MAP OF UNIQUE SCIENTIFIC AND TECHNICAL INFRASTRUCTURES (ICTS)

GOBIERNO DE ESPAÑA
MINISTERIO DE ECONOMÍA Y COMPETITIVIDAD
Infraestructuras Científicas y Técnicas Singulares

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FOREWORD

Spanish science and technology have reached a considerable level of excellence over the last three decades. The number of researchers has multiplied, we are now able to attract and retain talent, centres have been created for highly-competitive research, and companies have emerged that are capable of tackling projects that require cutting-edge technology. Our position as tenth in the world in scientific production, eighth if we consider the journals with the greatest impact, reflects the quality of our science.

The growth that has characterised Spanish R&D over the last thirty years would not have been possible without facilities and infrastructures of first international level. Research of excellence must rely on an advanced network of infrastructures and scientific equipment, like the Unique Scientific and Technical Infrastructures (ICTS) are. Access to these advanced infrastructures is an essential asset to achieve and maintain leadership in research, increase specialised training capacity in R&D, capturing talent and develop highly competitive R&D business activities.

The Ministry of Economy and Competitiveness has promoted, in conjuntction with the Autonomous Communities, an updated ICTS Map approved on 7 October 2014 by the Council of Scientific, Technological, and Innovation Policy, a coordination body for scientific and technological research in Spain. Thanks to a productive collaboration with the Autonomous Communities, we have joined forces to foster ICTS capacities, avoid redundancies, and boost their industrial use.

Criteria of maximum scientific, technology, and innovation quality, submitting infrastructures to independent assessment by top-level international experts, have been taken into account to create this map. The map lists the most representative facilities of Spanish science, unique in their fields and with a very high investment, maintenance, and operating costs that the Spanish Central Administration and the Autonomous Communities, often through their dependent entities, jointly sustain in an exercise of public shared responsibility. The mechanisms to access these infrastructures are public and transparent, and ensure that proposals of maximum scientific and technological quality also obtain top priority in its realization.

Spain is a country of science, technology, and innovation. We participate in many of the most important global infrastructure sites and we are capable of competing for large international projects. Reading through the pages of this book will allow you to get an idea of our scientific and technological capabilities. I invite you to get to know our Unique Scientific and Technical Infrastructures, the ICTS, products of the effort of the scientific and technological community.

Carmen Vela Olmo
Secretary of State for Research, Development, and Innovation

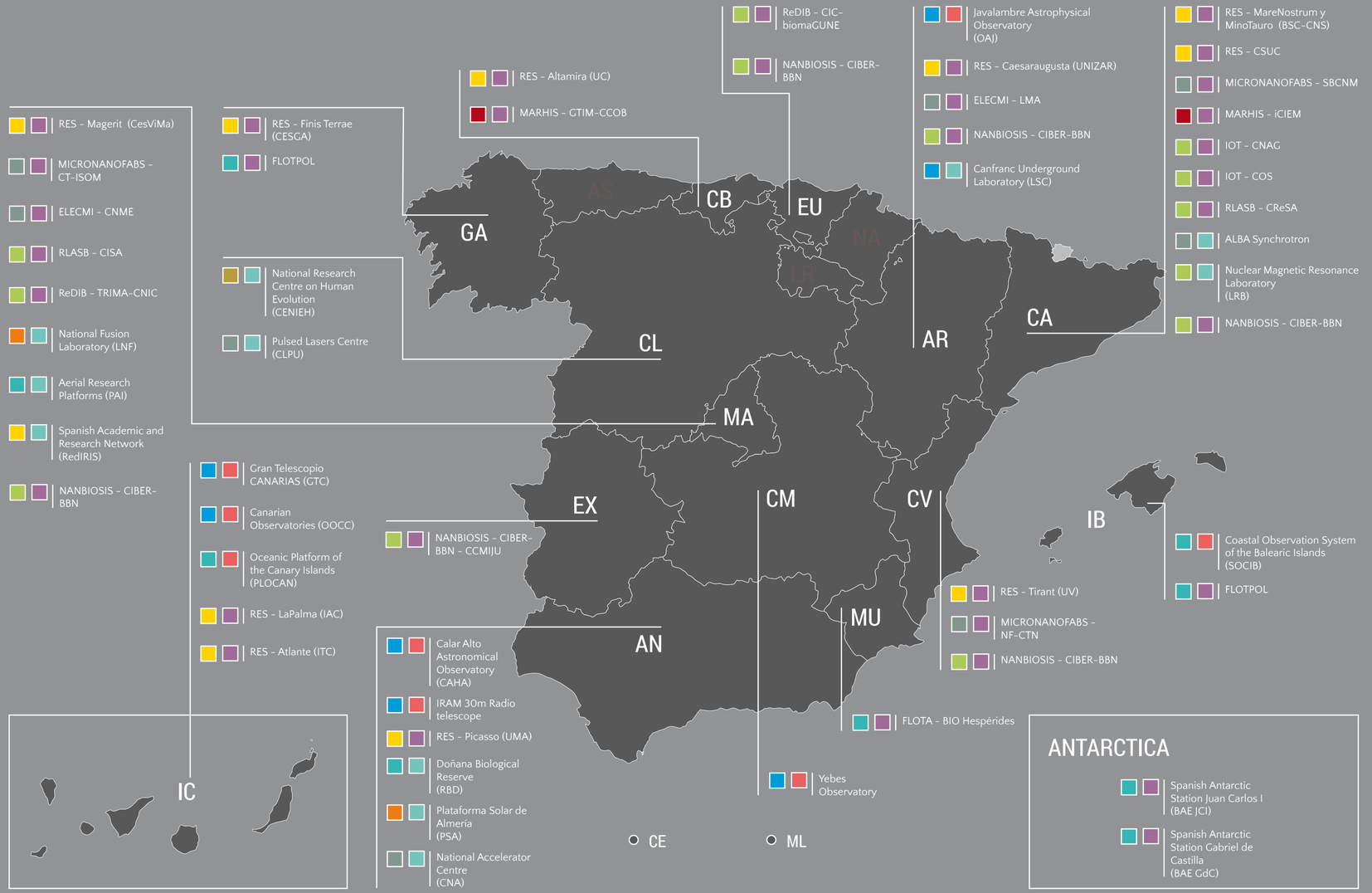
MAP OF **UNIQUE SCIENTIFIC AND TECHNICAL** INFRASTRUCTURES (ICTS)

TYPES OF ICTS

- ICTS WITH A SINGLE LOCATION
- DISTRIBUTED ICTS
- NETWORK OF ICTS

SCIENTIFIC FIELDS

- ASTRONOMY AND ASTROPHYSICS
- OCEAN, LIFE, AND EARTH SCIENCES
- HEALTH SCIENCES AND BIOTECHNOLOGY
- INFORMATION AND COMMUNICATIONS TECHNOLOGY
- ENERGY
- ENGINEERING
- MATERIALS
- SOCIAL SCIENCES AND HUMANITIES



INTRODUCTION

INTRODUCTION

The term **Unique Scientific and Technical Infrastructure (ICTS)** refers to facilities, resources, or services for the development of top-quality cutting-edge research, as well as the communication, exchange, and preservation of knowledge, the transfer of technology, and promotion of innovation. They are unique or exceptional in their fields, with a high cost of investment, maintenance, and operation, and are of a strategic importance that justifies their availability to all actors in the field of R&D&I.

The ICTS share three fundamental characteristics:

- they are infrastructures with public ownership, meaning that they belong to or are managed by public entities, whether they are under the authority of the Spanish Central Administration and/or the Autonomous Communities. In any case, they are mainly financed by public funds.

- they are unique, meaning that they are the only one of their kind, including:
  - Large pieces of equipment that allow the observation, analysis, or interpretation of phenomena of interest.
  - Complex experimental research infrastructures designed to create, reproduce, and study physical, chemical, or biological phenomena of interest.
  - Large experimental research infrastructures for the engineering and development of new technologies for application in a variety of fields.
  - Infrastructures necessary for facilitating access for scientists to natural environments that provide and exhibit unique conditions for research.
  - Advanced technology that provides horizontal and fundamental support to any field of science and technology

- they are open to competitive access by users in the entire research community, from the public as well as the private sector.

The ICTS are located throughout the country and are displayed on the "Map of Unique Scientific and Technical Infrastructures (ICTS)." The first Map of ICTS was agreed upon at the III Conference of Presidents, held on 11 January 2007. This Map was in force until 7 October 2014, when the Science and Technology Policy Council (CPCTI) approved the current Map, composed of 29 ICTS that bring together a total of 59 facilities.

NATIONAL CONTEXT

There is a clear connection between the ability of a country to create knowledge and innovation and its economic and social development. For that reason, policies regarding science, technology, and innovation constitute a fundamental element in the development of modern societies. In the same manner as its neighbouring countries, the Government of Spain periodically plans these policies. Article 149.1.15 of the Spanish Constitution lists the promotion and general coordination of scientific and technological research as one of the sole responsibilities of the State.

In this context, and under Law 14/2011 regarding Science, Technology, and Innovation, the Spanish Central Administration created the "Spanish Strategy for Science and Technology and Innovation" in the year 2012. Additionally, it took into account the participation of social agents and an extensive group of independent experts belonging to the scientific, technological, and business communities. This Strategy regards R&D&I activities from a general perspective for the period from 2013 to 2020,

and considers that the use of the "Map of Unique Scientific and Technical Infrastructures (ICTS)" as key to the development of the Spanish Science, Technology, and Innovation System, as well as its integration into the European Research Area.

The outline of the scientific policy listed in the previously-mentioned Strategy is made specific in the state plans. In this manner, the "Spanish State Plan for Scientific and Technical Research and Innovation" for the years 2013-2016 lists the objectives for this period and the instruments for articulating the different planned measures. One of the objectives is to facilitate access to scientific and technological infrastructure and scientific equipment, with special reference to large, singular scientific and technological facilities at the national as well as international level. All of this is laid out in the "State Subprogramme for Scientific and Technological Infrastructures and Equipment" with the main objective of providing, maintaining, and updating scientific and technological infrastructures, in order for them to be accessible to all the agents of the Spanish System of Science, Technology, and Innovation, and facilitates high-quality scientific-technological research, as well as the development of highly-competitive R&D&I industrial activities.

EUROPEAN AND INTERNATIONAL CONTEXT

The instrument of the European Union (EU) to promote and support R&D&I is the Framework Programme that, for the period 2014-2020, is known as Horizon 2020 (H2020). The development of the State Plan 2013-2016 coincided with the debate and creation in Europe of H2020, and with the reflection on the greatest challenges and opportunities of European R&D&I policy and of the Member States. The result was a perfect alignment between the policies of the Spanish Central Administration and those of the European Union in regards to promotion of R&D&i.

The Framework Programme for R&D&I of the EU H2020 includes, within the pillar "Excellent science," actions that support scientific infrastructures, with the objective of reinforcing and extending European scientific excellence and consolidating the European Research Area (ERA) in order for the EU system of science to be more competitive at the global level. The general objectives of H2020 regarding research infrastructures are as follows: (i) To optimise the use and development of European scientific infrastructures; (ii) To promote their human potential and potential for innovation; and (iii) To reinforce the coherence of national and European policies in terms of infrastructures.

The EU funding Programming Period 2014-2020 reinforces the role of *ex ante* evaluation. This evaluation is one of the requirements to receive European funding and actually is a previous, exhaustive planning of the activities that each one of the Member States plans to invest in with this funding. The updating of the ICTS Map has been the tool used to implement *ex ante* assessment in regards to the investment priorities of the European Regional Development Fund (ERDF) "*enhancing research and innovation (R&I) infrastructure and capacities to develop R&I excellence and promoting centres of competence*" At the same time, it has been coordinated with the Regional Research and Innovation Strategies for Smart Specialisation (RIS3), which are instruments to assist regions in proposing and reaching optimal choices for their prosperity. As a consequence of this, the ICTS will be able to benefit from co-financing by the ERDF over the Programming Period 2014-2020.

Furthermore, the ICTS are aligned with the European Strategy Forum on Research Infrastructures (ESFRI) and with other international plans of specific application, including those on the agendas of the European Technological Platforms, the Joint Technology Initiatives (JTI), Joint Programming Initiatives (JPI), etc. In this manner the scientific and technological competitiveness of Spanish infrastructures is assured and promoted on the international stage, especially the ICTS.

CONFIGURATION OF THE ICTS MAP

The Science, Technology, and Innovation Policy Council (CPCTI), formed on 18 September 2012, is the general coordination body of scientific and technological research in Spain, made up of representatives of the Central Government and the Autonomous Communities. One of their functions has been the approval of the updated ICTS Map 2013-2016, in which existing infrastructures have been prioritized over new construction. In particular, efforts are focused towards maintainenane the ICTS that are already in operation, avoiding their obsolescence, promoting their open competitive use, and completing infrastructures that are partially under construction.

In summary, the process of renewal of the ICTS map was begun by defining the objectives and principles required of the infrastructure that would form part of the updated Map, carried out by the CPCTI. Additionally, a procedure for updating the Map was established, and the Advisory Committee on Unique Infrastructures (CAIS) was formed, as a Work Group of the Executive Board of the CPCTI. After a detailed process of analysis and assessment of the Strategic Plans presented by the infrastructures candidates, with the participation of the National Agency for Assessment and Forecasting (ANEP) and international experts, the CAIS created a proposal for the configuration of the new Map. Finally, the CPCTI approved the Map of Unique Scientific and Technical Infrastructures (ICTS) on 7 October 2014. This Map will be submitted to a complete update and review at the beginning of the period of validity for each State Plan.

The ICTS can have a single location (**infrastructure with a single location**), can form part of a **Network of Infrastructures (RI)** or be considered **Distributed Infrastructure (ID)**, depending on the level of integration and coordination of their capacities. Furthermore, the ICTS Map is dynamic and open, in the sense that the infrastructures included on the current Map must continue to comply with the requirements necessary to maintain their status as ICTS. Moreover, it is open to the addition of other infrastructures, as long as they comply with these requirements.

The requirements that a facility must comply with in order to be considered an ICTS, under any of the previously-mentioned subcategories, are formally defined in a CPCTI document that accompanies the configuration of the current ICTS Map. Summarised, these requirements are as follows:

- ***Unique and strategic nature***.- An ICTS is a unique infrastructure, an experimental cutting-edge tool unique in Spain for its content and features, open to the entire R&D&I system of our country, scientifically and technologically advanced, essential for carrying out specific technological research and/or development.

- ***Objectives***.- As mentioned above, they should be in alignment with the objectives of the Spanish Strategy for Science, Technology, and Innovation, the State Plan for R&D&I and with the corresponding European and international programmes.

– ***Investment***.– They entail a high cost of investment in their construction, updating, and improvement (starting from 10 million Euro of investment accumulated in technological assets), as well as in their maintenance and operation.

– ***Open access***.– The ICTS should apply a policy of competitive open access for the scientific, technological, and industrial communities as well as government administrations. There should be a demonstrable and proportionate demand for use or access on behalf of the national and international community. This access will be assessed and prioritized with criteria for excellence and scientific-technological feasibility.

– ***Scientific and Technical Advisory Committee***.– In general, unless discouraged by the specific nature of the infrastructure, the scientific-technological activities and strategies of the ICTS should be assessed by a Scientific and Technical Advisory Committee of international relevance.

– ***Management***.– The ICTS will possess appropriate management schemes in accordance with their specific characteristics, especially in regards to the infrastructure and services competitively offered and support given to users.

– ***Strategic Plan***.– The ICTS must have a quadrennial Strategic Plan that establishes the objectives, strategies, and resources and is periodically reviewed.

– ***Production and Performance***.– The production and performance of the ICTS should be in proportion to the cost and size of the facility. Each ICTS should maintain a Record of R&D&I Activity that includes all the access offered, projects and activities carried out, and the results of R&D&I achieved by the use of the facility (publications, patents, etc.).

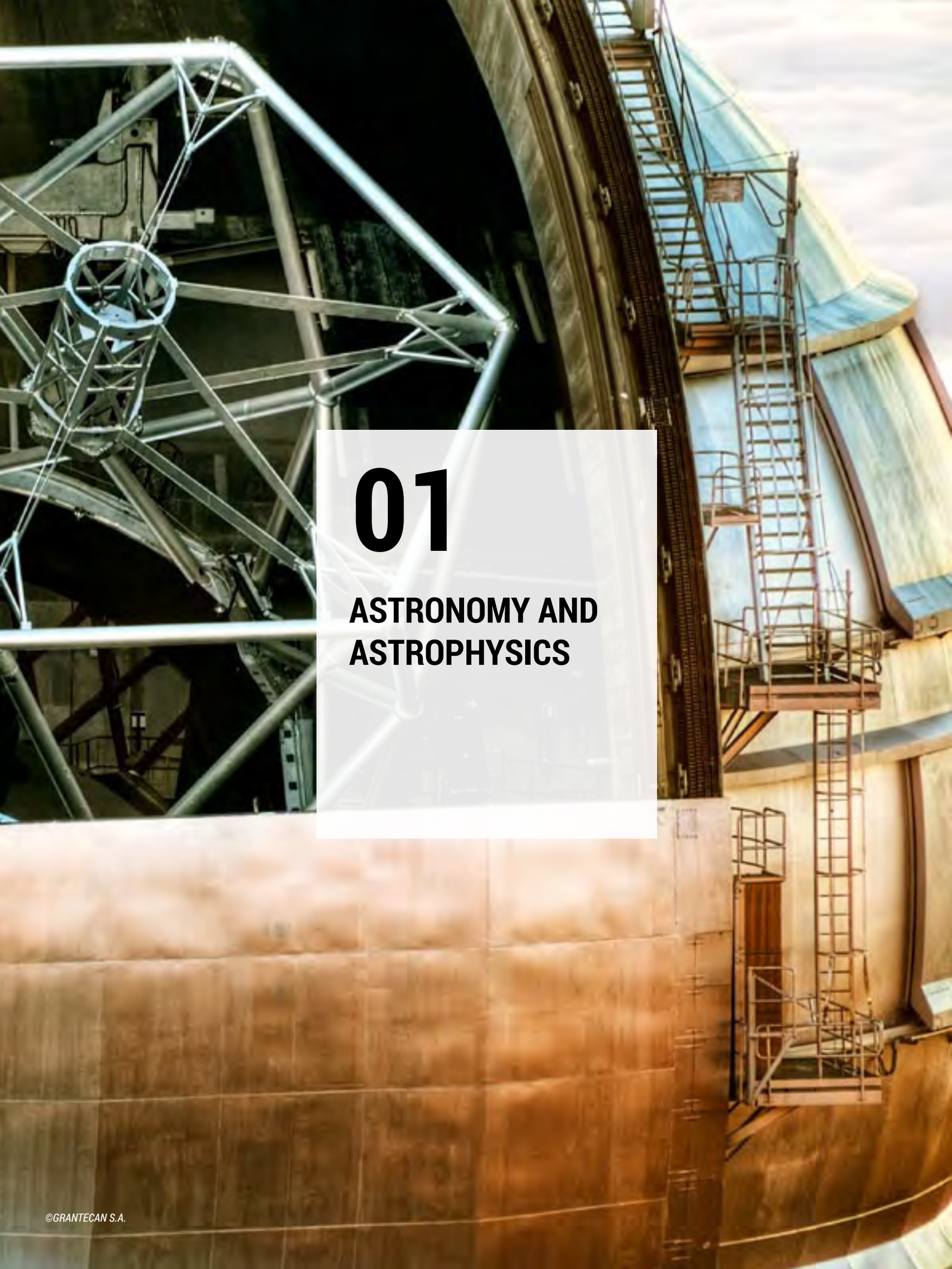
The ICTS Map spans a wide range of fields, and the same infrastructure can be used, in an integrated manner, to provide services that fall under different scientific disciplines. From an organizational point of view, the ICTS Map defines the following areas:

– Astronomy and Astrophysics
– Ocean, Life, and Earth Sciences
– Health Sciences and Biotechnology
– Information and Communications Technology
– Energy
– Engineering
– Materials
– Social Sciences and Humanities

Regardless of the area of knowledge into which a certain ICTS has been classified, it is important to always keep in mind the integration between the different applications and services offered by each. It is for this reason that, in view of this document, the reader is invited to get to know each of the ICTS on the current Map, with the knowledge that unknown scientific applications will be discovered that will contribute to the expansion of our scientific culture. Additionally, the reader is invited to further their knowledge on this matter by using online tools where each one of the ICTS can be found (web pages, social networks, etc.), listed on each of their corresponding descriptions.

