

**ESS
Bilbao**

**Big Science
Business
Forum
2022**

ESS-Bilbao

**Developments in Neutron and Accelerator
Science & Technology**

**“Current and Future Opportunities for Industry”
BSBF 2022**

Mario Pérez, ESS-Bilbao
Granada, 6 October 2022



Who we are...

Public consortium of Central and Basque Governments; bringing knowledge and added value in particle accelerators and neutron scattering science and technologies; by leveraging its in-kind contribution to the European Spallation Neutron Source, in Lund (Sweden).



~50 employees
age average: 40



29% women



71% men



Qualification



Headquarters



Technology Park
Zamudio (Bilbao)

R&D Center



Techology Park
Zamudio (Bilbao)

AWF



Industrial Park Júndiz
Vitoria-Gasteiz

Madrid Satellite



Instituto de Fusión Nuclear
Madrid



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

Host Countries Sweden and Denmark

Construction 47.5% Cash Investment ~ 97%; In-kind Deliverables ~ 3%
Operations 15%

Non Host Member Countries

Construction 52.5% In-kind Deliverables ~ 70%
Operations 85%



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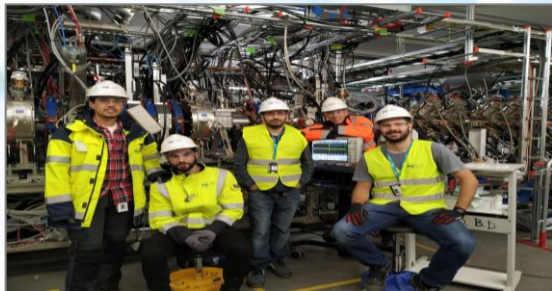
Developments in Neutron and Accelerator
Science & Technology

**ESS ERIC Construction -
Delivering on our commitment**

Mario Pérez, ESS-Bilbao
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Accelerator System Contribution



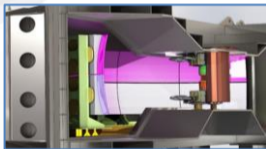
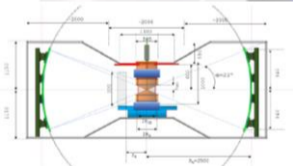
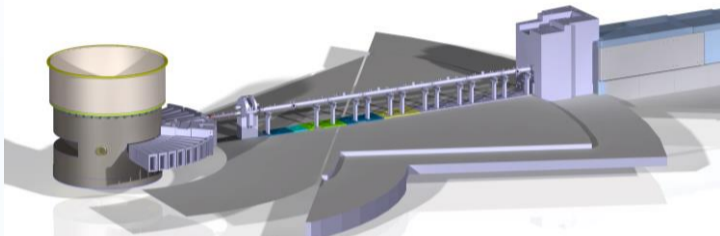
- ❖ The **Init. Ops. budget (810 M€₂₀₁₃)** and a detailed Initial Operations Plan was approved by Council
- ❖ Cost book for in-kind during initial operations and the ESS procedure for in-kind contribution management during initial operations phase was first presented at the IKRC (22 Oct 2020) – **new version recently released.**

Package	Definition	Value (k€ ₂₀₁₃)
352 MHz Klystron spare	1 spare 352 MHz Klystron	980
704 MHz Klystron spares	Initially 2 spare 704 MHz Klystrons	440
Spare modulators	Two complete spare modulators build to print	1 707
Modulator oil and oil treatment	Spare oil and oil treatment for all modulators	676
Backup cryo compressor	Backup compressor and oils system for the accelerator cryo plant	3 165
Cryogenic Liquids	Approximately 26600 liters of LHe	527
Spare medium-beta cavities	4pcs	879
RFPS installation		176
Contracted RF technicians for test and commissioning	2 FTE, starting July 2022	176
Contracted BI technicians for test and commissioning	1 FTE, starting July 2022	88
EMU for TS4	Copy of existing unit	120
Support for test stand 2 programme	Manpower to operate test stand 2	440

