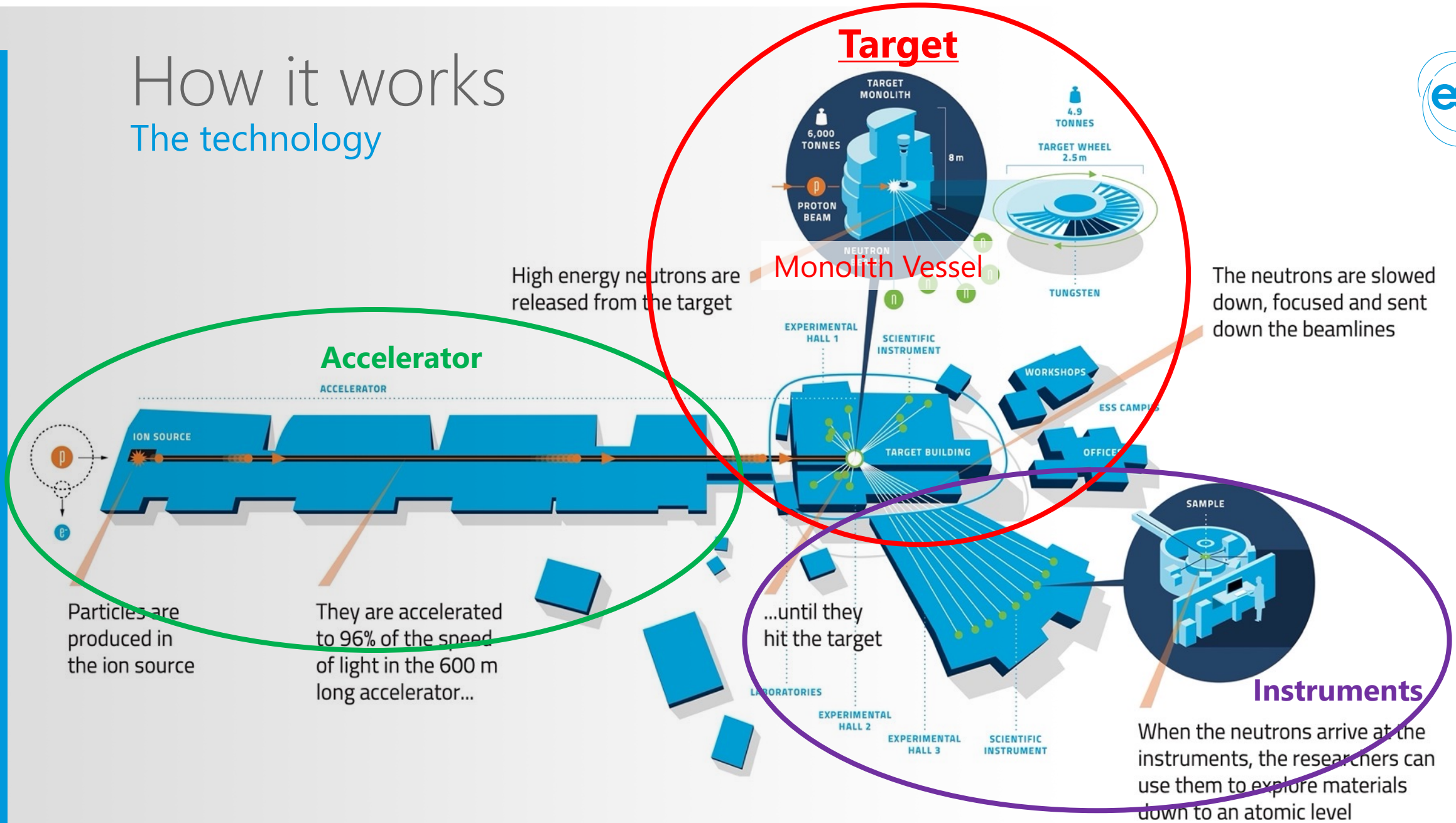
Target Wheel: design upgrade and replacement

Target Instrumentation: additional system

Maintenance of heavy components - vacuum/radiation: maintenance support

How it works

The technology



Target

Monolith Vessel

Accelerator

Instruments

High energy neutrons are released from the target

The neutrons are slowed down, focused and sent down the beamlines

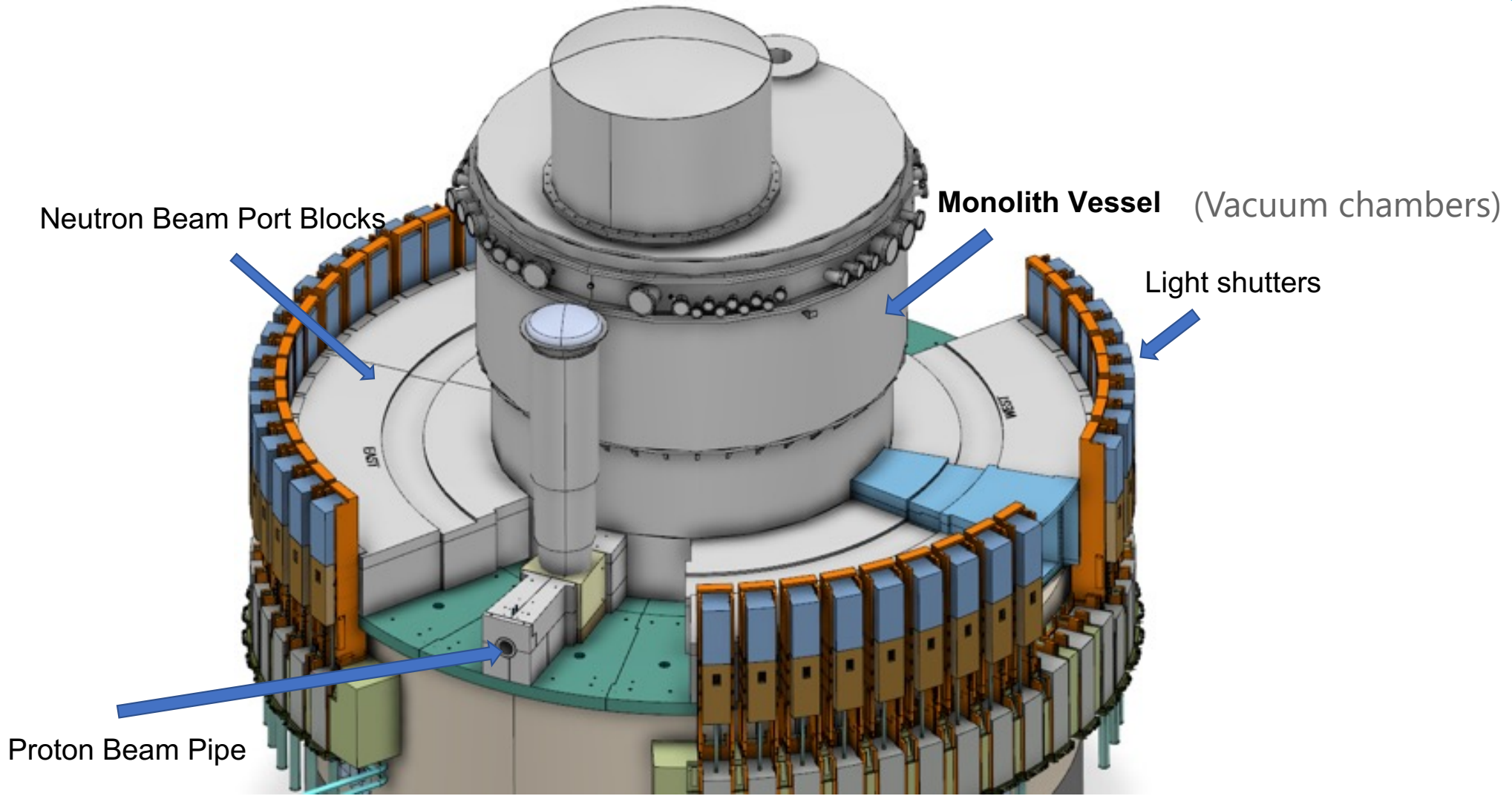
Particles are produced in the ion source

