ESS Bilbao activities update

ICANS XXV, 14.04.2026, Malmö

F. Sordo, on behalf of M. Pérez

GOBIERNO DE ESPAÑA
MINISTERIO DE CIENCIA, INNOVACIÓN Y UNIVERSIDADES
EUSKO JAURLARITZA
GOBIERNO VASCO

ESS Bilbao

Who we are and what we do...

MISIÓN

- Designated as Spain's national institution responsible for channeling the **In-Kind Contribution to the European Spallation Source (ESS ERIC)**.
- Operates as an independent **R&D Center** advancing **science, technology, and engineering** in **particle accelerators** and **neutron techniques**.

VISIÓN

By 2027, ESS Bilbao aims to be:

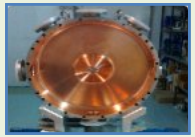
- A **center of excellence** with its own infrastructure serving national and international users..
- A **reference in innovation** for **accelerator, target, and neutron technologies**, contributing to global scientific progress and international projects.
- **A strategic partner and effective instrument** of **scientific policy** serving both the **Central and Basque Government**, offering expertise, added value, and promoting internationalization in its filed of activity.
- A **trusted and preferential partner for the European Spallation Neutron Source**, recognized for delivering successfully their **In-Kind contributions**.
- Recognized by the entire value chain as an **efficient manager of "In-Kind"** contributions and **added-value partner**.
- Known for its **advance management model**.

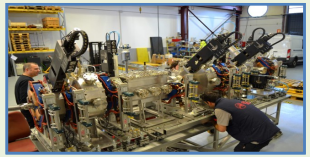
ESS In Kind contribution

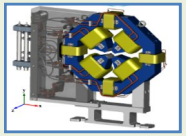
Successfully delivering….

In-Kind Contribution

MEBT







Accelerating element: complete subsystem that goes after the RFQ and integrates: design, manufacturing, diagnostics, control, assembly and testing.

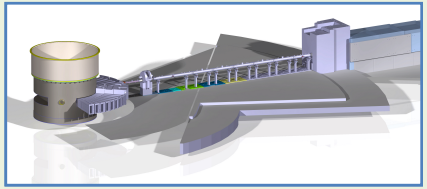
RF Systems

RF chains: 1 for RFQ and 5 for DTL. Composed by klystrons, modulators, loads, waveguides, interlocks and LLRF

TARGET

The spallation process takes place when the accelerated proton beam hits the Tungsten bricks of the 11-tonne target wheel. This will produce neutron brightness for scientific experiments across multiple disciplines.

MIRACLES Instrument



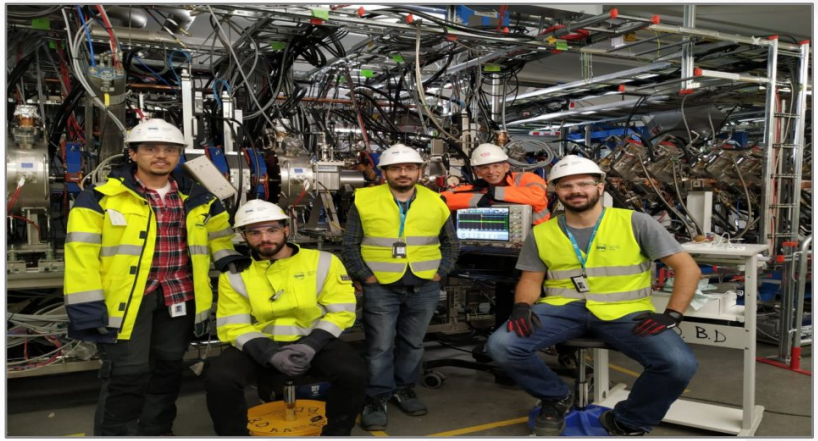
Time-of-Flight backscattering instrument for polymer science, energy materials, and magnetism studies.

ACCELERATOR

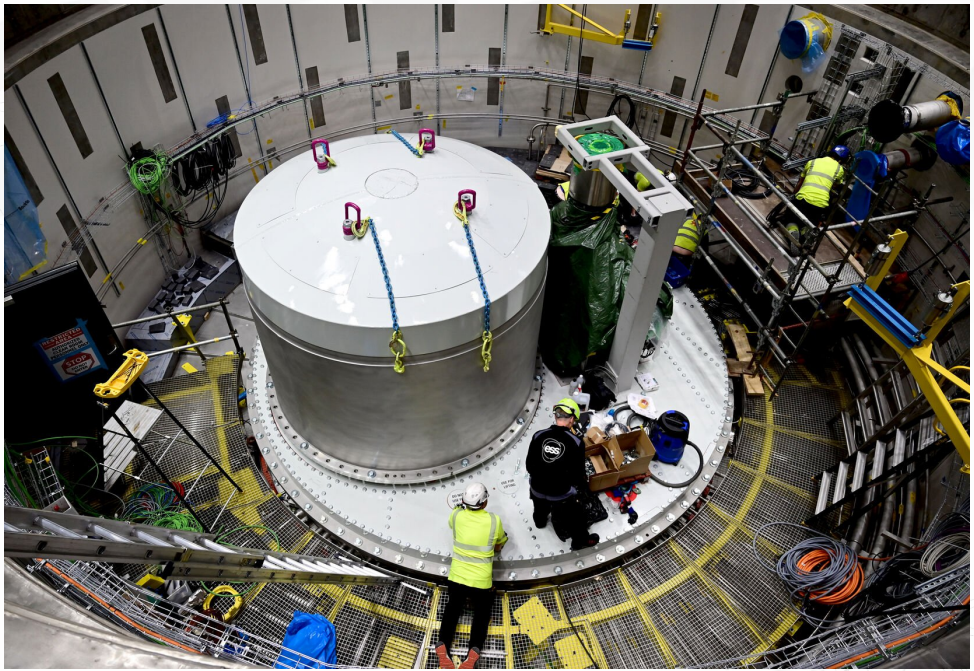
In-Kind Contributions in figures

Sub. PROJECT	SUMMARY	TA No.	CB VALUE €
ACCSYS	MEBT	AIK. 3.1	4.522.285,00 €
	Installation, Testing and Commissioning of the MEBT	AIK. 3.7	400.000,00 €
	RF for Warm Linac	AIK. 8.1	6.644.000,00 €
	Klystron Modulators for RFQ and DTL	AIK. 17.6	3.370.000,00 €
ICS	MEBT Integration	IIK 14.10.4 #	963.258,00 €
TARGET	Target Wheel	TIK 2.1	8.420.000,00 €
	Protom Beam Instrumentation Plug	TIK 4.2	540.000,00 €
	Proton Beam Window	TIK 4.4	890.000,00 €
	Monolith Vessel	TIK 4.5	4.680.000,00 €
	Tuning Beam Dump	TIK 4.9	2.480.000,00 €
NSS	Beam Trasport Optimisation for the Extreme Condition Diffractometer	NIK 2 #3	20.000,00 €
	Training of Motion Control Engeneer (ES)	NIK 5.3 #7	97.000,00 €
	Secondment of a Mechanical Engineer to LOKI	NIK 6.3 #1	54.000,00 €
	Instrument Miracles - PHASE 1	NIK 6.16 #1	423.500,00 €
	Miracles In-Kind Contributions for PHASE 2-4	NIK 6.16 #3	11.590.250,00 €
TOTAL			45.094.293,00 €

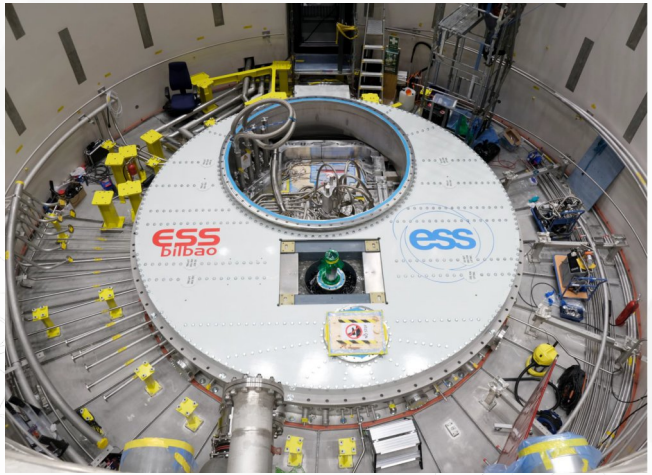
ESS In-Kind Contribution - Accelerator (MBET and RF Systems)



ESS In-Kind Contribution to Target : Monolith Vessel



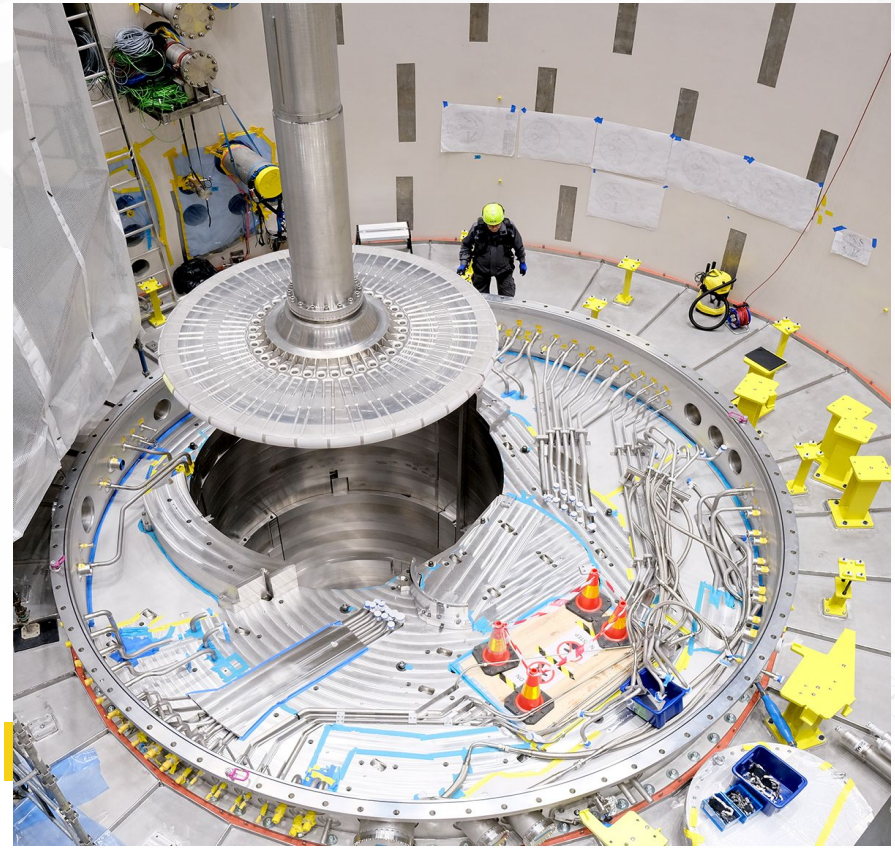
Back in summer 2024, the Pressure and vacuum leak tests of the Monolith vessel and its components was successfully conducted, marking a crucial step towards the commissioning of the ESS Target Station.