Directorate General for Innovation and Competitiveness

Sub-Directorate General for Planning of Scientific and Technological Infrastructure



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ASTRONOMY AND ASTROPHYSICS

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ASTRONOMY AND ASTROPHYSICS

ASTRONOMY INFRASTRUCTURES NETWORK (RIA)

The Astronomy Infrastructures Network (RIA) was created in 2007, at the request of the current Ministry of the Economy and Competitiveness as a Work Group of the National Astronomy Commission (CNA) with the objective of advising the Central Administration and interested Institutions in the field of Astronomical Infrastructure and Instrumentation, and to create a forum for coordination between the different Infrastructure sites of the Network. Additionally, the RIA coordinates the studies related to future infrastructures as well as the projects of instrumental development and carries out the systematic monitoring of the productivity of the diverse astronomical infrastructures sites.

The ICTS integrated into the Astronomy Infrastructures Network are: *Gran Telescopio CANARIAS* (GTC), Canarian Observatories, Calar Alto Astronomical Observatory, Yebes Observatory , IRAM 30-m Radio telescope, and the Javalambre Astrophysical Observatory.

The Network also ensures the coordination and optimisation of the Scientific Program of the European Space Agency (ESA) and the infrastructure of the European Southern Observatory (ESO).

http://riastronomia.es

CANARIAN OBSERVATORIES (OOCC)

The Canarian Observatories (OOCC), operated by the *Instituto de Astrofísica de Canarias* (IAC), are made up of the Roque de los Muchachos Observatory (ORM, La Palma) and the Teide Observatory (OT, Tenerife), both located at a height of 2,400 m. The excellent astronomical quality of the sky above the Canary Islands, exhaustively characterised and protected by law, allows them to be astronomical reserves, open to the international scientific community since the year 1979. Currently, the OOCC host telescopes and instruments belonging to 60 institutions from 20 different countries, forming the most important group of astrophysical facilities in the European Union (EU), for night-time and solar observations, visible and infra-red, as well as the largest collection of multinational telescopes in the world. Other experiments designed for the study of high-energy physics and the cosmic microwave background complete the array of available facilities .

The Teide Observatory stands out for its atmospheric conditions and telescopes available for the study of solar physics, and the Roque de los Muchachos Observatory is one of the most complete complexes in the world of telescopes, in the visible spectrum as well as the infrared, devoted among other subjects to the study of the sun or cosmic radiation.

The OOCC have adapted to the needs of the largest telescopes as well as the simplest experiments, on-site or even robotic observations, and host everything from occasional experiments for a particular astronomical event to research into quantum communication or tests of cutting-edge instruments.

Every year, more than two thousand astrophysicists arrive at the OOCC to use their facilities. The Canary Islands have become a natural meeting place for astrophysicists from around the world. This enormous wealth has been the principal drive behind the spectacular growth of Astrophysics in Spain.

http://www.iac.es

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ASTRONOMY AND ASTROPHYSICS

The *Gran Telescopio CANARIAS*, with a main mirror measuring 10.4 m in diameter, is currently the largest optical-infrared telescope in the world. It can be found at the Roque de los Muchachos Observatory, in the municipality of Garafía, on the island of La Palma.

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GRAN TELESCOPIO **CANARIAS** (GTC)

The GTC, an initiative of the *Instituto de Astrofísica de Canarias* (IAC), is property of the public company Gran Telescopio de Canarias, S.A. (GRANTECAN) belonging to the Central Administration and the Autonomous Community of the Canary Islands, which is responsible for its operation and future development. It is assisted by international collaboration from institutions from Mexico (Astronomical Institute of the Autonomous National University of Mexico and the National Astrophysics, Optics, and Electronics Institute) and the United States (University of Florida).

The GTC has been in operation since the year 2009. Since then, it has offered the scientific community a unique capacity for carrying out programs of observation using the instruments currently installed at the telescope and those that are being developed through an ambitious program of innovative instrumentation. The 36 hexagonal segments of the GTC provide an area for the collection of light equivalent to a circular monolithic mirror measuring 10.4m in diameter. These segments act as a single surface thanks to the extremely precise optical alignment reached by these mirrors. Another key feature is the exquisite image quality that the telescope delivers and therefore it can exploit the good sky quality to its maximum. This is possible thanks to the alignment, deformation and movement of the active optics. Scientific operation is principally based on a system of "observation by queues," making the programme flexible and adaptable to conditions, optimising in this manner the observation times.

To date, the GTC has provided significant advances in the topical areas of astrophysics, such as exoplanets, black holes, the farthest and youngest stars and galaxies of the universe, and the initial conditions following the 'Big Bang'.

http://www.gtc.iac.es

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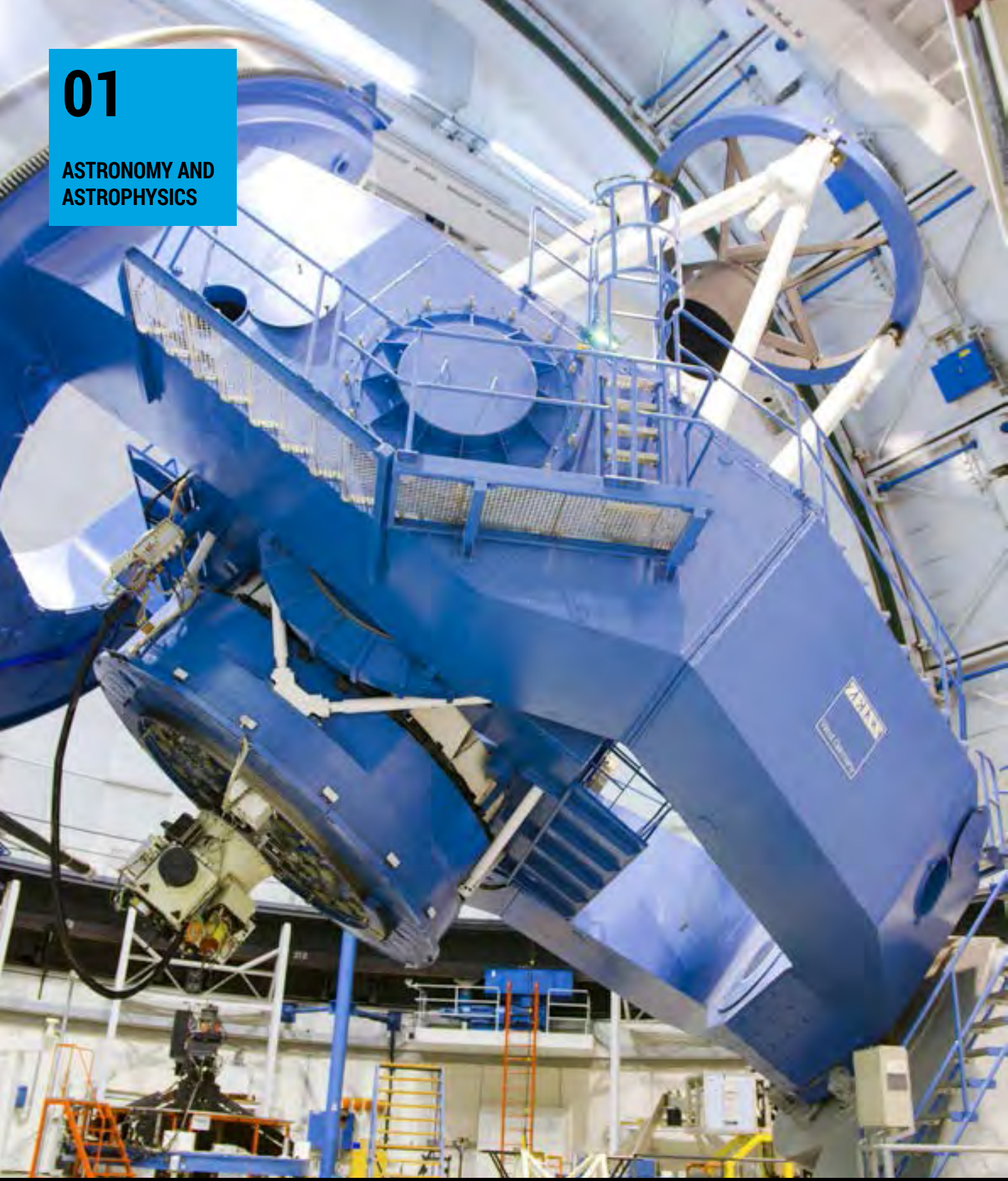
ASTRONOMY AND ASTROPHYSICS



The Calar Alto Astronomical Observatory (CAHA) is located at a height of 2,168 m in the Sierra de Los Filabres (Almería). It is managed by the German Max Planck Society and the Spanish National Research Council (CSIC), and is jointly operated by the Max Planck Astronomical Institute of Heidelberg and the Andalusia Institute of Astrophysics of Granada.

CALAR ALTO ASTRONOMICAL OBSERVATORY (CAHA)

The Calar Alto Astronomical Centre is the second-largest astronomical site in the northern hemisphere, after Roque de los Muchachos Observatory, and is the most important of continental Europe. It offers excellent transport connections and simple, affordable, and reliable logistics.

The observatory has three telescopes with respective apertures of 1.23, 2.2 and 3.5m. CAHA also hosts telescopes belonging to other institutions, such as a telescope with an aperture of 1.5m belonging to the National Astronomical Observatory (OAN) of Madrid, a Schmidt camera belonging to the Hamburg Observatory (Germany) and a robotic telescope measuring 60cm, belonging to the Centre of Astrobiology of Madrid (CAB-INTA).

The telescopes have at their disposal a wide variety of astronomical instrumentation in the optical and near-infrared range, as well as direct image sensor cameras and spectrographs of low, high or very high resolution. There are also monitors to analyse quality of the night sky. These facilities are supplemented by clean rooms, electronic, mechanical, and computer workshops. Additionally, the observatory features an aluminizing system for large-scale astronomy mirrors (mirrors of up to 4 m) that offers aluminization services to the scientific community.

At the Calar Alto Astronomical Observatory, astronomical studies are carried out on a wide range of fields, such as the Solar System, Cosmology, large-scale studies of the universe, galaxies, galaxy clusters, stars, and star clusters. It is worth to mention that CAHA has produced important observational legacy projects for the international community, such as CALIFA or ALHAMBRA, among others.

http://www.caha.es

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ASTRONOMY AND ASTROPHYSICS

This 30m radio telescope is one of the two observatories of the Institute of Millimetric Radio Astronomy (IRAM). This institute is a collaboration between the French CNRS (*Centre National de la Recherche Scientifique*), the German MPG (*Max-Planck-Gesellschaft*) and the Spanish National Geographic Institute (ING).

IRAM 30M RADIO TELESCOPE (IRAM 30M)

Built in only four years (1980-1984) at an altitude of 2,850 meters at Pico Veleta (Sierra Nevada, Granada), it is currently one of the largest and most sensitive millimetre-wave radio telescopes in the world. The telescope itself is a classic parabolic antenna that enables the exploration of extensive cosmic objects such as near galaxies and interstellar clouds. Thanks to its large collecting surface, the 30 m telescope is unrivalled in sensitivity and has been very well adapted to detect weak astronomical sources. The panels of its parabola are calibrated with a precision of 55 micrometres in relation to an ideal paraboloid.

The radio telescope is equipped with a series of receptors that operate at wavelengths of around 3, 2, 1, and 0.8 mm, simultaneously recording up to 160,000 channels of a high-resolution frequency, for the mapping of molecular gas in extensive nebulas. The telescope is also equipped with two cameras that operate at wavelengths of 2 and 1mm, devoted to the observation of the emission of dust in near molecular clouds and in galaxies, including the farthest (and youngest) galaxies in the known universe.

By pointing the telescope towards a celestial source, and then by scanning and tracking the source, one can build up radio images, for example, of complete galaxies or regions of star formation in the Milky Way. With its capacity to observe simultaneously at different wavelengths, multiple images can be produced. Radio astronomers therefore have the ability to obtain detailed maps of the universe at different millimetre wavelengths, explore previously-unknown structures, or submit the wave spectra of astronomical bodies to a detailed study, searching for new molecules.

http://www.iram-institute.org

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ASTRONOMY AND ASTROPHYSICS

The Yebes Astronomical Centre (National Geographic Institute, Ministry of Development) is devoted to the development and construction of instrumentation in the field of radio astronomy, as well as astronomical observations that are of astronomical as well as geodetic or geophysical interest.

YEBES OBSERVATORY (YEBES)

Located at an altitude of 930 m, about 80 km from Madrid in the municipal area of Yebes (Guadalajara), the Centre hosts four main scientific-technological facilities: (i) a large radio telescope measuring 40 m in diameter; (ii) a radio telescope measuring 13.2 m of the RAEGE network (Atlantic Spanish-Portuguese Network of Geodynamic and Astronomical Stations, composed of 4 radio telescopes of this type locate in Yebes (1), the Canary Islands (1), and the Azores (2)) along with the central headquarters of this network; (iii) an anechoic chamber capable of operating at very high frequencies; (iv) a pavilion of relative (superconductor) and absolute gravimetry.

Its three geodetic technologies (radio astronomy (VLBI), gravimetry, and permanent GNSS station), make the Yebes Observatory the fundamental geodetic station in Spain. Furthermore, the Observatory fits very well into an international context. The 40m radio telescope is one of the most important nodes of the European VLBI Network (EVN), one of the largest scientific facilities in the world, and is a station of the IVS, the International VLBI Service for Geodetics and Astrometry. For its part, the RAEGE network is one of the most important components of the Global Geodetic Observing System (GGOS). The gravimetry station, designed to carry out comparisons and calibrations of other exterior gravimetres, forms part of the International Gravitational Reference System (IGRS).

The Centre also features a very well-equipped laboratory for the development of state-of-the-art ultra-sensitive amplifiers of very low radio frequency noise, as well as laboratories and workshops for the design and construction of cryogenic receivers for radio astronomy. Work in these laboratories has already led to important contributions to large international projects such as the HERSCHEL Infrared Space Telescope and the ALMA and SKA interferometers. All the observational premises are available for the use of the scientific community.

http://www.fomento.es/MFOM/LANG_CASTELLANO/DIRECCIONES_GENERALES/INSTITUTO_GEOGRAFICO/Astronomia/instalaciones/cay

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ASTRONOMY AND ASTROPHYSICS

The Javalambre Astrophysical Observatoy (OAJ) is a new facility located at Pico del Buitre, at an altitude of 1,956 m in the municipal area of Arcos de las Salinas, Teruel. Built and managed by the *Centro de Estudios de Física del Cosmos de Aragón* (CEFCA), it was designed to carry out large-scale multi-filter astronomical mapping of maximum scientific interest in the fields of Astrophysics and Cosmology.

©CEFCA

JAVALAMBRE ASTROPHYSICAL OBSERVATORY (OAJ)

The facility features laboratories, control rooms, sky brightness monitors, and two latest-generation telescope whose main mirrors have apertures of 2.55 m (T250 or JST, Javalambre Survey Telescope) and 83 cm (T80 or JAST, Javalambre Auxiliar and Survey Telescope), with fields of vision measuring 3 and 2 degrees in diameter, respectively. The first scientific instrumentation consists of two panoramic cameras with a large field of vision, JPCam (5 square degrees of effective field of vision) and T80Cam (2 square degrees of effective field of vision), equipped with sets of filters that are able to obtain images at different spectrum bands that provide a low-resolution spectrum for each pixel of the sky.

This infrastructure possesses a dedicated data centre (UPAD), for storing and processing the data obtained from the OAJ. The UPAD features a storage capacity of 5PB (1PB in disk drive systems and 4PB in a robotic library) and 400 processing cores. The data centre will provide access to images and scientific databases for the entire community.

http://www.cefca.es

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ASTRONOMY AND ASTROPHYSICS

The Canfranc Underground Laboratory is the only underground facility in Spain and one of few in the world devoted to astroparticle physics and research into underground physics. It is managed by a Consortium composed of the Central Government , the Regional Government of Aragón, and the University of Zaragoza.

CANFRANC UNDERGROUND LABORATORY (LSC)

Since 1986, taking advantage of the location of the Canfranc railway tunnel in the Pyrenees in Huesca, experiments have been carried out here in search of dark matter and to study the nature and properties of the neutrino. The Canfranc Underground Laboratory is located at a depth of 850 m below the Pyrenees mountain of El Tobazo, between the railway tunnels and the highway tunnel of Somport. This depth eliminates most of the cosmic radiation present on the surface and allows for experiments that, due to their high level of sensitivity, require a low radiation background. This infrastructure is currently, due to its extensive area and characteristics, the second most eminent underground laboratory in Europe after the Gran Sasso Laboratory in Italy.

The laboratory's facilities cover an area of about 1250 m^2 that, including access corridors and adjacent areas, amount to a total of 1560 m^2 excavated into high-quality rock. This experimental space first played host to experiments into nuclear physics and astroparticles of the University of Zaragoza. Currently, it hosts two experiments devoted to the study of dark matter, one for neutrino physics, and another for geodynamics proposed by researchers from international universities and laboratories. In addition, two ancillary projects for experiments are being developed that will be located at similar facilities in other international laboratories. The plan for expansion includes a project for an astrophysics facility and a new proposal for underground biological study.

The laboratory began its activities in 2010 and the main lines of research of the scientific programme currently being carried out concern cutting-edge subjects in the field of astroparticles. Also notable is the service for categorization of materials via measurement of radioactivity for scientific or technological-industrial applications, as well as studies of geophysics and underground biology.

www.lsc-canfranc.es

02

OCEAN, LIFE, AND EARTH SCIENCES

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OCEAN, LIFE, AND EARTH SCIENCES

MARINE RESEARCH INFRASTRUCTURES NETWORK (RIM)

The Marine Research Infrastructures Network was created in 2008 with the aim of promoting exchange and development of methodologies and tools in the fields of knowledge shared by different marine infrastructures and other actors in the world of R&D&I. It seeks to find complementarity between different infrastructure sites, avoid redundancies, and increase competitiveness and the availability of results. This network has been the source of joint action of strategic importance for the country, as well as unifying management of marine data collected by this type of infrastructures, in cooperation with other organizations in the field (National Port Authority, Spanish Oceanographic Institute, etc.)