They are accelerated to 96% of the speed of light in the 600 m long accelerator...

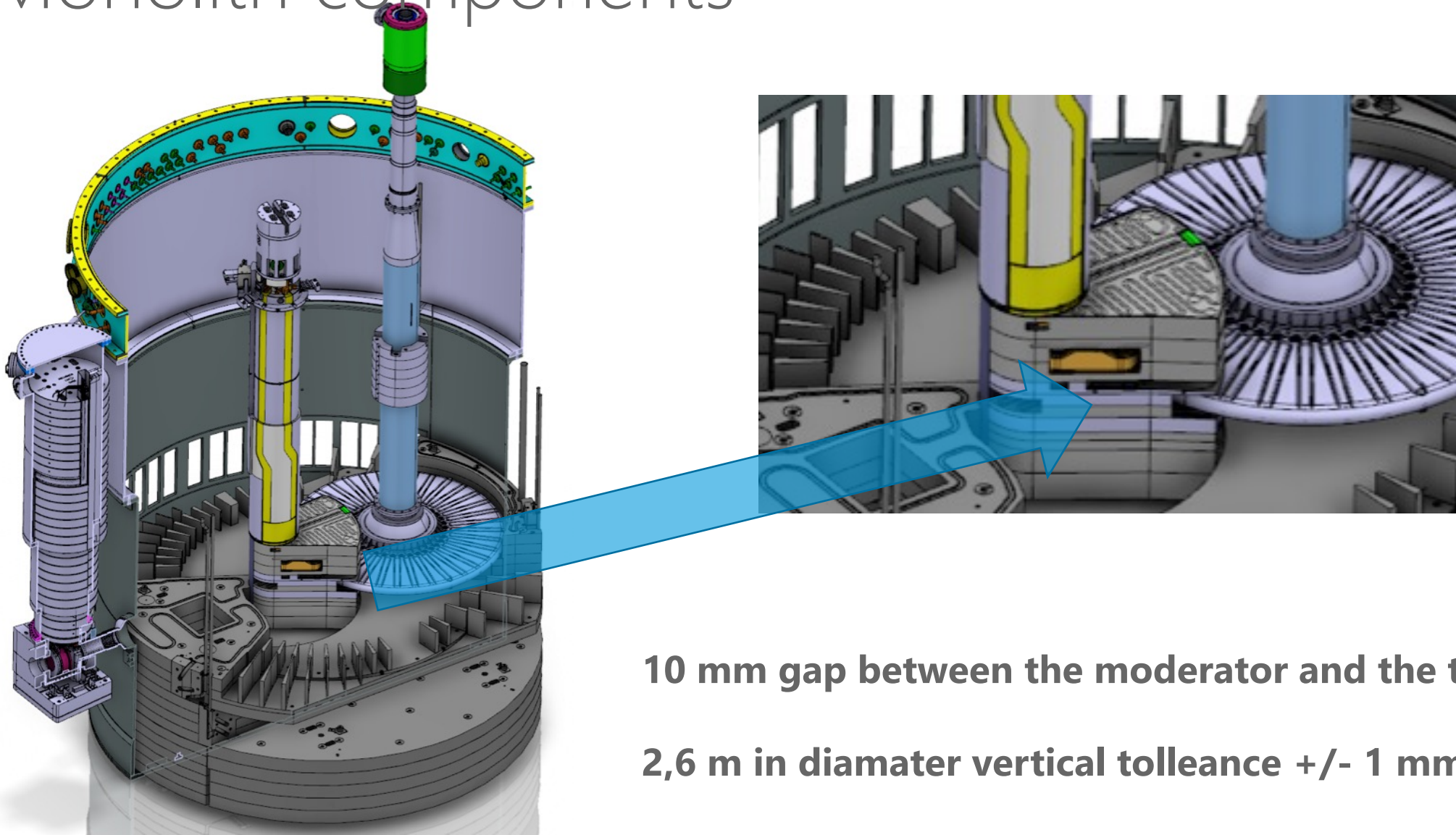
...until they hit the target

When the neutrons arrive at the instruments, the researchers can use them to explore materials down to an atomic level

Monolith Vessel



Monolith components



10 mm gap between the moderator and the target
2,6 m in diameter vertical tolerance +/- 1 mm

Target Wheel

Requirements

Don't interfere with the protons and neutrons.

- Minimum distance

- Minimum material

- Heat load 3 Mw (5MW proton beam)

- 3 kg/s helium mass flow (11 bar)

