II Jornada Industria de la Ciencia – ICTS Infraestructuras Científicas y Técnicas Singulares de física de partículas, fusión y astronomía: estrechando lazos con la industria

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Jefa de Oficina de Dirección, ESS Bilbao
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Financiado por la Unión Europea NextGenerationEU

1. ESS BILBAO– Descripción general

Who we are?

International Research and Development center for Particle Accelerator and Neutron Science and Technologies which generates knowledge and added value through the in-kind contribution to the European Spallation Neutron Source, in Lund (Sweden).

Employees

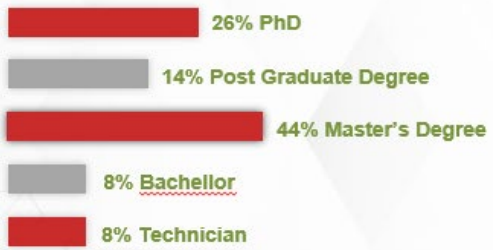
47

Age average: 43

28% women

72% men

Qualification



Where we are?

Headquarters

Parque Tecnológico de Zamudio (Bilbao, Bizkaia)

R&D Center

Parque Tecnológico de Zamudio (Bilbao, Bizkaia)

AWF

Pol. Ind. Júndiz. Vitoria, Gasteiz

Madrid Satellite

Instituto de Fusión Nuclear (Madrid)

EUSKO JAURLARITZA
GOBIERNO VASCO

ESS bilbao

European Spallation Source ESS, Lund

Total construction cost: >1.843 M€ (2013-2028)
13 European countries and 100 Institutions

Host Countries Sweden and Denmark

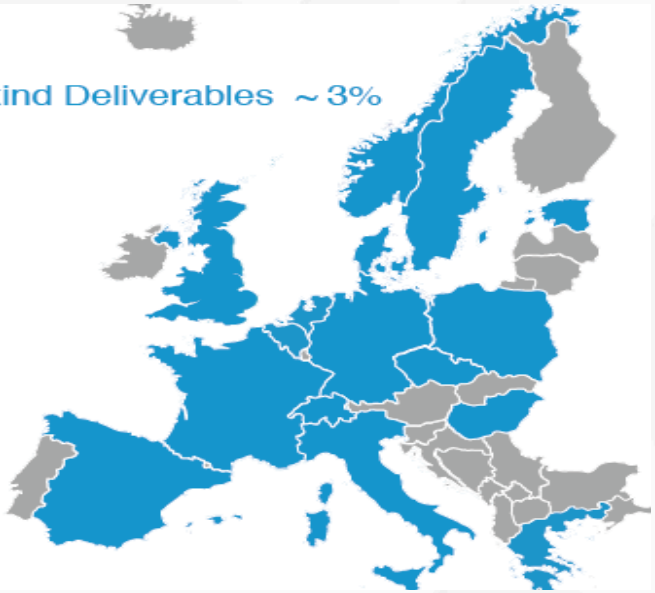
Construction 47.5%
Operations 15%

Cash Investment ~ 97%; In-kind Deliverables ~ 3%

Non Host Member Countries

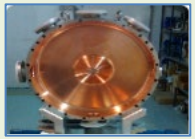
Construction 52.5%
Operations 85%

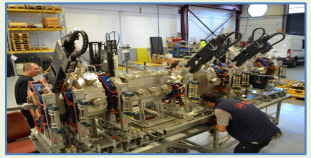
In-kind Deliverables ~ 70%

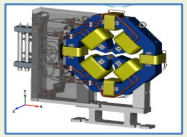


In-Kind Contributions to ESS

MEBT







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

RF Systems

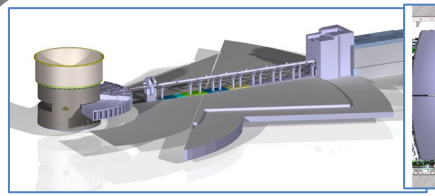
RF chains: 1 for RFQ and 5 for DTL. Composed by klystrons, modulators, loads, waveguides, interlocks and LLRF

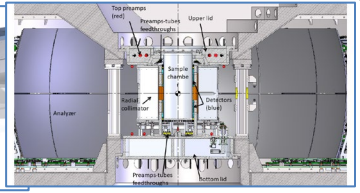
TARGET

MIRACLES Instrument

ACCELERATOR

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.