The two ICTS that currently belong to the Marine Research Infrastructures Network are the Oceanic Platform of the Canary Islands (PLOCAN) and the Coastal Observation System of the Balearic Islands (SOCIB). Both ICTS feature independent mechanisms for access but share a collective strategy, carrying out joint initiatives in their common interest.

OCEANIC PLATFORM OF THE CANARY ISLANDS (PLOCAN)

The Oceanic Platform of the Canary Islands is managed by the PLOCAN Consortium (equally co-financed by the Central Government and the Regional Government of the Canary Islands). Its objective is to allow for research, technological development, and cutting-edge innovation in the marine and maritime fields. The infrastructure allows access to and efficient study of the ocean with strict environmental guarantees, providing scientific laboratories, vehicles, offshore aquaculture, and in general, technological tools and infrastructures located in the PLOCAN marine environment. The infrastructure is open to the entire scientific and technological communities, nationally as well as internationally, and is integrated into current and future European initiatives for coordination and cooperation in the field.

PLOCAN is currently in the construction phase. Although operation is slated to begin near the end of 2015, some of the facilities, such as the shore offices, offshore aquacultre, and submarine vehicles such as the gliders, have begun partial operation.

The main facility of PLOCAN, the ocean platform, is located in open sea, a mile from the coast, in the municipality of Telde (located on the north-western portion of the Island of Gran Canaria) on an area totalling 23km^2 reserved for scientific and technological experimentation. The marine test site provides a set of facilities and services to facilite the testing and monitoring of new marine technologies, especially those related to marine renewable energies. Additionally, the electric and communications infrastructure (IECOM) allow for connection to the network of electricity and transfer the energy generated by new marine technology and devices.

PLOCAN, in its capacity as an ocean observation initiative, constitutes a Spanish node in the EMSO (European Multidisciplinary Seafloor Observatory) network of European observatories, included on the roadmap of the ESFRI (European Strategy Forum on Research Infrastructures).

Infographics: Fernando Montecruz

http://www.plocan.eu

02

OCEAN, LIFE, AND EARTH SCIENCES

The Coastal Observation System of the Balearic Islands (SOCIB) is managed by the SOCIB Consortium, equally co-financed by the Central Government and the Regional Government of the Balearic Islands. Located on Palma de Mallorca, it has been in operation since 2013.

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COASTAL OBSERVATION SYSTEM OF THE BALEARIC ISLANDS (SOCIB)

The activities carried out by SOCIB are mainly focused on the Western Mediterranean, especially the Balearic Islands and surrounding areas (the Alboran Sea, Algerian Basin, etc.). Thanks to its strategic location, near the area of transition between the Mediterranean and the Atlantic, it is one of the "hot points" of global biodiversity.

SOCIB is a system of observation, prediction, management, and distribution of data on the coastal ocean, from the shore and coastline to the exterior limit of the continental slope and its area of influence. It promotes a paradigm change in the observation of the oceans, previously based exclusively on large ships, now and in the future to be based on integrated, multi-platform systems. SOCIB is made up of a network of facilities and equipment devoted to marine observation, acquisition of data, processing, analysis, operational numeric modelling, and dissemination of multidisciplinary marine information in a systematic and consistent manner. It openly provides oceanographic data in real time and prediction services in support of operational oceanography, answering the needs of a wide range of society's scientific, technological, and strategic priorities in the context of climate and global change.

The synergy between the different systems of observation (oceanographic catamaran, high-frequency radar, autonomous submarine vehicles, buoys, ARGO profilers, etc.), the systems of prediction, and the tools for assimilation of data and the computerized system for management and distribution of data allow a complete and integrated description of the physical and biogeochemical properties of marine and coastal systems, as well as their evolution.

http://www.socib.es

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OCEAN, LIFE, AND EARTH SCIENCES

The ICTS FLOTA is composed of 10 oceanographic vessels, each with technical management and financing by the Central Government. These oceanographic vessels fundamentally provide services to campaigns being carried out within the framework of the Spanish State Plan for Scientific and Technical Research and Innovation and of the framework programme of the European Union, as well as the specific responsibilities assigned to different Public Research Organizations of the Secretary of State for Research, Development, and Innovation. The on-board technical support of the oceanographic vessels of the campaigns approved by the Commission for the Coordination and Monitoring of Oceanographic Vessels Activities (COCSABO) is provided by the Marine Technology Unit of the Spanish National Research Council (CSIC). Currently, the oceanographic vessels belonging to the ICTS FLOTA are as follows:

- the oceanographic research vessel BIO Hespérides of the Spanish Navy
- the oceanographic vessels materially integrated into or loaned to the CSIC: B/O Sarmiento de Gamboa, B/O García del Cid, and B/O Mytilus,
- the oceanographic vessels materially integrated into the Spanish Oceanographic Institute (IEO): B/O Ramón Margalef, B/O Ángeles Alvariño, B/O Francisco de Paula Navarro, B/O Jose Mª Navaz, and B/O Lura
- the oceanographic vessel belonging to the consortium Coastal Observation System of the Balearic Islands (SOCIB), B/O SOCIB.

SPANISH OCEANOGRAPHIC FLEET (FLOTA)

Oceanographic Research Vessel (BIO) Hespérides

The BIO Hespérides entered into service in 1991 and since then has carried out more than 120 oceanographic campaigns in the Antarctic, Arctic, and in the Pacific and Atlantic Oceans. The important role that it plays in the field of oceanographic research was recognized in 1995 as a Large Scientific Facility by the Advisory Commission for Large Scientific Facilities, currently known as Unique Scientific and Technical Infrastructure (ICTS). The BIO Hespérides is a vessel of the Navy integrated into the Maritime Task Force of the Spanish Navy, based in Cartagena (Murcia). Its scientific equipment is completely managed by the Marine Technology Unit of the CSIC.

Its hull is reinforced for the navigation of the polar areas of the Antarctic and the Arctic. Its main activity focuses on austral summers, carrying out scientific research campaigns in the Antarctic and occasionally providing support to Spanish Antarctic Facilities and their research projects. The rest of the year its activities are primarily carried out in the Atlantic, Pacific, and Mediterranean, providing support to different scientific campaigns, such as the mapping programme of the Exclusive Economic Zone of the Ministry of Defence. It is a global research vessel with instrumentation and laboratories that allow for investigation of natural resources and risks, global change, marine resources, global ocean currents, and marine biodiversity.

http://www.armada.mde.es/ArmadaPortal/page/Portal/ArmadaEspannola/buques_superficie/prefLang_es/12_buques-investigacion-oceanografia--01_buque-investigacion-oceanografica-hesperides

Sarmiento de Gamboa

FLOTPOL (Mixed CSIC-IEO unit for the management of the oceanographic fleet and Antarctic facilities)

B/O SARMIENTO DE GAMBOA

The **B/O Sarmiento de Gamboa**, belonging to the CSIC, was launched in 2006, and focuses on the study of global ocean currents, marine biodiversity, fishing resources, and climate change. Based in Vigo (Pontevedra), it is a ocean research vessel. It features scientific and technological equipment for carrying out research into marine geophysics, oceanography, biology, and geochemistry. It also possesses advanced technology in regards to navigational systems (such as dynamic positioning), and has been the first Spanish oceanographic vessel able to work with Remote Operated Vehicles (ROVs) at great depths. It is currently the vessel in the fleet with the capability to carry out geophysical research in accordance with the current standards of the exploration and extraction industries.

http://www.utm.csic.es/sarmiento

B/O GARCÍA DEL CID

The **B/O García del Cid**, belonging to the CSIC, was launched in 1979. It is a vessel specifically used for marine scientific research and is at the service of national or international groups that carry out oceanographic research. Its main areas of work are the Western Mediterranean, the Iberian area of the Atlantic, and the Canary Islands. It is based in Barcelona and is a vessel for regional research. The vessel's equipment allows for marine research into oceanography, geology, and geophysics, as well as experimental fishing research using benthic and pelagic techniques and research into phytoplankton, zooplankton, and ichthyoplankton. The vessel is equipped with both wet and dry laboratories, a gantry located astern, and winches for working on the deck (20m^2) and diverse acoustic equipment. It has good manoeuvring capabilities for anchoring and recovery of buoys, currentmeters, sediment traps, etc.

http://www.utm.csic.es/garciadelcid

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B/O MYTILUS

The **B/O Mytilus**, launched in 1997, belongs to the CSIC. It is based in Vigo (Pontevedra). It is a coastal research vessel and its research work is mainly focused on the area of Galicia, although it occasionally carries out work in other areas of the Iberian Peninsula and the Canary Islands. It is designed for study of marine biology, physical oceanography, and marine geology.

http://www.iim.csic.es/-waldo/Index.html

B/O ÁNGELES ALVARIÑO

The **B/O Ángeles Alvariño**, belonging to the IEO, was launched in 2012 and is based in Vigo (Pontevedra). This vessel provides the national and European oceanographic fleet with a floating laboratory equipped with the latest technology, allowing for a notable improvement of research into ocean sciences. Classified as a regional vessel, it holds a capacity of 15 researchers and technicians, as well as its 12 crew members. It also features a design that reduces the underwater radiated noise, allowing it to work without altering the marine life behavior. It features cutting-edge technology for the study of marine geology, physical, and chemical oceanography, marine biology, fishing, and environmental protection.

http://www.ieo.es/web/ieo/flota

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B/O Ángeles Alvariño © IEO • B/O Ramón Margalef

©IEO

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B/O RAMÓN MARGALEF

The **B/O Ramón Margalef**, belonging to the IEO, was launched in 2011 and is based in Vigo (Pontevedra). This vessel is specially designed for oceanographic and fishing research, including the integrated study of ecosystems. Due to its dimensions and capacity, it is classified as a regional vessel. It has 10 days of autonomy and space for 13 researchers and technicians, as well as its 14 crew members. It carries out its activities nationally or in the surrounding seas, and features the latest technology for the study of marine geology, physical and chemical oceanography, marine biology, fishing, and environmental protection.

B/O FRANCISCO DE PAULA NAVARRO

The **B/O Francisco de Paula Navarro**, belonging to the IEO, is a versatile boat for fishing and oceanography based in Palma de Mallorca and classified as a coastal vessel. This vessel is normally used for fishing and oceanographic campaigns throughout the Spanish coast, mainly in the North-eastern Atlantic, Southern Atlantic, and Mediterranean. With an overall length of 30.5m, it has a total capacity of up to 17 people between the crew and scientific team. It can carry out a range of studies, from geomorphology, hydrography, and plankton to mapping projects for benthic and pelagic habitats, protected marine areas, contamination, and assessment of ecosystems and living marine resources.

B/O Francisco de Paula Navarro

http://www.ieo.es/web/ieo/flota

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B/O JOSÉ MARÍA NAVAZ

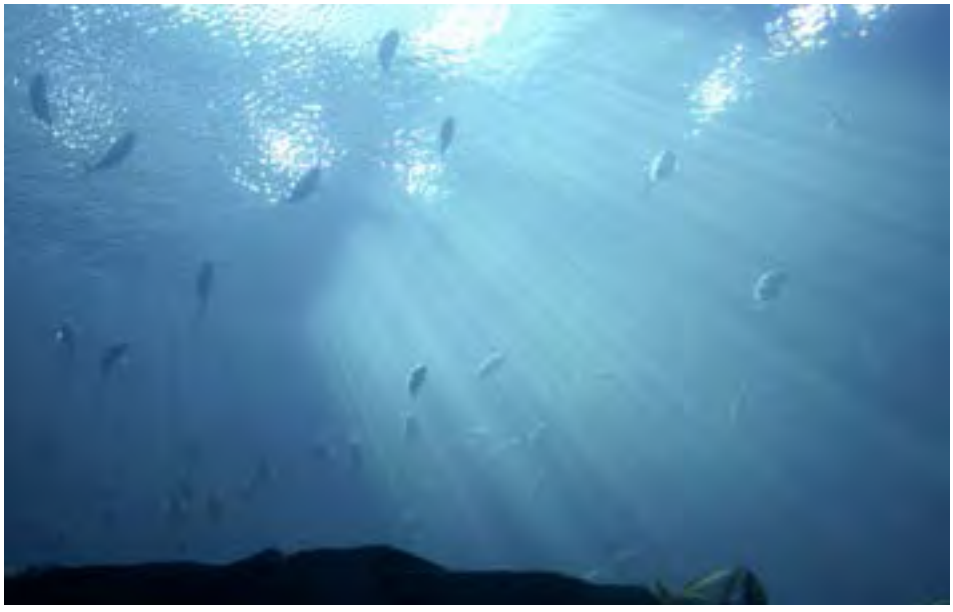
The **B/O José María Navaz** is a versatile boat for fishing and oceanography belonging to the IEO, based in Vigo (Pontevedra). It has a capacity of up to five crew members and 7 scientists and an overall length of 15.8m, classified as a coastal vessel. It is normally used for campaigns to research oceanography and coastal ecology, principally in the waters of Galicia.

B/O LURA

The **B/O Lura** belongs to the IEO and is based in La Coruña. With an overall length of 14.3m, it is classified as a coastal vessel. It has a capacity of up to 10 people, and is normally utilised for campaigns for research into oceanography and coastal ecology, principally in the waters surrounding the area of La Coruña.

B/O SOCIB

The **B/O SOCIB** is a catamaran with a overall length of 24m, developed as part of the observational strategy of the consortium of the Coastal Observation System of the Balearic Islands (SOCIB), and is based in Palma de Mallorca. This catamaran carries out oceanographic research in the maritime and coastal areas of the Balearic Islands and the Mediterranean. Among the most striking characteristics of its design is the bridge, which offers 360-degree visibility and a wide deck measuring 60m^2. It is equipped with the latest technology for scientific study and navigation.



http://www.socib.es

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OCEAN, LIFE, AND EARTH SCIENCES

Spanish fixed-infrastructures in polar areas are currently limited to those operating in the Antarctic, and are the Spanish Antarctic Station Juan Carlos I (BAE JCI) and the Spanish Antarctic Station Gabriel de Castilla (BAE GdC). Both are located on the archipelago of the Southern Shetlands and are seasonal stations, only in operation during the austral summer. Spain also has a temporary scientific camp located on the Byers Peninsula of Livingston Island.

The scientific fields studied by Spain in the Antarctic are very diverse: geology, biology, glaciers, atmospheric studies, chemical studies, studies of human impact, communication engineering, meteorology, climate change, vulcanology, geodetics, hydrography, and oceanography.

The BAE JCI is logistically managed by the Marine Technology Unit of the Spanish National Research Council (UTM-CSIC) and, in the case of the BAE GdC, managed by the Army in its operational aspects with scientific instrumentation and logistical management provided by the UTM-CSIC. Coordination of activities at both stations is carried out under the authority of the Spanish Polar Committee, with the UTM-CSIC responsible for logistical coordination.

SPANISH ANTARCTIC FACILITIES (BAES)

Spanish Antarctic Station Juan Carlos I (BAE JCI)

The Spanish Antarctic Station Juan Carlos I is located on the Hurd Peninsula of Livingston Island (62° 39´ 46´´ S, 60° 23´ 20´´ O). Since 1999, it has been operated by the UTM-CSIC, which provides the technical and logistical support necessary to carry out the scientific activities of the National R&D&I plan in the Antarctic.

The BAE Juan Carlos I was inaugurated in January of 1988, when Spain became a consultative member of the ATCM (Antarctic Treaty Consultative Meeting), and has been modified and expanded several times, the latest in 2009. It features information and communication systems, an international camp located on the Byers Peninsula, camps located in isolated areas, a research laboratory, and a mountain shelter. It has a maximum capacity of 19 people between scientific and technical staff. It is equipped with meteorological, geological, and biological laboratories, microscope equipment, and auxiliary laboratory equipment. It also offers the instrumentation necessary for the study of coastal oceanography.

The location of the BAE Juan Carlos I is optimal for carrying out different scientific programs under the main lines of research in the Antarctic. Research is being done into the atmosphere, glaciology, the climate, global change, geomagnetism, biodiversity, and risks to the environment. The station is equipped to serve the priorities of the Spanish research community according to the requirements of Antarctic projects as well as being open to the scientific programs of other countries, sharing permanent as well as temporary facilities and promoting cooperation between different nations.

http://www.utm.csic.es/web/index.php/es/instalaciones/jci

Spanish Antarctic Station Gabriel de Castilla (BAE GdC)

The Spanish Antarctic Station Gabriel de Castilla (latitude 62° 55' S and longitude 60° 37' W) is located on Deception Island, in the archipelago of the Southern Shetlands, 100km to the North of the Antarctic continent, more than 1000km from the nearest human settlement and 13,000km from Spain. Deception Island is a unique location due to its history, landscapes, plants, and wildlife. The island is the main active volcano of the marginal basin of the Bransfield Strait, one of the main focal points of seismic and volcanic activity in Antarctica. It has a horseshoe shape with a deep sea entrance (Foster Port). The strait, which serves as the entrance to the interior waters, is the site of an interior bay with a gently-sloping coastline, considered the best

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natural port of the Antarctic. It has a diameter of 15km and a maximum altitude of 540m. The base of this volcano, whose eruption in the Quaternary period gave birth to the island, is located 850 m below sea level, with a diameter of 25-30 km.

The station is managed by the Operations Bureau of the Army General Staff, which organises and directs the operation of the station. During the Spanish Antarctic campaign of 1988, the refuge "Gabriel de Castilla" was installed on Deception Island, being officially inaugurated in 1989 as a military refuge to support research and topographical surveys. Since its installation, this refuge has been managed by the Army, in close collaboration with the UTM-CSIC. In 1998 the refuge was classified as an Antarctic Station, and in 1999 as a Unique Scientific and Technical Infrastructure (ICTS). Since then it has undergone various periods of remodelling, the most important in the year 2009.

This station is designed to carry out singular, cutting-edge scientific activities, and its results are valuable for polar research. Due to its singular nature, it is at the disposal of the national and international scientific communities, hosting studies concerning volcano monitoring, astrobiology, geology, and ecology.

http://www.ejercito.mde.es/unidades/Antartica/antartica

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OCEAN, LIFE, AND EARTH SCIENCES

The Doñana Biological Reserve (RBD, Almonte, Huelva), located to the southwest of the Iberian Peninsula and founded in 1964 by the Spanish National Research Council (CSIC), is managed by the Doñana Biological Station (EBD, Sevilla), a research institute belonging to the CSIC. The protected area of Doñana, also known as the Doñana Natural Area, extends over 106,047 hectares and includes the National Park and Natural Park of Doñana. In both areas there is a regulated use of natural resources (mainly forestry, fishing, and livestock). The Biological Reserve forms part of the National Park and is composed of two protected areas, the RBD, measuring 6,794 hectares, and the Biological Reserve of Guadiamar, measuring 3,214 hectares.

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DOÑANA BIOLOGICAL RESERVE (RBD)

The National Park of Doñana was declared a Biosphere Reserve in 1980, a Wetland of International Importance in 1982, an area of Special Protection for birds in 1987, a World Heritage Site in 1994, and an area of importance to the European Community in 1997. The RBD was named a European Research Infrastructure site during the fourth and fifth Framework Programmes and recognized as Unique Scientific and Technical Infrastructure (ICTS) in 2006. This protected area, which includes four large ecosystems (beach, dunes, Mediterranean scrubland, and marshland) is host to numerous endemic and threatened species. As many as 700,000 water birds gather in the marshland each winter, making Doñana the most important wetland area in Spain and Europe. This ICTS is considered an ideal platform for field experimentation and the sharing of experiences associated with the environmental impact of global change. It provides a set of unique natural resources for carrying out research on the processes that promote, limit or threaten biodiversity within a multidisciplinary context, providing a solid quantitative framework that serves as a guide for the conservation of biodiversity and making predictions about future scenarios in the context of global change.