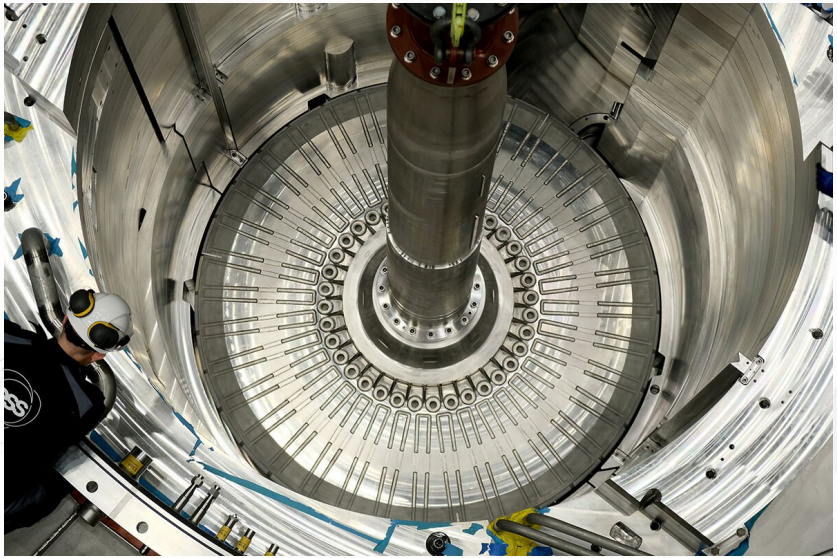
GOBIERNO DE ESPAÑA MINISTERIO DE CIENCIA E INNOVACION

EUSKO JAURLARITZA GOBIERNO VASCO

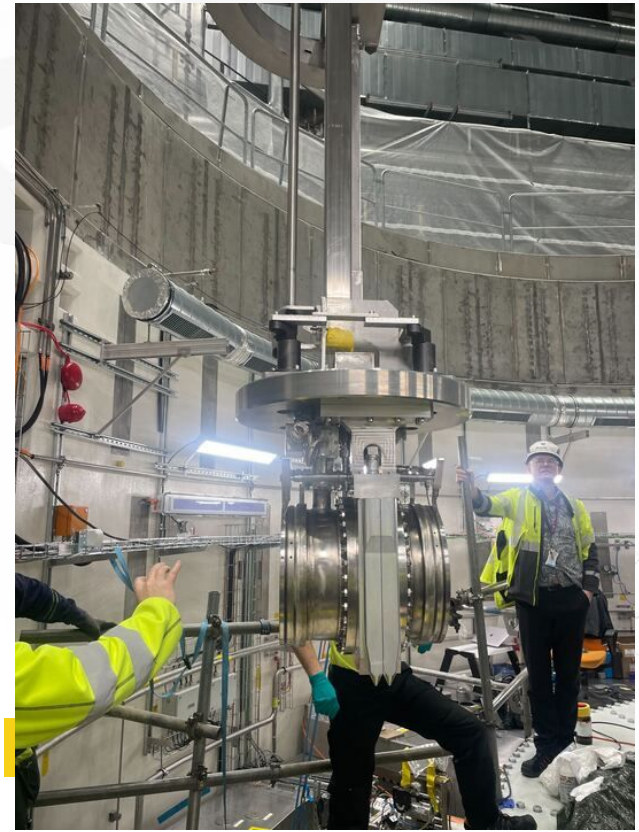
ESS In-Kind Contribution to Target: Target System



In October 2024, the first-ever in-situ rotation of the target wheel took place inside the monolith vessel at the ESS site, marking another step towards the first proton-beam-on-target in late 2025.



ESS In-Kind Contribution to Target: PBW and PBIP



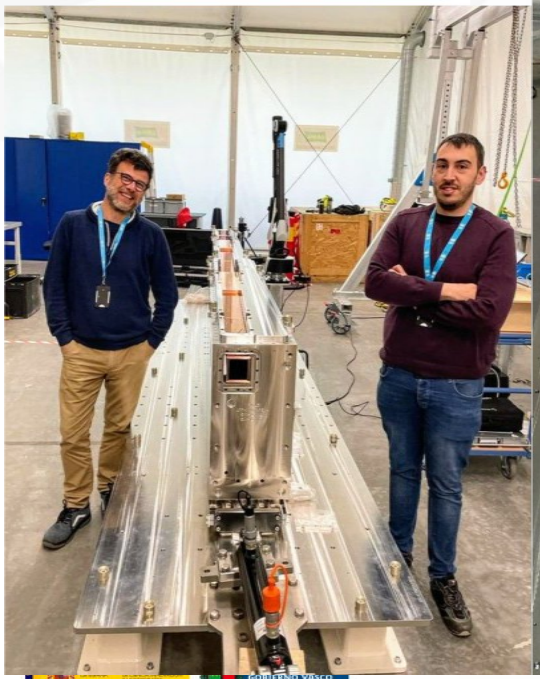
- ✓ 165.ESS Proton Beam Window (PBW): From Manufacturing to Site Commissioning Sara Ghatnekar Nilsson (European Spallation Source ERIC)
- ✓ The last component of the Target System – the Proton Beam Window (PBW) was FAT Tested in October 2024.
- ✓ The component was delivered and successfully installed at ESS Lund in January 2025.
- ✓ PWB#2 and PWB#3 through a direct contract from ESS ERIC are being manufactured

ESS In-Kind Contribution to Instruments - Miracles

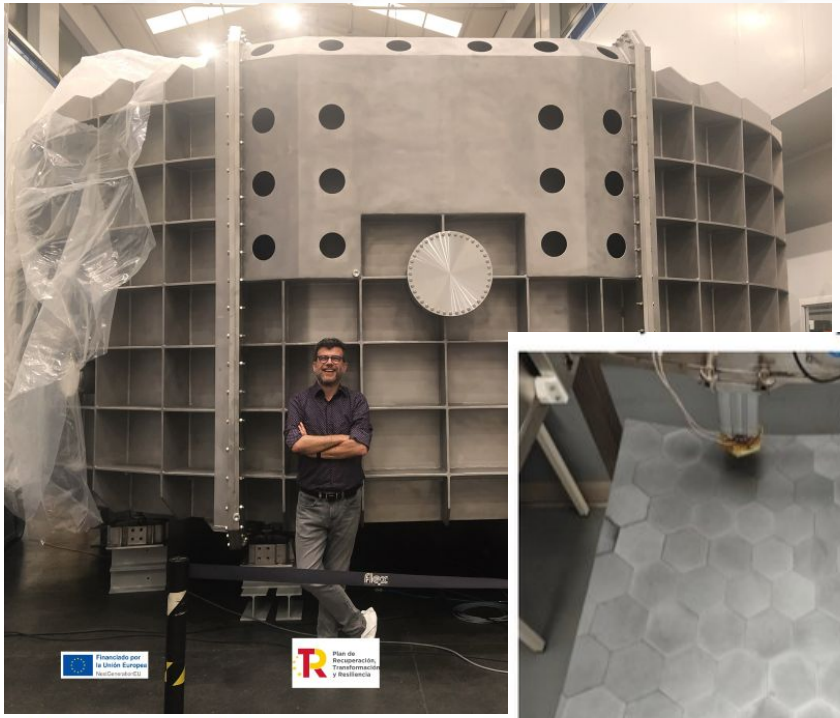
- ✓ The MIRACLES instrument is the time-of-flight backscattering instrument of the ESS. This spectrometer is designed to provide a high energy resolution and flexible resolution for the study of the dynamics of molecules and atoms in biological systems, energy materials and other functional materials.