- Radiation and vacuum

 - cold welding

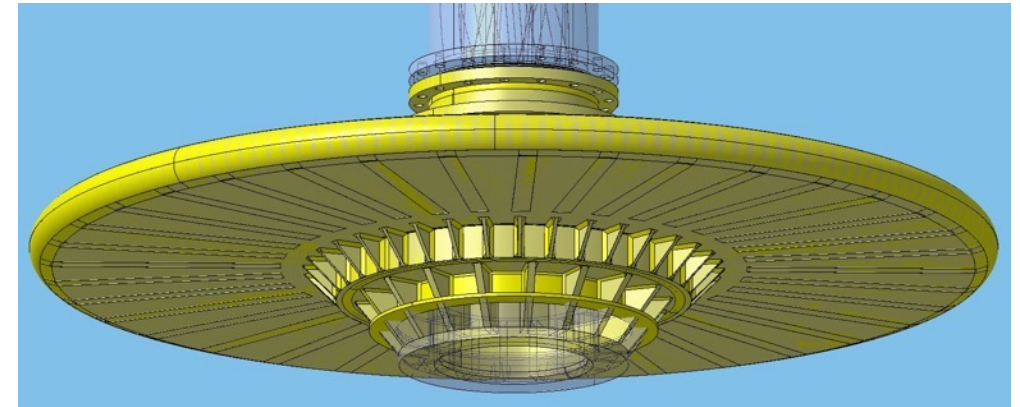
 - instrument failure

 - leakage

- Design code

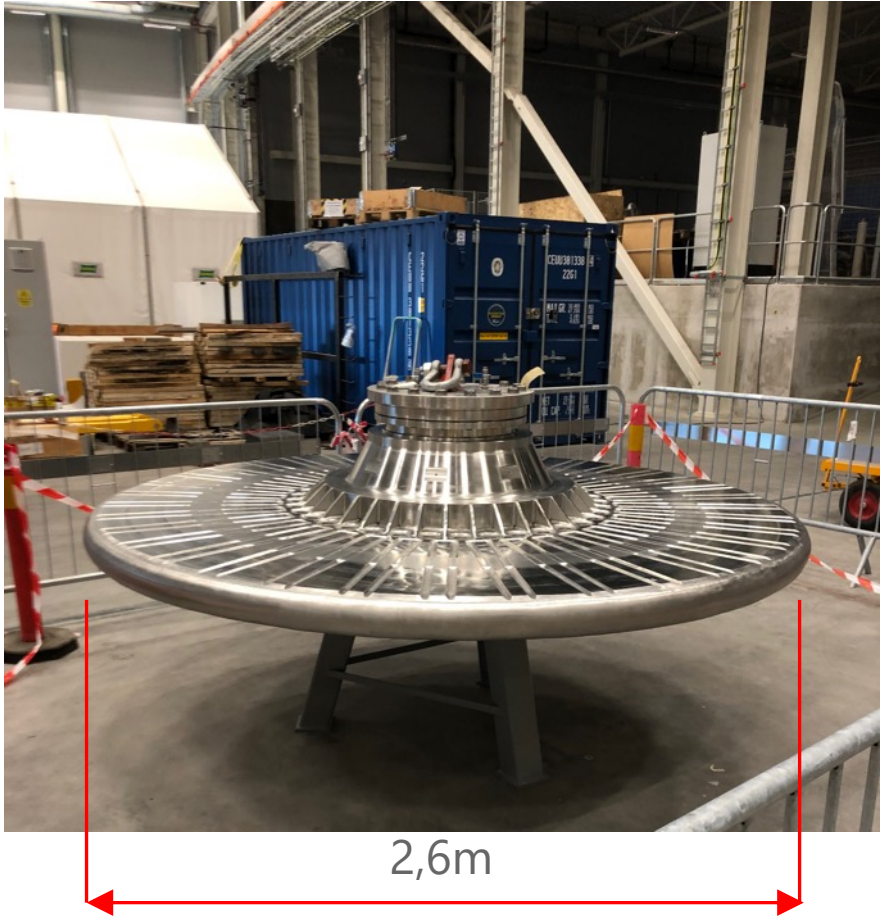
 - RCC-MRx category N3. / MQC4

 - quality vs possibility to repair, impact to the availability



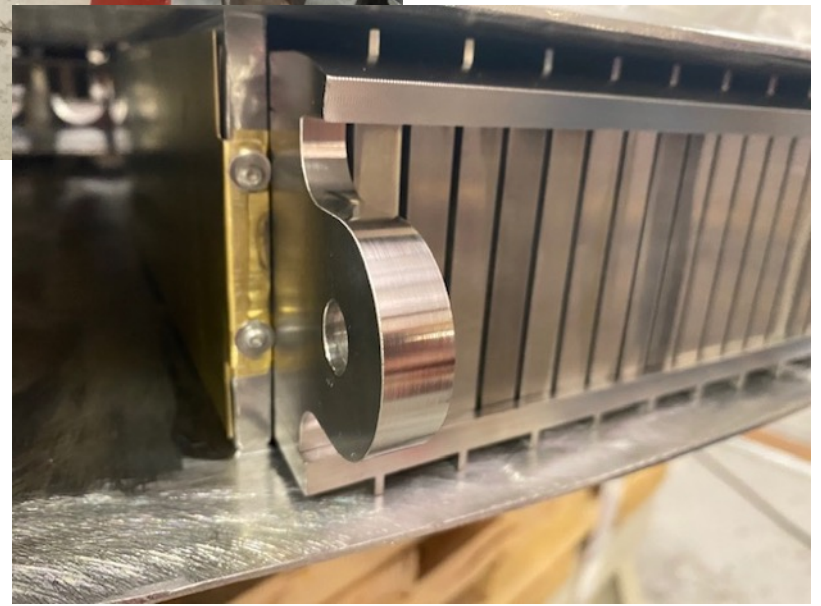
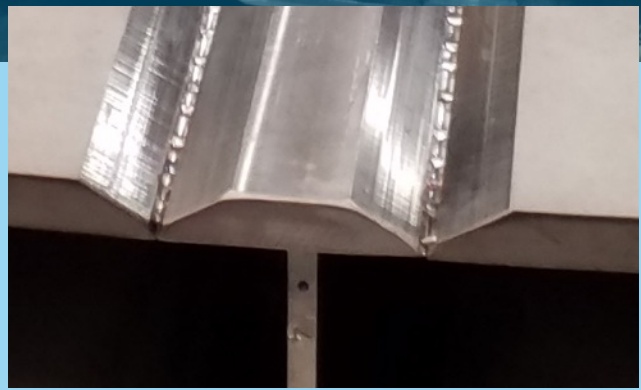
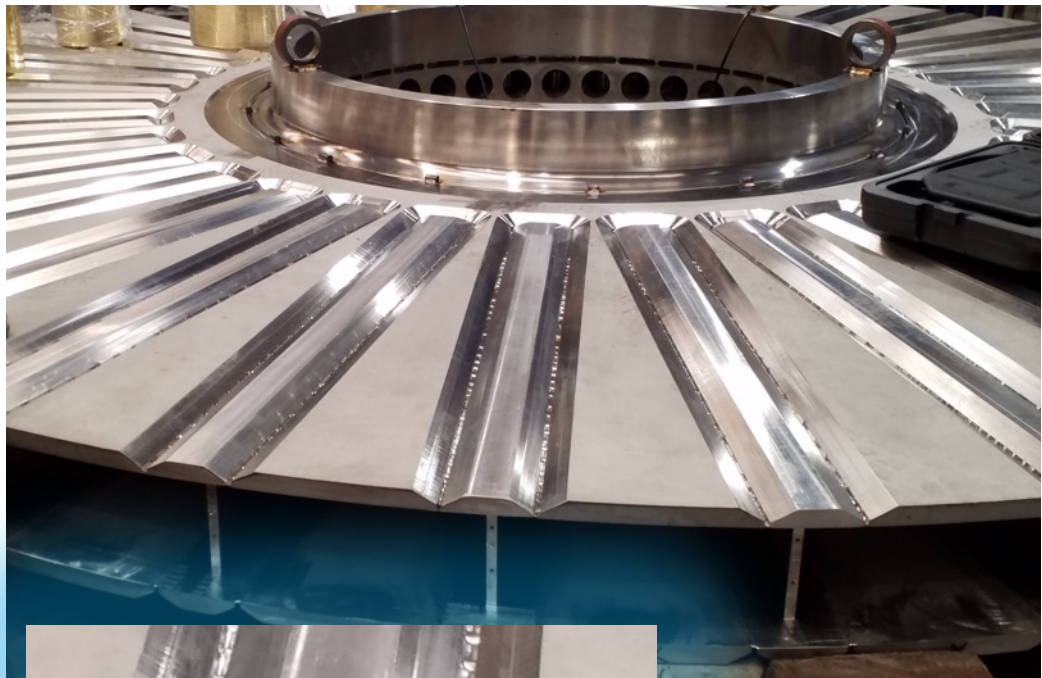
3 tons pure tungsten

