



Una manera de hacer Europa



BUENAS PRÁCTICAS Actuaciones Cofinanciadas

"New beamline BL20-LOREA at the ALBA synchrotron"

Secretary of Universities and Research

**Programa Operativo
de Catalunya**

Año 2021

Fondo Europeo de Desarrollo Regional

The project "NEW BEAMLINE BL20-LOREA AT THE ALBA SYNCHROTRON" is presented as a Good Practice



The project **NEW BEAMLINE BL20-LOREA AT THE ALBA SYNCHROTRON** consists of the construction of a new synchrotron beamline that allows to visualize the atomic and molecular structure of materials and study their properties. With this new beamline, the capabilities of the ALBA facility will be extended to offer to users more hours of synchrotron light per year, thus making available to them a technique that was not available at this scientific center.

The ALBA Synchrotron is a third-generation scientific infrastructure located in Cerdanyola del Vallès (Barcelona) and is the most important in the Mediterranean area.

It is a complex of electron accelerators to produce synchrotron light, and covers a range of the spectrum from infrared light to X-rays, including visible light and ultraviolet. 6,000 hours of light are generated yearly and it is available to serve more than 2,000 researchers from academia and industry each year. In one hand, and depending on the experiment to be carried out, reaching a wide range of wavelengths allows to choose which light is most suitable for the subject to be analyzed. Thus, for example, if we want to see how the atoms are arranged in a material, we will use higher energy X-rays. On the other hand, if we want to study the electronic or magnetic properties of materials, we will use low-energy X-rays.

For this reason, as the main objective of the project is the construction of a new synchrotron beamline at the Centre, it increases the capabilities and tools that ALBA can offer for conducting experiments, broadening the scope of research for both science and technology.

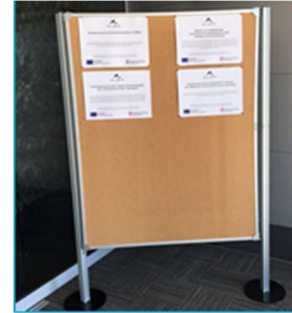
The project involves a total cost of 5,163,070.00 € and an eligible cost of 4,267,000.00 €, and an ERDF grant of 2,133,500.00 €. In addition, it entails a significant increase in the number of researchers who will work in the improved research infrastructure facilities, with an increase of up to 206 researchers (147 men and 59 women).

This operation is presented as a Good Practice because it meets the following criteria:

1. **High dissemination among beneficiaries, potential beneficiaries and the general public.**

This operation has been well disseminated, as shown below:

Poster during the execution of the operation, located at the entrance of the building.



Dissemination of the project on the website

<https://www.cells.es/es/que-es-alba/cofinanciado-con-fondos-feder-catalunya>

ALBA QUE ES ALBA | LÍNEAS DE LUZ | ACCELERADORES | SEGURIDAD | USUARIOS | INDUSTRIA | TECNOLOGÍA | ACTUALIDAD

QUÉ ES ALBA

PORTAL DE TRANSPARENTA
POLÍTICA DE VISIÓN
CENTRO DE ATENCIÓN AL USUARIO
MÉTODOS
PARTICIPACIÓN ELECTRÓNICA
PREF. DEL CONTACTANTE
TRABAJA CON NOSOTROS
SÍMBOLO ALBA

El Sincrotrón ALBA gestiona los siguientes proyectos cofinanciados con Fondos Europeos de Desarrollo Regional (FEDER) LORDE.

Unió Europea Fons Europeus de Desenvolupament Regional

Generalitat de Catalunya Departament d'Empresa i Coneixement Secretaria d'Universitats i Recerca

Mejoras en la fiabilidad de los transmisores de radiofrecuencia (RF) utilizados en los aceleradores de ALBA

Este proyecto tiene dos objetivos: reemplazar los cables de tubos amortiguadores de alta potencia (SAP) en todas las estaciones de RF del anillo de almacenamiento y reemplazar los sistemas actuales para generar ondas de radio de alta potencia por una tecnología ultrarrápida, basada en el acoplamiento de energía al de longitud de onda de centímetros, SASE. El objetivo es mejorar la fiabilidad del sistema y reducir el mantenimiento de los aceleradores.

El proyecto estará finalizado a finales de 2019.