Package	Definition	Value (k€ ₂₀₁₃)
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.	3 183
Mark-2 PBW	Two replacement items of the PBW, including moderate technical development and timely delivery of the actual hardware items as required.	560
ACF supplier support	As described above	To be costed

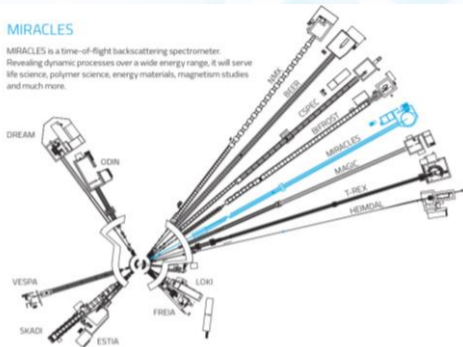
Excluded from last version, but most probably soon to be added again

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



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:



MAPPING CELLULAR BEHAVIOUR

Biological perspective of a cell

- Organelles
- Membranes
- Genes
- Proteins



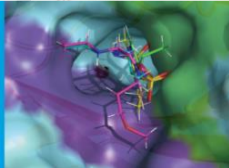
Neutron scattering perspective of a cell

- Timescales
- Hydrogen atoms

Both perspectives can be combined to understand the actual role played by water in cells' behaviour

Molecular maps for tumour cells will open up cancer drug studies to innovation currently not possible.

This image shows the chemical structure of Aspirin (acetylsalicylic acid) in the active site of the human carbonic dehydratase (CDCA). The image is based on neutron-molecular crystallography. The active site is located in the cytoplasmic domain and is particularly general binding pocket that can be used to design specific drugs targeting cancer-associated CDCA. ©Wiley, Wiley InterScience



Breast cancer is the most common cancer in women worldwide.

Choice of existing molecules called polymers may be the key to developing the most efficient drug design, carbon capture and new medical technologies.

DESCRIPTION	ESTIMATED COST	DATE
Detectors	200-250 k€	Q4-2022
Guide Supports	120-150 k€ (1 o 2 tenders)	Q4-2022
Vessel shielding (& beam stop neutron capturer)	150-200 k€	Q1-2023
Cave	500-700 k€	Q1-2023
Control Hutch	50-70 k€	Q3-2023
Crane	40-70 k€	Q1-2023
Si(111) hexagonal crystals	300 k€	Q2-2023

MAPPING CELLULAR BEHAVIOUR

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This image shows five-throat drug aspirin (red) in the active site of the protein tyrosine kinase (PTK). The image is based on neutron-scattering crystal structures. The protein was obtained by hydrogen isotope and hydrophobic groups labeling proteins that can be used to design specific drugs targeting cancer-associated PTKs. (CNSC) Institute, University



Blood cancer is the most common cancer in women worldwide.

Choice of repeating molecules (carbon polymers) may be the key to biodegradable plastics: efficient data storage, carbon capture and new medical technologies.



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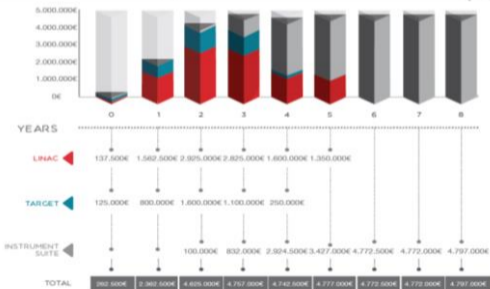
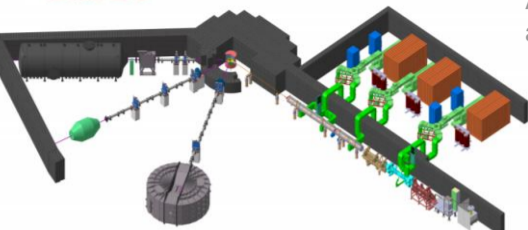
**ARGITU,
A unique and versatile Low Energy (30 MeV)
accelerator-based Neutron source**

