GOBIERNO DE ESPAÑA
MINISTERIO DE CIENCIA E INNOVACIÓN

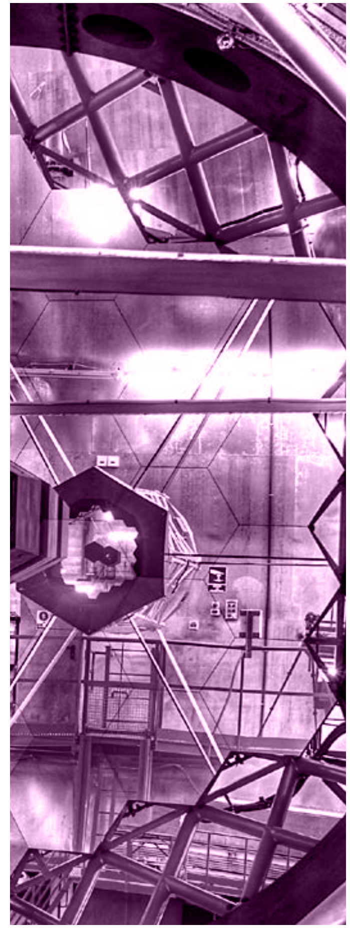
Plan de Recuperación, Transformación y Resiliencia

UNIÓN EUROPEA
Fondo Europeo de Desarrollo Regional









Unique Scientific and Technical Infrastructures (ICTS) 2021-2024

Una manera de hacer Europa

DIANA MORANT

MINISTER OF SCIENCE AND INNOVATION

The Spanish Government has set itself a priority challenge: to make our country a place of knowledge and innovation, capable of facing the future with guarantees. For this reason, we are embarking on an unprecedented commitment to science and innovation as a driver of sustainable growth, social welfare, resilience and strategic autonomy. For the first time, science is recognised as a "common good" in the reform of the Law on Science, Technology and Innovation, approved by the Government and currently in parliamentary procedure. This is a transformative instrument that will make a decisive contribution to strengthening Spain's Public Science and Innovation System, by guaranteeing by law a growing and stable public investment in R&D&I that will reach 1.25% of GDP by 2030 and providing solutions to the historical demands of our scientific and innovative community. This public commitment to R&D&I already materialised in 2022 with the most ambitious budget of the Ministry of Science and Innovation (MCIN), almost double that of 2020.

This increased public funding, together with a strong political commitment and agenda, is already creating more quality R&D&I-related jobs in Spain. And we will continue to allocate this unprecedented investment to dignify the working conditions of our research staff, retain and attract talent, carry out more research in all the territories of Spain, extend the culture of innovation in companies and improve the equipment and facilities of our scientific infrastructures.

In this context, it is worth highlighting the decisive boost to our Map of Unique Scientific and Technical Infrastructures (ICTS, from its Spanish initials), which brings together 29 ICTSs located throughout Spain, and these in turn add up to 64 infrastructures, allowing us to tackle the most ambitious R&D&I projects, from our supercomputers, telescopes, clean rooms, biomedical technologies, underground laboratories, synchrotrons, particle accelerators, advanced lasers, biological reserves, solar, oceanic or hydraulic platforms, oceanographic ships, or the polar bases in the Antarctic. Our ICTSs, open to the entire scientific community, are a source of patriotic pride and a driving force for attracting talent and increasing the technological and innovative capacity of Spanish companies, an essential factor for the green and digital transformation of our production model.

Today the Ministry of Science and Innovation is firmly committed to the ICTS and to the excellent national and international professionals who work in them. This Map is a clear example of the universal vocation of science, which knows no borders and must be able to be carried out from anywhere and for the benefit of all people, regardless of their postcode or socio-economic status. And it is also a fundamental asset in the model of co-governance that we are imprinting on our public R&D&I policies. The new reform of the Science Act, for the first time, defines this Map, in which both the Government and the other administrations that participate in its ownership will be able to invest.

Between 2021 and 2022, the MCIN earmarked 75 million euros, from the funds of the Recovery, Transformation and Resilience Plan, to strengthen these strategic infrastructures for the future of our country. The aim is to finance lines of investment associated with the construction, development, instrumentation, equipment and improvement of their scientific and technical capabilities. Likewise, in the 2014-2020 period, the European Regional Development Fund (ERDF) pathway allocated for ICTS amounted to approximately 169 million euros. Better endowments to do more excellent science and provide more and better opportunities for the scientific and innovative community. Our commitment is to continue investing in these key facilities and also to increase our participation in the world's major scientific and technological infrastructures.

The Unique Scientific and Technical Infrastructures are crucial to the current country project based on science and innovation that we are building together: administrations, research and technology centres, companies and society. I encourage you to browse through the pages of this book and discover cutting-edge facilities that represent the excellent scientific and technological capabilities that exist in Spain today.

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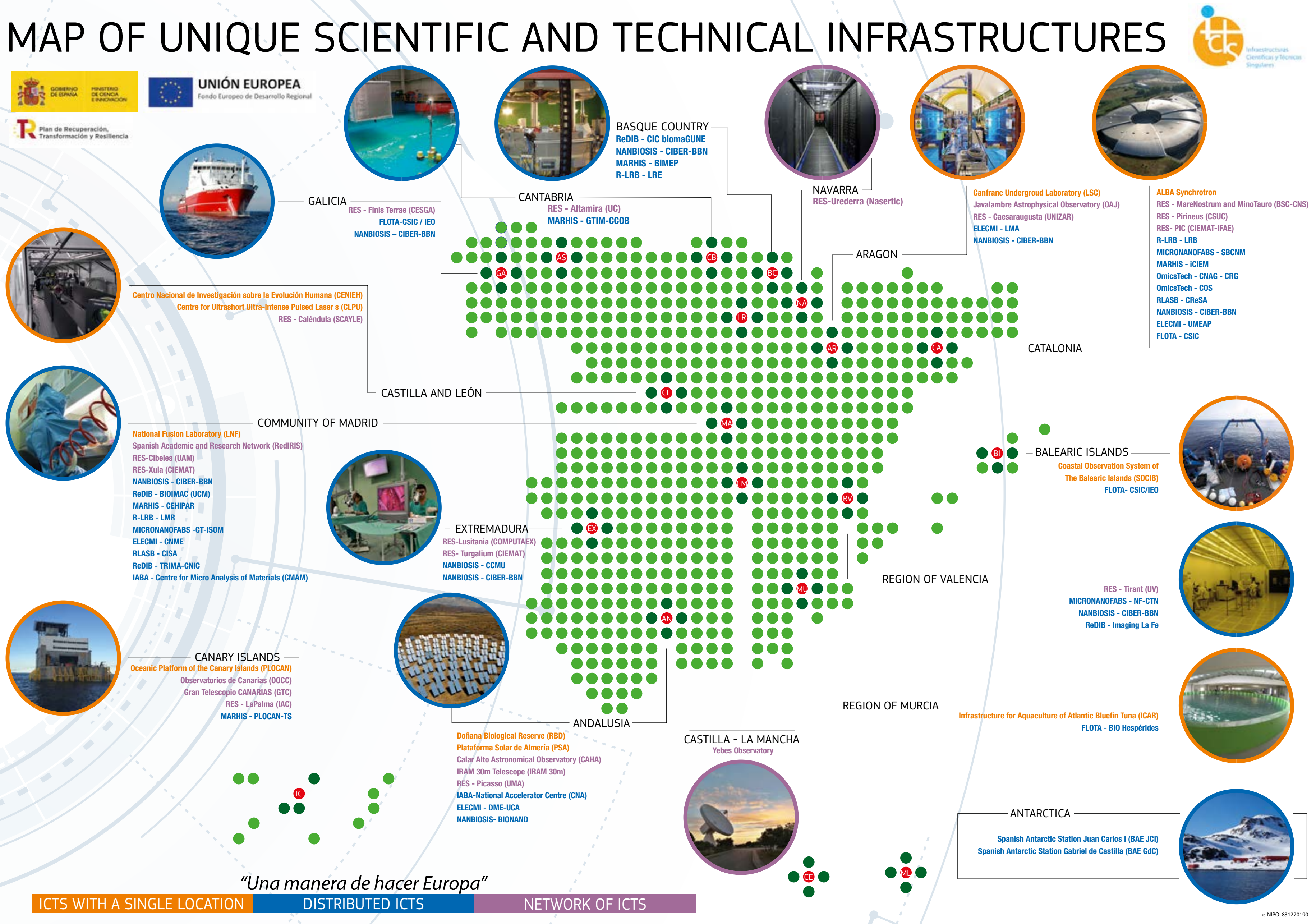