ESS In-Kind Contribution - Miracles

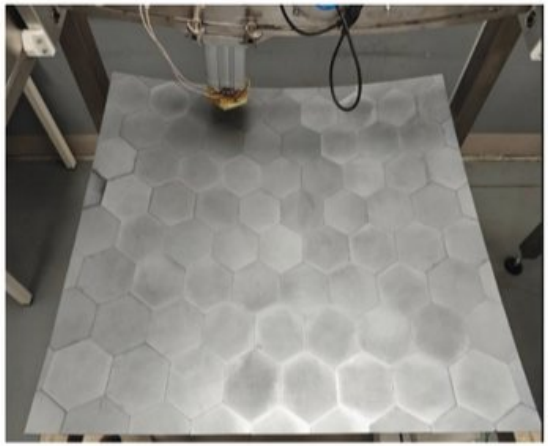
- ✓ Last chopper module shipped to ESS on Q4-2025
- ✓ Neutron guide install on 2024-2025
- ✓ Focusing guide installation scheduled for Q2-Q3 2026

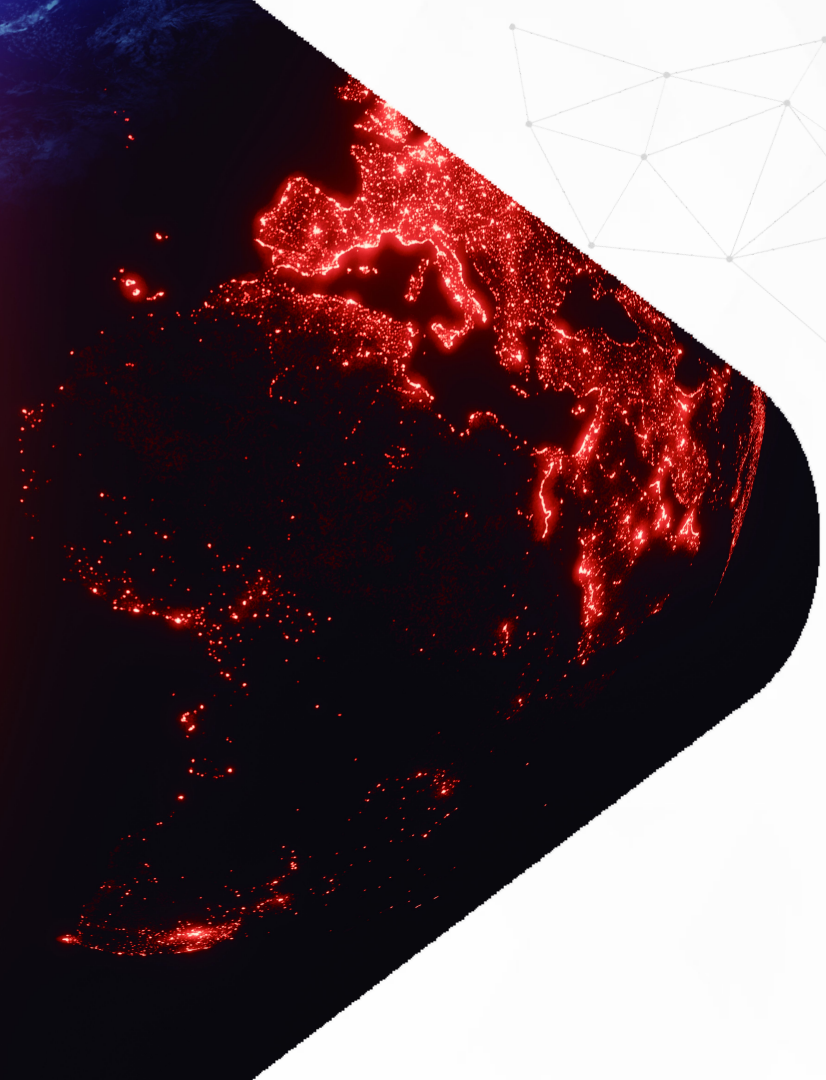


ESS In-Kind Contribution - Miracles



- ✓ The vaccum vessel was install on Dec. 2024
- ✓ Back scattering pannels production will be completed on Q1 2026. Installation scheduled for Q2-Q3 2026





Other international Projects

Keep on growing our portfolio…

INTERNATIONAL PROJECTS – keep on growing our portfolio...

FOCUSED ENERGY

IFMIF DONES GRANADA

iter

EUROfusion

2.025 ~ 1 M€
Backlog + 2 M€

PERLE

Hydrolyca

ESS EUROPEAN SPALLATION SOURCE

CERN

ISOLDE

CSIC

ESS bilbao

OAK RIDGE National Laboratory

sck cen

MYRRHA

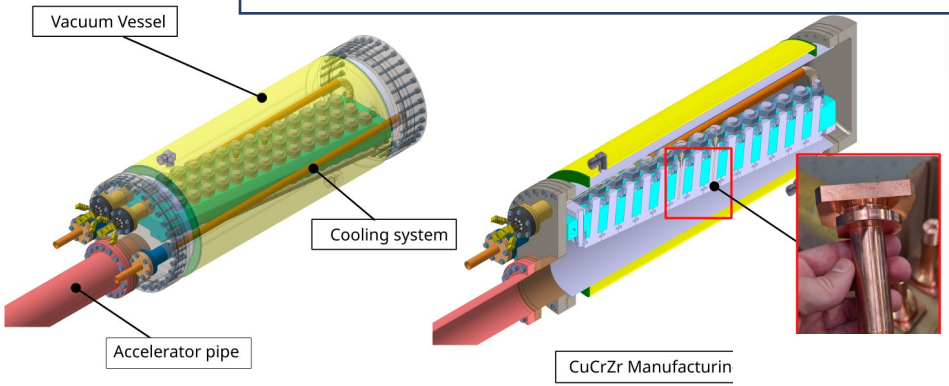
ESSνSB ESS NEUTRINO SUPER BEAM

DAMIC-M

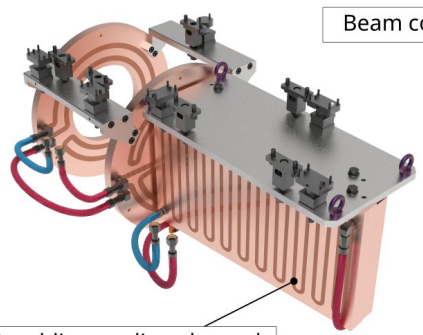
ESS bilbao

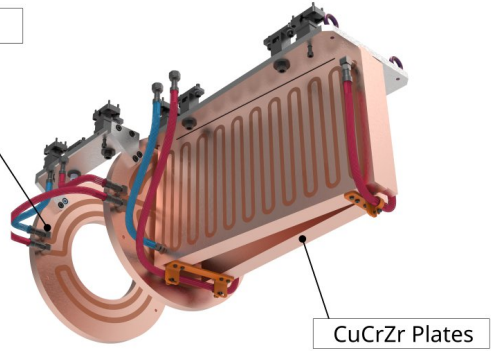
International Projects – SCK-CEN - MYRRHA

The MINERVA LINAC injector beam dump
(4 - 100 MeV, 4 kW)



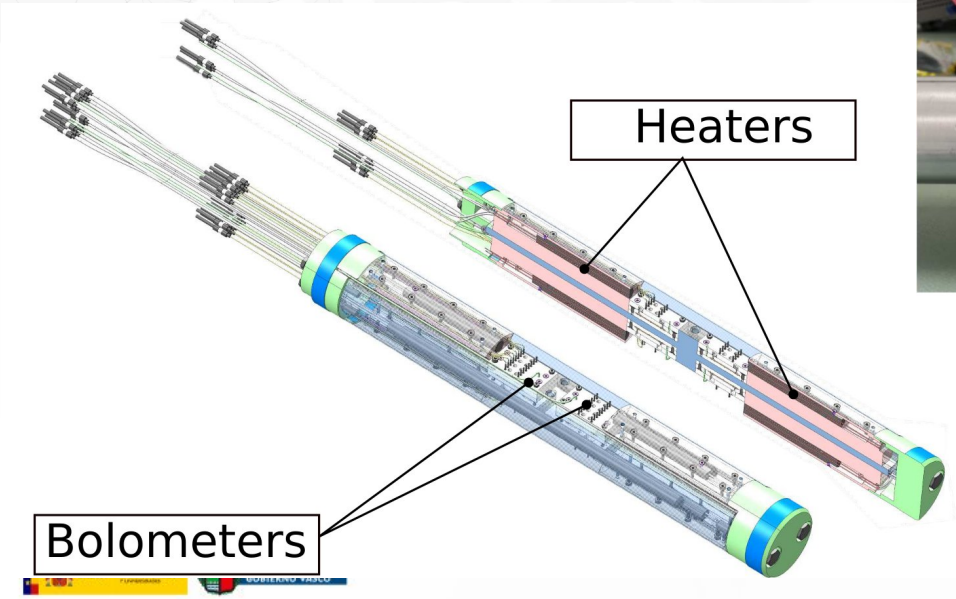
ISOL target MINERVA PTF beam dump
(30 - 100 MeV, 25-50 kW)

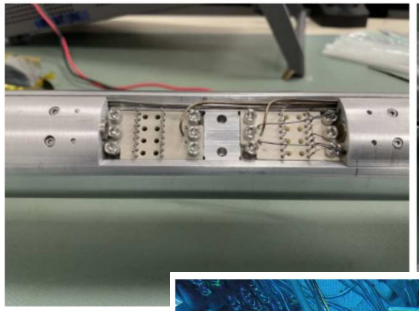


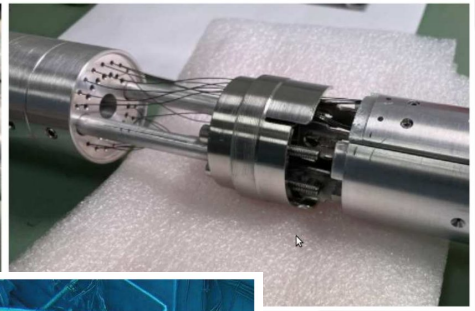


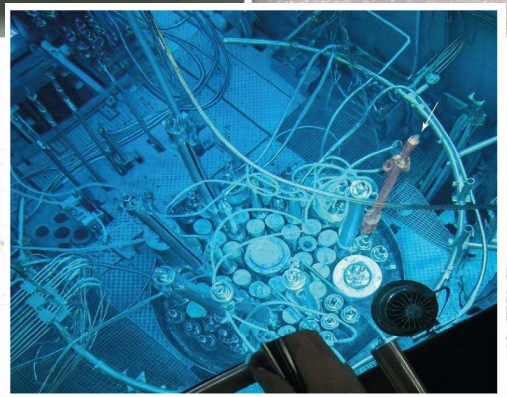
International Projects – SCK-CEN - BR2

ESS-Bilbao was responsible of the design of the irradiation ring for IRBOL project. ng for ITER bolometers (IRBOL). The design and manufacturing was completed on 2024, including all review and licensing steeps required for BR-2 reactor irradiation campaign (CEE1, CEE2 and CEE3).