In addition to the natural resources offered by ICTS-RBD, there are lab facilities (basic and specialized) located both at the field facility and the EBD headquarters in Seville, which provide the equipments and facilities needed to carry out experiments and ecological studies. The ICTS-RBD also provides a data base offering physical and biological metadata obtained from the ecosystems which have been systematically and continuously recorded during the last 30 years. Based on the facilities of the ICTS-RBD, Spain participates in LifeWatch (European Strategy Forum on Research Infrastructures), hosting the administrative and legal headquarters in Seville, as well as the centre for information technology and communication (sensor networks, information and knowledge systems, etc.).

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http://icts-rbd.ebd.csic.es

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OCEAN, LIFE, AND EARTH SCIENCES

The Aerial Research Platforms (PAI) is an infrastructure managed by the Spanish National Institute for Aerospace Technology (INTA), belonging to the Spanish Ministry of Defense. The facilities contain complete instrumentation for carrying out atmospheric research and observation of the earth's surface, adapted for installation in two CASA C-212-200 aircraft and a Motorglider STEMME S15. It is precisely the combination of cutting-edge instrumentation and the capacity for remote observation from the air that makes this infrastructure one of the best in its field in Europe.

AERIAL RESEARCH **PLATFORMS (PAI)**

Each one of the C-212-200 aircraft is equipped to carry out a specific type of measurement. One of them is devoted to atmospheric research (physical-chemical measurements of the atmosphere, cloud composition, particle analysis, aerosol distribution, ozone measurements, etc.). This platform is also used for the development and testing of airborne sensors and on-board instrumentation. The other aircraft is designed for the observation of the Earth, equipped with instrumentation adapted for aerial photography and high-resolution hyperspectral remote sensing along the entire radiometric spectrum. It is worth noting that the hyperspectral measurement equipment of this aircraft includes the Airborne Hyperspectral Scanner (AHS) and the Compact Airborne Spectographic Imager (CASI 1500i). Digital processing of the data allows the generation of geo-referenced hyperspectral images displaying different surface properties: radiance, reflectance, temperature or emissivity. Those products are an essential tool for members of the scientific community involved in research and development in geological sciences and can be applied to many fields, such as agriculture, forest engineering, geology, inland water, oceans, etc. Lastly, the Motorglider STEMME S15 ,will be modified for the installation of Synthetic Aperture Radar equipment and could be prepared for other configurations for Earth observation as well as atmospheric research.

The aerial platforms are complemented with another set of facilities and on-ground systems, such as hangars, calibration and characterization labs, auxiliary laboratories to test on-board equipment; as well as reception, processing, archiving and distribution of data and images obtained by the aircraft.

http://www.inta.es/grandesInstalaciones.aspx?Id=2&SubId=9

03

HEALTH SCIENCES AND BIOTECHNOLOGY

03
HEALTH SCIENCES AND BIOTECHNOLOGY

This distributed ICTS is composed of the CIBER-BBN (Biomedical Research Networking Center in Bioengineering, Biomaterials, and Nanomedicine) and Jesus Usón Minimally Invasive Surgery Centre (CCMIJU). These two centres group together 27 complementary and coordinated units, located at different institutions, which in turn are distributed throughout 6 Autonomous Communities: Aragon, Catalonia, Extremadura, Madrid, the Basque Country, and Valencia.

It is organized into five platforms: Production of Biomolecules, Production of Biomaterials and Nanomaterials, Preclinical Validation-Tissue, Biomaterial and Surface Characterization, Preclinical Validation-Bioimaging, and High Performance Computing.

Each platform is organised into one or more units, which are distributed throughout the country: one in Alava, one in Badajoz, thirteen in Barcelona, seven in Cáceres, two in Madrid, one in Valencia, and three in Zaragoza. This infrastructure provides cutting-edge technological resources and highly-qualified staff, and provides services open to the entire scientific community.

The research infrastructure is geared towards medical applications, offering a complete service that uses a single contact point model, involving the design and production of biomolecules, biomaterials, nanomaterials and their conjugates, as well as the characterization of these materials, tissues, medical devices, and systems from physicochemical, toxicological, and biological points of view, including *in vivo* preclinical validation.

http://www.nanbiosis.es

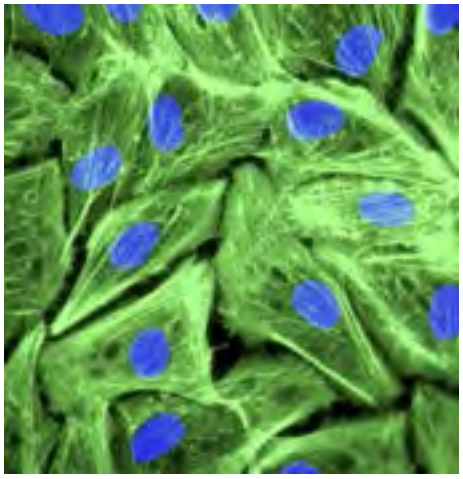
©CIBER-BBN / NANBIOSIS

INTEGRATED INFRASTRUCTURE FOR PRODUCTION AND CHARACTERIZATION OF NANOMATERIALS, BIOMATERIALS, AND **SYSTEMS IN BIOMEDICINE (NANBIOSIS)**

Platforms for Bioengineering, Biomaterials, and Nanomedicine

These platforms belong to the area of Bioengineering, Biomaterials, and Nanomedicine (CIBER-BBN), of the Biomedical Research Networking Centre (CIBER), a consortium that is part of the Institute of Health Carlos III (Ministry of Economy and Competitiveness). The CIBER-BBN has been carrying out its work since 2007, and is currently made up of 44 research groups, selected on the basis of their scientific excellence, working mainly within three scientific programs: Bioengineering and Medical Imaging, Biomaterials and Advanced Therapies, and Nanomedicine. The CIBER-BBN participates in NANBIOSIS with 20 Units, 9 of which are specialised in *a la carte* production of biomolecules (proteins, antibodies, and peptides), biomaterials and nanomateriales, conjugated or not, with different purposes and able to be categorised up to their pre-clinical validation by singular equipment available in other units such as the light-scattering "3D SLS & DLS," nuclear magnetic resonance (NMR, 10 equipments operating at magnetic fields between 5.8 and 14.1 Teslas) and fluorescence and bio-luminescence spectrophotometers, as well as micro CT, ToF-SIMS, and the Instron machines for mechanical characterisation, among others.

The twenty units that make up the Platform are complementary and work together in a coordinated manner. Ten of them are focused on the production of biomolecules, biomaterials, and nanomaterials capable of providing a wide range of biological molecules (proteins, peptides, and antibodies), 2D and 3D biomaterials, as well as their conjugates for biomedical applications, specifically in regenerative medicine, medical devices and smart devices, implants, therapeutic nanoconjugates, systems for the controlled release of pharmaceuticals, contrast agents for *in vivo* imaging, *in vitro* diagnosis, and biosensors. All of these biomaterials, nanomaterials, implants, therapeutic nanconjugates, systems for the



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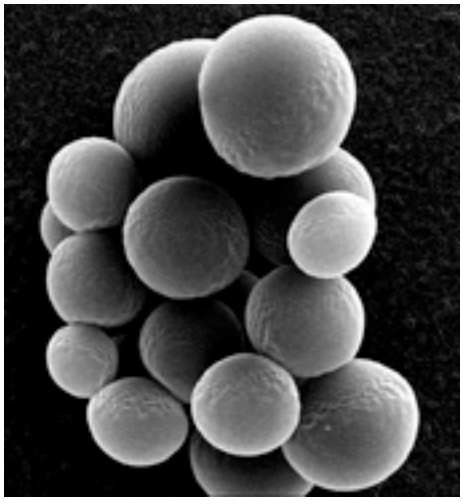
controlled release of pharmaceuticals, and contrast agents, produced by the previously-mentioned units, along with others, such as medical devices, smart devices, or biosensors and devices for diagnosis, can be pre-clinically validated. For this purpose, there are six units with the capacity to characterize them from a physical-chemical, functional, and toxicological perspective, and another three units for carrying out a complete *in vivo* pre-clinical validation using various imaging techniques, among others. There is also a high-performance Computing unit that allows remote access for applications related to the analysis of biomedical images and signals as well as applications that require complex calculations for *in silico* experimentation.

http://www.ciber-bbn.es



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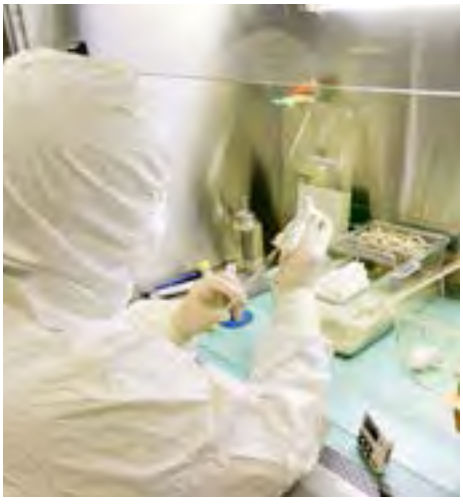

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Preclinical Infrastructure for Development of Minimally Invasive Technologies

It is located in Cáceres, in the Jesús Usón Minimally Invasive Surgery Centre (CCMIJU), a public research centre whose strategic mission focuses on expanding the knowledge and use of technology related to biomedicine and minimally-invasive surgery, as well as other related fields in the area of public health, through research, dissemination, innovation, and transfer of technology in cooperation with other organizations at the international level.

The CCMIJU participates with seven units distributed among the different platforms of NANBIOSIS. Some of the most singular facilities are the animal lab, measuring 2.000m^2, and the surgical unit, made up of ten experimental operating rooms supplied with cutting-edge equipment, providing top-level services in translational research and methodology.

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http://www.ccmijesususon.com

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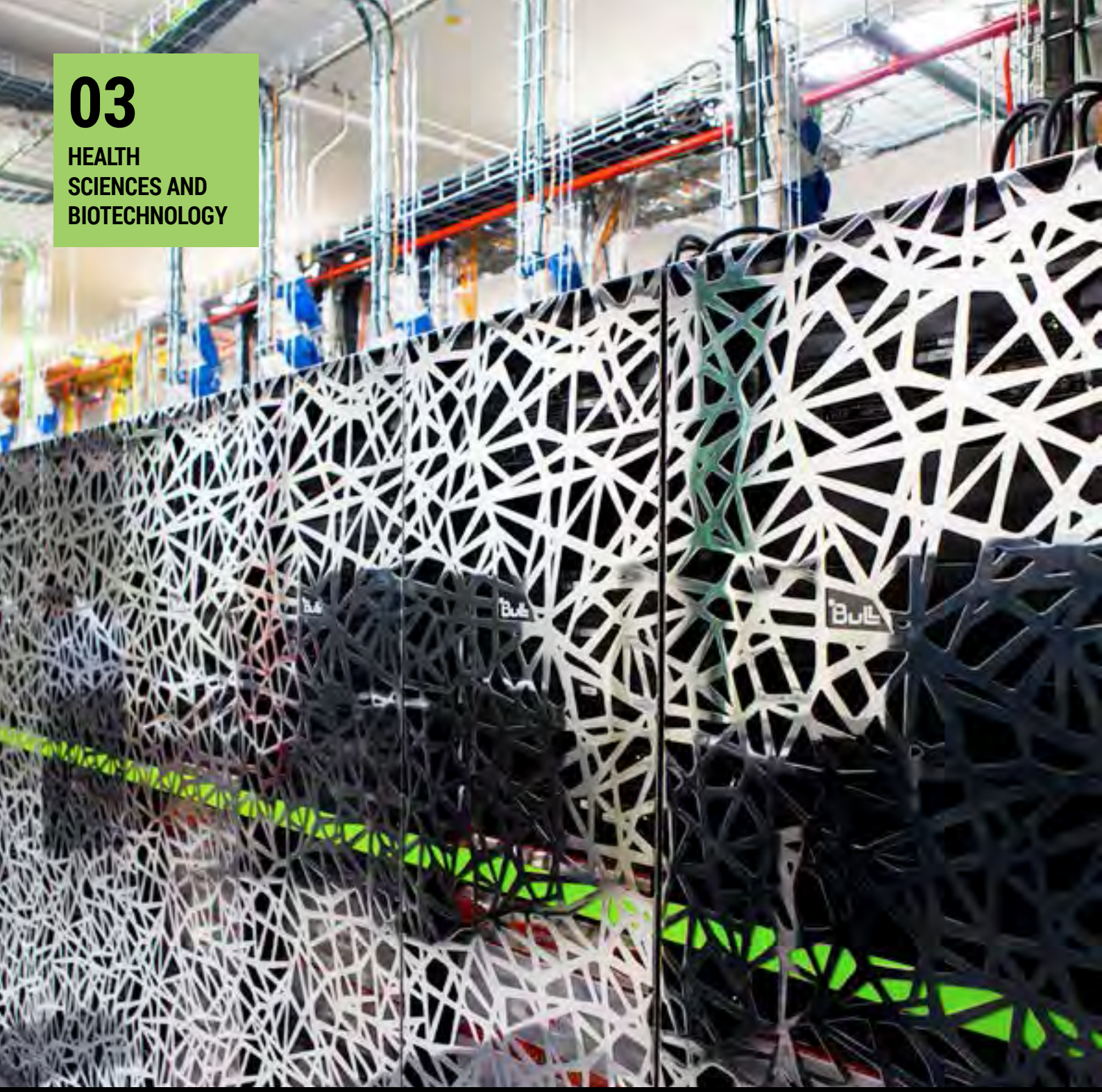
HEALTH SCIENCES AND BIOTECHNOLOGY



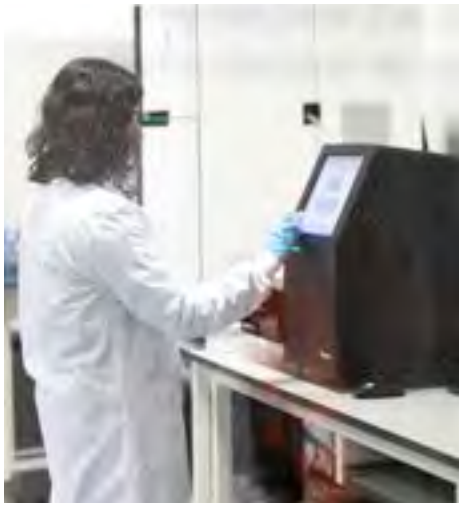
This distributed ICTS is composed of the Genomics Platform of the *Centro Nacional de Análisis Genómico* (CNAG) and the Metabolomics platform of the Centre for Omic Sciences (COS). This facility has the whole range of required technologies to quantify all the elements that make up biological systems, including DNA, RNA, epigenomic marks, proteins, metabolites, and structural elements such as membranes. In this manner, it provides an integrated solution for deciphering biological processes through systems biology.

https://ictsomicstechnologies.wordpress.com/

INTEGRATED INFRASTRUCTURE FOR OMICS TECHNOLOGIES (IOT)

Genomics Platform of the *Centro Nacional de Análisis Genómico* (CNAG)

The CNAG was set up in 2009 by the Central Government and the Regional Government of Catalonia, and it is located at the *Parc Cientific de Barcelona*. Its mission is to carry out large-scale projects in genome analysis that will lead to significant improvements in public health and quality of life. The CNAG focuses its efforts in four interconnected reseach areas: Disease Gene Identification, Cancer Genomics, Genomics of Infectious Diseases, and Genomics of Model Organisms, in collaboration with scientists from universities, hospitals, research centres, and companies in the sector of biotechnology and pharmaceuticals.



The CNAG Genomics Platform has a park of twelve second-generation DNA sequencers (nine HiSeq2000, two HiSeq2500 and one MiSeq) that produce a total of more than 800 Gigabases of nucleic acid sequences per day, which is equal to eight complete human genomes every 24 hours. The sequencing operation is supported by an extensive informatic infrastructure: 2.7 petabytes of data storage, over 1200 computing nodes with a capacity of 13 TFlops, an internal 10 Gb/s network and multiple 10 Gb/s direct physical connections to the Barcelona Supercomputing Center (BSC-CNS). The integrated CNAG infrastructure is the largest Genome Centre in Spain and possesses one of the largest DNA sequencing capacities in Europe.

http://www.cnag.cat

Metabolomics Platform of the Centre for Omic Sciences

The Centre for Omic Sciences (COS) is a scientific-technological facility equipped with the latest technology in metabolomics and proteomics, complemented with technology for transcriptomics, genomics, and validation of biomarkers. The COS belongs to the Rovira i Virgili University , and is managed by the Nutrition and Health Technology Centre, which provides scientific advice and technical support for the application of omic technologies in an integrated manner to the new challenges of the life sciences.

The integration into a single facility of multiple technologies for metabolomics and proteomics allows for the use of the most suitable technologies, or a combination of them, in order to determine their metabolic profiles. The methodologies of undirected metabolomics allow for the postulation of hypotheses that can be checked, and elucidate the biochemical mechanisms involved, via the use of complementary omic technologies such as genomics, transcriptomics, or proteomics and validation *in vitro, in vivo*, or in humans. The COS applies these technologies in order to increase knowledge on the subject and for innovative applications in health, human and animal nutrition, and the pharmaceutical and environmental industries.

http://omicscentre.com

03
HEALTH SCIENCES AND BIOTECHNOLOGY

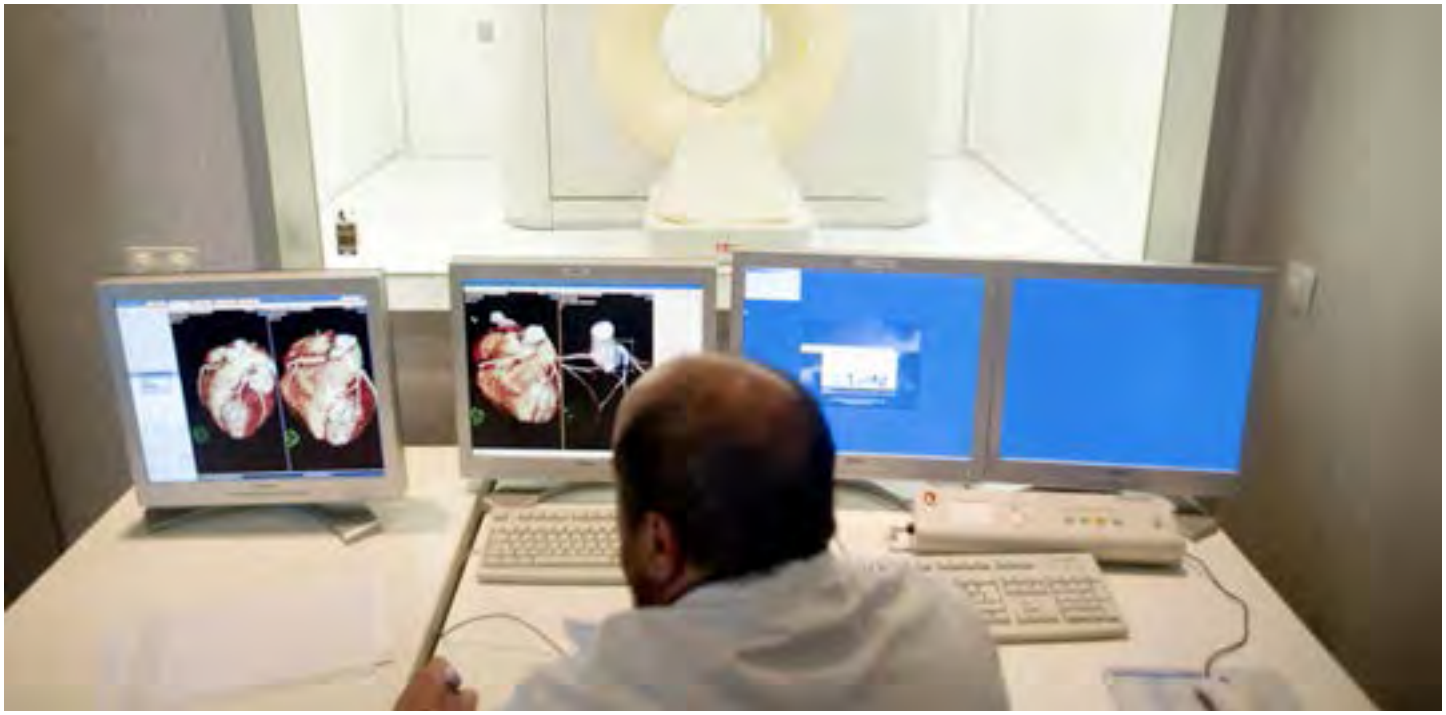
The equipment, staff, and organization of this distributed ICTS form a dynamic collective for providing service to the scientific community in the field of molecular and functional imaging, as well as advanced imaging. It includes latest-generation technologies and resources for researchers in the field of biomedical imaging. This distributed ICTS is composed of the Translational Imaging Infrastructure of the CNIC and the Platform for Molecular and Functional Imaging of CIC-biomaGUNE.