Mejoras relacionadas

Equipos transversales de electrónica y sistemas de cableado para líneas de luz nuevas y operativas

El objetivo de este proyecto es desarrollar e instalar el equipo de vacío y electrónica estándar y sistemas de cableado para las nuevas líneas de luz en construcción así como para actualizar algunas de las líneas de luz existentes con el fin de optimizar su rendimiento.

El proyecto estará finalizado en diciembre de 2022.

Tecnología transversal y equipos de vacío estándar para líneas de luz nuevas y operativas

Este proyecto tiene la finalidad de adquirir equipos y tecnología de vacío para fabricar o mantener el nivel adecuado de presión de alto vacío en los sistemas de vacío de alta potencia de los aceleradores y líneas de luz de ALBA. El tipo de material necesario en esta disciplina por bombas, válvulas, sondas y otros dispositivos estándar que se instalarán en las nuevas líneas de luz que se están construyendo, así como para reemplazar algunos equipos en líneas de luz existentes, garantizando así la gestión y el mantenimiento de los sistemas.

El proyecto se completará en el verano de 2023.

Construcción de la línea de luz de fase II LOREA

LOREA estará basada en la tecnología de inyección en ángulo, una técnica que ofrece una brillantez puntual en Física de la Materia Condensada, en concreto para el estudio de materiales avanzados, en el grafeno, superconductores de alta temperatura o materiales 2D, entre otros.

El proyecto estará acabado en junio de 2022.

Construcción de la línea de luz de fase III FAXTOR

FAXTOR será una línea de dispersión rápida de rayos X y tendrá como objetivo ofrecer nuevas capacidades de emisión en los límites de las líneas de luz de alta potencia, de alta resolución, de alta intensidad, de patrimonio cultural y de desarrollo, entre otros.

El proyecto estará acabado en octubre de 2023.

Implantación de mejoras en diferentes líneas de luz y subsistemas del Sincrotrón ALBA

Con el fin de optimizar y mejorar el rendimiento de algunas de las líneas de luz operativas que ya tienen ciertos actualizaciones, la implantación de mejoras para el anillo de almacenamiento y la instalación de un nuevo sistema para la recuperación y la liberación del haz, la mejora de los sistemas de vacío y el desarrollo de los componentes de los aceleradores de ALBA, el objetivo es mejorar el rendimiento de los aceleradores y las líneas de luz, sistemas relacionados con la mejora de las líneas de luz de ALBA. Mejoras de los sistemas de vacío y sistemas de vacío de alta potencia de ALBA y de otros en la línea de luz de ALBA. Mejoras de los sistemas de vacío y sistemas de vacío de alta potencia de ALBA y de otros en la línea de luz de ALBA. Mejoras de los sistemas de vacío y sistemas de vacío de alta potencia de ALBA y de otros en la línea de luz de ALBA.

El proyecto estará acabado en diciembre de 2023.

QUE ES ALBA | USUARIOS | INDUSTRIA | SEGURIDAD | ACTUALIDAD

CONSEJO DE ADMINISTRACIÓN | ALBA | MINISTERIO DE CIENCIA, INNOVACIÓN Y TURISMO | MINISTERIO DE ECONOMÍA Y ASUNTOS EXTERIORES | MINISTERIO DE EDUCACIÓN Y POLÍTICA SOCIAL | MINISTERIO DE SANIDAD Y POLÍTICA CONSUMIDORES | MINISTERIO DE TRABAJO Y POLÍTICA SOCIAL | MINISTERIO DE VIVIENDA Y POLÍTICA TERRITORIAL

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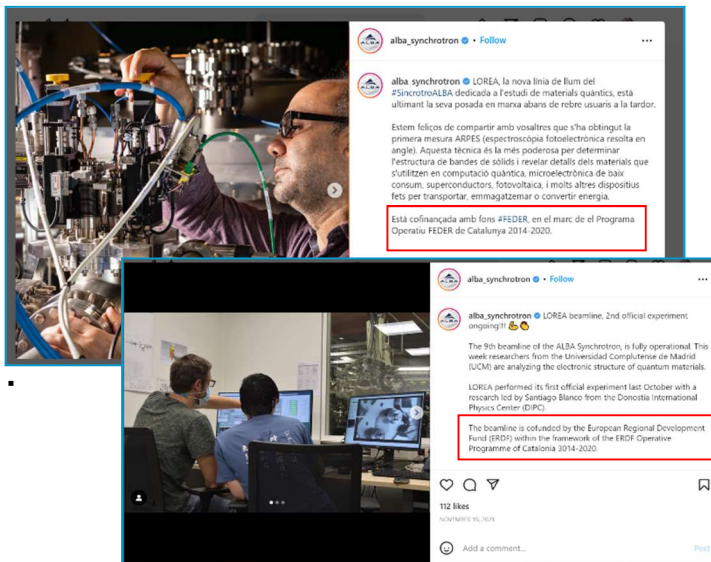
CONSEJO DE ADMINISTRACIÓN | ALBA | MINISTERIO DE CIENCIA, INNOVACIÓN Y TURISMO | MINISTERIO DE ECONOMÍA Y ASUNTOS EXTERIORES | MINISTERIO DE EDUCACIÓN Y POLÍTICA SOCIAL | MINISTERIO DE SANIDAD Y POLÍTICA CONSUMIDORES | MINISTERIO DE TRABAJO Y POLÍTICA SOCIAL | MINISTERIO DE VIVIENDA Y POLÍTICA TERRITORIAL