Mario Pérez, ESS-Bilbao
Granada, 6 October 2022

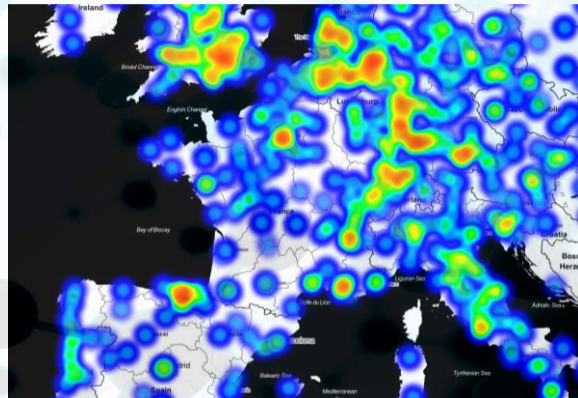
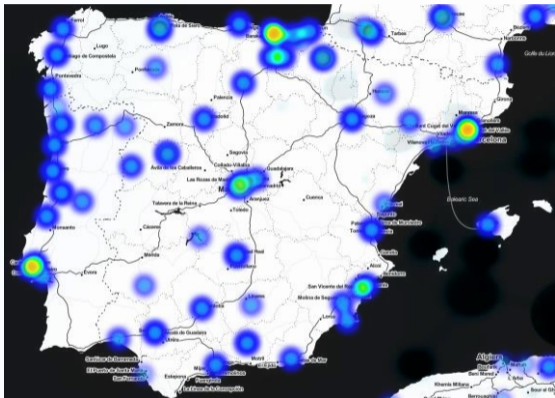


ARGITU, a unique and versatile Low Energy (30 MeV) accelerator-based Neutron source

- 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.



Fostering Neutronic R&D ecosystem...



Heat maps of neutron scientists, in terms of their scientific productivity, as a function of their home institutions in Spain (left) and in western Europe (right), denoting a leading role of Basque scientists in the use of neutron scattering tools for research and development activities.

IKUR estrategia



EUSKO JAURLARITZA



GOBIERNO VASCO

HEZKUNTZA SAILA

DEPARTAMENTO DE EDUCACIÓN



High Performance Computing e Inteligencia Artificial

Garantizar y extender las prestaciones de una **Infraestructura referente de supercomputación**
Impulsar un **uso intensivo de la inteligencia artificial**...



Neurobiociencias

Impulsar la excelencia investigadora del País Vasco en neuro- y biociencias
Infraestructuras experimentales singulares en caracterización e imagen, supercomputación e inteligencia artificial



Tecnologías Cuánticas

Polo de tecnologías cuánticas
Desarrollo de una **Internet Cuántica**
'Quantum computing as a service' para finanzas o sector aeroespacial



Neutriónica

Investigación en **neutrinos** con alto **potencial de descubrimiento científico** y de aplicaciones de **transferencia de tecnología** en el ámbito biomédico,...
Potenciar el liderazgo científico del País Vasco en **ciencia de neutrones** aplicado a la caracterización y estudio de materiales (ESS Lund – ESS Bilbao)

Grandes Infraestructuras Singulares

30M€

Atracción de personal investigador de excelencia

30M€

Participación en proyectos internacionales

10 M€

Impulso Colaboración Redes de Conocimiento

30 M€

€

Inbertsioa orotara

+282M€

- EJ Hezkuntza Saila: 100M€
- Enpresak: +139M€
- Administrazioak: +18M€
- Nazioartea: +25M€

€

Inbertsioa
100M€
Hezkuntza
Saila

IKUR

- ❖ *“The only route for entirely new facilities with significant capacity are High Current Accelerator-driven Neutron Sources (HiCANS), which could occupy the role played by national reactor-based sources in the past....”*
- ❖ *“.... there is now increased interest in High Current Accelerator-driven Neutron Sources (HiCANS)...”*
- ❖ *“...Due to their considerable flexibility - in terms of cost, capacity and capability - HiCANS could play an important role in sustaining the European neutron science ecosystem...”*





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Mario Pérez
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ESS BILBAO

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