INTRODUCTION

The term **Unique Scientific and Technical Infrastructure (ICTS)** refers to cutting-edge R&D&I infrastructures that, either individually or by coordinating several facilities, provide services to develop cutting-edge research of the highest quality, as well as for the transmission, exchange and preservation of knowledge, the transfer of technology and the promotion of innovation. The ultimate aim is to provide the national and international scientific, technological and industrial community with cutting-edge scientific and technical infrastructures, which are essential for the development of competitive, high-quality scientific and technological research, these being understood as those technical means that are unique or exceptional of their kind, with a very high investment and/or maintenance and operating cost, and whose importance and strategic nature justifies their availability for the entire R&D&I community.

ICTSs have three fundamental characteristics:

- They are publicly owned infrastructures, i.e. they belong to or are managed by public entities that are either dependent on the Central Government and/or the Autonomous Communities.
- They are Unique, which means that they are unique in their kind, and can be:
  - › Large-scale facilities for observing, analysing and interpreting phenomena of interest.
  - › Complex experimental infrastructures designed to create, reproduce and study physical, chemical or biological phenomena of interest.
  - › Large-scale experimental infrastructures for engineering and for the development of new technologies for application in various fields.
  - › Infrastructures necessary to facilitate scientists' access to natural environments that offer and present unique characteristics for research.
  - › Advanced technologies that provide horizontal and fundamental support across all disciplines of science and technology.
- CTSs are open to competitive access by users from across the research community, from both the public and private sectors.

The ICTS are distributed throughout the national territory and included in what is called the "National Map of Unique Scientific and Technical Infrastructures (ICTS)" (hereinafter the ICTS Map). This map is periodically reviewed and evaluated, and is updated in accordance with the mandate established in the scientific policy of the competent ministerial department. The **current Map was approved on 11 March 2022 by the Council for Scientific, Technological and Innovation Policy (CPCTI)**, and is made up of 29 ICTSs that bring together a total of 64 infrastructures. This is the fourth ICTS Map since the first one agreed at the 3rd Conference of Presidents, held on 11 January 2007, which was drawn up with the participation of the Autonomous Communities.

In summary, the process of renewing the ICTS Map began with the definition of the objectives and principles to be met by the infrastructures participating in its updating, carried out by the CPCTI. The evaluation was carried out by the **Advisory Committee for Unique Infrastructures (CAIS)**, as a Working Group of the CPCTI's Sectorial Commission. After a thorough process of analysis and evaluation of the Strategic Plans presented by the candidate infrastructures, in which the State Research Agency participated with the intervention of international experts, the CAIS generated a proposal for the configuration of the new Map. Finally, the CPCTI approved the Map of Unique Scientific and Technical Infrastructures (ICTS) on 11 March 2012.

ICTSs can be located in a single location **(single location infrastructures)**, they can be part of a **Network of Infrastructures (RI, as per Spanish initials)** or be constituted as a **Distributed Infrastructure (DI)**, 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 in the current Map must continue to meet the requirements to maintain their ICTS status and, on the other hand, it is open to the incorporation of other Infrastructures, as long as they are operational and demonstrate compliance with these requirements.

The requirements that a facility must meet to be considered an ICTS, in any of the aforementioned modalities, are formally defined in the CPCTI document that accompanies the configuration of the current ICTS Map. In summary, these requirements are as follows:

- **Unique and strategic character**. - The ICTS is a unique infrastructure, a cutting-edge experimental tool that is unique in Spain in terms of its content and features, open to the entire R&D&I system in our country, scientifically and technologically advanced, and essential for carrying out certain research and/or technological developments.
- **Objectives:** They must be aligned with the objectives of the Spanish Science, Technology and Innovation Strategy, the State R&D&I Plan and the corresponding European and international programmes.
- **Investment:** They entail a high cost of investment in scientific and technological infrastructure in their construction, updating and improvement (from 10 million euros of accumulated investment in technological assets), as well as in their maintenance and operation.
- **Competitive open access** - ICTSs must apply a policy of competitive open access to the scientific, technological and industrial community and administrations. There must be a demonstrable and proportionate demand for use or access from the national and international community. At least 20% of the capacity of the essential infrastructure facilities must be offered in this access mode. Such access will be evaluated and prioritised according to criteria of excellence and scientific-technical feasibility, and is therefore regulated by a public "Access Protocol".
- **Scientific and Technical Advisory Committee**: In general, unless the specific nature of the infrastructure makes it inadvisable, the scientific-technological activities and strategies of the ICTS must be advised by a Scientific and Technical Advisory Committee of international relevance.
- **Management:** The ICTS will have appropriate management schemes, in accordance with its specific characteristics, particularly with regard to the infrastructures and services offered in a competitive manner and user support.
- **Strategic Plan:** ICTS should have a periodically reviewed four-year Strategic Plan, setting out objectives, strategies and resources.
- **Output and Performance:** The output and performance of the ICTS should be commensurate with the cost and size of the facility. Each ICTS must maintain a Register of R&D&I Actions that includes all the accesses offered, projects and activities carried out, and the R&D&I results achieved thanks to the use of the facility (publications, patents, etc.).

The ICTS Map covers a wide range of thematic fields, and even the same infrastructure can transversally provide services framed in different scientific disciplines.