News published on the website, showing the progress of the project in 2019, 2020 and 2021, with reference to the co-financing received

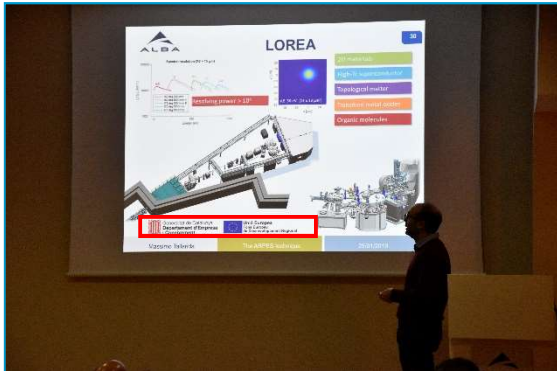


Presence in social media

Publications on Facebook, LinkedIn and Instagram.



Activities and Public Events carried out in 2019, 2020 and 2021 to present the project and its co-funding at national and international level (Barcelona and Madrid - *IMDEA Nanoscience Madrid, Germany - Brandenburgische Technische Universität, USA*, and events such as *The first European-Japanese workshop on SX beamline automation and experimental optimization* or the *ALBA II Workshop on Spintronics and the AUSE Congress and ALBA User Meeting*), with more than a thousand participants in total.



The LOREA ARPES beamline at the ALBA synchrotron
 F. Betti, D. Pericoli, M. Safford, A. Crisol and J. Nicolau

SCIENTIFIC GOAL

Electronic structure
 Fermi surface
 Band dispersion
 Spin polarization
 Band alignment

Optics layout

ARPES

Infrastructure
 Instrumentation
 Vacuum chamber

Beamline specifications
 Photon energy: 100 eV - 1000 eV
 Spot size: 100 μm x 100 μm
 Photon flux: 10^{14} ph/s
 Resolution: $> 10^4$

Monochromator
 Advanced optical design at the engineering level of ALBA

Specifications
 Analyzer: 400 channels
 20 eV eV eV
 Multiplexing: Continuous
 2 axes fully motorized
 0-200°

Sample preparation
 Sample size: 10 mm x 10 mm x 1 mm
 Sample temperature: 4 K - 300 K
 Sample rotation: 0-360°

End station

Sample preparation

Acknowledgments
 ALBA project funded by:
 Departament d'Empresa i Coneixement
 Fons Europeu de Desenvolupament Regional

Schedule

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Conclusions and acknowledgments

- The new ARPES beamline at ALBA is on the way
- A good opportunity for the Spanish ARPES community to grow and improve the technical capabilities
- Low T, High resolution, wide energy range, 2D measurements, automatization, wide variety of sample preparation tools,...

This project is co-funded by the European Regional Development Fund (ERDF) within the Framework of the Smart Growth Operative Programme 2014-2020