Time-of-Flight backscattering instrument for polymer science, energy materials, and magnetism studies.
Prime contractors: design, manufacturing, assembly &cold commissioning

2. ESS BILBAO– Proyectos

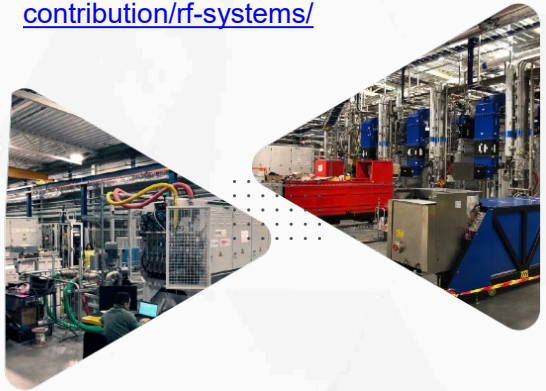
ACCELERATOR

MEBT https://www.essbilbao.org/in-kind-contribution/mebt/

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

RF Systems

RF stations: 1 for RFQ and 5 for DTL. Composed by klystrons, modulators, loads, waveguides, interlocks and LLRF https://www.essbilbao.org/in-kind-contribution/rf-systems/

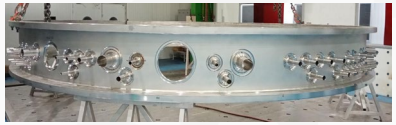


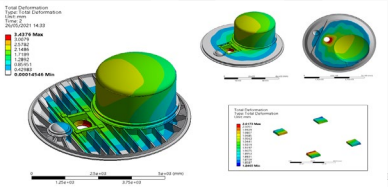
2. ESS BILBAO– Proyectos

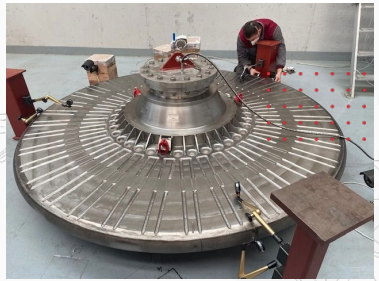
TARGET

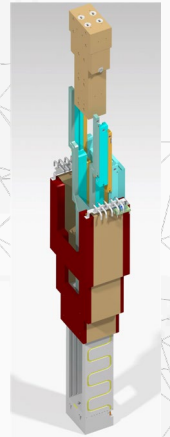
The spallation process takes place when the accelerated proton beam hits the Tungsten bricks of the 11-tonne target wheel. This will produce neutron brightness for scientific experiments across multiple disciplines. https://www.essbilbao.org/in-kind-contribution/target/

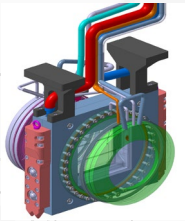
Target System Overview











2. ESS BILBAO– Proyectos

MIRACLES Instrument

MIRACLES is a time-of-flight backscattering spectrometer. Revealing dynamic processes over a wide range of energies, it will serve life-science, polymer science, energy materials, magnetism studies and much more.
This contribution from ESS Bilbao will allow research into degenerative diseases such as Alzheimer´s or Parkinson´s or enable the development of antibiotics and medicines for various types of cancer. It will also help develop storage devices for hydrogen or new batteries, which is key for the energy transition and the fight against climate change.
https://www.essbilbao.org/in-kind-contribution/instrument/