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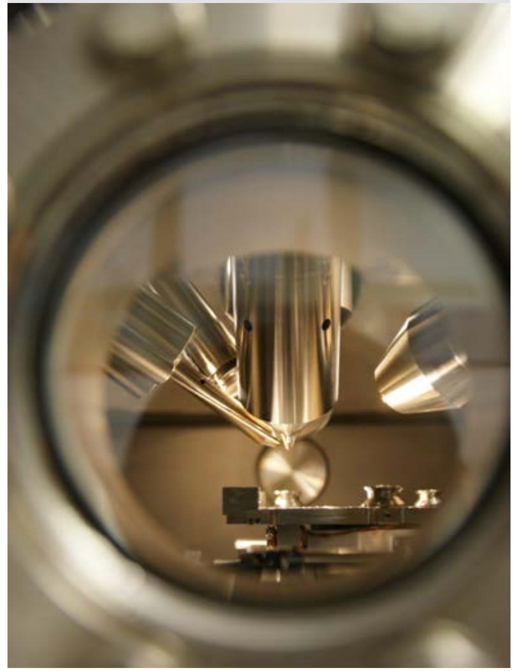
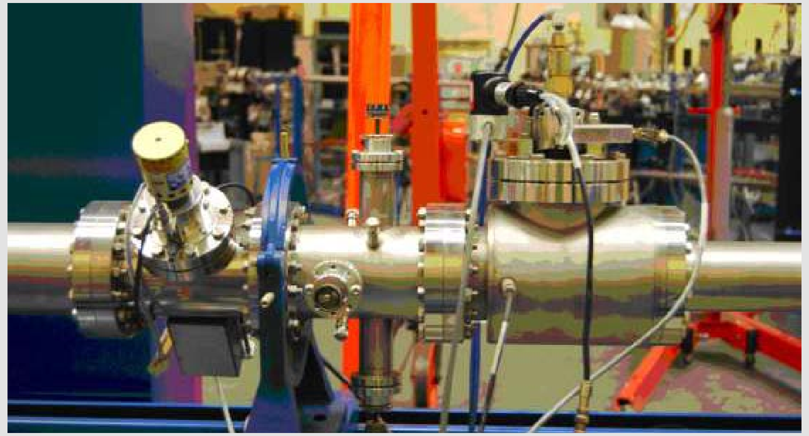
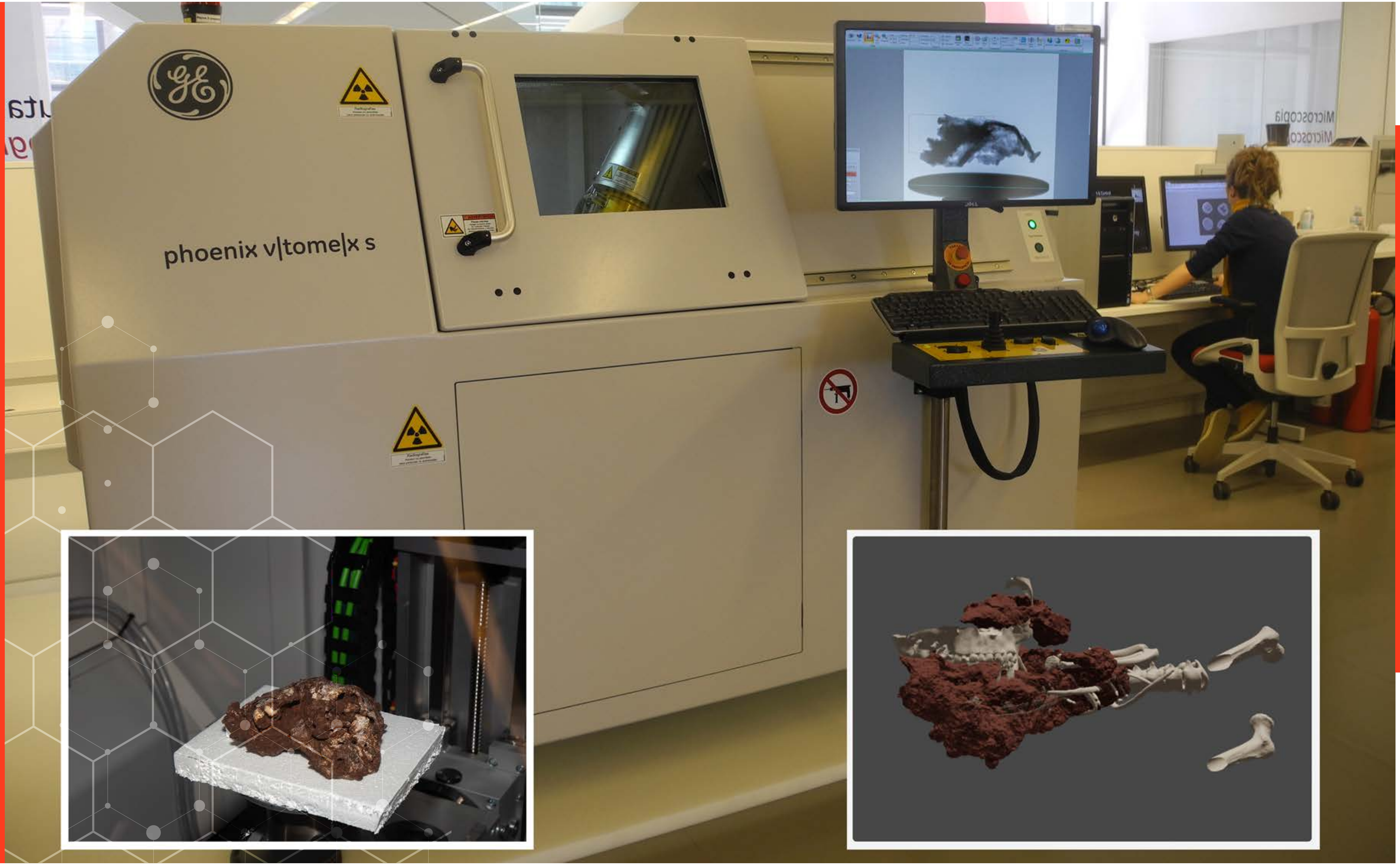


ICTS WITH A SINGLE LOCATION





CENTRO NACIONAL DE INVESTIGACIÓN SOBRE LA EVOLUCIÓN HUMANA (CENIEH)

The Centro Nacional de Investigación sobre la Evolución Humana (CENIEH) was created in 2004 as a public consortium co-financed in equal parts by the Central Government and the Regional Government of Castilla y León, with headquarters in Burgos. Since 2009, its facilities have been located in one of the buildings that make up the Human Evolution Complex, in the city of Burgos. The CENIEH facilitates research in the field of Human Evolution during the Pliocene and Pleistocene, promoting awareness and transfer of knowledge to society and encouraging and supporting excavations and collaboration in the excavation of 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 registration of the palaeontological and archaeological collections from the excavations at Atapuerca and other sites, both nationally and internationally. It is currently structured into three research programmes: Archaeology, Palaeobiology and Geochronology and Geology. It is currently the only European centre that can offer up to five different types of dating methods (Electronic Paramagnetic Resonance, Luminescence, Palaeomagnetism, Uranium/Thorium Series and Cosmogenic Nuclides) from the same location, these methods being fundamental for dating the antiquity of prehistoric finds, but also for studying the evolution of the landscape or analysing the seismic safety of a given region, among other purposes. Since its commissioning, there have been many studies using the facilities of this ICTS, the results of which have helped to reveal important questions about human evolution.