First Target Wheel manufactured



Target Wheel

Workarounds



Factory Acceptance Test

In Kind contribution – Sub suppliers



In Kind partner



ESS
bilbao

Sub suppliers

ThuneEureka



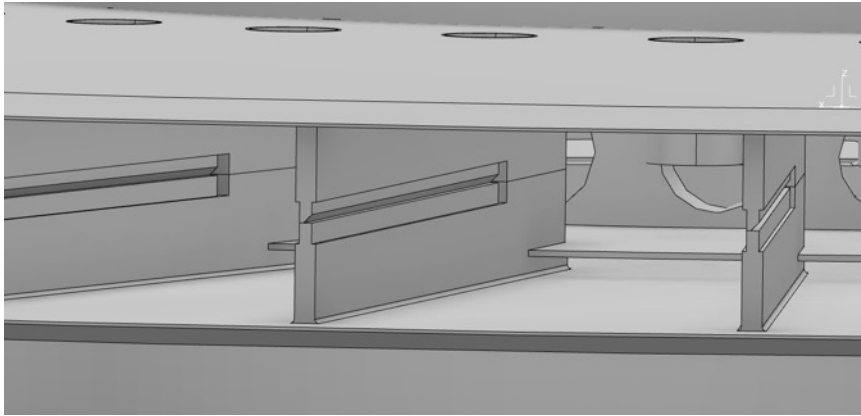
Nortemecánica



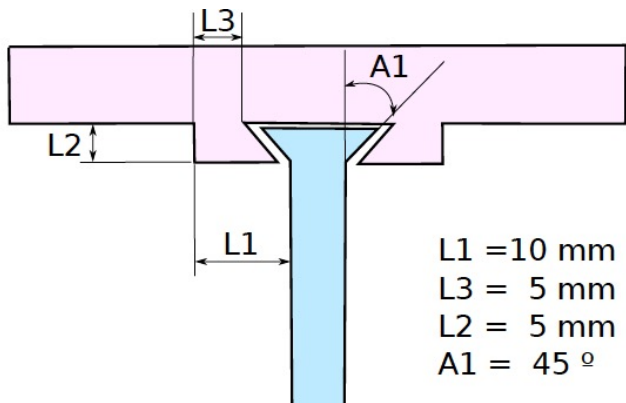
Target Wheel version 2.0??

Altrnative design solutions

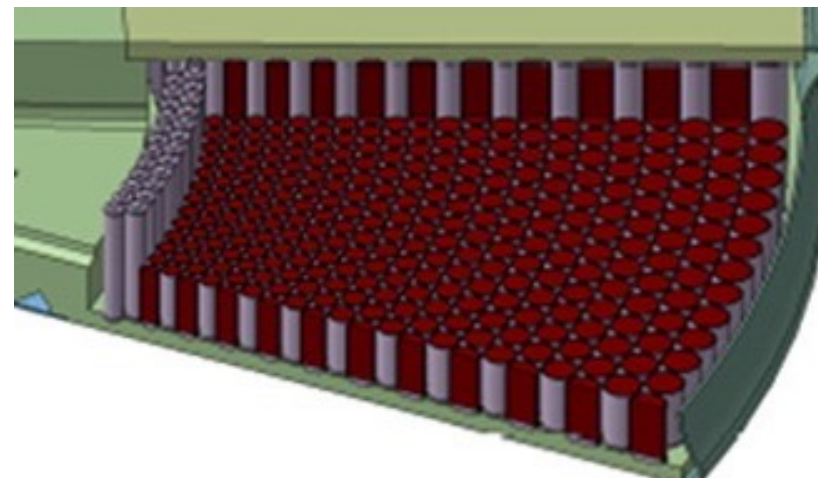
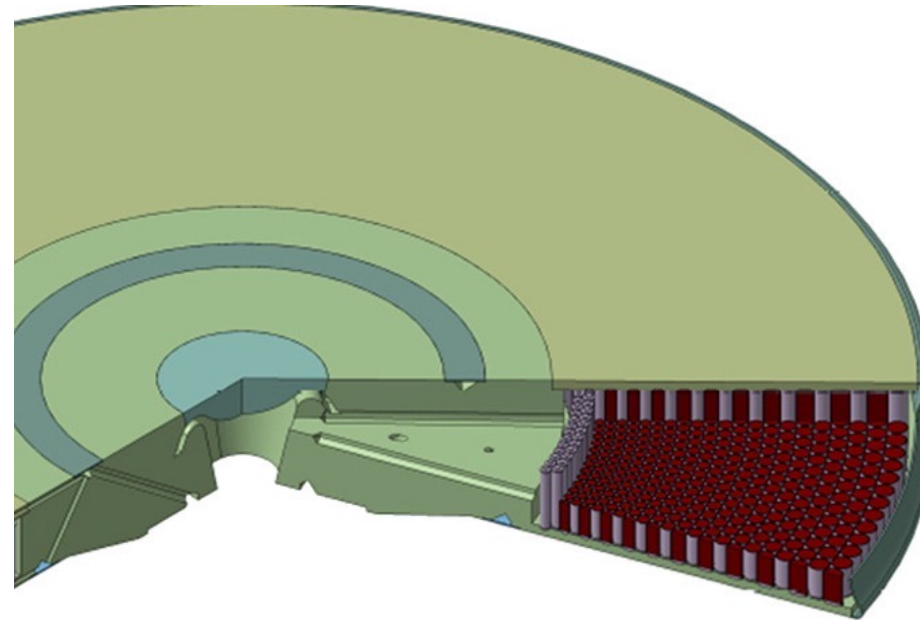
I