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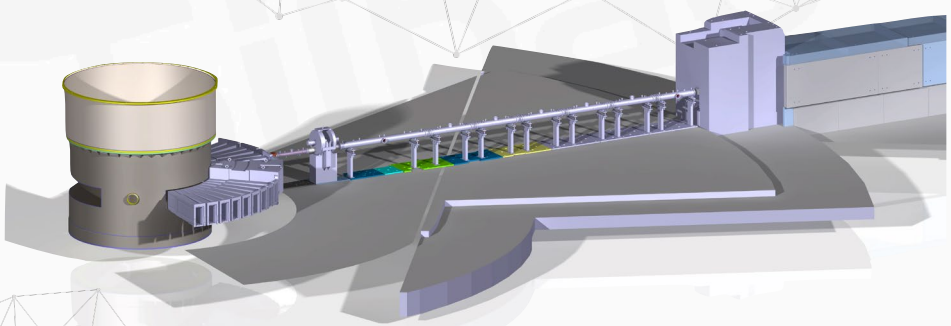
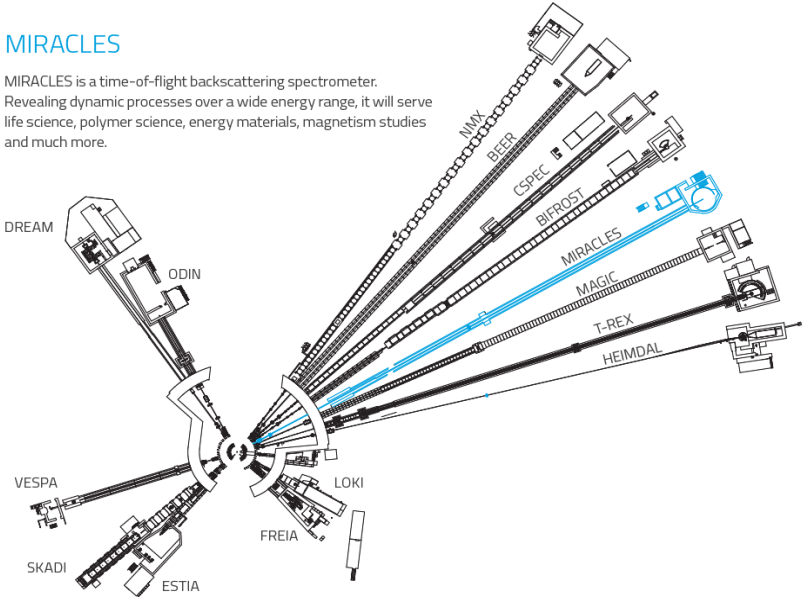
Miracles Instrument Overview



MIRACLES

MIRACLES is a time-of-flight backscattering spectrometer. Revealing dynamic processes over a wide energy range, it will serve life science, polymer science, energy materials, magnetism studies and much more.



Fifteen instruments are currently under construction at ESS.
The in-kind partner institutions collaborating with ESS to design and build MIRACLES are:

ESS bilbao

UNIVERSITY OF COPENHAGEN

Financiado por la Unión Europea NextGenerationEU
GOBIERNO DE ESPAÑA MINISTERIO DE CIENCIA E INNOVACIÓN
EUSKO JAURLARITZA GOBIERNO VASCO

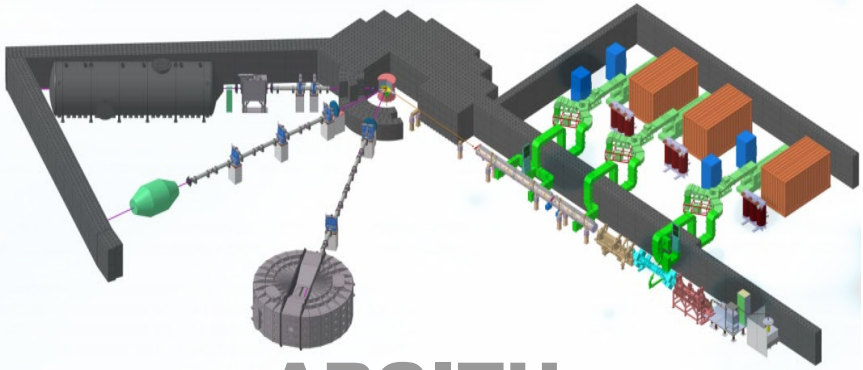
2. ESS BILBAO– Proyectos- ESS ERIC-Initial Operations

- The **Init. Ops. budget (810 M€$_{2013}$)** and a detailed Initial Operations Plan was approved by Council
- Cost book for in-kind during initial operations and the ESS procedure for in-kind contribution management during initial operations phase was also approved by council.
- Continuous updates are foreseen