ICTSs OF UNIQUE LOCATION

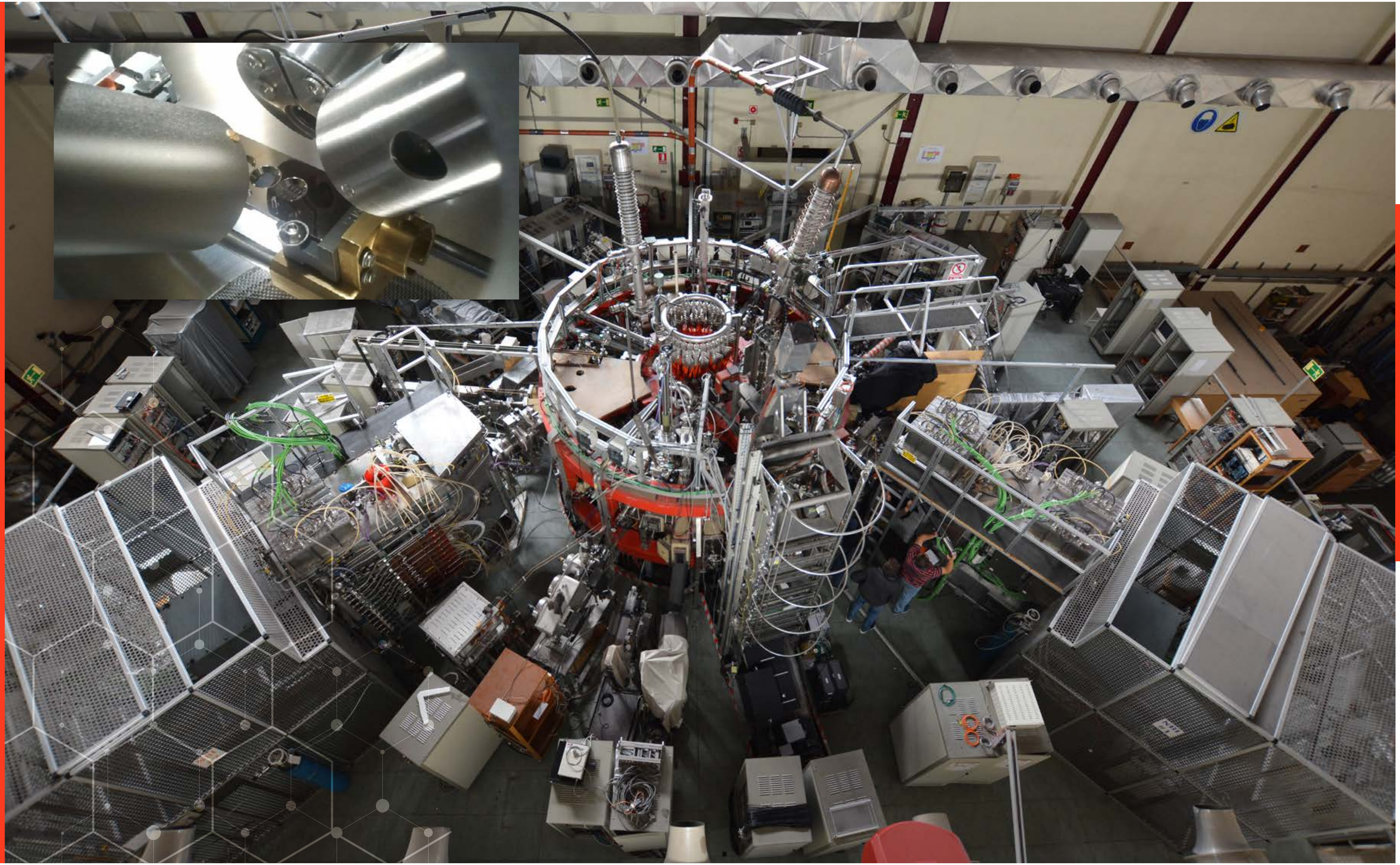
INFRASTRUCTURE FOR AQUACULTURE OF ATLANTIC BLUEFIN TUNA (ICAR)

The Infrastructure for Aquaculture of Atlantic Bluefin Tuna (ICAR), belonging to the CN Spanish Institute of Oceanography (IEO-CSIC), consists of a set of land-based facilities dedicated to the integrated aquaculture of this species (*Thunnus thynnus*). It consists of two facilities in close proximity: the Facility for Controlling the Reproduction of Atlantic Bluefin Tuna (ICRA) and the Marine Culture Plant, located respectively in the municipalities of Cartagena and Mazarrón (Region of Murcia).

Sustainable growth can only be achieved through an efficient production of high-value fish products in an environmentally responsible manner. One of the objectives of the European Union (EU) for the year 2030 is to double aquaculture production. Europe is well positioned to achieve this goal in terms of expertise, technologies and know-how in areas that are crucial for the advancement of the marine bioeconomy. This is a major challenge for the EU aquaculture scientific community to remain a world leader and a challenge to transfer research excellence and contribute to innovation and industrial growth in this area. Bluefin tuna is a flagship species that has been feeding Mediterranean populations for millennia.

In this infrastructure, which is unique in the world for this species, it is possible to carry out studies on the reproduction, incubation, larval culture and weaning-pre-fattening of bluefin tuna. They offer the opportunity to carry out research in different fields of interest on bluefin tuna, such as studies on physiology, welfare, pathology, nutrition, behaviour, etc. All of this is necessary to contribute to the sustainable production of Atlantic bluefin tuna through integrated aquaculture techniques that are independent of fishing and to increase knowledge about the biology of this species for its application in better management of its fisheries, thus contributing to its sustainability.

The objectives of the ICTS-ICAR are: 1) To contribute to the sustainable production of bluefin tuna through integrated aquaculture techniques independently of fisheries, 2) To increase knowledge about the biology of this species for its application in the improvement of fisheries management, contributing to its sustainability, 3) To improve the dissemination of the results of scientific and technological research obtained in the farming of this species and 4) To train human teams in bluefin tuna farming techniques.



NATIONAL FUSION LABORATORY (LNF)

The LNF is a department within the Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas (CIEMAT), a Public Research Organisation belonging to the Central Government. It is located at the CIEMAT headquarters in Madrid and its activity began with the start-up of the TJ-II experiment in 1998. The LNF centralises fusion research in Spain, leading Spanish participation in the construction of the international ITER project (the first fusion device that will produce net energy and test the technologies necessary for the construction of the first commercial reactor to produce electricity) and has been an essential part of securing the location of the European F4E Agency in Spain. It has also assumed from the outset the Spanish participation in the Broader Approach agreement signed between the European Union and Japan, as well as in the projects included in the ESFRI (IFMIF) roadmap and in the European fusion programme.

ICTSs OF UNIQUE LOCATION

CANFRANC UNDERGROUND LABORATORY (LSC)

This is the only underground scientific facility in Spain, the second largest underground laboratory in Europe in terms of size and characteristics. Since 1986, taking advantage of the site of the Canfranc railway tunnel in the Huesca Pyrenees, it has housed experiments in the search for dark matter and the nature and properties of the neutrino. The ICTS is located at a depth of about 800 m below the Pyrenean summit of El Tobazo, between the Somport railway and road tunnels. This depth eliminates most of the cosmic radiation present on the Earth's surface and allows the performance of experiments which, due to their sensitivity, require a low radiation background. The ICTS started its full activity in 2010 and develops the characterisation services of materials through radioactivity measurements for scientific or technological-industrial applications as well as geophysics and underground biology studies.

OCEANIC PLATFORM OF THE CANARY ISLANDS (PLOCAN)

The Oceanic Platform of the Canary Islands Consortium is an infrastructure that is co-financed in equal parts by the Spanish government and the regional government of the Canary Islands, and its objectives are to promote research, technological development and innovation in the marine and maritime fields. The main facility is an oceanic platform, located a mile and a half off the northeast coast of Gran Canaria, in the waters of the municipality of Telde, with a 23 km^2 area reserved for scientific and technical experimentation. This test bench is characterised and equipped for the testing of different technologies, as well as for their monitoring by means of a coastal observatory made up of different equipment (buoys, weather station, HF radar, lidar, hydrophones, etc.) with power supply node functions and real-time connection for the operation and testing of observation systems. Coastal components of the observatory are part of the JERICO European research infrastructure and contribute to Copernicus. It facilitates user access and also supplies scientific laboratories, observation systems, autonomous vehicles and, in general, technical capabilities and means located in the marine environment.

In the context of observation in the open ocean, PLOCAN's participation as manager and coordinator of the European Time Series Oceanographic Station of the Canary Islands (ESTOC), whose objective is to serve as a reference oceanic station from the Central Eastern Atlantic to international oceanic observation programmes and strategies, stands out. ESTOC currently forms part of the European deep observatory infrastructure known as EMSO ERIC and is integrated in the global network of fixed observation structures known as OceanSITES.