II



III

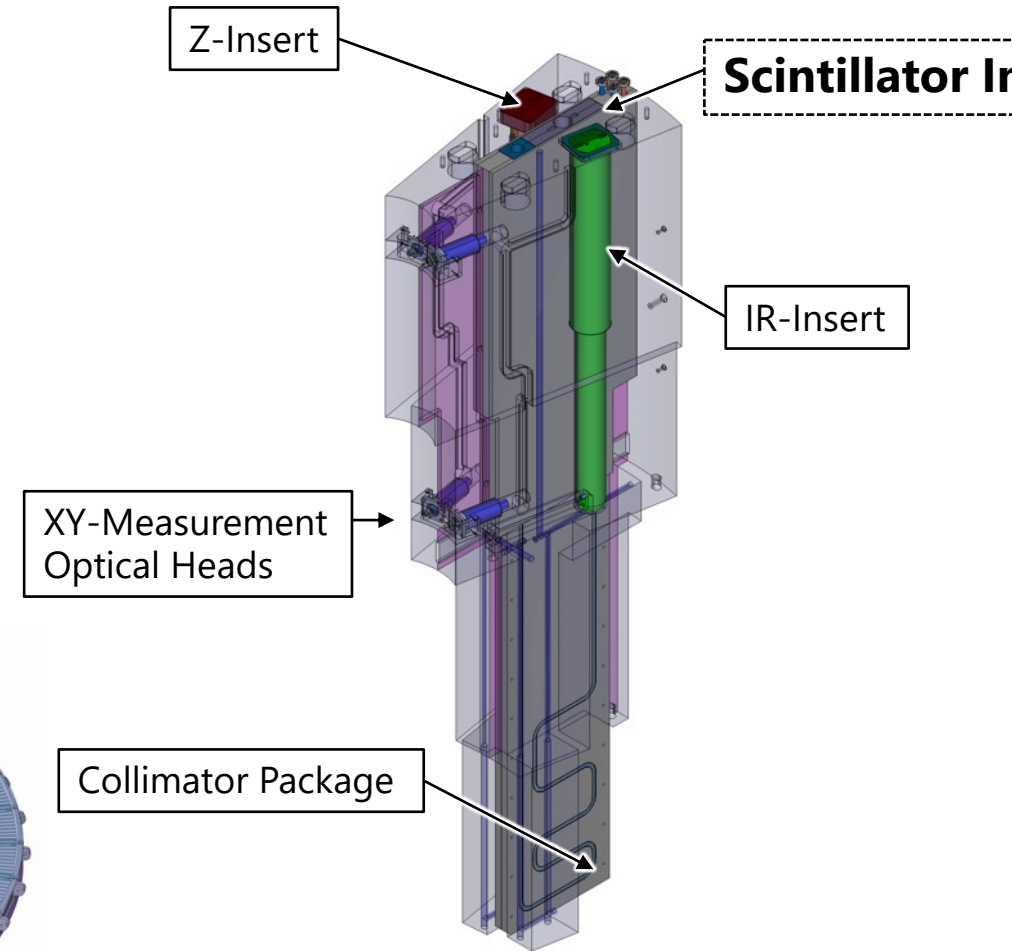
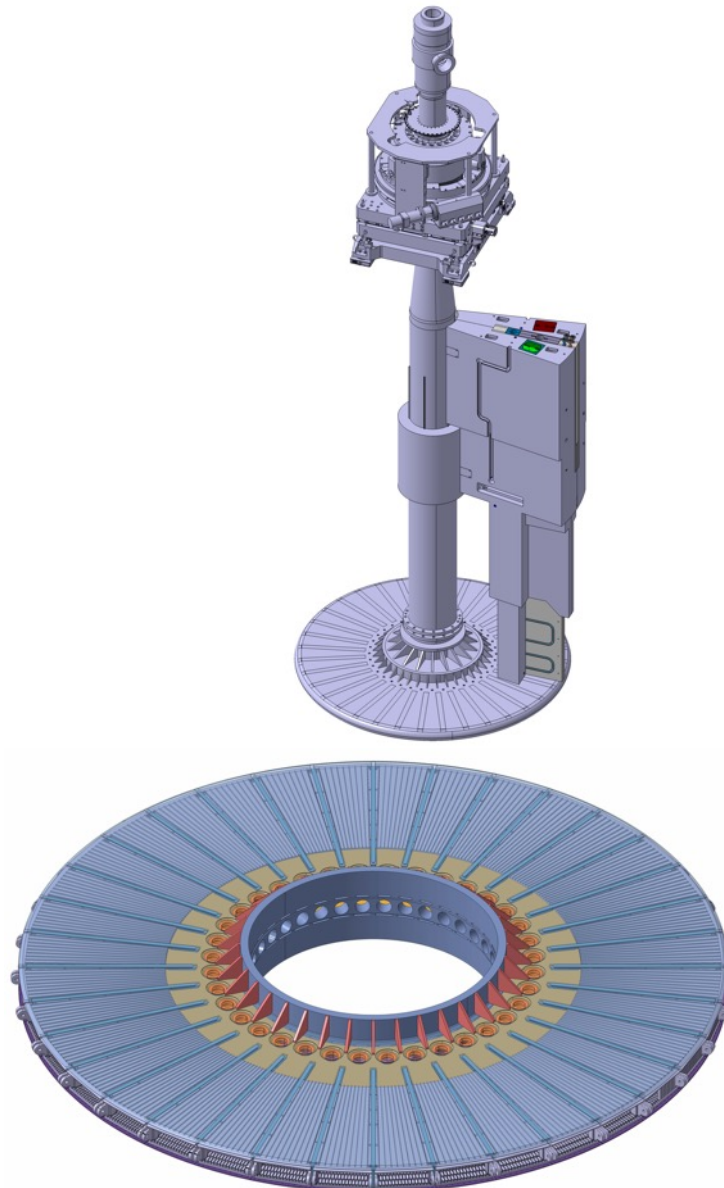