Package	Definition	Preliminary Value (k€$_{2020}$)
352 Klystron spares	2 spare 352 MHz Klystrons	1 230
Spares for Spoke RF stations	Replacement parts for spoke RF stations	1 272
Spare modulator	One complete spare modulator built to print	900
Modulator spare parts	Spare and replacement parts for modulators	1 168
Modulator oil and oil treatment	Spare oil and oil treatment for all modulators	769
Spare Medium Beta Cryomodule	Additional components and effort needed to build a spare cryomodule	500
Backup cryo compressor	Backup compressor and oils system for the accelerator cryo plant	3 600
Cryogenic Liquids	Approximately 26 600 liters of LHe	400
Spare LEBT	Spare LEBT, complete with diagnostics	331
Spare RFQ Copper	Spare copper material for an RFQ	285
Test stand 2 Operation[6]	Manpower to operate test stand 2	550

Package	Definition	Preliminary Value (k€$_{2013}$)
Mark-2 Target Wheel	Technical development of the Mark-2 Target Wheel unit, provisionally including the delivery of the actual hardware item for mitigation of the risk of Mark-1 TW infant mortality.	4 500
Mark-2 MR	Technical development of the Mark-2 MR, i.e. of the BF-1 type, including timely delivery of the actual hardware item as required.	2 750
Mark-2 and Mark-3 PBW	Two replacement items of the PBW, including moderate technical development and timely delivery of the actual hardware items as required.	1 000
ACF supplier support	As described above	To be costed
Casks Assembly – manufacture, testing and commissioning	Seven (minimum) shielded handling and transfer casks and one maintenance and decontamination station.	7 000

2. ESS BILBAO– Proyectos



ARGITU

PARAMETER	VALUES
Specimen	H+
Beam Pulse (ms)	1.5
Rep Rate (Hz)	30
Beam Current (mA)	32
Beam Energy (Mev)	31.47
Duty	4.5
Peak Power (KW)	1,007.15

ARGITU, a unique and versatile Low Energy (30 MeV) accelerator-based Neutron source

- Provides easy access to neutrons at a much lower running cost than a high flux neutron source.
- Allows proof-of-concept and proof-of-principle investigations of materials that, if satisfactory, will be analyzed more in detail in a high-flux neutron source, complementing a currently lacking link between lab-based research and expensive high-flux neutron source experiments.
- Increases the efficiency of the neutron scattering experiments, providing more opportunities to incubate new ideas, pioneering works and epoch-making breakthrough experiments.
- Enables cheaper and faster proof-of-concept experiment sources for industrial partners with fast access needs.
- Represent a strong opportunity for a cost-effective training of scientists on the use of neutron scattering experiments and to use them in hands-on experiences on seasonal neutron scattering schools.
- Allows cost-effective instrumentation developments.

2B. ESS BILBAO– Proyecto MIRACLES- Oportunidades

- **Oportunidad**: Suministro de Detectores para Miracles
- **Descripción**: Fabricación y test necesarios para los detectores de neutrones sensibles en posición del instrumento MIRACLES. 96 tubos de helio-3 con sensibilidad a la posición.
- **Fecha aproximada**: Primer semestre 2023
- **Importe aproximado**: 250.000€
- **Competencias industriales:** diseño mecánico, diseño eléctrico, electrónica, acceso a helio-3, detectores de radiación.

2B. ESS BILBAO– Proyecto MIRACLES- Oportunidades

- **Oportunidad**: Suministro de Cristales del Analizador de Miracles
- **Descripción**: Fabricación y tests necesarios de los Cristales del Analizador del Instrumento Miracles.
- **Fecha aproximada**: Segundo semestre 2023
- **Importe aproximado**: 350.000€
- **Competencias industriales:** mecánica de precisión, óptica de rayos X / neutrones.

2B. ESS BILBAO– Proyecto MIRACLES- Oportunidades

- **Oportunidad**: Suministro de Blindaje Interno para la vasija de Miracles
- **Descripción**: Fabricación y tests necesarios para el suministro del Blindaje Interno para la vasija de instrumento MIRACLES.
- **Fecha aproximada**: Segundo semestre 2023
- **Importe aproximado**: 150.000€
- **Competencias industriales:** Materiales.