PLOCAN has a multidisciplinary fleet of autonomous vehicles that contributes to coastal and oceanic observation and is intended to provide operational support in the framework of both competitive scientific-technical accesses and national and European R&D&I projects and programmes. The information acquired complies with European quality protocols and is collected and distributed for use by the scientific community and by society in general through the European data centres Copernicus and EMODNET.

ICTSs OF UNIQUE LOCATION

PLATAFORMA SOLAR DE ALMERÍA (PSA)

The Plataforma Solar de Almería 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 Renewable Energies Institute of the CIEMAT, a Public Research Organisation dependent on the State. It is located in the southeast of Spain in the municipality of Tabernas at 37°05'27.8" North Latitude and 2°21'19" West Longitude. The PSA is the largest research centre in Europe dedicated to concentrating solar power, desalination and photochemical technologies. It receives a direct annual insolation of over 1,900 kWh/m^2, which makes it a privileged location for the development, demonstration and transfer of concentrating solar technologies for both thermal applications and photo and thermochemical processes. It has the most advanced and complete scientific facilities in the world together with insolation and climatic characteristics similar to those of many countries in the so-called "Sun Belt" (located between latitudes 40° North and 35° South), where solar technologies are undergoing the greatest development.

ICTSs OF UNIQUE LOCATION

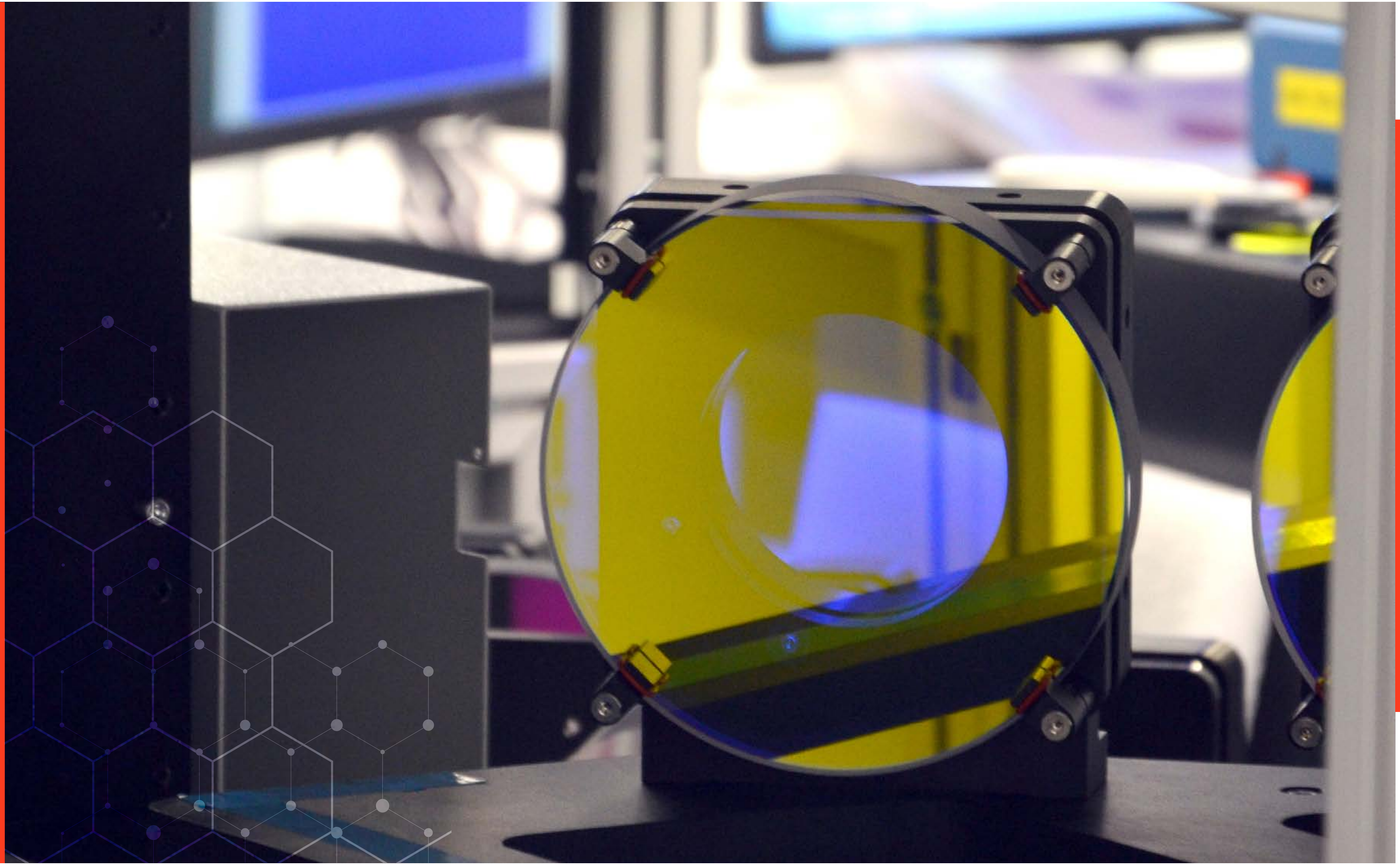
DOÑANA BIOLOGICAL RESERVE (RBD)

The Doñana Biological Reserve (RBD), located in the southwest of the Iberian Peninsula and created in 1964 by the Spanish National Research Council (CSIC), is managed by the Doñana Biological Station (EBD), a research institute belonging to the CSIC. The Doñana Protected Area, also known as the Doñana Natural Area (END), with 128,737.7 hectares, includes the National Park, special protection areas and the Doñana Natural Park. In both areas there is a regulated exploitation of its natural resources (mainly forestry, fishing and livestock). The Biological Reserve is part of the National Park and consists of two protected areas, the Doñana Biological Reserve, with 6,794 hectares, and the Guadiamar Biological Reserve, with 3,214 hectares. The Doñana National Park was declared a UNESCO Biosphere Reserve in 1980, a RAMSAR Wetland of International Importance in 1982, a Special Protection Area for birds (Natura 2000 Network) in 1987, a World Heritage Site in 1994 and an Area of Community Importance (Natura 2000 Network) in 1997. This protected area, which includes four major ecosystems (beach, dunes, Mediterranean scrubland and marshland), has numerous endemic and endangered species, and in winter can concentrate up to 700,000 water birds in the marshland, making Doñana one of the most important wetlands in Spain and Europe.

ALBA SYNCHROTRON

The ALBA Synchrotron is a complex of electron accelerators designed to produce synchrotron light with which to visualise the structure and properties of matter, especially at the nanometric scale. It is located in Cerdanyola del Vallès (Barcelona) in Parc de l'ALBA. It is a public consortium, co-financed in equal parts by the Central Government and regional government of Catalonia. Its construction began in 2006, it was inaugurated in 2010 and became operational with official users in mid-2012. ALBA is a third-generation synchrotron light source comparable to the latest ones built in Europe. The accelerator complex consists of a linear accelerator, which is used to accelerate electrons up to 100 MeV; a driving synchrotron, where electrons are accelerated to 3 GeV; and a storage ring where synchrotron light is generated and beamed to the different experimental stations. Each year the ALBA Synchrotron generates about 6,000 hours of light and serves more than 2,000 researchers, both from the academic community and the industrial sector. ALBA currently has ten operational beamlines, mainly focused on biosciences, condensed matter (nanosciences, magnetic and electronic properties) and materials science. Four more lines are under construction.