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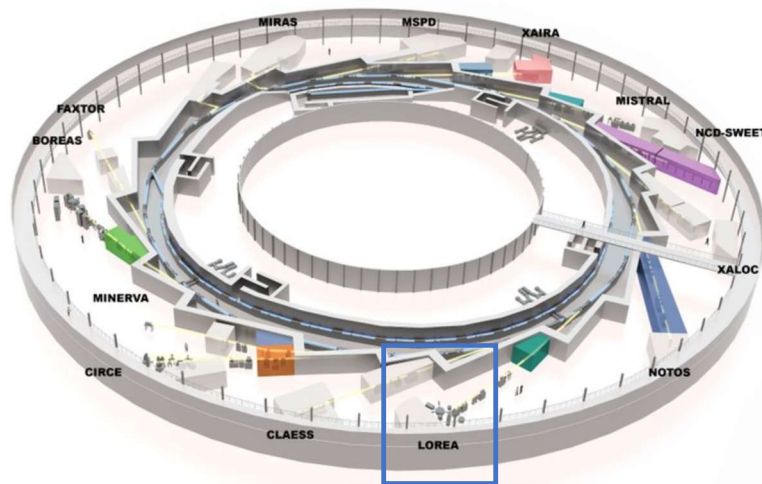
Stickers placed on the equipment



2. Incorporation of innovative elements

The actions proposed in this project provide to the academic and industrial community with a new tool in a field of application with great scientific and technological impact. The new beamline represents a clear qualitative leap in the category of experiments that can be undertaken in the field of condensed matter Physics (the branch of physics that studies the macroscopic physical characteristics of matter, such as density, temperature, hardness or colour of a material), with a window open to the exploration of new materials.

ALBA also makes a significant contribution to business innovation through its collaborations with the science industry through its needs for advanced and innovative equipment.



The creation of an innovation environment or ecosystem is perfectly aligned with the investment in meeting spaces for science, technology and innovation, which is central to ALBA's role and its varied offer for both scientists and industry. The ALBA Synchrotron supports a wide range of industrial sectors through the use of its several synchrotron light laboratories. It also promotes the access of external researchers to the beamlines to carry out public research projects through its annual calls for proposals.

3. Adequacy of the results to the established objectives

The main objective of the project is the construction of a new synchrotron beamline to provide the possibility to visualize the atomic and molecular structure of materials and to study their properties. This addition will improve the capacities of the facility and will offer more hours of synchrotron light per year to users.

The main objectives are, on the one hand, the design, construction, installation and commissioning of the beamline and the adaptation of the infrastructure to a basic configuration sufficient for users to start using it. On the other hand, by completing the infrastructure, capabilities are added to the station to determine and study the magnetic moment of electrons and their role in the behavior of materials.

The project is at a very advanced stage. The line is partially operational and has already allowed first experiments to be conducted with expert users. However, the first experiments have already shown that all technical objectives have been met and the performance of the installation has exceeded expectations.

The interest in the user community of users is high. The infrastructure has been included in the management systems and processes (maintenance, development, user office, competitive open access) and can be fully exploited once construction is completed. All planned activities are either completed or at a very advanced stage of implementation. The European funds are undoubtedly the main driving force for the implementation of this project at the specific moment it was started



4. Contribution to the resolution of a regional problem or weakness

The continuous improvement of infrastructures is a requirement for maintaining excellence in the region. ALBA, as the only facility of its kind in the Iberian Peninsula, confirms this circumstance.

The criterion of excellence for the scientific use of ALBA and the degree of uniqueness of the technologies generates a natural tendency to stimulate emerging activities, which are those activities generated by new scientific knowledge and technological applications, for which the European Union has made a clear commitment to the future, based on innovative, groundbreaking technologies or processes and which aim to open up new markets or transform existing ones. In the field of advanced materials, which is specific to the new LOREA beamline, there is the potential to create a regional pole in this area.

Likewise, an innovation environment or ecosystem is created: technology and innovation are a fundamental aspect of the operation and of the role of ALBA and its varied offer for scientists and industry.

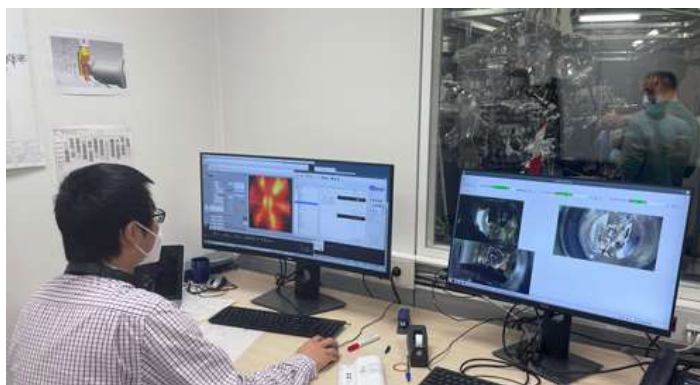
As a socio-economic impact, more than 1,000 publications on ALBA experiments have been published, resulting in the creation of 32 patents, while the technologically innovative concepts of the elements to be acquired potentially allow technology suppliers to develop know-how and thus strengthen their competitive position through participation in public tenders.