DISTRIBUTED NETWORK FOR BIOMEDICAL IMAGING (ReDIB)

Infrastructure for Advanced Translational Imaging (TRIMA)

The facilities included in this infrastructure are located at the Spanish National Centre for Cardiovascular Research Carlos III (CNIC, Madrid) and have been in complete operation since 2010. They are organized into three platforms: Molecular and Functional Imaging, Advanced Imaging, and High Throughput/ Content imaging.

The Molecular and Functional Imaging unit provides services of optical and fluorescent microscopy and develops new imaging applications that allow researchers to reach molecular details in large samples such as organs and model organisms. They also develop special applications such as very large image tiling, cell tracking, shape recognition, and 3D/4D- multicolour rendering and co-localization. This unit is also strongly committed to technological innovation and the development



of new applications of interest, as well as training in this type of techniques. The Advanced Imaging unit provides cutting-edge technologies for imaging of organs in five different types: Magnetic Resonance (MRI), X-ray computed tomography (X-ray CT) and advanced Positron Emission Tomography (PET), as well as hybrid imaging technology PET/MRI, ultrasounds and optical imaging (bi- and tri-dimensional fluorescence and luminescence). Moreover, it features a laboratory devoted to nanotechnology and organic chemistry that produces multifunctional nanoparticles and a radiochemical laboratory that provides radiotracers for the pre-clinical imaging techniques available at the centre. This unit is equipped to carry out advanced applications of molecular imaging for specific studies that increase the specificity and sensitivity of the different types of imaging. It not only allows working with pre-clinical models, but it also performs imaging studies in humans. The high-performance imaging unit is a fully automated facility that provides the latest technology in Flow Cytometry to simultaneously measure multiple optical characteristics of each one of the particles or cells in a suspension, as well as High Content Screening, for the discovery of new pharmaceuticals or approaches of functional genomics using siRNA libraries.

It is a facility with a translational mission that offers latest-generation technology for the advancement in the study of different cardiovascular illnesses and pathologies from molecular to tissue levels, for pre-clinical studies of small animals, also applicable to humans. The goal is to accelerate the development process of new pharmaceuticals and therapies as well as new tools for diagnosis.

http://www.cnic.es/imaging

Platform for Molecular and Functional Imaging at CIC biomaGUNE

This facility has been configured as a section of ther Cooperative Research Centre in Biomaterials (CIC-biomaGUNE), which officially opened in 2006 and is located in San Sebastián.

Among other equipments, the facility contains a cyclotron capable of producing a large variety of positron emitter isotopes, a radiochemical laboratory that is completelly equipped with versatile automated systems for the manufacture of new chemical entities and high-quality cutting-edge control equipment, hybrid PET-CT equipment (Positron Emission Tomigraphy – Computed Tomography), hybrid SPET-CT (Single-photon emission computed tomography - Computed Tomography) with energy discrimination, two chambers for high-field (11.7 and 7 Tesla) nuclear magnetic resonance (MRI), and fluorescence imaging equipment. The facilities are completed by an animal lab devoted to small rodents.

With the equipment, infrastructure, and organization of this facility, services are provided to the scientific community, as well as carrying out their own research projects in the fields of radiochemistry, nuclear imaging, magnetic resonance imaging (MRI), and imaging analysis. Specifically, the infrastructure has been designed, constructed, and equipped to carry out longitudinal and multi-modal research projects in the pre-clinical environment, as well as developing applications in the areas of Pre-Clinical Molecular and Functional Imaging and Nanomedicine.

http://www.cicbiomagune.es/icts

03
HEALTH SCIENCES AND BIOTECHNOLOGY

This network comprises publicly-owned high biosafety laboratories open to the national and international scientific communities, that due to their dimensions and/or the characteristics of their facilities, provide a unique opportunity for experimental studies otherwise not feasible at conventional centres. This distributed ICTS includes the High Biosafety Laboratory at Animal Health Research Centre (CISA) and High Biosafety Laboratory at the *Centre de Recerca en Sanitat Animal* (CReSA).

HIGH BIOSAFETY LABORATORIES NETWORK (RLASB)

High Biosafety Laboratory at Animal Health Research Centre (CISA)

The High Biosafety Laboratory at Animal Health Research Centre (CISA) was founded in 1993. The centre is located in Valdeolmos (Madrid) and belongs to the Spanish National Institute for Agricultural and Food Research and Technology (INIA), a public research organization. CISA's high biosafety laboratory (Biological Safety Level 3, BSL-3) is composed of 40 laboratories and common rooms, as well as 19 animal housings designed to accommodate a variety of different species, ranging from fishes to horses. This facility enables experimental work with animals and research on highly transmissible and exotic infectious diseases of severe impact either on animal health and/or for public health (zoonosis). Two of the laboratories at CISA are equipped to perform research and development with high-risk, exotic viruses that may affect humans (NCB-3+, the highest biosafety level in the country). In total, these facilities span an area of 10,824 m^2.

CISA's mission focuses on research, prevention and control of infectious and exotic diseases of Spanish livestock and wildlife, with a very active involvement in the development of technologies for improving diagnostic and control systems. It develops and promotes research in animal health at the highest scientific level, and participates as a supporting laboratory for the national reference laboratories of the Ministry of Agriculture, Food, and Environment.

As a result of its capabilities and level of biocontainment, CISA is one of the only two Spanish facilities licensed by the EU to work with the foot-and-mouth disease virus; Also, it is an EU reference laboratory for African swine fever, a FAO reference laboratory for biosafety and biocontainment, takes part in the Spanish Network of Laboratories for Biological Alerts (acronym in Spanish: RELAB) and has actively participated in a number of recent biological alerts, such as anthrax, BSE, avian flu, SARS (Severe acute respiratory syndrome), Ebola, etc.

CISA, in addition to being a international reference centre for the World Organisation for Animal Health (OIE) and the Food and Agricultural Organisation of the United Nations (FAO), it also holds close partnerships with both national and international organizations like AECID (Spanish Agency for International Cooperation for Development), OIRSA (International Regional Organization for Plant and Animal Health), IAEA (International Atomic Energy Agency), ICLAS (International Council for Laboratory Animal Science), and AFAAR (American Fund for Alternatives to Animal Research), among others. As well, it also forms part of specific networks in the field such as EPIZONE (Network for the Diagnosis and Control of Epizootic Animal Diseases), DISCONTOOLS (Development of effective instruments for the control of infectious diseases in animals), MEDILABSECURE (Network of laboratories for emerging pathological viruses for humans and/or animals).

http://wwwsp.inia.es/Investigacion/centros/cisa/Paginas/Cisa.aspx

High Biosafety Laboratory at the *Centre de Recerca en Sanitat Animal* (CReSA)

This infrastructure is part of the *Centre de Recerca en Sanitat Animal* located on the campus of the *Universitat Autònoma de Barcelona* (UAB). It is a public foundation created in 1999 by the UAB and the Institute for Agrifood Research and Technology of Catalonia (IRTA).

CReSA's High Biosafety Laboratory has a total work area, with a Biological Safety Level 3 (BSL-3), measuring 1.500m^2. It provides the opportunity to work in labs with a total area of 350m^2, being totally equipped for studies of virology, immunology, and cell and molecular biology. Worth noting is the ability to carry out studies with Cytometry and Cell Sorting under BSL-3 environment. It also features the ability to work in 12 experimental animal labs with a total surface area of 1,150m^2 for farm and wild animals (large-sized), as well as laboratory animals (small-sized).

All of the activities carried out at the Centre fall within the certification of Good Laboratory Practices. Many of the diagnostic techniques used are also certified under a ISO 17025 accreditation audited by the Spanish National Accreditation Body (ENAC). With the use of animals for experimental purposes, the Centre complies with the strictest European regulations and criteria for animal welfare. The main objectives of CReSA are research, development of technology, transference, and education in the field of animal health and all its consequences for public health.

http://www.cresa.es/cresa3/default.asp

03
HEALTH SCIENCES AND BIOTECHNOLOGY

The Nuclear Magnetic Resonance Laboratory (LRB) is located in the Barcelona Science Park and is part of the Scientific and Technological Centres (CCiT) of the University of Barcelona. The LRB is located on a 722m^2 site specially designed to host high-field Nuclear Magnetic Resonance (NMR) spectrometers. It is vibration-free and has precise thermoregulation, thus meeting the requirements in terms of mechanical and thermal stability, as well as featuring the absence of magnetic interference. The facility began operation in the year 2000.

©LRB

NUCLEAR MAGNETIC RESONANCE LABORATORY (LRB)

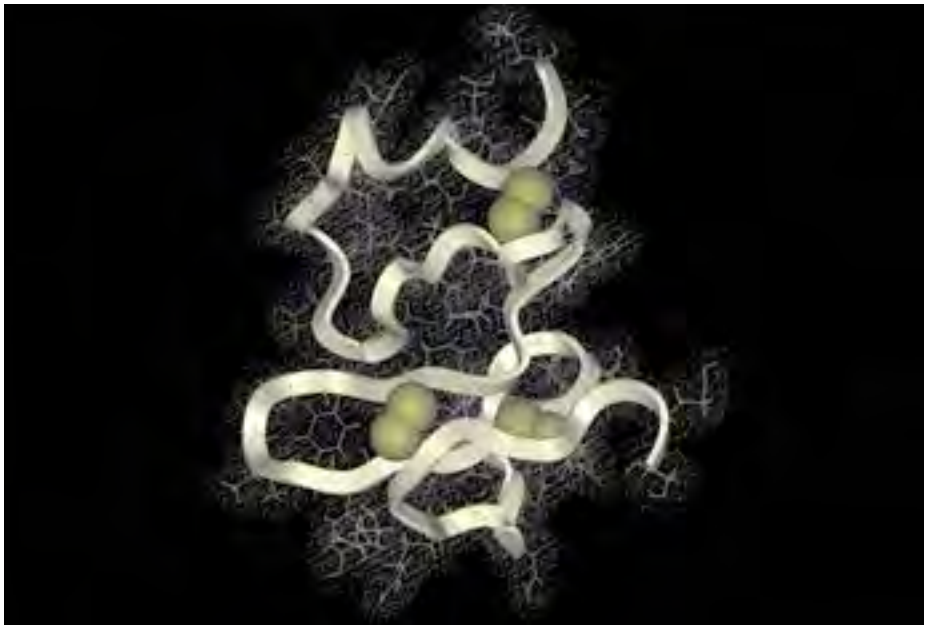
It features a wide collection of instruments for diverse fields and configurations supplemented by access to laboratories of expression and purification of marked proteins as well as the ability to integrate NMR with a large number of other experimental techniques at the CCiT of the University of Barcelona. It offers access to an 800 MHz, two 600 MHz, and three 500 MHz instruments, as well as to a Dynamic Nuclear Polarization (DNP) instrument attached to one of the 500 MHz instruments. Besides, the 800 MHz and one of the 600 MHz spectrometers are equipped with cryoprobes, in order to obtain maximum sensitivity. In addition, one of the 500 MHz NMR machines is equiped with a HRMAS probe, specially adapted for the study of biological tissue or gel phase samples. The LRB is prepared to integrate latest-generation instruments with magnetic fields above 23 Tesla (1 GHz) and equipment for the study of biosolids.

NMR is used for the study of a large number of fields, such as the structure and dynamics of biomolecules, functional biology (NMR *in vivo*), identification and optimisation of pharmaceuticals in pharmaceutical research, including drug delivery , structural identification in organic or inorganic chemistry, food technology, and new materials. The LRB works continuously with methodological development in order to optimise the features of the available instrumentation and to facilitate, along with the users, the development and implementation of new applications.

http://www.rmn.ub.es/lrb

©LRB

©Dr. Ernest Giralt



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04

INFORMATION AND COMMUNICATION TECHNOLOGIES

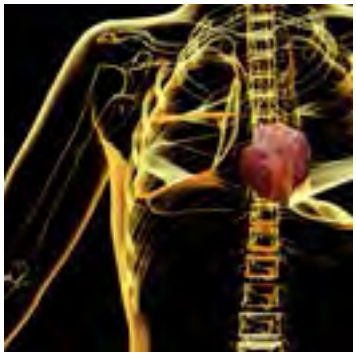
04
INFORMATION AND COMMUNICATION TECHNOLOGIES

The former Spanish Ministry of Science and Innovation founded the Spanish Supercomputing Network (RES) in July 2006 as a response to the need of the Spanish scientific community for increased computation capacity and access to intensive calculation resources, considering the supercomputing resources as a decisive asset for the scientific and technological development of the country.

The RES consists of a distributed virtual infrastructure of supercomputers located in different sites, each of which contributes to the total processing power available to users of different R&D groups. Currently, the supercomputers are located in Madrid (Supercomputing and Visualization Centre of Madrid), the Canary Islands (Astrophysical Institute of the Canary Islands and the Technological Institute of the Canary Islands), the Universities of Cantabria, Malaga, Valencia, and Zaragoza, Supercomputing Centre of Galicia (CESGA), and *Consorci de Serveis Universitaris de Catalunya* (CSUC), with the coordinating body being the Barcelona Supercomputing Center (BSC-CNS).

The RES not only provides supercomputing resources, it also offers service of technical support to users as well as specific training. Moreover it organizes users' meetings and scientific seminars. The goal of these actions is to improve the efficient usage of the resources and expand the use of supercomputing to all the research areas.

http://www.res.es



SPANISH EXPANDED SUPERCOMPUTING NETWORK (EXPANDED RES)

MareNostrum and MinoTauro of the Barcelona Supercomputing Center – *Centro Nacional de Supercomputación* (BSC-CNS)

The (BSC–CNS) was officially created in 2005 by the Central Government, the Regional Government of Catalonia, and *the Universitat Politècnica de Catalunya* (UPC). The BSC specialises in High Performance Computing (HPC) and it has a two-fold mission: to provide infrastructure and supercomputing services to European scientists; and to generate knowledge and technology for the greater needs of society. The BSC is a Severo Ochoa Centre of Excellence and a top-level hosting member of the European research infrastructure PRACE (Partnership for Advanced Computing in Europe); and co-ordinator of the Spanish Supercomputing Network (RES). The BSC provides the RES with its two most powerful machines: MareNostrum and MinoTauro. MareNostrum is a general-purpose machine featuring x86 processors (with 49,568 cores) and more than 1,1 Pflops/s of computational power. MinoTauro is a heterogeneous machine with its main computational power derived from their graphical accelerators (GPUs, Graphics Processiong Units). These GPUs provide more than 180 Tflops/s of peak performance. The BSC provide the RES with 24% of the computational power of MareNostrum (totalling about 80 million CPU hours per year) and 60% of that of MinoTauro (totalling more than 6 million of CPU hours per year).

http://www.bsc.es

Magerit at the Supercomputing and Visualization Centre of Madrid (CesViMa)

The CeSViMa belongs to the Technical University of Madrid (UPM). It was created in 2004 and is located at Montegancedo, a Campus of International Excellence. The purpose of the centre is to provide High Performance Computing capabilities and expertise, mainly to UPM researchers, although it has also been one of the largest resource providers to the Spanish Supercomputing Network (RES). Currently, the centre provides roughly 45 Million hours and serves more than 100 projects per year. CeSViMa hosts Magerit, a heterogeneous cluster with nearly 4000 Power 7 cores and 800 Intel Xeon. All nodes have 16 cores and 32 GB RAM (Power7) or 64 GB (Intel Xeon E5-2670). It also has several special nodes with large memory and accelerators (NVidia K20x and Intel Xeon Phi) for development purposes. An Infiniband QDR network connects all the nodes. Other clusters of the centre are devoted to providing virtual private servers and cloud storage. In addition, the centre has access to an immersive visualization cave: a cube measuring 2.4m per side, in which five of its faces are high resolution screens. CesViMa allocates 20% of the resources of Magerit2 to the RES.

http://www.cesvima.upm.es

Altamira at the University of Cantabria (UC)

This supercomputer is integrated into the scientific and technical (SCTI) services of the UC, and is installed at the Institute of Physics of Cantabria (IFCA), a centre belonging to the UC and the Spanish National Research Council (CSIC). The IFCA carries out research into astrophysics, high energy physics, and distributed computing. The second Altamira system was launched in October 2012 and has 163 IBM iDataPlex nodes with Xeon processors, connected by a QDR Infiniband network, including five nodes with Tesla GPUs, featuring a total of more than 7,500 cores. The total memory available is over 10 TB (64 GB/node), and the computing power reaches over 50 Tflops/s. Each node is interconnected by an Infiniband network to a high performance global parallel file system GPFS, with a total capacity of more than 2 PB. It is directly connected to RedIRIS by dark fiber, at a current bandwidth of 10 Gb/s. Altamira contributes to the RES with 20% of its resources.

https://www.unican.es/WebUC/Unidades/Investigacion/scti/ssc

LaPalma at the Canary Islands Astrophysical Institute (IAC)

The Centre for Astrophysics in La Palma (CALP), is part of the Astrophysical Institute of the Canary Islands, composed of the Central Government, the Regional Government of the Canary Islands, the University of La Laguna and the Spanish National Research Council (CSIC). The main objective of the IAC is astrophysics research, development of scientific instrumentation and management of the observatories of the Teide and Roque de los Muchachos.To facilitate the use of supercomputers, the IAC has specialized engineers to support researchers. CALP provides the RES with 1024 cores, is capable of carrying out more than 9 billion operations per second, and can store 37 TB. As CALP is also a point of presence in the Spanish academic and research network (RedIRIS), the node connectivity is 10Gbps. This allows for connection to the observatory at the Roque de los Muchachos and Teide at high speeds, as well as being accessible from any national, European or international research centre. LaPalma provides 50% of its computational power to the RES.