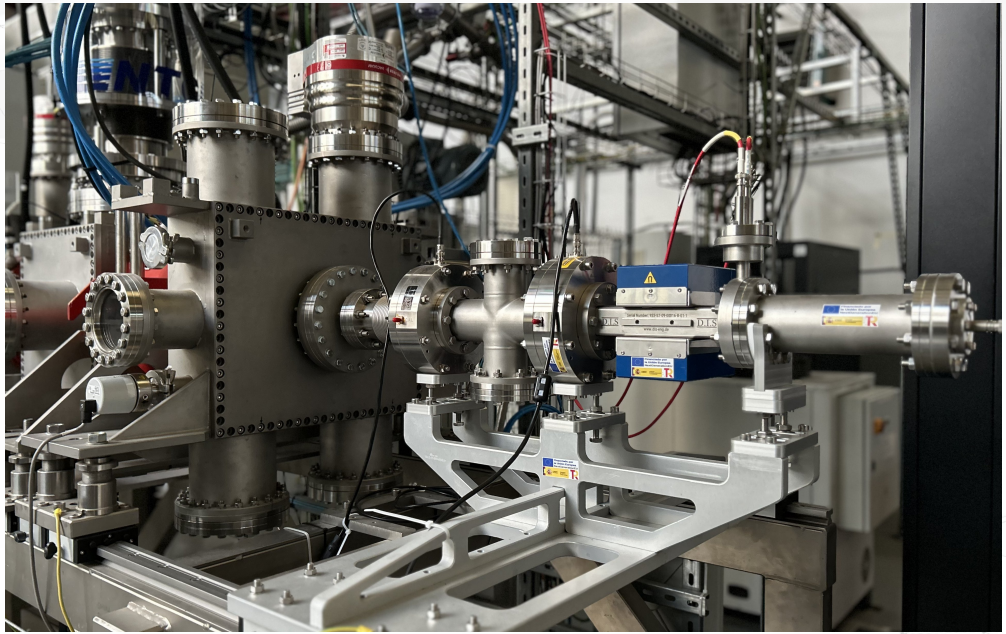








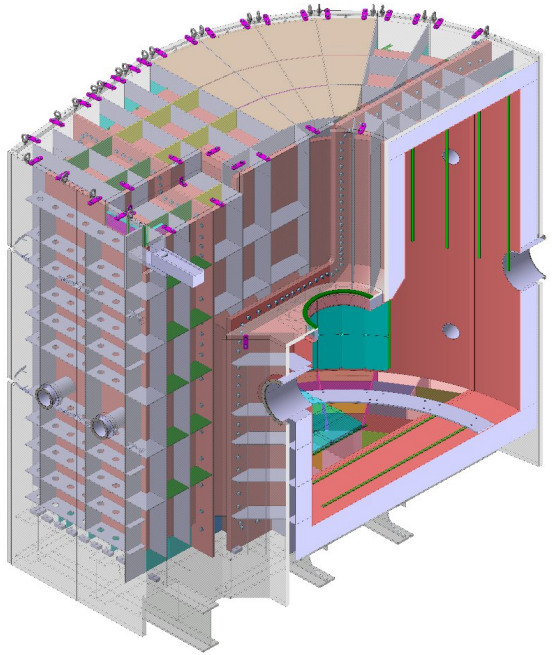
International Projects – CERN



The “Multi-Harmonic Buncher Test Bench” project, developed within the ISOLDE–ISRS collaboration, aims to design, build, and experimentally validate a complete test bench for a multi-harmonic buncher cavity at CERN’s HIE-ISOLDE facility.

Its goal is to improve the beam’s time structure by increasing the spacing between particle bunches without affecting transmission or beam quality.

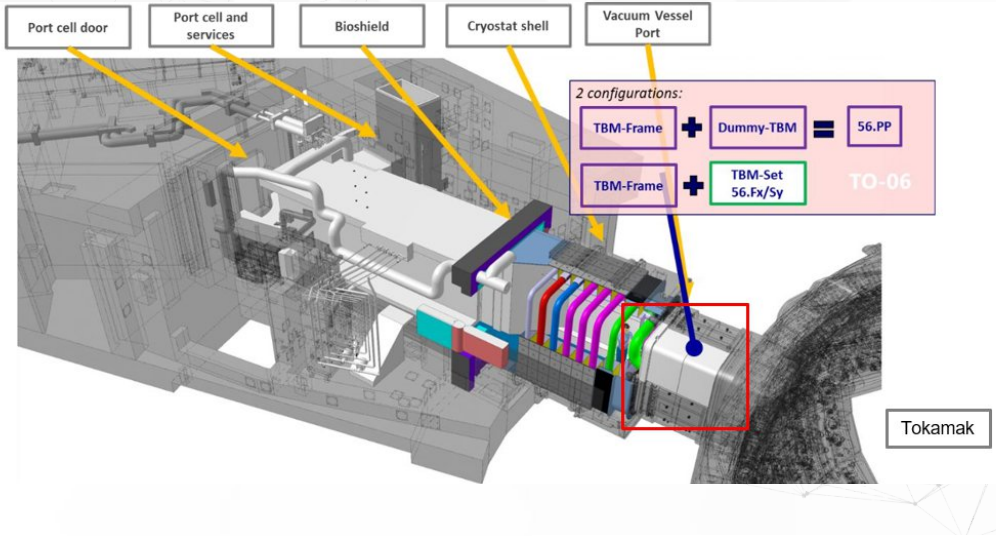
International Projects – Oak Ridge National Laboratory

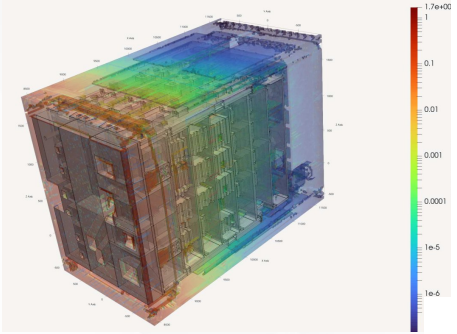


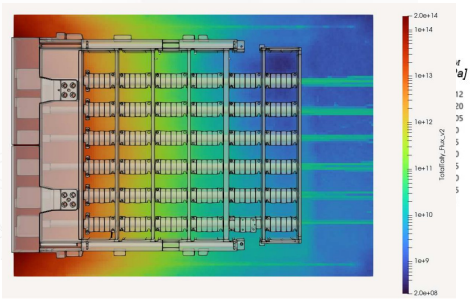
158.Design and manufacturing preparation of a spectrometer vacuum vessel for the Second Target Station (STS) J. GARCIA TORTOSA

International Projects – ITER

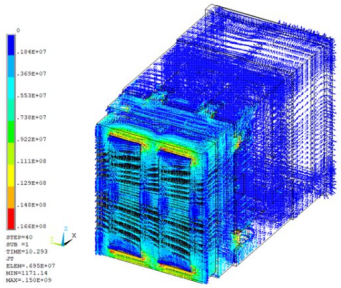
"SUPPORT FOR PORT INTEGRATION ENGINEERING" Ref IO/22/CT/6000000434 (Shielding, activation and mechanical analysis)



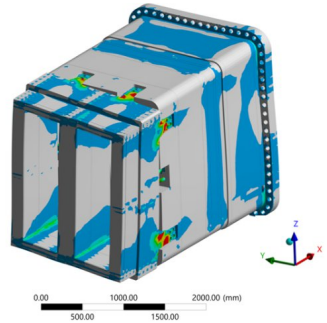




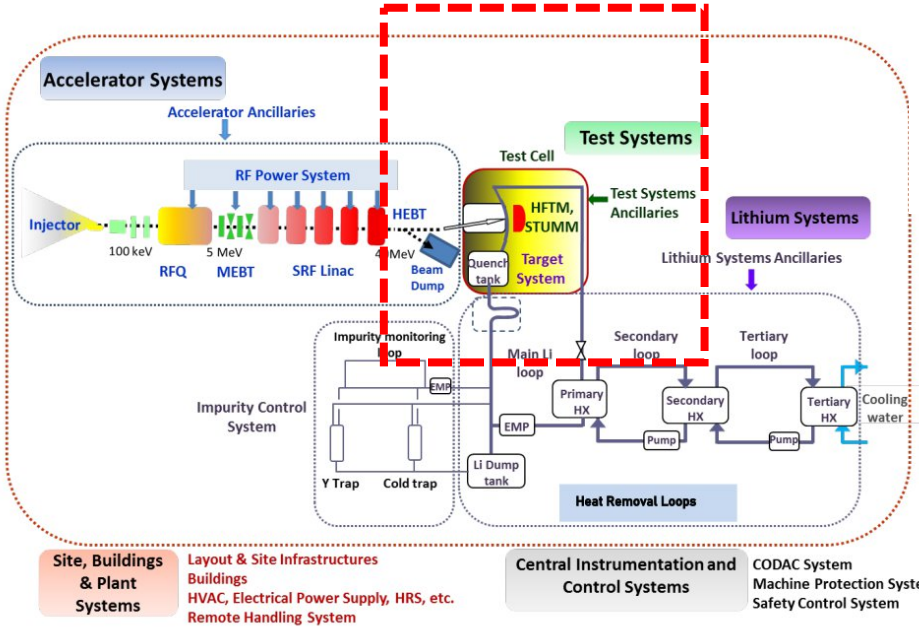
Plasma major disruption EM loads



Equivalent stress contour map
(x100 scaled deformation)