Target Monitoring System

The Tungsten will be brittle
2 mm cooling gap



1 of 36 tungsten cassettes

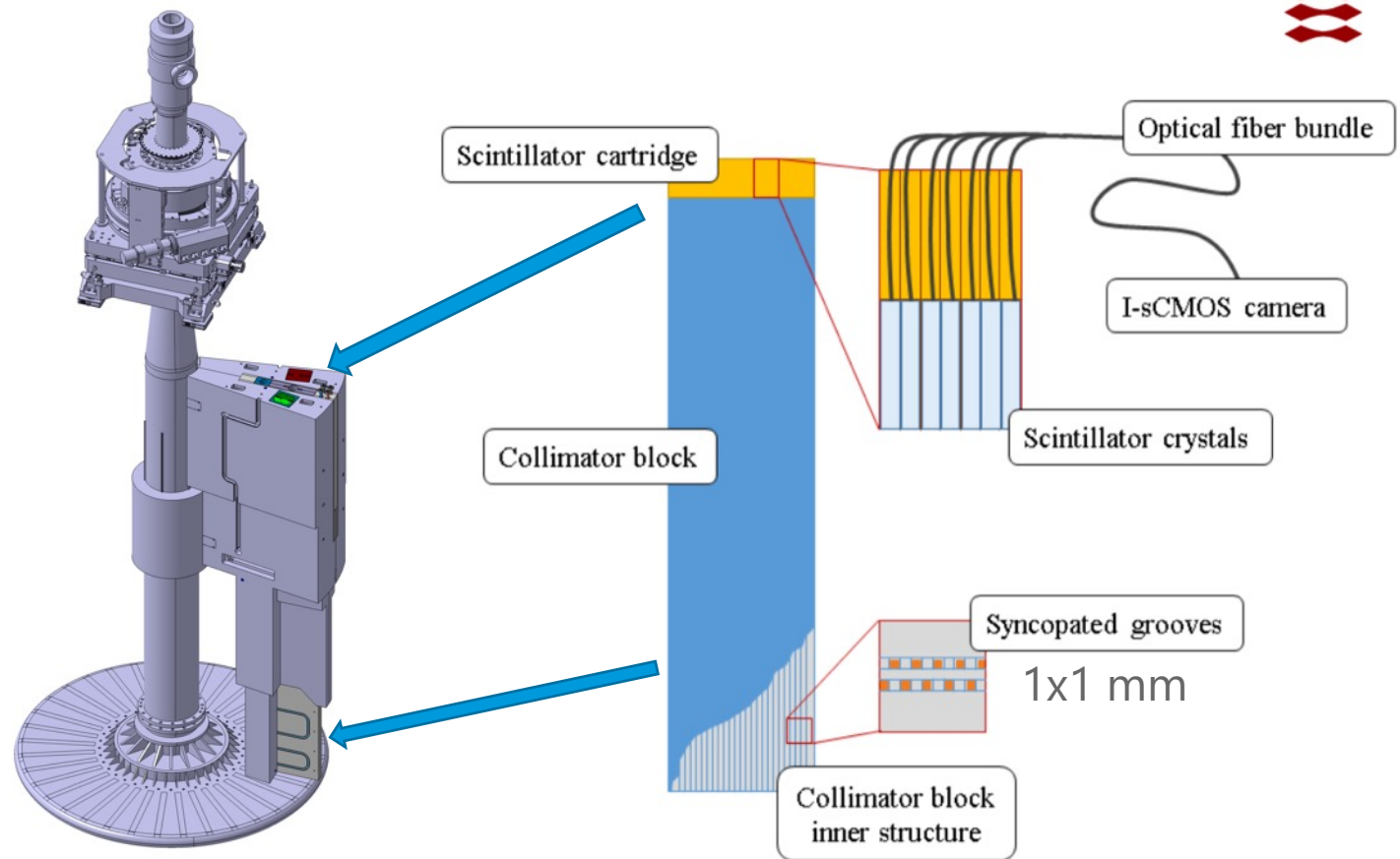


Gamma Imaging System

PhD Thesis "Developing a Target Imaging System for the European Spallation Source" (Nicolo Borghi - DTU)