Tirant at the University of Valencia (UV)

The UV hosts the supercomputer Tirant. Tirant is located at the Campus of the University of Valencia (UV) at Burjassot. It is managed by the Computing Service of the UV (SIUV). The SIUV is responsible for managing this infrastructure, as well as the system itself (at the hardware and software levels). The SIUV staff also offers support services to users. The supercomputer Tirant began service in January, 2008. Its current configuration, after the last upgrade (December 2012), is made up of 512 blades (a total of 1,024 cores) JS21 with 2 processors PowerPC 970MP dual core at 2,2 GHz and 4 GB of RAM, interconnected by a Myrinet network (2Gbit/s). This set up leads to a total of 2,048 cores with a peak performance around 18.8 Tflops. Tirant allocates 50% of its computing capacity to the RES.

Atlante at the Canary Islands Technological Institute (ITC).

This institute is administered by the Regional Government of the Canary Islands, and features Atlante, a publicly-accessible High-Performance Computer made available to R&D&I groups, technology companies and local government administrations. The ITC aims to promote the development of skills and excellence in the field of supercomputing, and to improve access to the resources of the Spanish Supercomputing Network (RES). Atlante has been part of the RES since it began operation in 2009. It is located at the Science and Technology Park of the University of Las Palmas de Gran Canaria. Atlante is a distributed memory cluster, based on PowerPC processors and IBM Bladecenter architecture, consisting of 84 compute nodes (a total of 336 cores) interconnected by Myrinet and Gigabit Ethernet networks. It hosts 672 GB of total memory and a network storage shared system GPFS (General Parallel File System) totalling 96 TB. The operating system is SuSE Linux and its peak performance can reach 3.1 Tflops/s. The ITC provides support, training, and assessment to users. Atlante provides the RES with 30% of its computing power.

http://www.itccanarias.org/web/servicios/software/Supercomputador.jsp

Picasso at the University of Málaga (UMA)

The Supercomputing and Bioinformatics (SCBI) Centre of the University of Malaga (UMA), located in the technological park of Andalusia, hosts the Picasso computer which began operations in February 1997, serving since then to the scientific community. In 2007 there was a turning point, when the University complemented the supercomputing facilities with bioinformatics tools and experts. The services offered by the SCBI are as follows: access to High Performance Computers, assistance and advice on the use of scientific applications and programming, training courses for users, software adapted to the researchers needs and specialized support for bioinformatics data analysis. Picasso stands out because of its seven shared memory computers, each with 2TB of RAM and 80 cores, which enable dealing with problems that would be imposible to solve with a classical cluster architecture. It also has 89 computers, with different technologies, so each researcher can use seamlessly, through a queue system, the one most suitable for each problem. Picasso provides 27% of its resources to the RES.

http://www.uma.es

Caesaraugusta at the University of Zaragoza (UNIZAR)

The Institute for Biocomputation and Physics of Complex Systems (BIFI) is a research institute of the University of Zaragoza (UNIZAR). The Institute was founded in 2002 and its research activities are classified into four main areas: Biochemistry and Molecular and Cellular Biology, Physics, Biophysics, and Computing. The Computing area plays a two-fold role, providing BIFI researchers and external organisations with computing resources and, at the same time, carrying out research into different fields of distributed/scientific computing.

The BIFI operates Caesaraugusta, a supercomputer with 3,072 cores and 25 TFLOPs, which is the current node of Aragón in the Spanish Supercomputing Network (RES). This computing infrastructure is supplemented by more than 10,000 volunteer computing cores (the Ibercivis project) and two special-purpose machines (JANUS I and II) devoted to material science calculations that are equivalent to several thousand cores. Caesarugusta provides 20% of its power to the RES.

http://bifi.es/en/infrastructures/scientific-equipment/memento-caesaraugusta

Computing Infrastructure of the *Consorci de Serveis Universitaris de Catalunya* (CSUC)

The *Consorci de Serveis Universitaris de Catalunya* (CSUC) is a public consortium that has been provided ICT infrastructure services for over 22 years. Sharing academic, scientific, library, knowledge transfer and management services, its goal is to achieve better efficacy and efficiency by boosting synergies and economies of scale. CSUC is formed by ten Catalan universities and the Regional Government of Catalonia. Originally founded as the Supercomputing Centre of Catalonia in 1991, with the purpose of providing computing services, it currently provides services to over 200 institutions (universities, research institutions, hospitals, technology centres, scientific parks, etc.) with numerous research projects in areas such as physics, theoretical chemistry, biomolecular modeling, Earth sciences, numerical methods in engineering, etc.

The CSUC has three supercomputers with different architectures and numerous specialized software to meet the wide variety of users' needs, not only providing them easy access to supercomputers but also technical and scientific highly specialized support through a comprehensive supercomputing service.

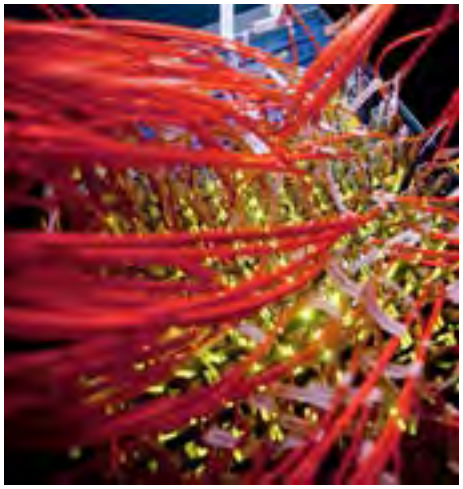
The infrastructure includes two clusters and a shared memory supercomputer, a SGI Altix UV1000 with 1,344 cores, 112 TB of disk and 6 TB of memory which allow simulations with a high memory demand. CSUC provides 20% of its computing capacity to the RES.

http://www.csuc.cat/es

Finis Terrae Supercomputer at the Galicia Supercomputing Centre (CESGA)

The Supercomputing Centre of Galicia (CESGA) is an institution that is jointly owned by the Regional Government of Galicia and the Spanish National Research Council (CSIC). The mission of the CESGA, established in 1993, is to contribute to the advancement of science and technology through the research and application of high-performance computing and communications, in partnership with other institutions and for the benefit of society. The CESGA hosts the Finis Terrae supercomputer since 2008, with 2400 processors and 14,01 Tflops/s, currently undergoing a process of renovation, expected to reach more than 300 Tflops/s during 2015. Finis Terrae is a constellation-type supercomputer formed from two subsystems – a computing system and a massive online storage system, both of which are essential for its correct operation.

Supercomputers such as Finis Terrae can provide benefits to a very wide range of scientific areas. Additionally, CESGA has other cloud and grid type computing platforms and works in other areas of activity such as advanced communications, collaborative tools, transfer to industry, or GIS (Geographic Information Systems). Finis Terrae contributes to RES with 20% of its computing power.



http://www.cesga.es/


CESGA
UC
BSC-CNS
UZ
CSUC
UPM
UV
UMA
IAC
ITC

04
INFORMATION AND COMMUNICATION TECHNOLOGIES

RedIRIS - the advanced communications network for the research and education community in Spain – is overseen by the State Secretariat for R&D&I of the Ministry of Economy and Competitiveness, which finances it and set its strategy. Since 2004, the technical and operational management of RedIRIS has been carried out by the public corporate entity Red.es, which belongs to the State Secretariat of Telecommunications and the Information Society (SETSI) of the Spanish Ministry of Industry, Energy, and Tourism . The communications backbone of RedIRIS spans the entire national territory and contains approximately 60 Points of Presence distributed throughout all the regions of Spain. The RedIRIS headquarters is located in Madrid.

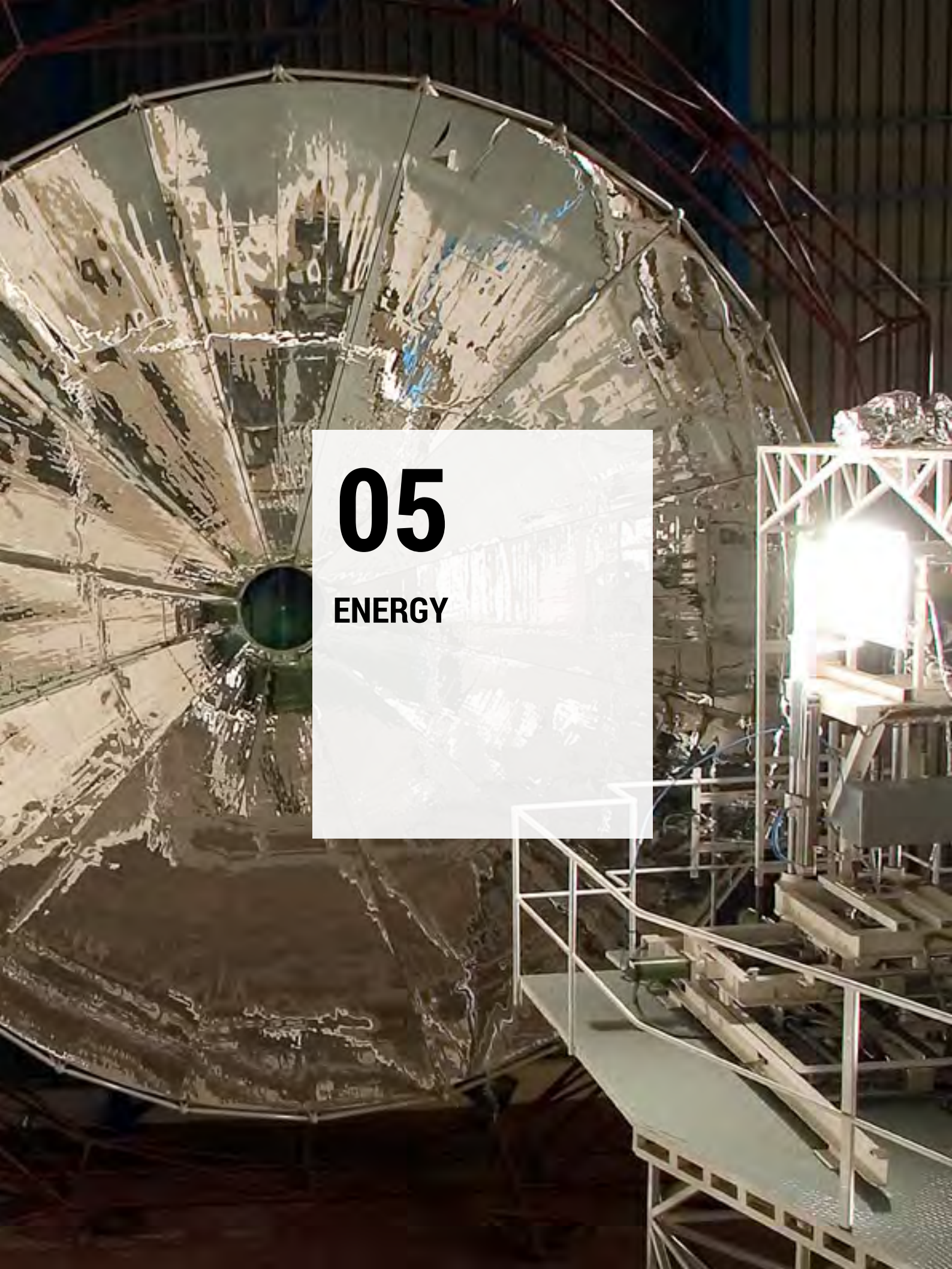
SPANISH ACADEMIC AND RESEARCH NETWORK (RedIRIS)

RedIRIS was launched in 1988, with the purpose of providing universities and scientific research centres with their own communications network, through which large amounts could be transferred easily and securely. This would facilitate remote cooperation between these centres and their participation in national and international projects. Over the last 25 years, the network infrastructure of RedIRIS has gradually evolved to adapt itself to increasingly more refined technologies as they became available and to the needs of its users. The most recent step in that evolutionary process has been the rollout of RedIRIS-NOVA, a very high-capacity dark fibre backbone network with 12,000 kilometres of fibre and the previously-mentioned 60 Points of Presence, to which are connected – either directly or via regional research and education networks – to over 500 academic and scientific institutions (mainly universities, public research entities and others ICTS).

RedIRIS operates within a framework of close collaboration with other research and education networks, both regional and international. These include the pan-European research and education network GÉANT, to which RedIRIS contributes financially, also participating in its management. Through GÉANT, RedIRIS is integrated into the Global Research Intranet.

RedIRIS provides its users with very high-capacity connections (10,000 Mbps), which are especially necessary for e-science projects (high-energy physics, life sciences, astronomy, etc.). The portfolio of services offered by RedIRIS also includes other network services (Virtual Private Networks / VPNs, IP addresses, DNS, network monitoring, etc.) and various additional services for its users (digital identity, digital certificates, anti-spam filtering, eduROAM mobility service, mailing lists, etc.).

http://www.rediris.es



05

ENERGY

05

ENERGY

The *Plataforma Solar de Almería* (PSA) is recognised as a Major European Scientific Facility. The International Energy Agency (IEA) began its construction in 1979, and in 1986 it became part of the Institute for Renewable Energies of *Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas* (CIEMAT), a Public Research Body administered by the State. It is located in the southeast of Spain, in the Tabernas Desert, at 37°05'27.8" north and 2°21'19" west. It receives a annual direct exposure to sunlight of over 1900 kWh/m^2, making it a privileged location for experimentation with solar energy systems.

PLATAFORMA SOLAR DE ALMERÍA (PSA)

The PSA is the largest research centre in Europe devoted to concentrated solar radiation technologies, desalatation and fotochemistry. It is a privileged place for the development, evaluation, demonstration, and transfer of solar concentrating technologies, both for thermal applications and for chemical processes. It offers researchers and companies scientific facilities that are among the most advanced and comprehensive in the world, along with sunlight and climate characteristics similar to those of many countries in the so-called "Sunbelt" (located between latitudes 40 north and 35 south). It hosts large test facilities that include central receiver systems with an output of up to 5 MWt, a field of parabolic trough collectors up to 2.5-MWt, a test bench for parabolic trough collectors with a length of up to 20 m, several solar furnaces (the greater with a total power of 60 kWt), a desalination pilot plant 3 m^3/h and a photochemical pilot plant with a capacity of up to 500 L.

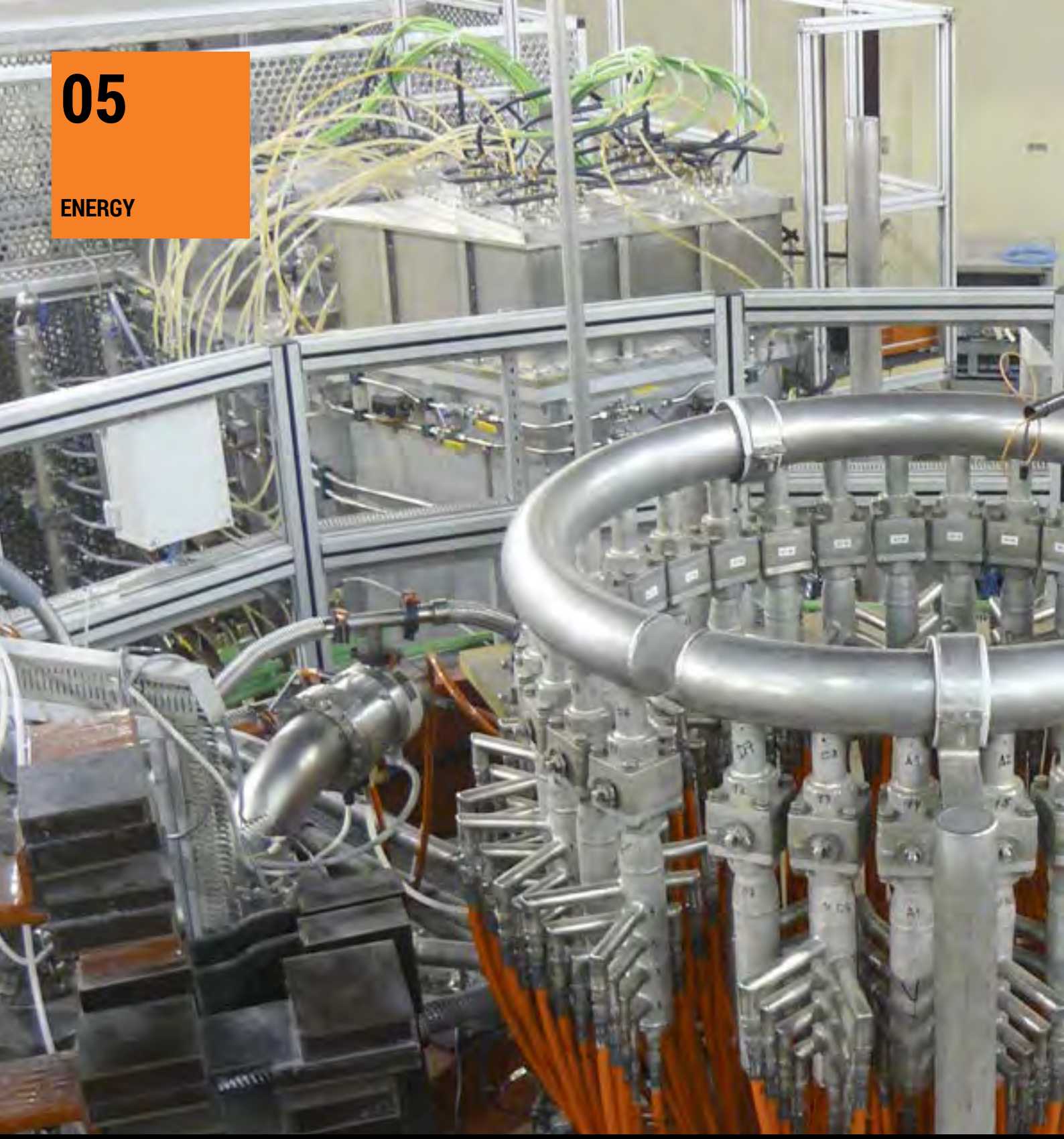
The *Plataforma Solar de Almería* offers a wide range of services befitting its international importance, allowing for the study of multiple aspects of concentrated solar technology, such as thermal and thermodynamic characterization of distinct elements of solar receptors, the characterization of materials for these elements, the qualification of new processes or testing, modelling, and simulation of thermosolar production plants.

Spain in general, and Andalusia in particular, possesses an abundant resource of energy available in the form of sunlight. Faced with increasing effects of climate change and an excessive dependence on external energy sources, the exploration and exploitation of national resources, such as renewable energies, is a matter of strategic importance. In this context, a scientific infrastructure like the *Plataforma Solar de Almería* is an essential tool.

http://www.psa.es

05

ENERGY



The LNF is a department belonging the *Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas* (CIEMAT) a Public Research Body administered by the State. It is located at the headquarters of CIEMAT in Madrid and its activity began with the start of the TJ-II experiment, in 1998. Fusion research, at European and international level, is divided into two large types of activity: on one hand, the study of plasmas confined at high temperatures, and on the other hand, the technology necessary to construct and operate fusion reactors: materials, superconductors, generation of tritium, energy extraction, remote maintenance, etc.