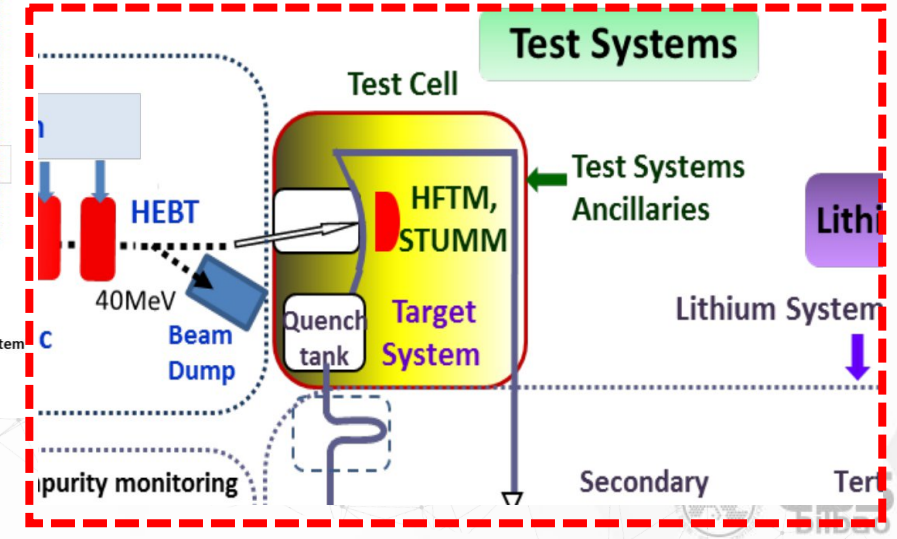


International Projects – IFMIF DONES



IFNIF DONES Main parameters considered:

- 250 mA
- 40 MeV Deuteron Beam
- 10 MW



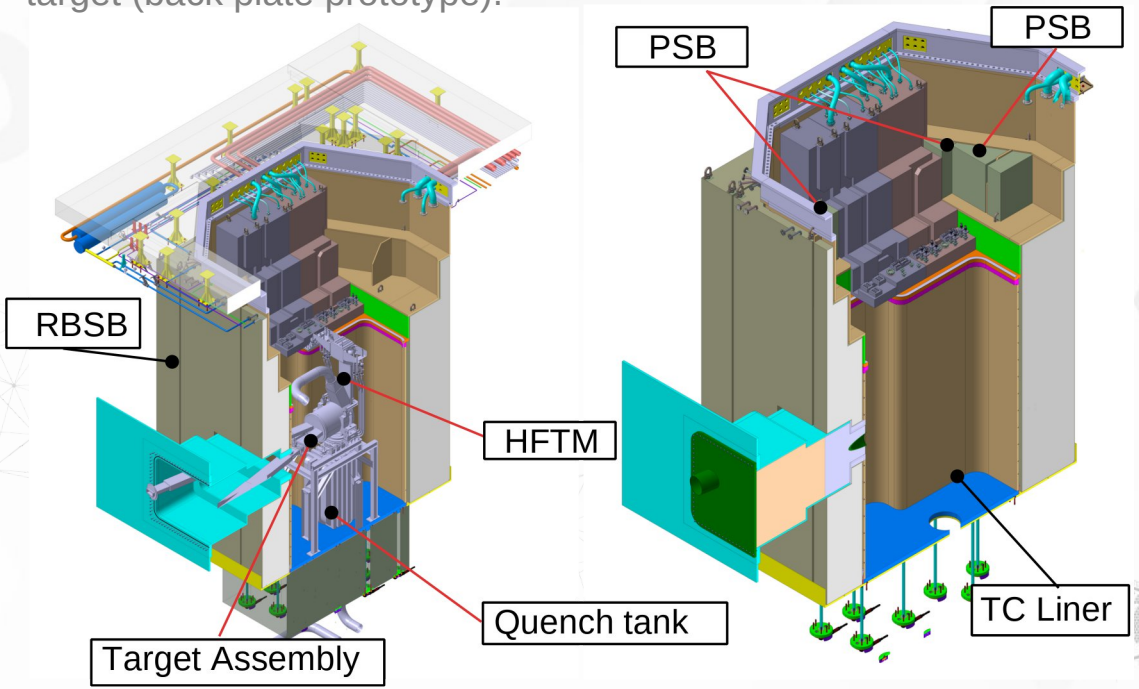
International Projects – IFMIF DONES: STUM PROTO

166.Structural Integrity, Manufacturability and pressure testing of STUMM-PROTO Fernando Sordo Balbín (ESS Bilbao)

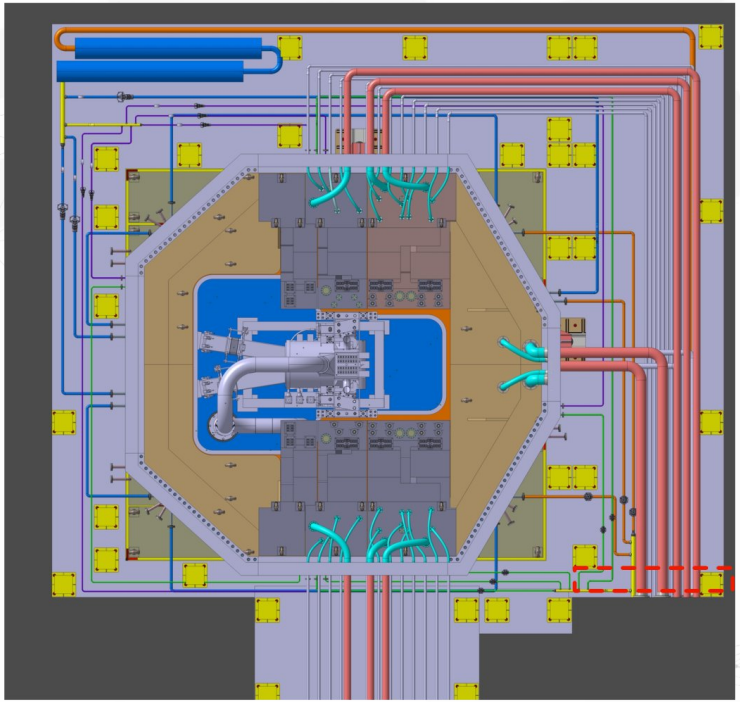
STUM PROTO SAT test. 2024-12

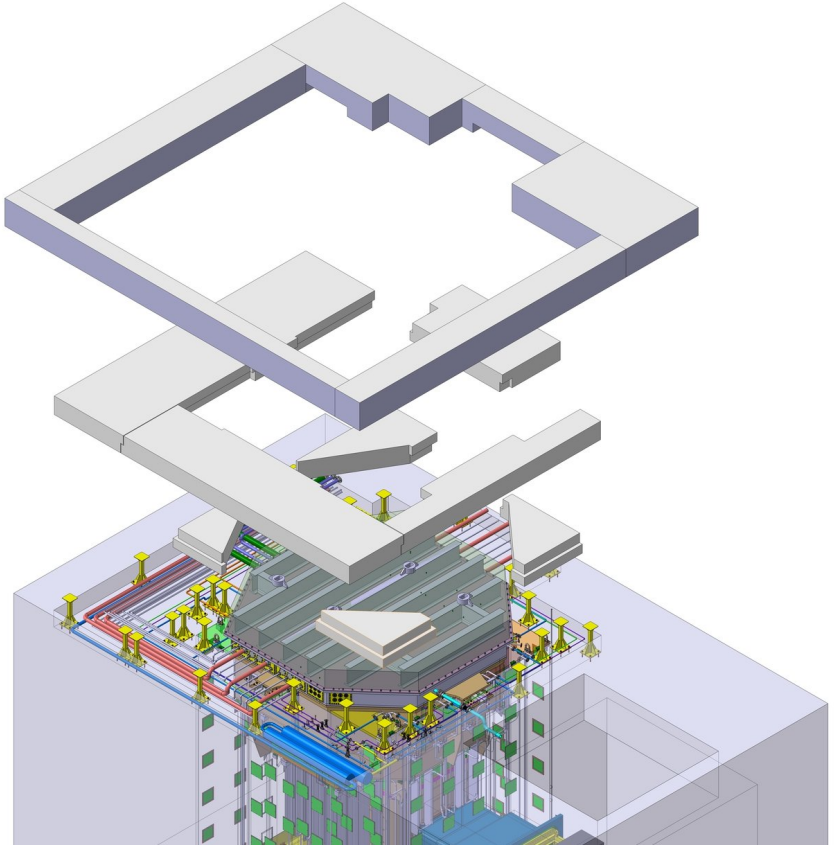
International Projects – IFMIF DONES: Test Cell

ESS Bilbao Consortium: acts as the engineering-phase integrator and is also responsible for the design of the vessel, penetrations, and lithium target (back plate prototype).