2B. ESS BILBAO– Proyecto MIRACLES- Oportunidades

- **Oportunidad**: Suministro de Soportes de Guia para Miracles
- **Descripción**: Fabricación y tests necesarios de los soportes para las guias de neutrones del instrumento MIRACLES.
- **Fecha aproximada**: Segundo semestre 2023
- **Importe aproximado**: 120.000€
- **Competencias industriales:** Diseño mecánico, fabricación estructuras aluminio/acero.

2B. ESS BILBAO– Proyecto MIRACLES- Oportunidades

- **Oportunidad**: Suministro de Electrónica de Detectores (PAs + HVs) para Miracles
- **Descripción**: Suministro y test necesarios para la eléctronica de los detectores de neutrones sensibles en posición del instrumento MIRACLES.
- **Fecha aproximada**: Primer semestre 2024
- **Importe aproximado**: 60.000€
- **Competencias industriales:** diseño eléctrico, electrónica.

2B. ESS BILBAO– Proyecto MIRACLES- Oportunidades

- **Oportunidad**: Suministro de Grúa pluma
- **Descripción**: Suministro e Instalación de grúa pluma (7m, 1tn) para el entorno de muestra del instrumento MIRACLES.
- **Fecha aproximada**: Primer semestre 2024
- **Importe aproximado**: 50.000€
- **Competencias industriales:** fabricación y suministro de gruas.

2B. ESS BILBAO– Proyecto MIRACLES- Oportunidades

- **Oportunidad**: Cave de Miracles
- **Descripción**: Diseño, fabricación, tests e instalación de la Cave de MIRACLES.
- **Fecha aproximada**: Primer semestre 2024
- **Importe aproximado**: 1.000.000€
- **Competencias industriales:** Diseño estructural, Diseño de instalaciones, infraestructuras, obra civil, estructuras hormigón.

2B. ESS BILBAO– Proyecto MIRACLES- Oportunidades

- **Oportunidad**: Sample positioning system
- **Descripción**: Suministro y montaje del sistema en vacío de posicionamiento de muestras del Instrumento Miracles.
- **Fecha aproximada**: Segundo semestre 2024
- **Importe aproximado**: 50.000€
- **Competencias industriales:** diseño mecánico, mecánica de precisión, vacio.

2B. ESS BILBAO– Proyecto TARGET- Oportunidades

- **Oportunidad**: 2ª RUEDA DEL TARGET (varias licitaciones)
- **Descripción**: diseño, fabricación y tests de la segunda rueda del target y de los cassettes. Servicios de calidad asociados. Suministro del tungsteno….
- **Fecha aproximada**: 2024/2025
- **Importe aproximado**: >5.000.000€
- **Competencias industriales:** Diseño mecánico, fabricación mecánica, calidad, Normativa nuclear RCCM

2B. ESS BILBAO– Proyecto ACELERADOR- Oportunidades

- **Oportunidad**: SISTEMA DE REFIRGERACION DEL RFQ
- **Descripción**: diseño, fabricación, e instalación del sistema de refrigeración del RFQ de ESS Bilbao.
- **Fecha aproximada**: 2024
- **Importe aproximado**: 400,000€
- **Competencias industriales:** Diseño mecánico, Infraestruturas, sistemas de refrigeración, control,electrónica.