ESS member country institute



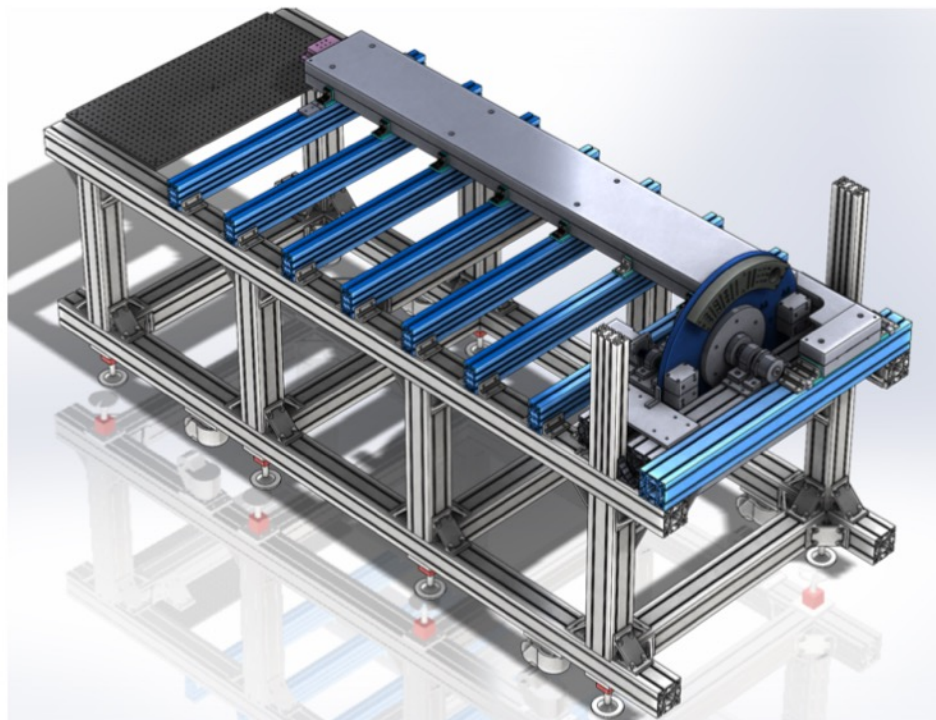
Gamma Imaging System

PhD Thesis Developing a Target Imaging System for the European Spallation Source



Status of research

The Experimental Test-Rig



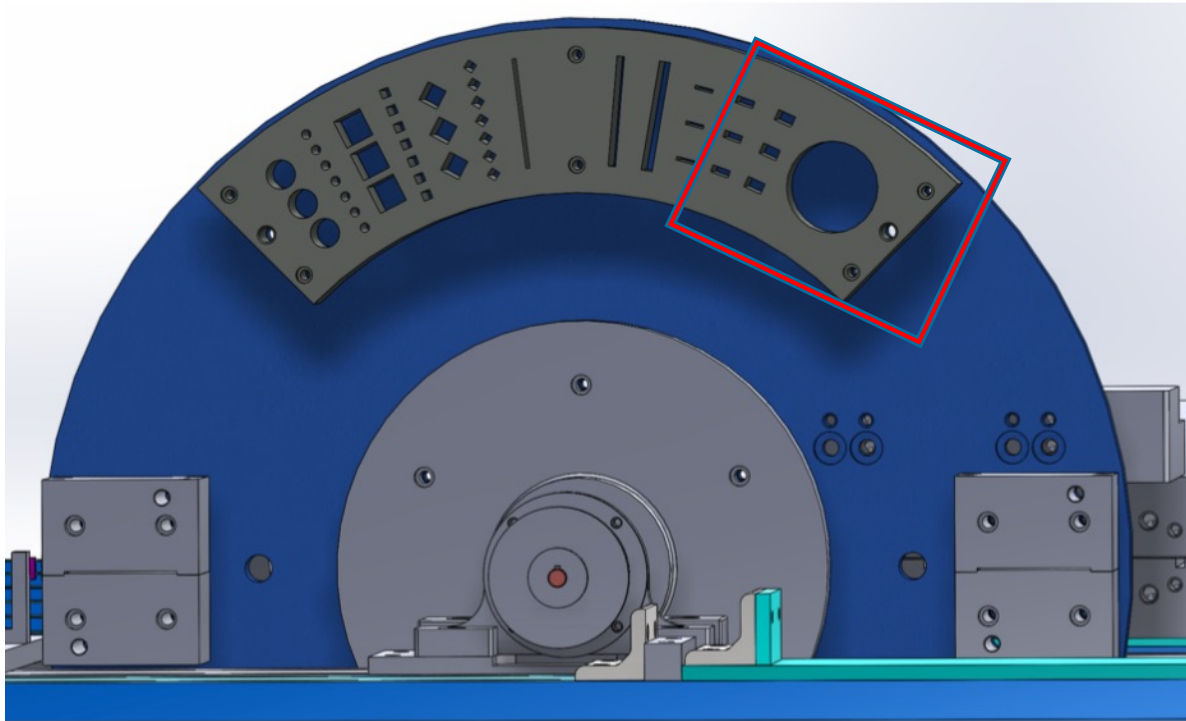
Testing the TIS principle under
ESS relevant conditions

- Collimator
- Scintillators
- Optical fibers
- Camera and gating techniques
- Software controls

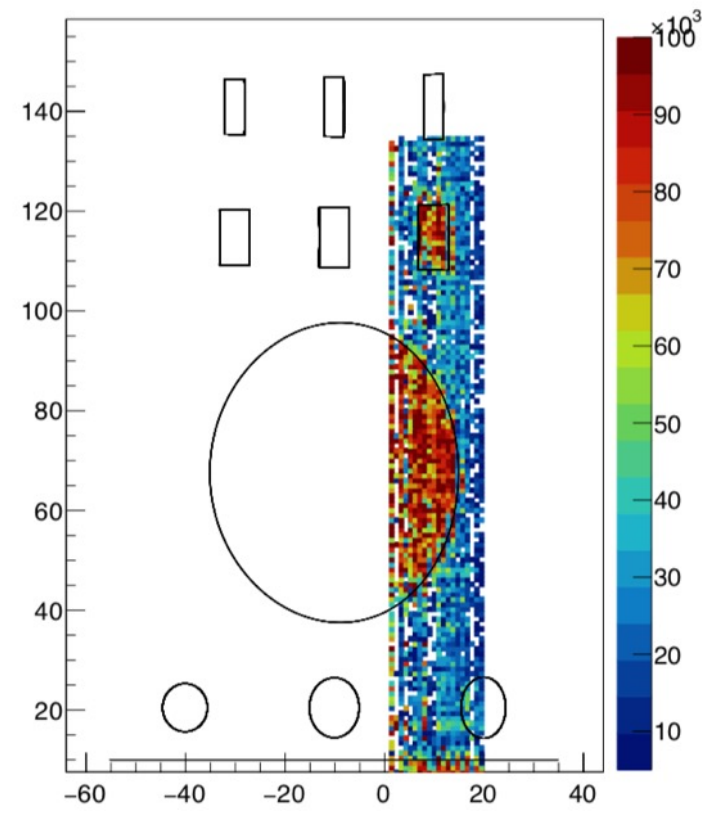
Placed in front of a
360 TBq ^{60}Co source.

Gamma Imaging System

PhD Thesis Developing a Target Imaging System for the European Spallation Source

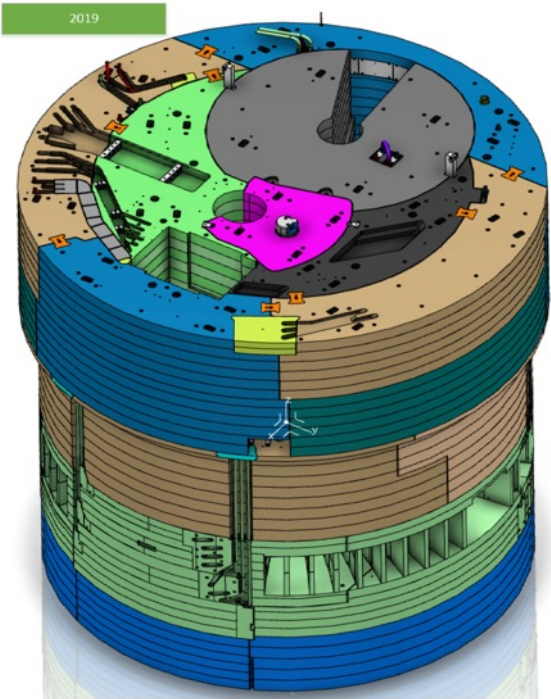
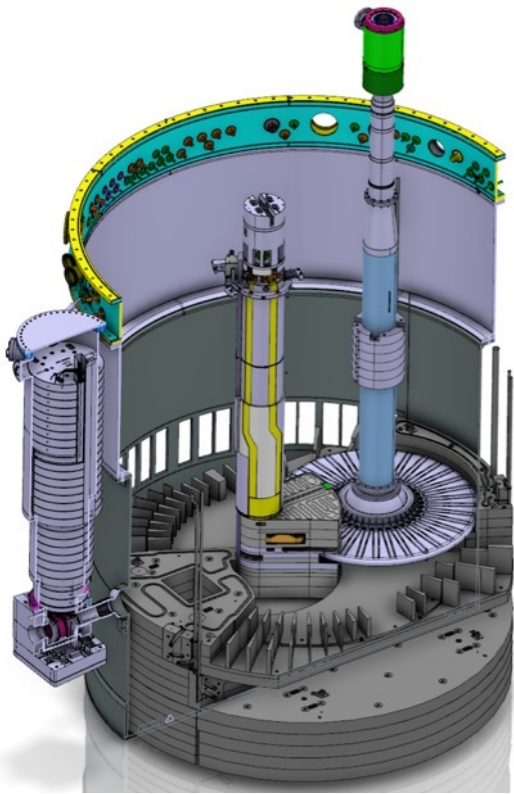