Since its commissioning, the ALBA Synchrotron has contributed to uncovering scientific questions in a wide range of disciplines. From making cements more resistant or controlling the magnetic properties of advanced materials to testing the effectiveness of new methods for the degradation of pollutants.



CENTRE FOR ULTRASHORT ULTRA-INTENSE PULSED LASERS (CLPU)

The Spanish Pulsed Lasers Centre. (CLPU) is an infrastructure dedicated to the research and development of ultra-intense pulsed laser technology. It is located in the Science Park of the University of Salamanca (Villamayor Campus), which is managed by a public consortium set up in 2007 and co-financed by the Central Government, the regional government of Castilla y León and the University of Salamanca. This centre houses VEGA, a titanium:sapphire laser system with CPA (Chirped Pulsed Amplification) technology capable of operating with a pulse duration of 30 femtoseconds and reaching a peak power of one petawatt. The VEGA architecture is unique worldwide and consists of three perfectly synchronised phases, sharing the same pulse generation system: VEGA1 and VEGA2 (20 and 200 terawatts respectively, both at 10 shots per second) and VEGA3 (1 petawatt at 1 shot per second). All three systems are operational, the first two are the most powerful lasers in Spain and VEGA3 is one of the ten most powerful lasers in the world. In addition, the facility has other CPA lasers with a higher repetition rate and a phase-stabilised laser with a duration of only 6 femtoseconds.

Thanks to the versatile design of the laser system, the list of potential applications is very broad, reaching disciplines at the cutting edge of science. These include, among others, the measurement and control of elementary processes in nature at timescales of attoseconds, the development of new light sources, the production of nanoparticles and nanosurfaces, the micromachining of all kinds of materials for industry, the development of microsurgical techniques, the display of molecules and biological tissues; electron and ion acceleration; X-Ray generation and a number of novel applications in plasma physics, nuclear physics (such as laser protontherapy) and particle physics (quantum vacuum).

COASTAL OBSERVATION SYSTEM OF THE BALEARIC ISLANDS (SOCIB)

The Coastal Observation System of the Balearic Islands (SOCIB) is an infrastructure managed by the SOCIB consortium, which is co-financed by the Spanish government (through the Ministry of Science and Innovation and the CSIC) and the regional government of he Balearic Islands. SOCIB has been operational since 2013 and is located in Palma de Mallorca. SOCIB's activities are centred on the Western Mediterranean, focusing on the Balearic Islands and adjacent areas (Alboran Sea, Algerian Sea, etc.). Due to its strategic position, close to the transition area between the Mediterranean and the Atlantic, it constitutes one of the world's biodiversity "hotspots". In this way, SOCIB's infrastructure is able to respond to scientific priorities, technological development and the needs of society, thus closing the cycle of the innovation process.

SOCIB's mission is to advance knowledge of the Mediterranean in the global context of ocean research around three essential themes: climate, ocean health and real-time services. It promotes a paradigm shift in ocean observation, previously based exclusively on large vessels and, now and in the future, based on integrated multi-platform systems. It thus contributes to meeting the needs of a wide range of scientific, technological, and strategic priorities of society.

NETWORK OF ICTS

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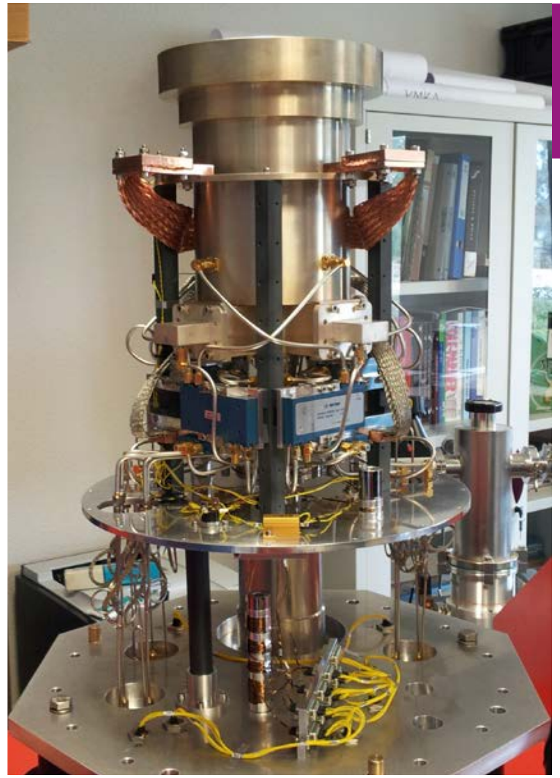

ASTRONOMY INFRASTRUCTURE NETWORK (RIA)

The Astronomy Infrastructures Network (RIA) was created in 2007 at the request of the Ministry of Science and Innovation, which was then responsible for R&D&I. Its purpose is to coordinate the activities of the Unique Scientific and Technical Infrastructures (ICTS) and International Astronomy Facilities and Organisations existing in our country and to promote initiatives for the promotion and dissemination of the use of the infrastructures that comprise it for scientific astronomical research. Likewise, the RIA will be able to advise and inform the institutions that so wish in the field of astronomical infrastructures.

The ICTSs integrated in the Network of Infrastructures in Astronomy are: **the Gran Telescopio CANARIAS, Observatorios de Canarias, the Calar Alto Astronomical Observatory, the IRAM 30m Telescope, Yebes Observatory and the Javalambre Astrophysical Observatory**.