3. ESS BILBAO– Retos tecnológicos de futuro-ARGITU

Proyecto: ARGITU

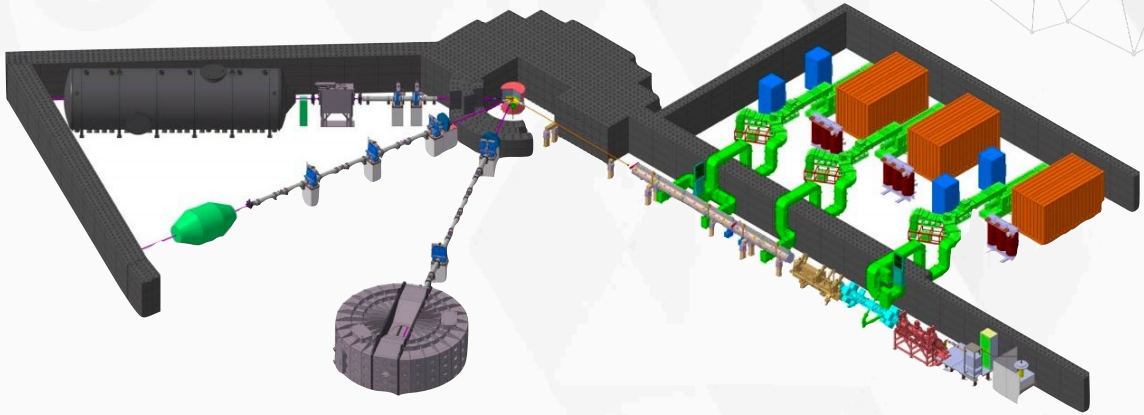
- **Reto**: Construcción de una fuente compacta de neutrones con el desarrollo de todas la tecnologías asociadas
- **Descripción**: Desarrollo de las diferentes capacidades tecnológicas en aceleradores y neutrónica que además tendrán luego aplicación en otros múltiples sectores: Electrónica, electromagnetismo, electrónica de potencia, vacío, radiofrecuencia, sistemas de sincronismo y control, criogenia, detectores y monitores de haz avanzados, computación y software para análisis científico, equipamiento de entorno de muestra, robótica, Componentes avanzados para blindaje …

3. ESS BILBAO– Retos tecnológicos de futuro-ARGITU

Low Energy (30 MeV) Accelerator Neutron Facility (ARGITU)

ARGITU, a unique and versatile accelerator-based Neutron source been proposed by ESS Bilbao

- Realization of routine experiments for complementary characterization of the structure and dynamics of the samples under study.
- Better preparation for outstanding experiments in high-flux neutron sources - such as the European sources, ILL and ESS.
- Serving as an attracting magnet to a future generation of young scientist studying materials, biology and other fields.



4. ESS BILBAO– Equipamientos y servicios. Capacidades.

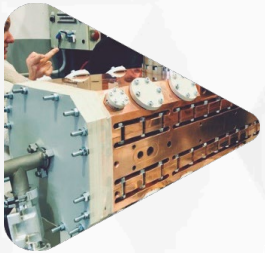
- **Equipamiento/laboratorio/servicios**: In-House facility: IS + LEBT + RFQ + RFTS

https://www.essbilbao.org/capabilities/in-house-projects/

RFQ

1st segment successfully tested; 3 segments under fabrication

- Innovative design results in a short (3.2 m; 4 segments) and more efficient RFQ
- From 45 keV to 3 MeV
- Uniform 85 kV inter-vane voltage
- Frequency tuning based on cooling water temperature control



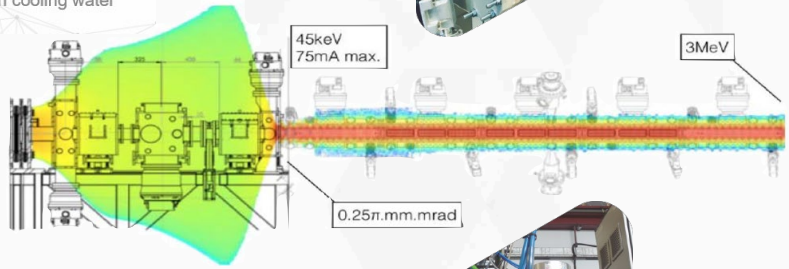
INJECTOR

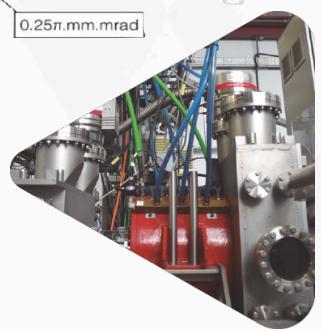
Ion Source + LEBT

Ion source and low energy beam transport

The Ion Source is an Electron Cyclotron Resonance (ECR) type, which has already been built and is in routine operation at the ESS Bilbao R&D lab. The proposed magnetic low energy transport system (LEBT) consists of two solenoids placed at fixed positions, producing tunable magnetic fields which are used to match the characteristics of the beam to those imposed by the RFQ input specification.