5. Coverage of the target population

ALBA's mission is to research, apply and maintain the methodologies and techniques to carry out R&D projects based on synchrotron light, contributing knowledge and value to the scientific and industrial communities, mainly in Spain, with the ultimate aim of contributing to the improvement of the welfare and progress of society.

ALBA currently has eight operational beamlines, comprising both soft X-rays and hard X-rays, which are mainly dedicated to biosciences, condensed matter (nanoscience, magnetic and electronic properties) and materials science, and four beamlines are under construction.

Thus, as mentioned above, this large scientific infrastructure generates about 6,000 hours of light annually and is available to serve more than 2,000 researchers from academia and industry each year. Since 2012, it has been hosting official users from Spanish institutions (65%) and also from other countries (35%).



The direct socio-economic impact materializes, among others, in the benefit of research, which is one of the main social benefits of scientific infrastructures. These benefits can be quantified on the basis of citations of articles by non-ALBA scientists. As usual, citations have grown from the birth of ALBA (40 in 2011) to the present (around 10,500 in 2021).

One more remarkable aspect in this context is the development of social capital: throughout the year, researchers organize academic seminars, workshops, courses and conferences that attract a range of visitors from all over Europe. As an example, in 2019, 1,225 people visited ALBA, either as invited speakers or as participants in seminars and workshops.

Finally, other additional benefits considered in this approach are the benefit for visitors or the value for the image of the territory. Throughout the year ALBA is visited by schools, companies, staff from universities, etc. In 2019, for instance, these visitors were around 700.

6. Compliance with horizontal principles (sustainable development, gender equality and non-discrimination) and environmental regulations

ALBA has a document on the promotion of gender equality, inspired by the official protocols of the European Research Area (ERA). This document includes: rules for defining the composition of staff selection panels; orientation to gender balance within the composition of committees; rules for the choice of meeting room names (names of relevant scientists, with a gender balance criterion).

There is also a procedure for dealing with cases of harassment and discrimination, as well as a prevention plan, following the current regulations in this area.

On the other hand, ALBA has been designed, right from the start of the project, as an energy efficient and environmentally friendly facility. The electrical and thermal energy for the operation of the equipment, together with the strict temperature regulation of all critical equipment, is obtained from a dedicated cogeneration plant, i.e. a plant that generates electrical energy as well as thermal energy. On the other hand, the effort catalyzed by ALBA in innovation and development of innovative scientific and industrial techniques, of new materials and its contribution to the generation of knowledge with a particularly intense degree of multidisciplinary, is reflected in the evolution of challenges such as the more efficient production of energy and even in direct research into aspects related to the environment.

One example that can be considered very significant in the long term is the expected contribution of the LOREA beamline to the development of high-temperature superconducting materials, which could eventually lead to a breakthrough in terms of global energy efficiency.

7. Synergies with other policies or instruments of public intervention

The LOREA beamline is integrated into the scientific and technical infrastructure of the ALBA Synchrotron. This means that the experimental station will be used mainly by the scientific community, subject to a research project proposal and evaluation based on scientific criteria and scientific-technical feasibility. The selected experiments are carried out at no cost to the external user. Most of this research carried out by external scientists is included in their scientific programs and projects without charging their research budgets.

LOREA is integrated in ALBA's research line on electronic and magnetic structure of matter, which is also perfectly aligned with the "**Spanish Technological Strategy for Advanced Materials and Nanomaterials**", thus contributing to the objectives of the **European Green Pact** (a new growth strategy that aims to transform the European Union (EU) into a sustainable economy and a fair and prosperous society).



The concept behind the existence of a large facility such as ALBA is inherently aligned with the basic underlying objectives of the **RIS3 Strategy** (the Research and Innovation Strategy for Smart Specialization in Catalonia, which is Catalonia's response to the European Commission's requirement for states and regions to develop research and innovation strategies for smart specialization that are in line with their innovation potential). ALBA is a clear commitment to research excellence.

ALBA also belongs to the network of **Singular Scientific and Technical Infrastructures (ICTS)**, which refers to large facilities, resources, equipment and services, unique in their kind, which are dedicated to cutting-edge research and technological development of the highest quality, as well as to promote the transmission, exchange and preservation of knowledge, technology transfer and innovation.



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