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

- GRAN TELESCOPIO CANARIAS
- OBSERVATORIOS DE CANARIAS
- CALAR ALTO ASTRONOMICAL OBSERVATORY
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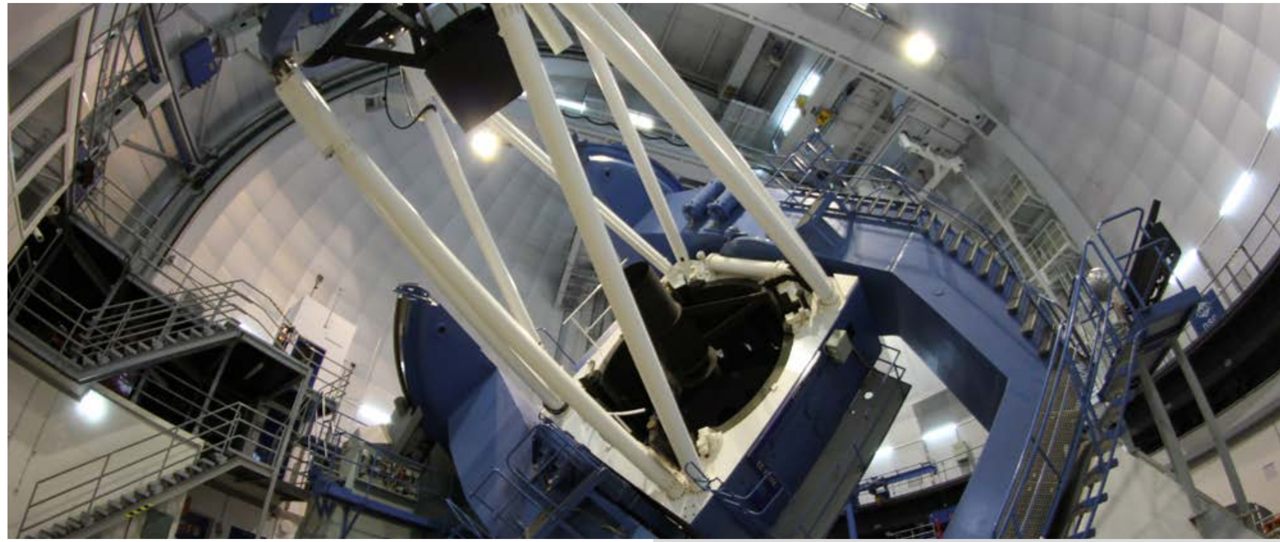
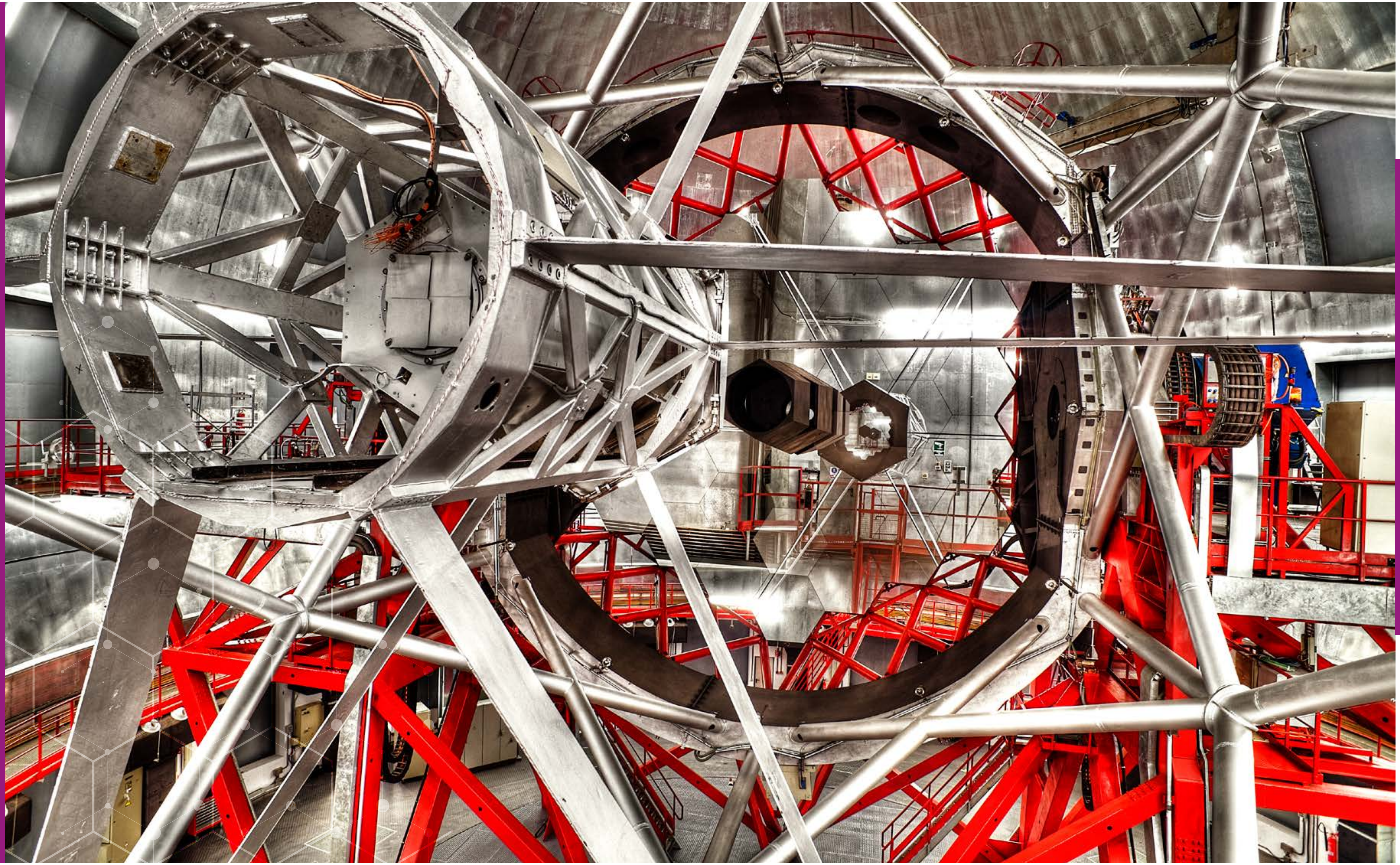
- JAVALAMBRE ASTROPHYSICAL OBSERVATORY





GRAN TELESCOPIO CANARIAS (GTC)

The Gran Telescopio CANARIAS, with a main mirror of 10.4 m in diameter, is currently the largest optical and infrared telescope in the world. It is located at the Roque de los Muchachos Observatory, in the municipality of Garafía, on the Canary island of La Palma. The GTC, an initiative of the Instituto de Astrofísica de Canarias (IAC), is owned by the public company Gran Telescopio de Canarias, S.A. (GRANTECAN), itself belonging to the Spanish government and the Autonomous Community of the Canary Islands, which is responsible for its operation and future development, with international collaboration from institutions in Mexico (Instituto de Astronomía de la Universidad Nacional Autónoma de México and the Instituto Nacional de Astrofísica, Óptica y Electrónica) and the United States (University of Florida).

The GTC has been operational since 2009 and its 36 hexagonal segments provide a light-collecting area equivalent to that of a circular monolithic mirror with a diameter of 10.4 m. These segments act as a single surface thanks to the extremely precise optical alignment achieved by the mirrors. Their basic pointing, tracking and guiding performance is very good, which means that the image quality of the GTC at the focal plane is in line with the excellent characteristics of the sky at the Observatory where it is installed.

NETWORK OF ICTS

OBSERVATORIOS DE CANARIAS (OOCC)

The Astronomical Observatories of the Canary Islands (OOCC), managed by the Instituto de Astrofísica de Canarias (IAC), consist of the Roque de los Muchachos Observatory (ORM, La Palma) and the Teide Observatory (OT, Tenerife), both at an altitude of about 2,400 metres. The excellent astronomical quality of the sky above the Canary Islands – protected by law– makes them astronomical reserves, open to the international scientific community since 1979. Currently, the OOCCs house telescopes and instruments belonging to 75 institutions from 25 countries, constituting the most important group of facilities for night and solar, visible and infrared, and high-energy astrophysics in the European Union (EU) and the largest collection of multinational telescopes in the world.

CALAR ALTO ASTRONOMICAL OBSERVATORY (CAHA)

The Calar Alto Observatory of the Centro Astronómico Hispano en Andalucía (CAHA) is located at an altitude of 2,168 m, in the Sierra de Los Filabres, Almería. Since 2019, its ownership is shared 50% by Spanish National Research Council (CSIC) and regional government of Andalusia, and its scientific reference centre is the Instituto de Astrofísica de Andalucía (IAA, of the CSIC).

The Calar Alto Astronomical Centre is the most important observatory with optical telescopes in continental Europe. Its main infrastructures are three telescopes with respective apertures of 1.23, 2.2 and 3.5 metres. In addition, it has a fireball detection system that monitors the entire sky visible from the observatory.

The telescopes are equipped with a variety of astronomical instrumentation in the optical and near-infrared range, including direct imaging cameras and spectrographs of low, high or very high resolution. In addition, the observatory has night sky quality monitors, clean rooms, electronic, mechanical and computer workshops, as well as vacuum hoods for aluminising large mirrors (up to 4 m), which offer aluminising services to the scientific community. Calar Alto is an energy sustainable centre thanks to the renovation of its heating systems (now based on biomass) and the recent installation of a solar photovoltaic plant.