Over the past few years, the ESS Bilbao team has accumulated extensive experience in design, manufacturing and tuning different parts comprising the ion source and LEBT through the commissioning of the existing injector and collaborations with other laboratories, as the national INFN in Italy or the Rutherford Appleton laboratory.





4. ESS BILBAO– Equipamientos y servicios. Capacidades.

- **Equipamiento/laboratorio/servicios**: Capacidades en el área de Aceleradores

Accelerator

Design, engineering and development of particle accelerator technology equipment:

- Accelerator physics simulations
  Beam transport, FEM calculations, plasma condition and extraction
- ECR ion sources/injectors and accelerator sections (RFQ, MEBT, DTL)
- Beam instrumentation/diagnostics development (ACCT, BPM, EMU, FCs,...)
- Accelerator control systems and interlocks
- RF Design
  EM simulation, magnets, cavities, high power amplifiers (tubes and solid state), RF distribution, LLRF, interlocks,...
- RF Test Stand (low and high power)
  Cavity characterization and conditioning

Electro Magnetic

Thermo mechanical

Machining

RF

Metrology

Cu plating

2B. ESS BILBAO– Equipamientos y servicios. Capacidades.

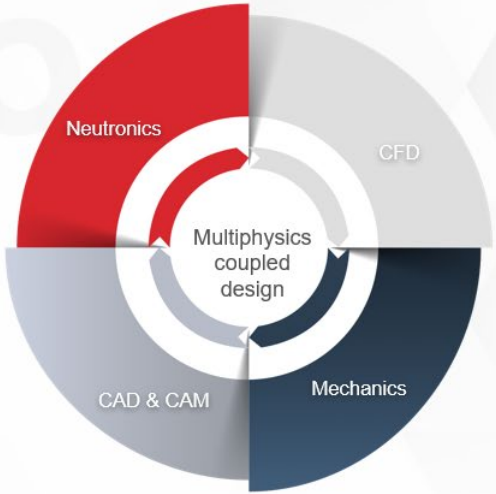
- **Equipamiento/laboratorio/servicios**: Capacidades en el área de Target

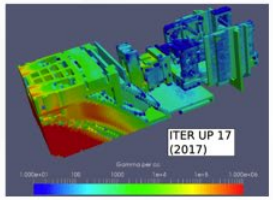
Target Division

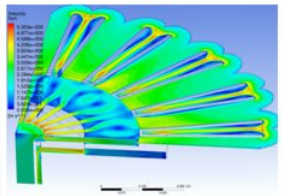
Design and engineering of nuclear technology equipment.

Main areas (Multiphysics analysis):

- Neutronics
  Particle transport (MNCPx), irradiation damage, shielding, activation (ACAB) and shutdown dose rate evaluation
- Computational Fluid Dynamics
- Mechanical analysis
- Accelerator control systems and interlocks
- CAD/CAM







ESS-Bilbao target flow velocity

4. ESS BILBAO– Equipamientos y servicios. Capacidades.

- **Equipamiento/laboratorio/servicios**: Capacidades en el área de Instrumentos

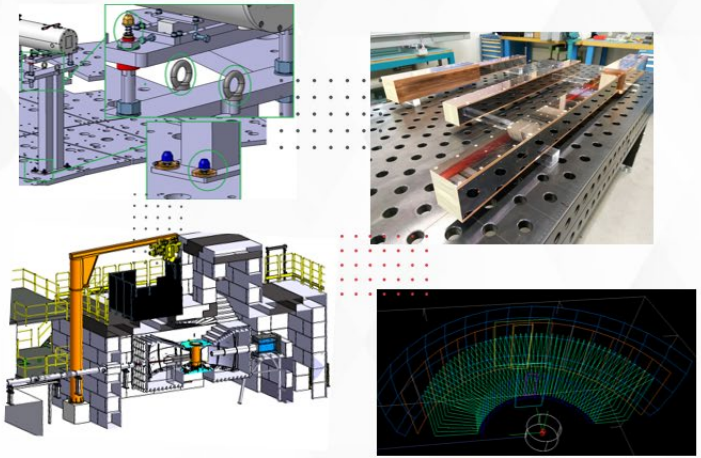
Expertise and capacities

Instrument Division

Design and engineering of neutron scattering instrument.