International Projects – IFMIF DONES: Test Cell

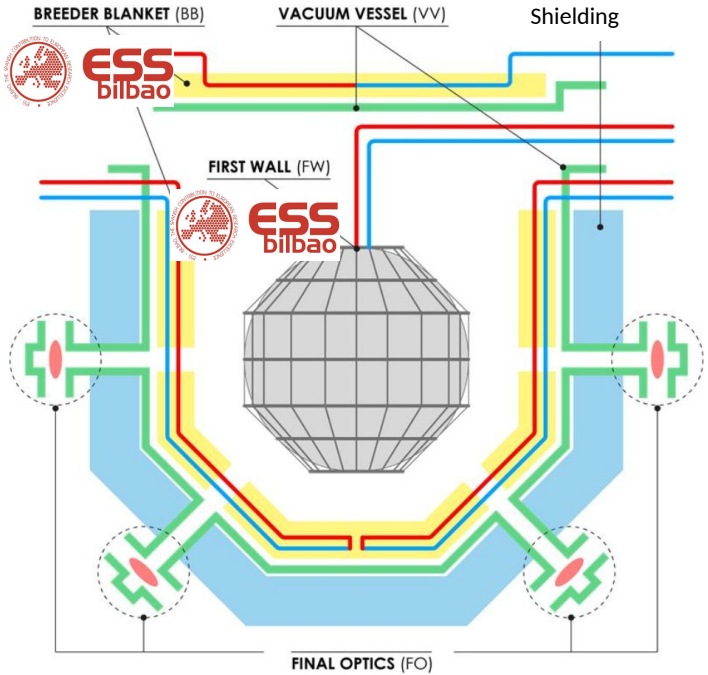


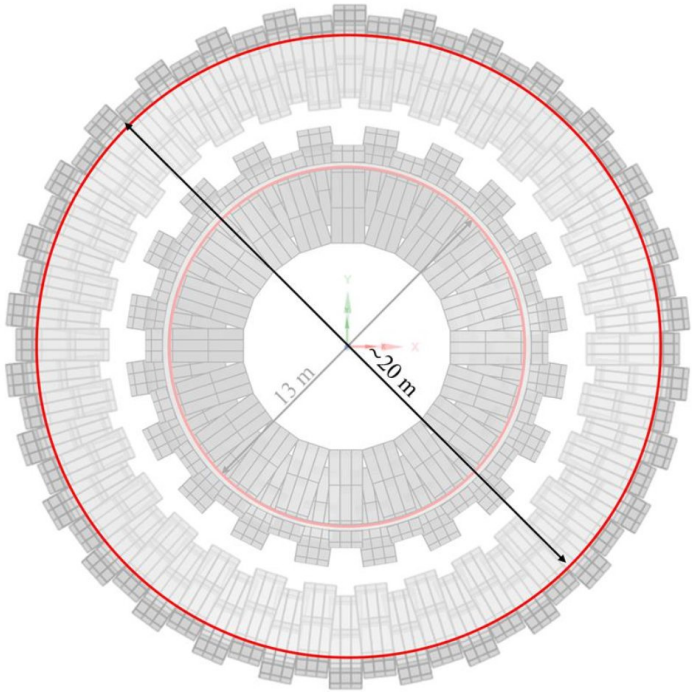


International Projects – FOCUSED ENERGY

ESS Bilbao is collaborating with Focused Energy on the development of the First Wall and Breeding Blanket for its inertial confinement fusion reactor concept.

This work supports the design of key components for a future fusion power plant.





International Projects – FOCUSED ENERGY

FOCUSED ENERGY

Reuters

World Business Markets Sustainability Legal Commentary Technology Investigations Mo

Fusion energy startup Focused signs agreement with RWE, German state

By **Timothy Gardner**

March 24, 2025 11:15 AM GMT+1 · Updated March 24, 2025

General view of the nuclear power plant in Biblis near Frankfurt, Germany March 15, 2016. REUTERS/Ralph Orlowski/File Photo Purchase Licensing Rights

Summary Companies

- Fusion pushes light atoms together to release energy
- Focused aims to use lasers 30 times more efficient than US lab's
- Project would cost up to 7 billion euros
- Fusion faces hurdles including laser supply chain

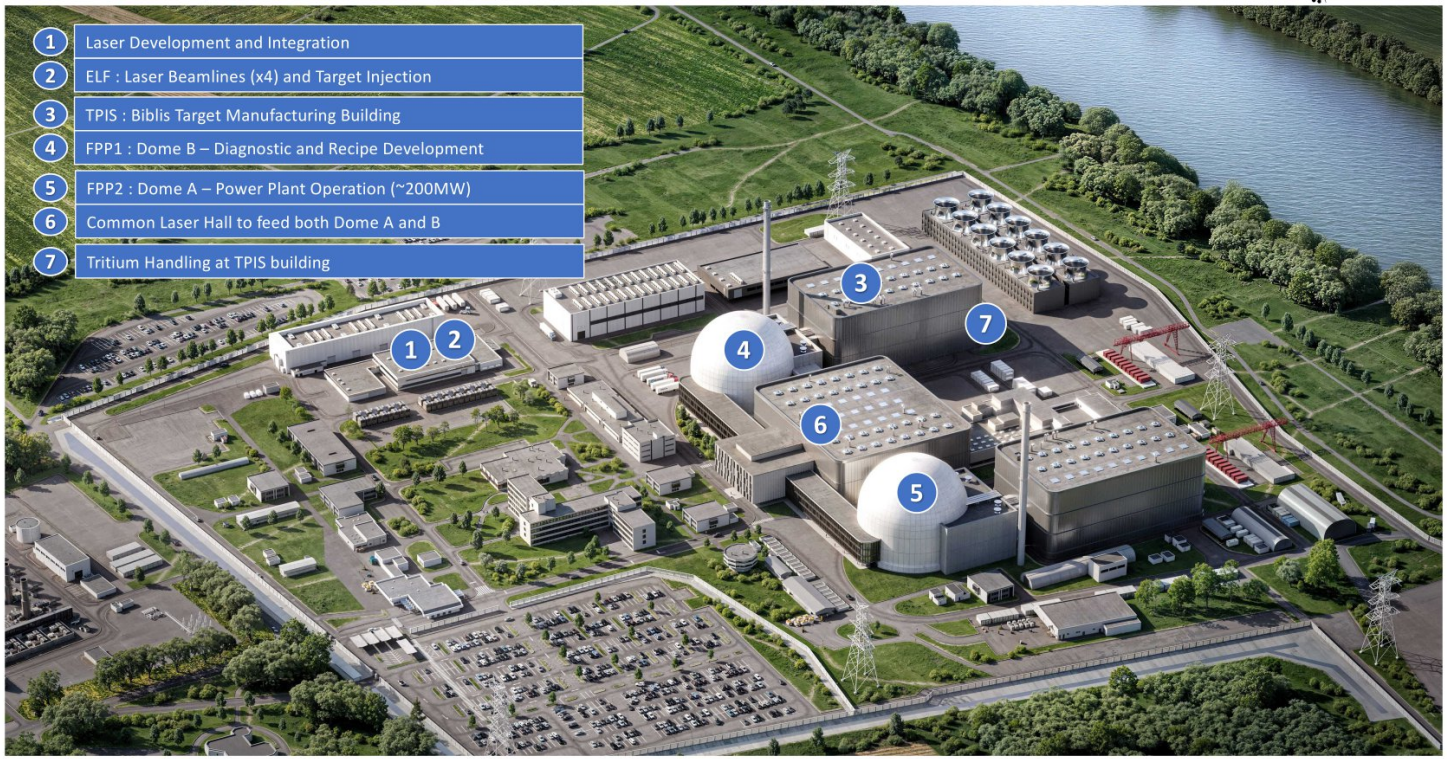
WASHINGTON, March 24 (Reuters) - U.S.-German startup Focused Energy, which aims to build power plants fueled by fusion, said on Monday it has signed an agreement with RWE (RWEG.DE) and the German state of Hesse on building a plant at a shuttered nuclear fission site.

Focused aims to build a fusion pilot plant at RWE's Biblis site by 2035. Biblis, Germany's oldest nuclear plant, has been shut indefinitely as a result of Berlin's decision to exit nuclear power. Germany's conservatives, winners of the February election, said in energy plans last November it aimed to create a regulatory framework for fusion technology in Germany and Europe.

ESS bilbao

International Projects – FOCUSED ENERGY

Fusion Machine At Biblis – Integration View



General view of the n
Licensing Rights

ARGITU

A unique infrastructure fostering the R&D&I ecosystem in Euskadi and Beyond

HiCANS Platform

A collaboration at the core of Europe…
staggered approach towards ARGITU.

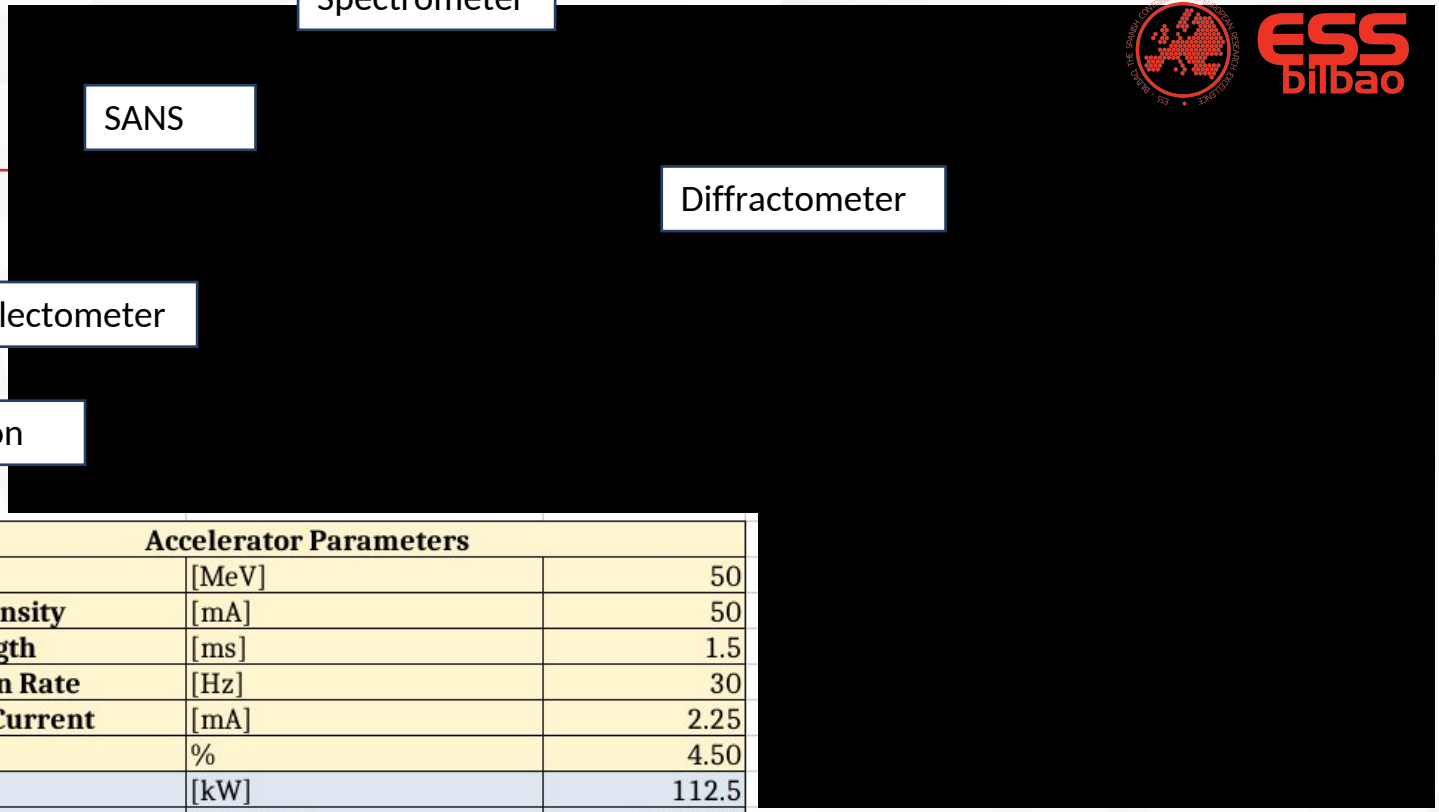
ARGITU, a Neutron Source based on the revolutionary HiCANS concept