First image



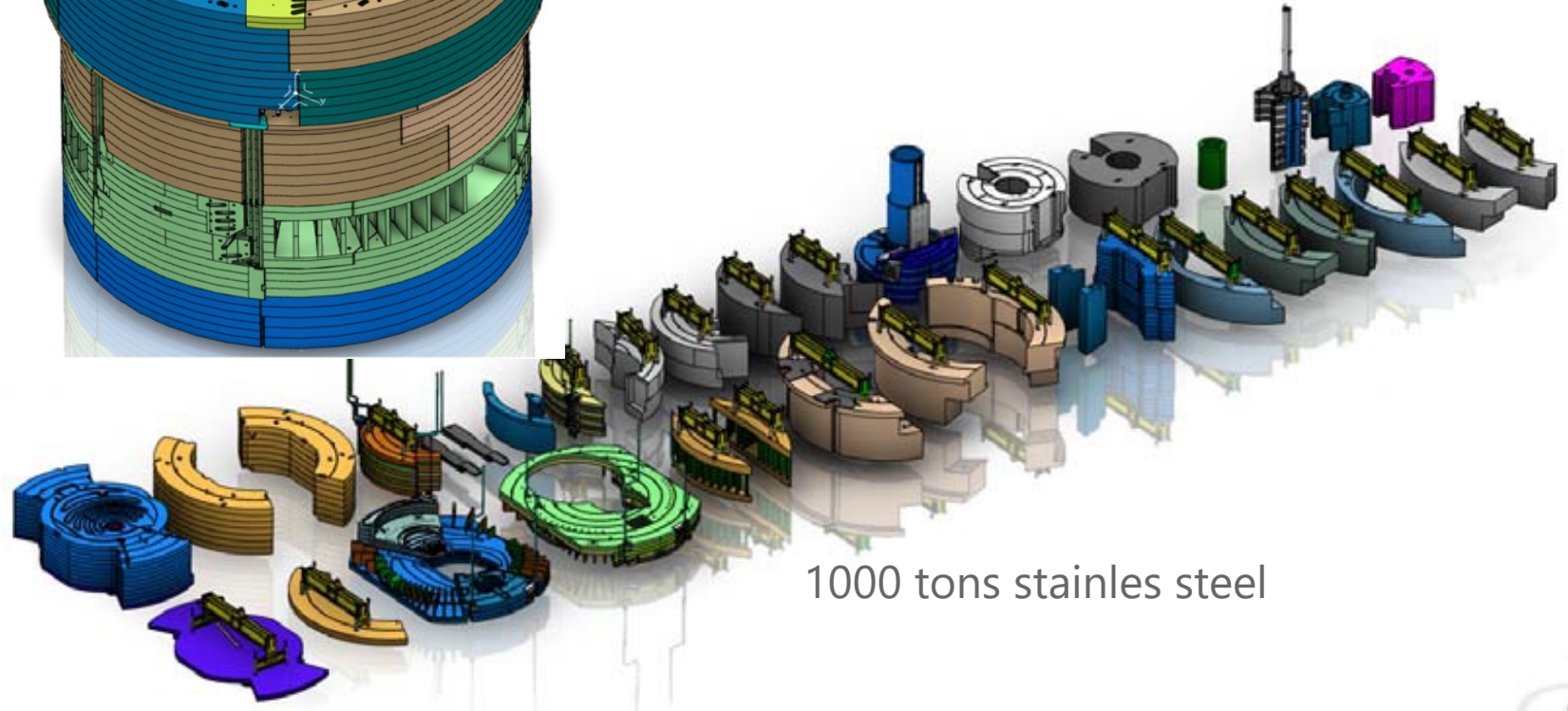


Inner Shielding



ESS in house design and procurement

Supplier:



1000 tons stainless steel

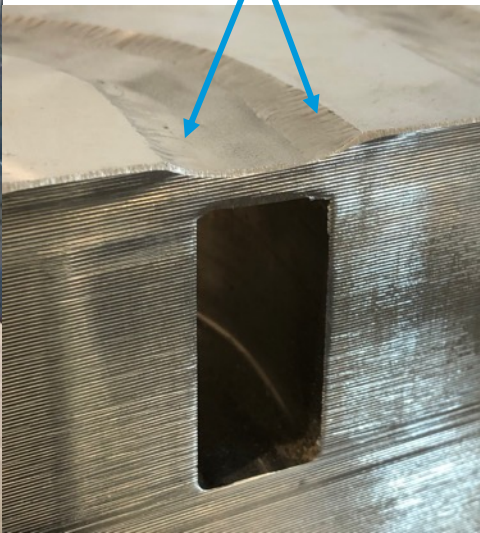


Inner Shielding

How to weld 1.3 km water cooling channel lid – NO defects



Water cooling channel weld



ESS in house design and procurement

Supplier:



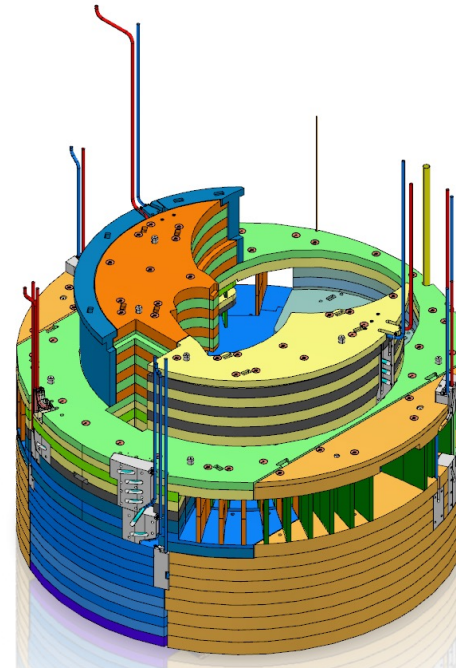
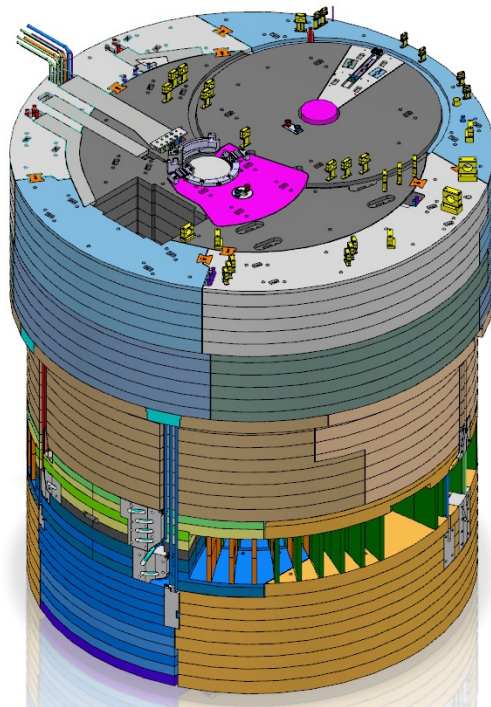
Inner Shielding

Detection and repair of a leak

Main Design Requirements:

Maximum leakage 1g water/h

Minimum 40 year of operation





ESS supplier experience

- Keep track of the interface requirements.
Internal and external
- Big components vs fine tolerances
- Contract requirements all the way to delivery
 - Workshop
 - sub contractors
 - Transport



Finish presentation