Main areas:

- Neutron optics
  Concepts for neutron scattering instruments (McStas)
- Neutron instrumentation
  CAD, integration, alignment & metrology
- Control systems
- Radiation detection
  Neutron & x-ray detectors
- DAQ chain, computing (Python, C++)
- Scientific equipment
  Sample environment…



Financiado por la Unión Europea NextGenerationEU

4. ESS BILBAO– Equipamientos y servicios. Capacidades.

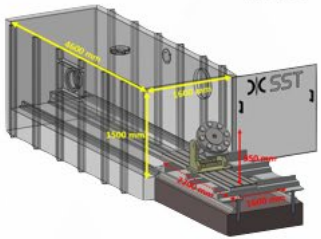
- **Equipamiento/laboratorio/servicios**: Electron Beam Welding (EBW)

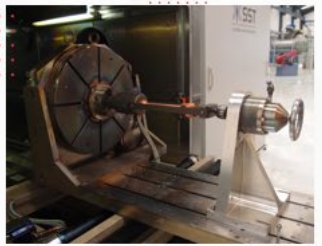
Characteristics

- Beam Power: up to 30 kW
- B High Voltage: Beam generator fixed
- Max linear Weld dim: 2200 x 1000 mm
- Max height: 950 mm
- Max load: 2500 kg
- CNC programming
- Welding options:
  - 8 fold rotatory device
  - Rotary device + tailstock

Capabilities

- Copper < 60mm
- Aluminium < 100mm (depending on alloy)
- Steel < 110mm
- Stainless Steel < 110mm
- Titanium < 110mm





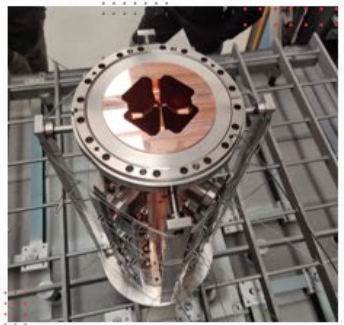
4. ESS BILBAO– Equipamientos y servicios. Capacidades.

- **Equipamiento/laboratorio/servicios**: Advanced Welding: Brazing

Advantages

- Cheap process for the manufacturing of complex and multiple joins.
- Good distribution of strenghs and heat transfer.
- It's posible to preserve the platings.
- Posibility of join metals and no metals.
- Different thickness materials.
- Porous materials.
- Maintain of the metal bases characteristics.
- The process can be automated.

Concept	Description	Value & Units
Useful dimensions	Width	1500mm
	Height	1500mm
	Depth	1500mm
	Volume	3375m³
Charge	max. gross charge	1200Kg
Temperature	Design temperature	1350ºC
	Normal working temp. range	From 600 to 1200ºC
	Temperature uniformity in vacuum (t > 600ºc)	± 5ºC
Vacuum	Ultimate vacuum level 1	1E-6 mbar
	Operating vacuum	1E-5 mbar
	Partial pressure	0.1 - 10 mbar
	Leak rate (empty, clean and cold surface)	≤1E-3 mbar s⁻¹
Furnace performances (empty furnace)	Pumping time to 1E-4 mbar range	<20 min
	Heating time from RT to 1200ºC	<90 min
Weight	Plant gross charge	approx. 20Ton



Brazing on RFQ manufactured by Egile (Mendaro)

https://www.essbilbao.org/capabilities/manufacturing-advanced-welding-facility/advanced-welding/

5. ESS BILBAO– CONTACTOS

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- **Contacto**: Ibon Bustinduy (en el área de Aceleradores)
- **Contacto**: Pedro González (en el área de Radiofrecuencia)
- **Contacto**: Fernando Sordo(en el área de Target)
- **Contacto**: Miguel Magán (en el área de Cálculos Neutrónicos)
- **Contacto**: Igor Rueda (en el área de Fabricación y soldadura avanzada)

6. ESS BILBAO– Otra Información de Interés