- **High Current Proton Beam:** a beam pulse of 1.5 ms, beam current of 32 mA, repetition rate of 30 Hz, and energy of 50 MeV.
- **Compact Design:** The target station has a compact design, using low activation materials to minimize the requirements for licensing
- **Multiple Instruments**: can support various neutron scattering instruments, making it a versatile facility for diverse science and industry applications

CAPEX ~ 100 M€ over 5 years

OPEX ~ 3-5 M€/year

ARGITU



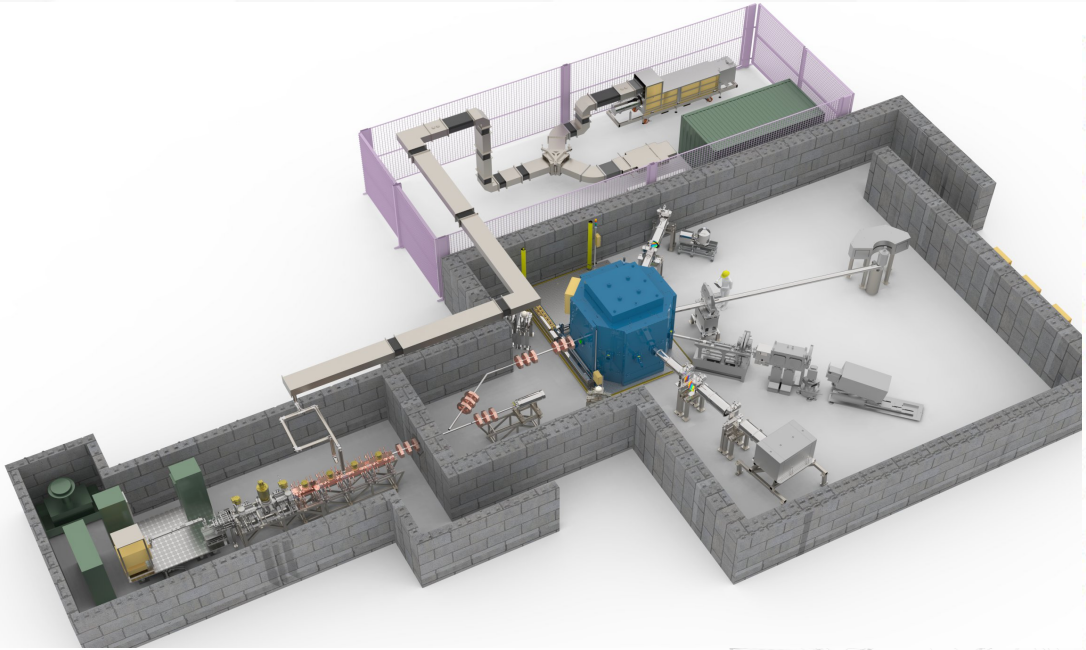
Accelerator Parameters		
Energy	[MeV]	50
Peak Intensity	[mA]	50
Pulse length	[ms]	1.5
Repetition Rate	[Hz]	30
Average Current	[mA]	2.25
Duty	%	4.50
Power	[kW]	112.5
Y_n(Ep)	[n/mu-C]	4.15E+11
Neutron yield	[n/s]	9.33E+14
Proton Current	[p/s]	3.60E+16
Neutron yield	[n/p]	2.59E-02
Head load Target	[MeV/n]	1.93E+03
Peak power	[kW]	2500

HiCANS platform
International collaboration with leading European R&D Centers

Photo: Members of ELENA, Thomas Gutberlet (JCNS) on the left, Mario Perez (ESS Bilbao) in the middle, and Arnaud Desmedt (LLB CEA-CNRS) on the right, during the IMoH Workshop held in Bilbao.

ELENA
European Low Energy accelerator-based Neutron facilities Association

HiCANS platform – (a.k.a ARGITU-Zero)
International collaboration with leading European R&D Centers



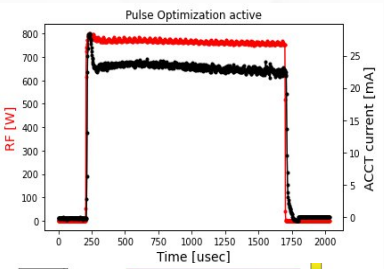
Accelerator Parameters		
Energy	[MeV]	3
Peak Intensity	[mA]	30
Pulse length	[ms]	1.5
Repetition Rate	[Hz]	30
Average Current	[mA]	1.35
Duty	%	4.50
Target Parameters: Lithium Target		
Power	[kW]	4.05
Y_n(Ep)	[n/mu-C]	4.39E+08
Neutron yield	[n/s]	1.92E+12
Proton Current	[p/s]	2.16E+16
Neutron yield	[n/p]	8.87E-05
Head load Target	[MeV/n]	3.38E+04

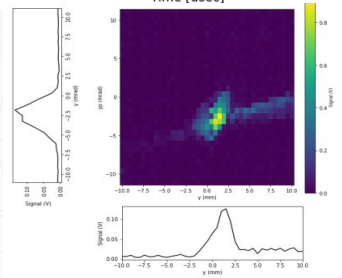
GOBIERNO DE ESPAÑA MINISTERIO DE CIENCIA, INNOVACIÓN Y UNIVERSIDADES
EUSKO JAURLARITZA GOBIERNO VASCO
ESS bilbao
Jülich Centre for Neutron Science
Laboratoire Léon Brillouin
ESS bilbao

ARGITU-Zero as a dedicated HiCANS platform – High Currrent Accelerator – Ion Source + LEBT

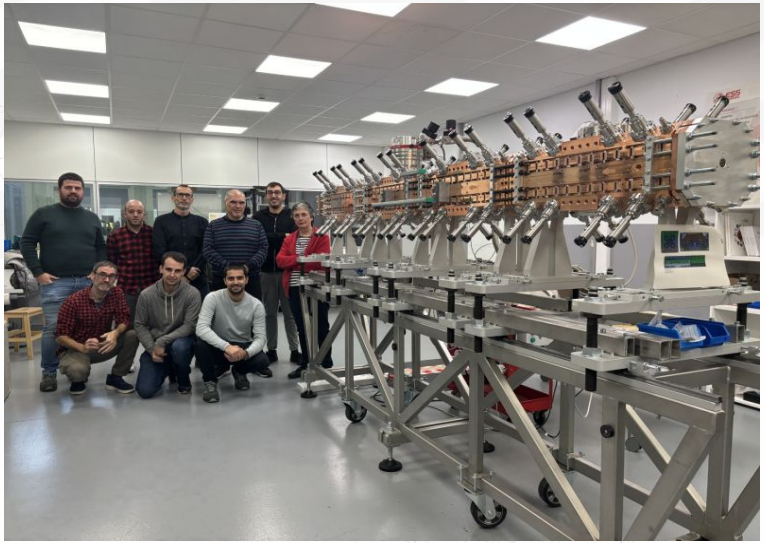
ISHP

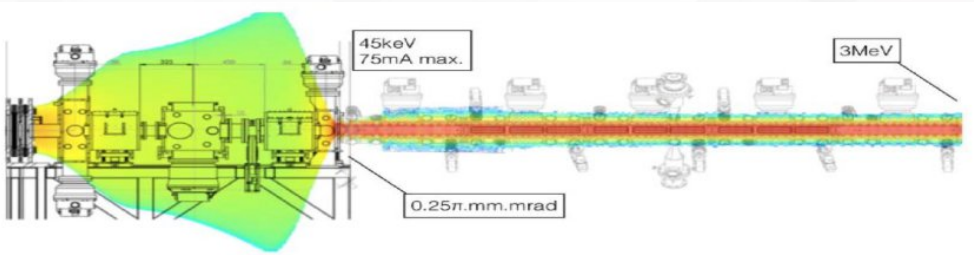
- 45 KeV Proton beam
- Up to 30 mA
- Pulse length up to 2 msec
- Pulse repetition rate up to 20 Hz





ARGITU-Zero as a dedicated HiCANS platform – High Currrent Accelerator – RFQ





- All four segments delivered at our facilities.
- RFQ assembly successfully finished
- **Beadpull and tuning completed**
- Power couplers v1.0 tested in low and high power
- Next step high-power conditioning