NATIONAL FUSION LABORATORY (LNF)

The LNF hosts the TJ-II stellarator, an average-sized magnetic confinement device with a major radius of 1.5 m, a minor radius of 0.2 m and a magnetic field of 1 T. The high temperature plasmas are obtained by means of radiofrequency heating (800 kW at 53 GHz) and the injection of hydrogen neutral beams with a power of 1,6 MW (at an energy of 40 keV). TJ-II features 92 ports where diagnostics have access for measuring different plasma parameters to carry out different experiments. In the field of fusion technology, the LNF features the instrumentation necessary for the modification by radiation of materials (Van de Graaf electron accelerator, low energy ion implanter), together with a whole laboratory for materials characterization to study the chemical, physical, and mechanical properties (impedance meters, UV-Vis and IR spectrometers, equipment mechanical testing machines, SIMS, SEM+FIB, etc.). Noteworthy among these due to its uniqueness is the SIM/SNMS equipment for elemental analysis in solids, the dual-beam equipment (electrons and ions) SEM+FIB, and the servo-hydraulic testing machine capable up to 100KN. These complete facilities and instrumentation allow for essential services for experimentation with fusion technologies by national and international users.

The LNF centralizes fusion research in Spain, leading Spanish participation in the construction of ITER, and has been an essential piece to achieve the placement of the European F4E Agency in Spain. Likewise, it has undertaken since the beginning the Spanish participation in the 'Broader Approach' agreement signed between the European Union and Japan, as well as the projects included in the IFMIF roadmap and the European fusion programme. It is important to note the socio-economic impulse achieved by its activities, positioning Spanish industry as a highly-competitive supplier for the construction of other fusion devices, especially ITER.

http://fusionsites.ciemat.es

06

ENGINEERING

06

ENGINEERING

MARHIS (Maritime Aggregated Research Hydraulic Infrastructures) is a distributed ICTS with the goal of increasing the competitiveness and efficiency of the Spanish ICTS in the area of hydraulic maritime engineering (coastal, ports, and offshore), offering its infrastructures and technological services in a coordinated manner. It is composed of the infrastructures of Maritime Engineering Laboratory of the Catalonia University of Technology, BarcelonaTech and the Environmental Hydraulics Institute of Cantabria.

MARITIME AGGREGATED RESEARCH
HYDRAULIC INFRASTRUCTURES (MARHIS)

Cantabria Coastal and Ocean Basin (GTIM-CCOB)

The Cantabria Coastal and Ocean Basin (GTIM/CCOB), located in the Scientific and Technological Park of Cantabria (PCTCAN) is managed by the Foundation for Environmental Hydraulics Institute. Its facilities are equipped with the latest technology for creation of waves, currents, and wind, with capacity for physical model testing. Here, phenomena are studied related to the generation and propagation of waves, wave-wave interaction and waves-structure interaction, stability and behaviour of coastal protection structures, seawalls and maritime structures, behaviour of floating structures, the operation of valves and hydraulic machinery, as well as the testing of devices for the generation of marine energy. It enables physical and numerical modelling of problems in deep and shallow waters, as it has the capacity for testing at any range of depth, including the possibility of carrying out experiments at depths equivalent to 1,000 m at a scale of 1/100.

It features two flumes for directional waves with the capacity to generate currents and wind, three flames for waves-currents, one current flume with a variable slope, a tank for the study of hypersaline spills, along with an area for the construction of fluvial models. The GTIM/CCOB tank has a width of 44 m, a length of 30 m, and a variable depth (maximum of 3.4 m), the capacity to generate multi-directional waves, omni-directional currents and wind, as well as a trench of 6m in diameter and 8 additional meters of depth. It is also worth noting the waves-currents-tsunami flume named COCoTsu (56m in length, 2 m in width, and variable height with a maximum of 2.5m), due to being a innovative facility designed for medium and large-scale testing of structures for coastal protection, floating structures, studies of wave-current and wave-structure interaction, among others.

The capacity of the facilities, the experience of the team members, and the use of latest-generation software for numerical modelling and advanced instrumentation, allow for tests of basic research of the behaviour of fluids, structures, and devices, the calibration and validation of all types of numerical models, as well as carrying out specific testing of design and optimisation of structure applied to the fluvial and maritime environments.

http://www.ihcantabria.com/es/instalaciones/itemlist/category/72

Integrated Coastal Infrastructure for Experimentation and Modelling (iCIEM)

The Integrated Coastal Infrastructures for Experimentation and Modelling (iCIEM) is an integrated infrastructure distributed among different locations of the coastal area of Barcelona devoted to research and engineering in the maritime field (coastal, harbour, and environmental applications). It is composed of a combination of different scales laboratories, field monitoring stations, and advanced platforms for numerical modelling. The iCIEM is managed by the Maritime Engineering Laboratory, a specialised research centre of the Catalonia University of Technology, BarcelonaTech (LIM/UPC).

The Modelling Laboratory is located on the UPC northern campus, in Barcelona. The main facilities are the large-scale wave flume CIEM (Flume for Maritime Research and Experimentation) and the small-scale flume CIEMito, both with the capacity to generate waves and currents. The first is a large flume for 2D tests with almost-null distortion (100m in length, 3m in width, and up to 7m in depth), a relevant tool for controlled hydraulic experiments in coastal, harbour and oceanographic engineering, as well as in other fields such as aquaculture and wave-energy facilities. CIEM is completely integrated into the European hydraulic institutions that currently make up the HYDRALAB network, of which it was a founding member. The CIEMito is a transparent flume with a total length of 18m, a useful section measuring approximately 0.40m in width and 0.56m in height. It allows for small-scale experimentation and to achieve optimisation and complementarity, mainly with optical measurements of transparent water with the CIEM.

The Maritime Field Observation Laboratory features the XIOM Shelf Observatory for the collection of meteorological and oceanographic variables along the Catalan coast, from the Gulf of Roses to the Ebro Delta with the ability to measure waves, currents, meteorology, long-period oscillations (tides and other long waves), and a group of maritime-shore meteorological stations especially adapted for the coastal area. The Pont de Petroli Coastal

Observatory is a jetty that extends 250m offshore, from the shallow surface waters to intermediate depths (12 m). It is the first installation in microtidal conditions in the European Union, and it supplements the network of instrumentalized jetties that includes HORS in Japan, or Duck in the USA.

Both Laboratories are supplemented with a high-resolution Numerical Modelling Laboratory, which provides services that run from the replication of hydraulic models to systems of meteo-oceanographic parameters prediction , as well as a Remote Wave Laboratory (rWLaB), a platform for educational, research, and the dissemination of knowledge that provides remote access to the laboratory facilities and the different field data stations (XIOM and Pont del Petroli).

http://ciemlab.upc.edu

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The ALBA Synchrotron is a complex of electron accelerators aimed at producing synchrotron light to analyse the structure and properties of materials at the nanoscale. It is located in Cerdanyola del Vallès (Barcelona) in the *Parc de l'ALBA*. It is a public consortium, equally co-financed by the Central Government and the Regional Government of Catalonia. The project was approved in 2003 and its construction began in 2006. ALBA was inaugurated in 2010 and has operated with official users since mid-2012.

©Sergio Ruiz

ALBA SYNCHROTRON

ALBA is a third generation synchrotron light source, similar to the latest sources built in Europe. The complex of accelerators is based on a lineal accelerator, used to accelerate electrons till 100 MeV, a booster – where the electrons are speeded up to 3,0 GeV, and a storage ring, where the synchrotron light is emitted to the different experimental stations.

Although up to 31 ports are available to extract the synchrotron light, ALBA has currently seven operative beamlines including hard and soft X-rays. These beamlines have applications in scientific areas such as life sciences, physics of condensed matter (nanoscience and magnetic and electronic properties), chemistry and material science. In 2014, ALBA has begun construction of two new beamlines which will be devoted to infrared spectroscopy and high resolution angular photoemission and will be operative in 2017 and 2019, respectively.

Every year, the ALBA Synchrotron produces about 6,000 hours of beamtime on each of the beamlines and is available to host more than 1,000 researchers, from both the public and the business sectors. Projects from the public sector are selected by an external international scientific committee, in a public call, based on the scientific excellence of the submitted proposals. Users form industrial companies can request light hours to carry out their experiments in accordance with an established fee.

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http://www.albasynchrotron.es

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This distributed ICTS is composed of the Integrated Clean Room for Micro and Nano Fabrication of the National Microelectronics Centre of the CSIC, located in Barcelona, the Centre for Technology of the Institute of Optoelectronics Systems and Microtechnology of the UPM, located in Madrid, and the Micro-Nanofabrication Infraestructure at the Nanophotonics Technology Center of the UPV, located in Valencia. The three infrastructure sites are coordinated to provide services to the entire scientific community in the fields of Microelectronics, Optoelectronics, and Nanophotonics. Together, they offer more than 2,000m^2 of clean rooms (types 10-100-10,000) to the scientific community and industry, along with associated laboratories for encapsulation and systems and devices characterization.

MICRO AND NANO-FABRICATION CLEAN ROOMS NETWORK (MICRONANOFABS)

Integrated Clean Room for Micro and Nano-fabrication of the National Microelectronic Centre of the CSIC (SBCNM)

This infrastructure is devoted to the development and application of innovative technologies in the field of Microelectronics and other Micro/Nano components. Since its creation in 1991, it has belonged to the Spanish National Reseach Council (CSIC) and is managed as part of the Institute for Microelectronics of Barcelona, of the National Micrioelectronics Centre.

The SBCNM is an open-access facility with the objective of providing support to national and international research groups as well as industry in order to carry out R&D&I based on a complete set of micro and nanotechnologies and processes of manufacture located in a highly-specialised clean environment (1,500 m^2). Led by a team of experts, and thanks to operational procedures and the reliability and repetitiveness of the processes, this infrastructure also provides services to companies, from the technology dissemination and training to small series of device prototypes, circuits, and systems based on micro and nanotechnologies.

The range of applications covered by the SBCNM is very wide, including biomedicine, environment, food, energy, mobility, security, communications, consumer electronics, etc. For these applications the main implementations offered by the SBCNM are semi-conductor devices, including power devices and radiation detectors, sensors, actuators and MEMS (Microelectromechanical Systems), nanoscale actuators and devices, Lab-on-Chip Systems, and polymeric devices.

http://www.imb-cnm.csic.es/index.php/en/clean-room

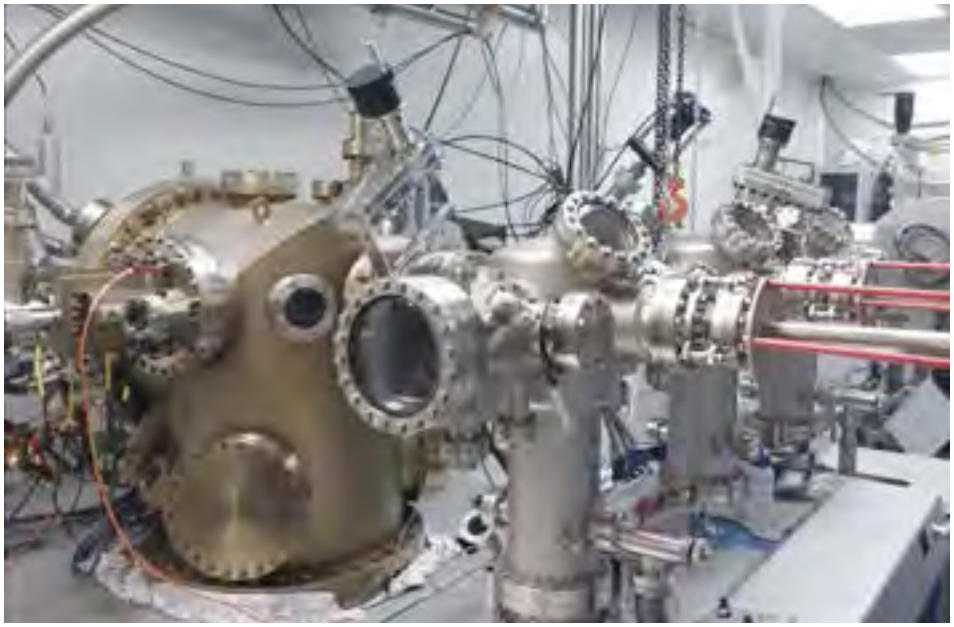
Centre for Technology of the Institute of Optoelectronic Systems and Microtechnology of the UPM (CT- ISOM)

The Institute of Optoelectronic Systems and Microtechnology (ISOM) is a University Research Institute within the Technical University of Madrid (UPM). It integrates several research groups carrying out projects in the areas of Optoelectronics and Micro-Nanoelectronics. It is located at the School of Telecommunications Engineering.

The equipment and advanced instrumentation of CT-ISOM allow the manufacture of various electronic materials others than silicon, technological processing, and obtaining electronic, optical, optoelectronic and magnetic devices. With the electron beam lithography system, it is possible to create these structures at the micrometer and nanometer size.

The facilities of CT-ISOM consist of 400 m^2 of clean rooms, 300 m^2 of characterization laboratories, and 200 m^2 of instrumentation and electronics laboratories. Facilities include a room for Industrial Cooperation and Technology Transfer, as well as an office for the management of external services. Support services and scientific activities provided by the CT-ISOM to the scientific community and technological companies to carry out their R&D&I projects are those related to the fields of research undertaken by ISOM: electronics, micro-nanotechnology, optoelectronics, magnetism, functional integration, among others.

http://www.isom.upm.es/CT-ISOM/pres.php



Micro and Nano-fabrication Infrastructure at the Nanophotonic Technology Center of the UPV (NF – CTN)

NF-NTC is a facility owned by the Technical University of Valencia (UPVLC) and is located in the Vera Campus. It began operations at the end of 2009, offering nanofabrication services.

NF-CTN has a complete 150 mm-wafer CMOS (Complementary Metal-Oxide-Semiconductor) production line located in a clean room of 500 m^2 that includes the following technology: optical lithography (mask aligners and a DUV stepper) and direct-writing (electron-beam based), photoresist coating and developer, both dielectrics and metal depositions, chemical etching (wet and dry), ion implantation, etc. Besides, it contains a complete laboratory for the assembly and encapsulation of integrated photonic components, laboratories for physical and optical characterization of devices, and a laboratory for the characterization of systems and optical networks.

The facility offers rapid prototyping nanofabrication services to research groups (basic and applied) and technology companies that may require its services. These services include from consultancy design services for specific photonic devices, or complete solutions based on integrated photonics of silicon, to specific CMOS step processes or a complete manufacture of a passive or active silicon photonic device. In addition, physical and optical characterization processes are also carried out on the devices or structures manufactured.

http://www.ntc.upv.es

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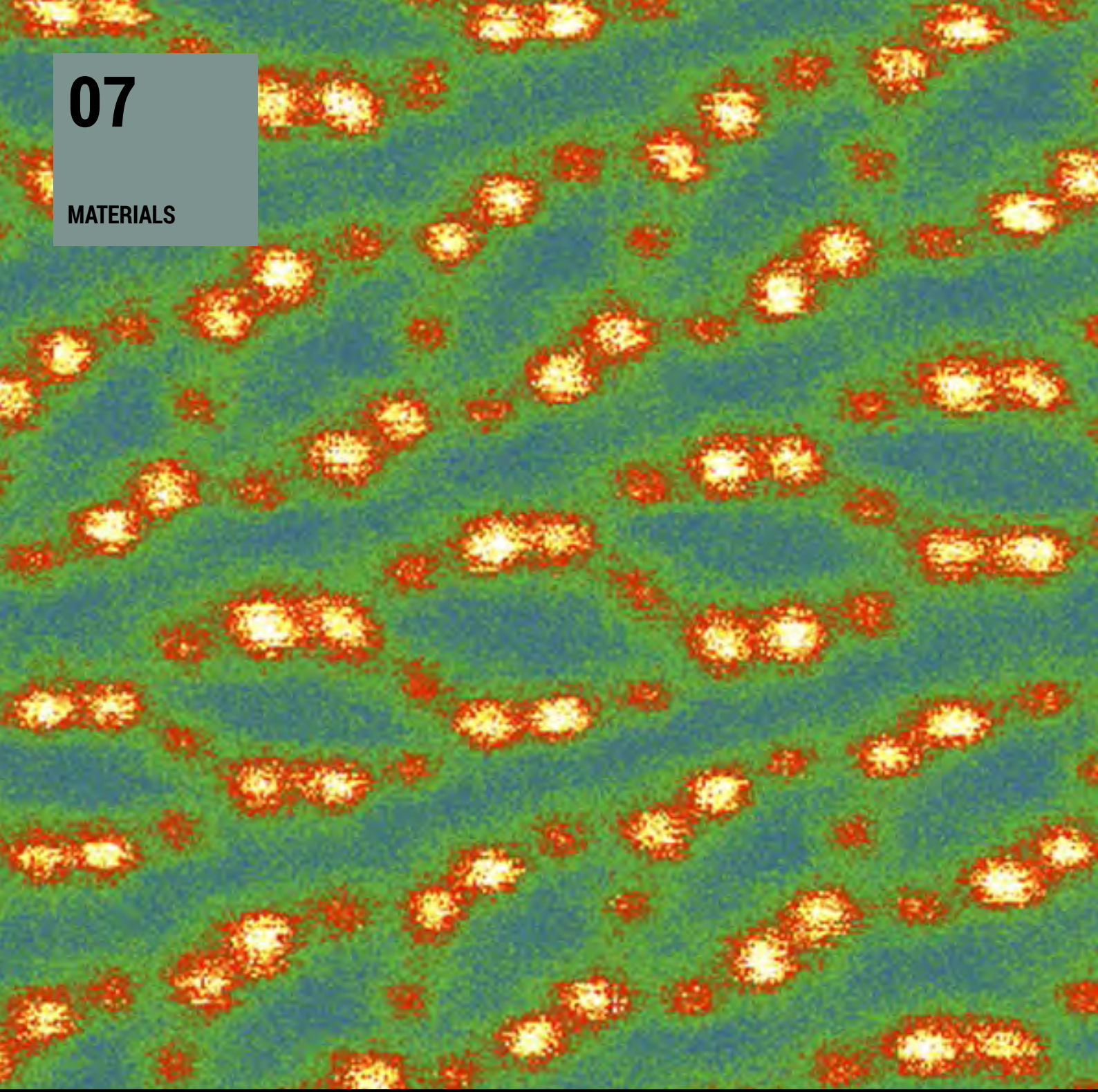


This distributed ICTS includes two infrastructure sites, the National Centre for Electron Microscopy in Madrid and the Laboratory of Advanced Microscopy in Zaragoza. Together, they offer microscopy equipment with exclusive design aspects that make them complementary for applications ranging from crystal chemistry of materials to catalysis, materials for energy, functional materials and communications.

1 nm

Atomic resolution image of Sr4Mn3O10 oxide taken with the ARM200cFEG electron microscope with aberration correction in the condenser lens

INTEGRATED INFRASTRUCTURE FOR ELECTRON MICROSCOPY OF MATERIALS (ELECMI)

National Centre for Electron Microscopy (CNME)

ICTS-CNME management is supervised by General Foundation of the Complutense University of Madrid (UCM) and the Vice-rectory for Scientific Research and Policy (UCM), which are responsible for its maintenance, providing all the technical and human resources necessary for its proper operation. It is located at the Chemistry Department of the UCM.