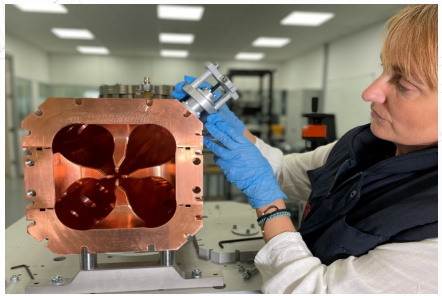


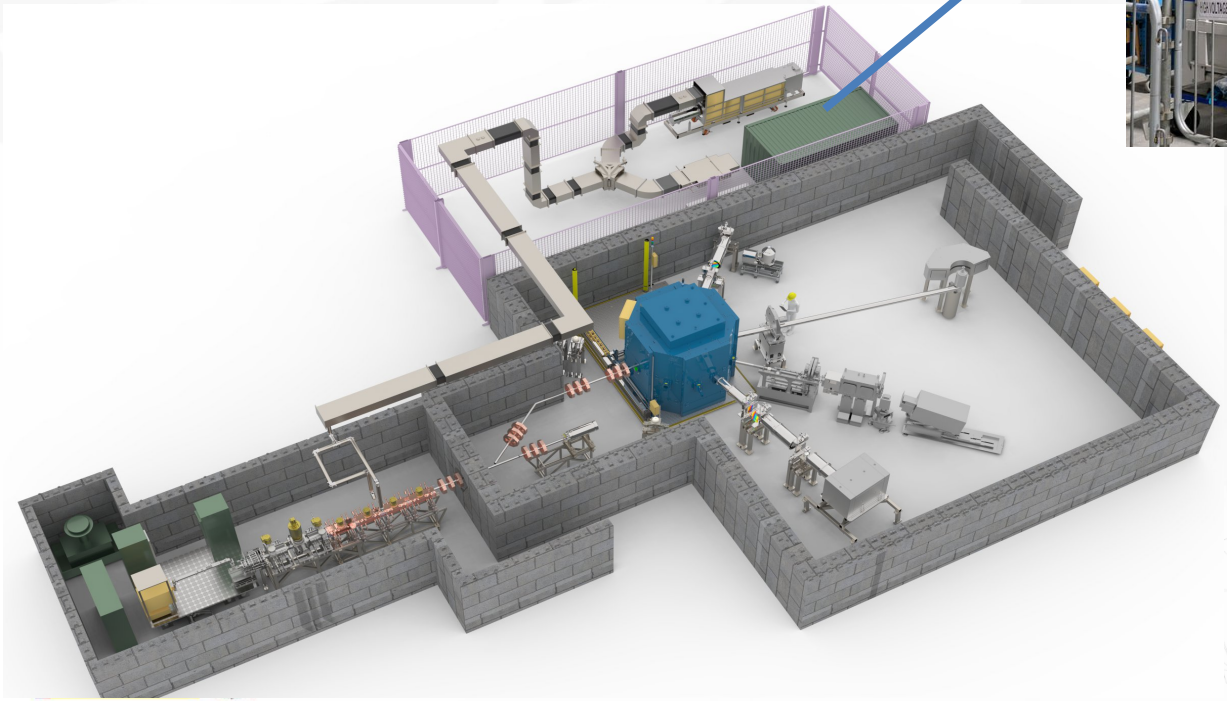
Table 1: ARGITU-RFQ Main Specifications

Parameter	Value
Specimen	H+
Beam current	32 mA
Beam energy	45 keV→3 MeV
RF Frequency	352.2 MHz
Pulse Operation	30 Hz; 1.5 ms; 4.5 %
Intervane Voltage	85 kV
Kilpatrick	1.85
Input emittance	0.25 π mm rad

ARGITU-Zero as a dedicated HiCANS platform – High Currrent Accelerator – RF Power System

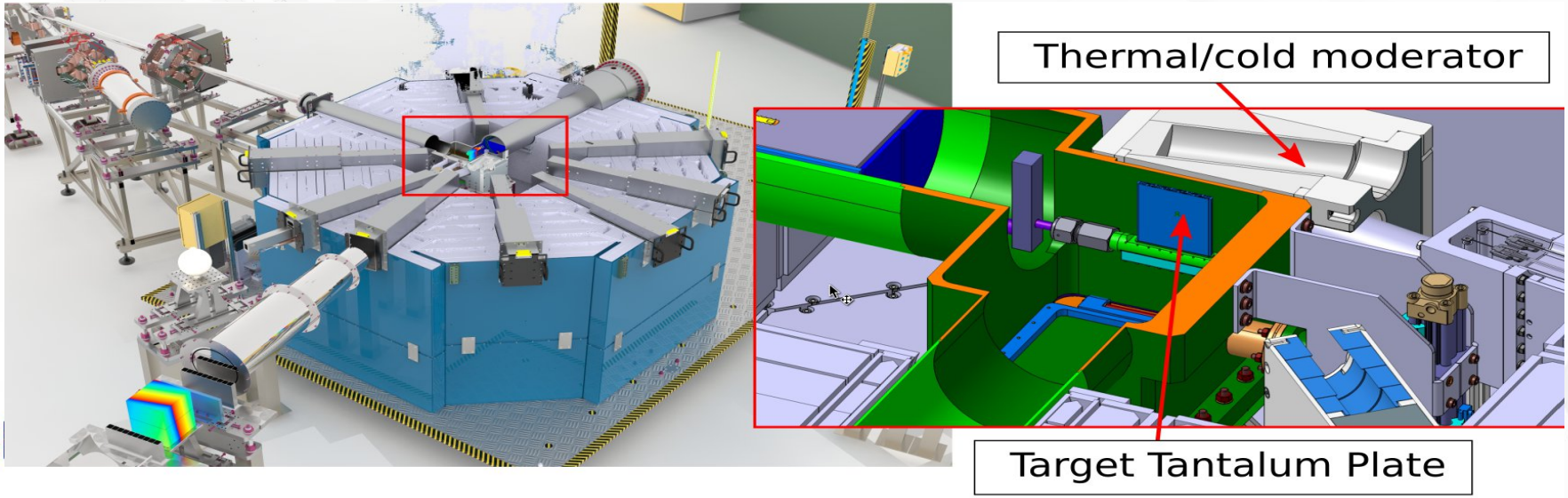
- **Lending agreement with ESS in place**
- Klystron is already at our R&D lab in Zamudio. Adaptation is on-going
- Modulator (Prototype) has been set up ready for operations by JEMA – procurement of a new one Q2 2025.
- Modulator, Waveguides and other auxiliaries are ready at our RF Test Stand in Bilbao.
- RF Power System integrated test is scheduled to run in parallel with the RFQ tunning activities along this year.

Replacement of the current modulator — a 2014 prototype — with a new modulator identical to the industrialized model for ESS ERIC.

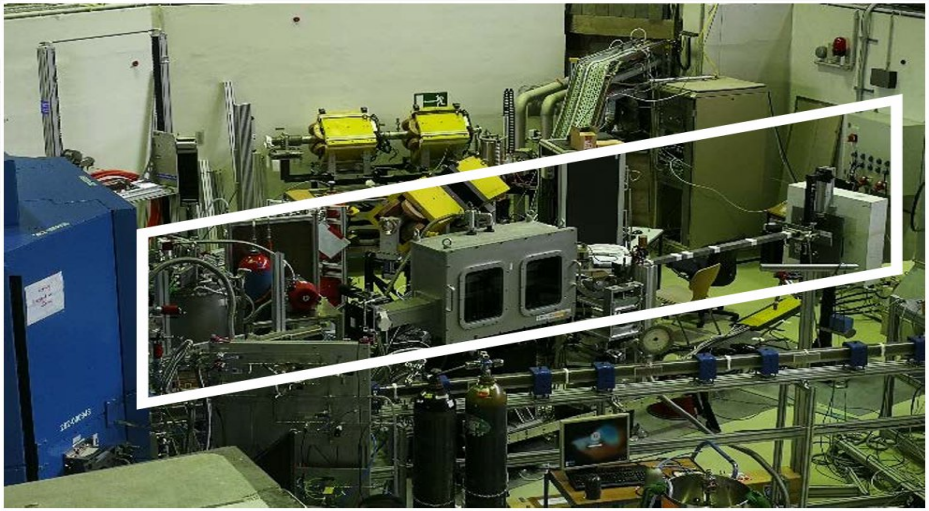


HiCANS platform – Integrating JCNS Target Station

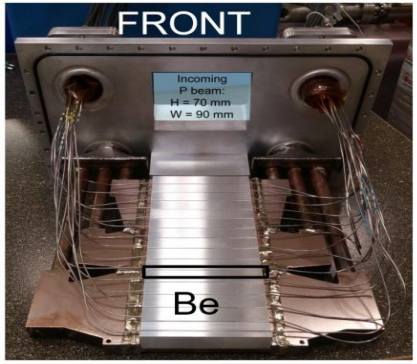
- ✓ BigKarl is based on a Tantalum Target that will not produce any neutron at 3 MeV.
- ✓ Litium based Target is needed to optimize neutron production at 3 MeV. However, the cooling scheme would be fully compatible, and the handling process could be reused.
- ✓ 1D moderators can be reused without modifications.
- ✓ The target station allows up to 7 experimental lines for neutron instruments

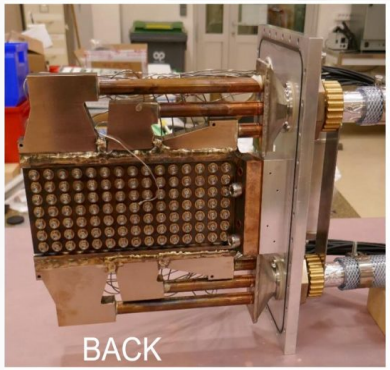


HiCANs Platform – HERMES reflectometer & 3T2 Diffractometer + High Power Be Target



HERMES Reflectometer at BigKarl Platform





High Power Tests of the Be Target at CEA

SUMMARY

- ESS Bilbao is a growing **center of excellence in accelerator, target, and neutron technologies**, delivering advanced engineering and R&D capabilities.
- Strong track record of successful **In-Kind Contributions** to the European Spallation Source (ESS), including accelerator subsystems, RF systems, target components, and the MIRACLES instrument.
- **Expanding international footprint** through major collaborations and projects, particularly via strong and **high-vaule industry partnerships**.
- Actively involve in **HiCANS-based neutron source** development within Europe (ELENA, ARGITU, HiCANs Platform).
- **ARGITU** / HiCANs emerging as a **strategic next-generation neutron source**, enabling multi-instrument capability and strengthening the European neutron science ecosystem.