The CNME main goals are development, implementation and availability of the most advanced electronic microscopy techniques and methods, allowing for the observation, analysis, characterization and manipulation of organic and inorganic materials at the atomic level. It includes a wide range of transmission, scanning, electron probe microanalyzers and atomic force microscopy devices, and it is equipped with last generation aberration corrected microscopes.

The presence of two particular microscopes provided with the most advanced technology currently available makes this facility remarkably relevant: An ARM 200cFEG probe corrected and equipped with last generation analytic techniques and another ARM 300cFEG device image corrected with a resolution of 0.05 nm. These two microscopes are supported by advanced SEM (Scanning Electron Microscopy) microscopes as well as various SEM/TEM (Transmission Electron Microscopy) devices for a full structural and compositional characterization prior to the sub-Angstrom analysis.

http://www.cnme.es

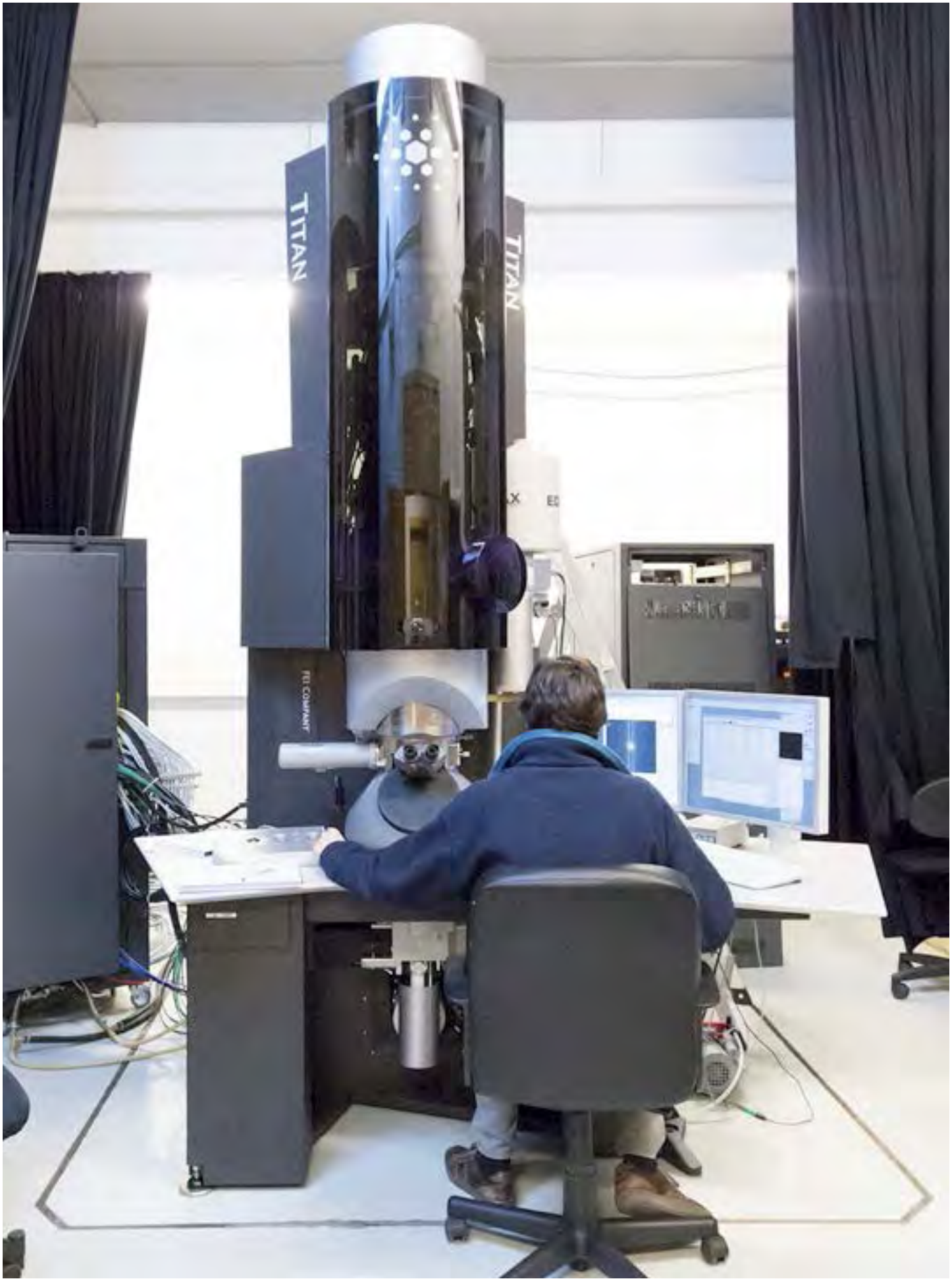
Advanced Microscopy Laboratory (LMA)

The Advanced Microscopy Laboratory depends administratively on the University of Zaragoza through the Institute of Nanoscience of Aragon and is located at the Río Ebro Campus in Zaragoza.

The LMA is a unique initiative at national and international levels, aimed at providing the Industrial and Scientific communities with the most advanced infrastructure for local probe and electron microscopies for the observation, characterization, nanopatterning and handling of materials at the atomic and molecular scales. In addition, the LMA hosts other important laboratories that are crucial for the characterization, processing and manipulation at the nanometric level including a clean room (photolithography), dual beam techniques for sample preparation and other characterization techniques based on photoelectron spectroscopy.

The singular and strategic nature of LMA, along with the availability of the most advanced technology, the experience of its staff, and its scientific excellence, make this facility one of the few infrastructure sites of this type available at the international level, and provide service to the scientific community for research and development in our country.

http://lma.unizar.es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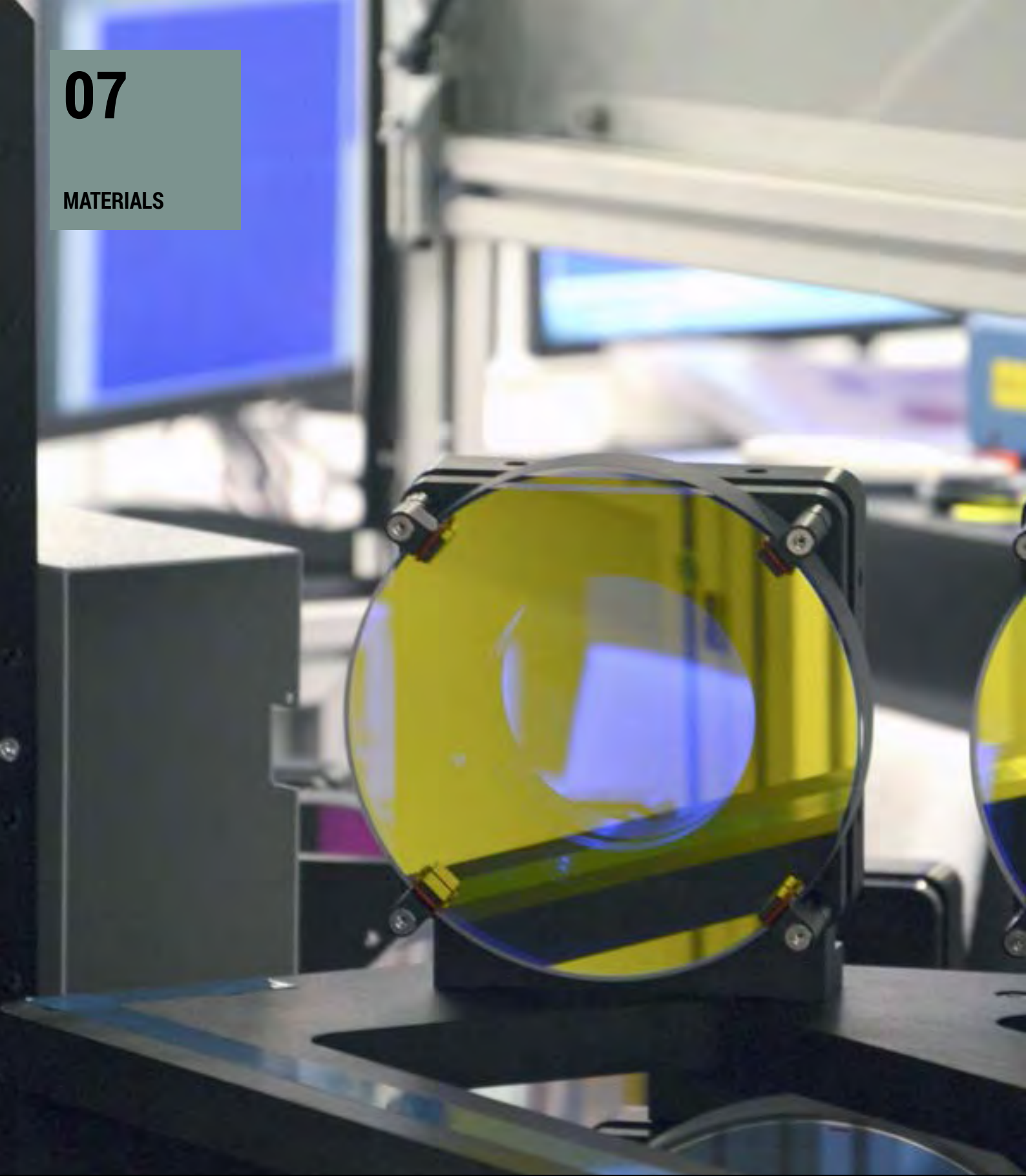

The Pulsed Lasers Centre (CLPU) is an infrastructure site devoted to research and development of technology of ultra-intense pulsed lasers. It is located at the Science Park of the University of Salamanca (Villamayor Campus), managed by a public Consortium founded in 2007 and co-funded by the Central Government, the Regional Government of Castilla y León, and the University of Salamanca.

CENTRE FOR ULTRASHORT ULTRAINTENSE PULSED LASERS (CLPU)

©CLPU

This facility hosts VEGA, a Titanium:Sapphire laser system with CPA technology (Chirped Pulsed Amplification) able to work with a pulse duration of 30 femtoseconds and to reach peak power of a Petawatt. The structure of VEGA is unique at the international level, with a design in three perfectly-synchronized phases, as they share the same pulse generator system: VEGA1 and VEGA2 (20 and 200 Terawatt respectively, both at 10 shots per second), and VEGA 3 (1 Petawatt at 1 shot per second).

VEGA 1 and VEGA 2 are already in operation, the two most powerful lasers in Spain; meanwhile VEGA 3 is in its final construction phase and start-up and will be one of the ten most powerful laser systems in the world. Furthermore, the facility has installed other CPA laser systems with a higher repetition rate and a carrier envelope phase system with only 6 femtoseconds of duration stabilized in phase, also unique in Spain.

Thanks to the versatility of the laser system, there is a wide list of potential applications, including those at the forefront of scientific research. Among others, it is important to note the measurement and control of the elementary nature processes at Attosecond time scales; the development of new light sources; the production of nanoparticles and nanosurfaces; the micromachining of all materials types for industry (aerospace, microelectronics, implantology, etc.), the development of microsurgery techniques; the display of molecules and biological tissues, electron and ion acceleration, X-Ray generation and new applications in nuclear physics (such as laser protontherapy) and particle physics (quantum vacuum).

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http://www.clpu.es

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The National Accelerator Centre (CNA) is a jointly-operated centre belonging to the University of Seville, the Regional Government of Andalusia, and the Spanish National Research Council (CSIC) located at the Scientific and Technological Park at the Isla de la Cartuja in Sevilla. Its mission is to carry out research on particle accelerators and their multiple applications since 1998.

NATIONAL ACCELERATOR CENTRE (CNA)

Currently, the CNA has three particle accelerators. A 3 MV van de Graaff Tandem Accelerator for the application of a large number of analysis techniques, with an associated measuremet service via the application of IBA techniques. A 1 MV Cockcroft-Walton Tandem Accelerator (Tandetron) used for mass spectrometry that allows for the study of problems of interest in archaeology, hydrology, glaciology, and the environment, among others. And a Cyclotron that supplies 18 MeV protons, primarily for the production of radiopharmaceuticals and research into nuclear medicine and basic nuclear physics that, along with a PET/CT scanner (Positron Emission Tomigraphy – Computed Tomography) for large animals and humans, allows for studies of radiopharmaceuticals of a short lifespan that cannot be carried out any other way.

Additionally, there is a ^{14}C dating service unique in our country, with a new dating system known as MiCaDaS (Mini radioCarbon Dating System), which reduces and simplifies this analysis as well as making it less expensive. There is also an irradiator of ^{60}Co that is currently the most powerful at national level and one of the most versatile available, opening up the possibility of carrying out radiation tests with protons and ions in fields as diverse as aerospace technology, meteorology of ionizing radiation, or tissues irradiation of biological research samples.

With all the aforementioned equipment, the CNA features ion accelerators with a wide range of application convering among others disciplines such as biomedicine, material sciences, pharmacology, environmental sciences, physics, and nuclear instrumentation.

http://acdc.sav.us.es/cna

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SOCIO-ECONOMIC SCIENCES AND HUMANITIES

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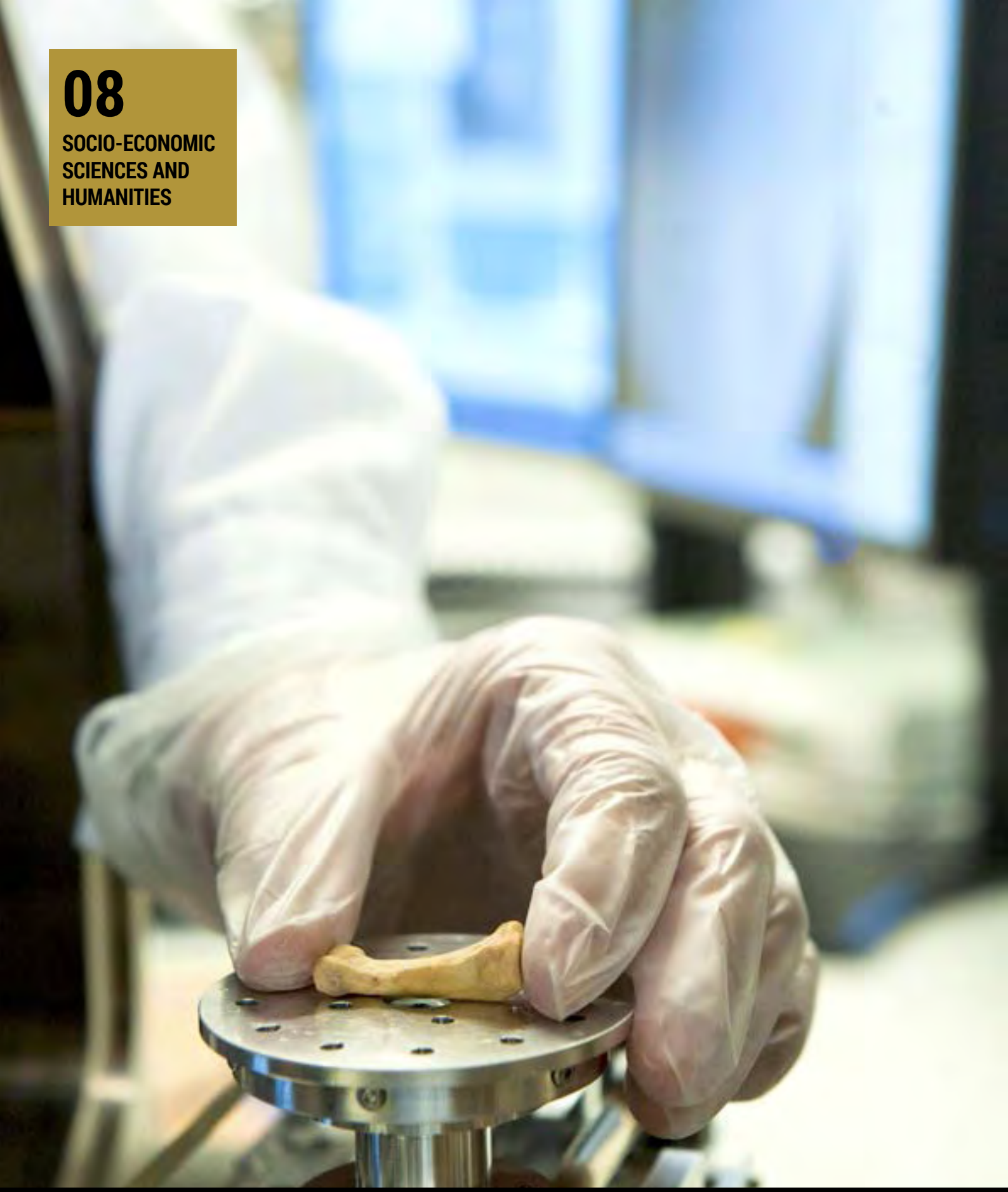
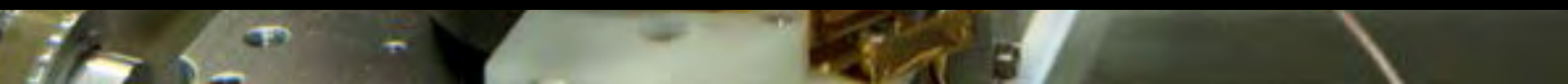
SOCIO-ECONOMIC SCIENCES AND HUMANITIES



The National Research Centre on Human Evolution (CENIEH) was founded in 2004 as a public consortium equally co-financed by the Central Government and the Regional Government of Castilla y León. Since 2009, its facilities have been located in one of the buildings of the Complex of Human Evolution, in the city of Burgos.



NATIONAL RESEARCH CENTRE ON HUMAN EVOLUTION (CENIEH)

The CENIEH facilitates research into the field of Human Evolution during the Pliocene and the Pleistocene eras, promoting awareness and transfer of knowledge to society as well as promoting and supporting collaboration with excavations at archaeological sites from these periods, both in Spain and in other parts of the world. The CENIEH is also responsible for the conservation, restoration, management and record of palaeontological and archaeological collections from the excavations at Atapuerca and other sites, both nationally and internationally, with similar characteristics that reach agreements with the Centre.

Currently, it consists of five research programmes: Spatial and Economic Archaeology, Geoarchaeology, Geochronology, Paleobiology of Hominids and Prehistoric Technology. Additionally, the CENIEH features laboratories, a specialized library, multi-purpose rooms, open spaces and work areas that have been equipped so that the research on Human Evolution can become an international point of reference. The laboratories that give it its status as a Unique Scientific and Technical Infrastructure (ICTS), regarded as essential, are grouped into three major technical areas:

- The area of Sedimentology and characterization of materials: including laboratories of Microscopy, Micro-Computed Tomography, Archaeometry, Geology, and Rooms for preparing thin sections of rock and studying soil micromorphology.

- The area of Geochronology: Includes large facilities and laboratories for Uranium Series dating, Luminescence, Electron Spin Resonance (ESR), and Archaeomagnetism as well as the corresponding spaces for preparation of samples, such as a Clean Room, Dark Room, and a room for sample preparation for dating of cosmogenic nuclides plus transverse equipment, HPGe germanium detectors, and a gamma irradiator.

- The area of Collections, Conservation, and Restoration: devoted to management and conservation of material from national and international excavation sites, especially from Atapuerca.

http://www.cenieh.es

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