IRAM30m TELESCOPE (IRAM 30m)

The 30m telescope is one of the two observatories of the Institute of Millimetre 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 IGN (Instituto Geográfico Nacional). At an altitude of 2,850 metres on Pico Veleta (Sierra Nevada, Granada), it is one of the largest and most sensitive millimetre-wave radio telescopes in the world today. It is a classical 30-m parabolic antenna which is unrivalled in sensitivity and its panels are tuned to an accuracy of 55 micrometres with respect to an ideal paraboloid.

The telescope is equipped with three high-performance instruments: EMIR is a heterodyne receiver with four bands with two polarisations, working in atmospheric windows with wavelengths around 3, 2, 1 and 0.8 mm, (90, 150, 230 and 330 GHz) with a bandwidth of 16 GHz. HERA is a heterodyne receiver consisting of two 3 x 3 pixel arrays for the detection of radiation in two polarisations in a band with a wavelength of around 1 mm (230 GHz). The heterodyne instruments are complemented by three high-capacity and high-resolution spectrometers (FTS, WILMA and VESPA). These instruments are primarily used for mapping molecular gas in our Galaxy as well as in nearby and distant galaxies. The latest addition to the 30m instrument suite is NIKA2, a camera for continuum observations in two bands at a wavelength of 1 and 2 mm, using the novel KID (kinetic induction detectors) technique. The three large detector arrays (with a total of almost 3,000 pixels) of which the instrument is composed are cooled to 150 mK. The use of KID technology makes this instrument unique in the world today in terms of design and performance. NIKA2 is primarily dedicated to the observation of dust emission in nearby molecular clouds and in galaxies, up to the most distant (and youngest) in the known universe, as well as to the study of galaxy clusters by means of the Sunyaev-Zel'dovich effect.

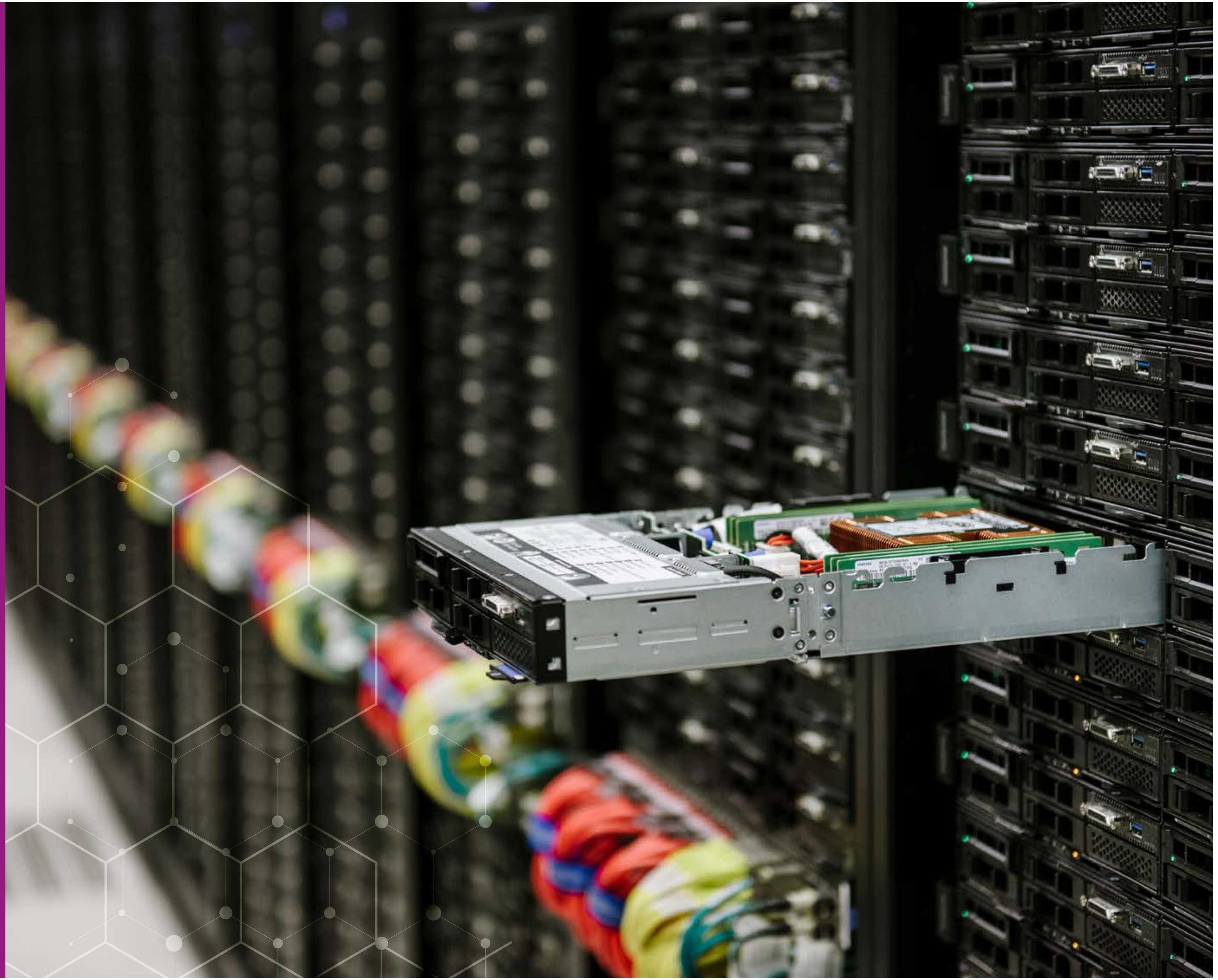
YEBES OBSERVATORY (YEBES)

The Yebes Observatory (Instituto Geográfico Nacional, Ministerio de Fomento) is dedicated to the development and construction of instrumentation in the field of radio astronomy, as well as to carrying out astronomical observations of astronomical, geodetic and geophysical interest. Located at an altitude of 980 m, about 80 km from Madrid, in the municipality of Yebes (Guadalajara), the Centre houses two essential scientific-technical facilities: the 40 m diameter radio telescope and the 13.2 m radio telescope belonging to the RAEGE network (Spanish-Portuguese Atlantic Network of Geodynamic and Space Stations) and to the international VGOS network. The 40m radio telescope is one of the most important nodes of the European Very Long Baseline Interferometry Network (EVN), and also belongs to the Global Millimetre VLBI Network (GMVA) and the International VLBI Service (IVS). Its facilities include high-tech microwave laboratories and a gravimetry pavilion. Its three geodetic techniques, radio astronomical VLBI, gravimetry and GNSS, and in the near future a station with SLR pulsed laser, make the Yebes Observatory a fundamental geodetic station.

JAVALAMBRE ASTROPHYSICAL OBSERVATORY (OAJ)

The OAJ is located on the Pico del Buitre, at an altitude of 1,956 m in the municipality of Arcos de las Salinas, Teruel. Built and managed by the Centro de Estudios de Física del Cosmos de Aragón, CEFCA, it has been conceived to carry out large multi-filter astronomical mapping of maximum scientific interest in the field of Astrophysics and Cosmology. The facility has laboratories, control rooms, sky quality monitors and two new generation telescopes whose main mirrors have apertures of 2.55 m (T250 or JST, Javalambre Survey Telescope) and 83 cm (T80 or JAST, Javalambre Auxiliary Survey Telescope), with fields of view of 3 and 2 degrees in diameter, respectively. The first scientific instrumentation consists of two wide-field panoramic cameras, JPCam (5 square degrees effective field of view) and T80Cam (2 square degrees effective field of view), equipped with filter trays that make it possible to obtain images in different spectral bands that ultimately provide a low-resolution spectrum for each pixel of the sky.

NETWORK OF ICTS

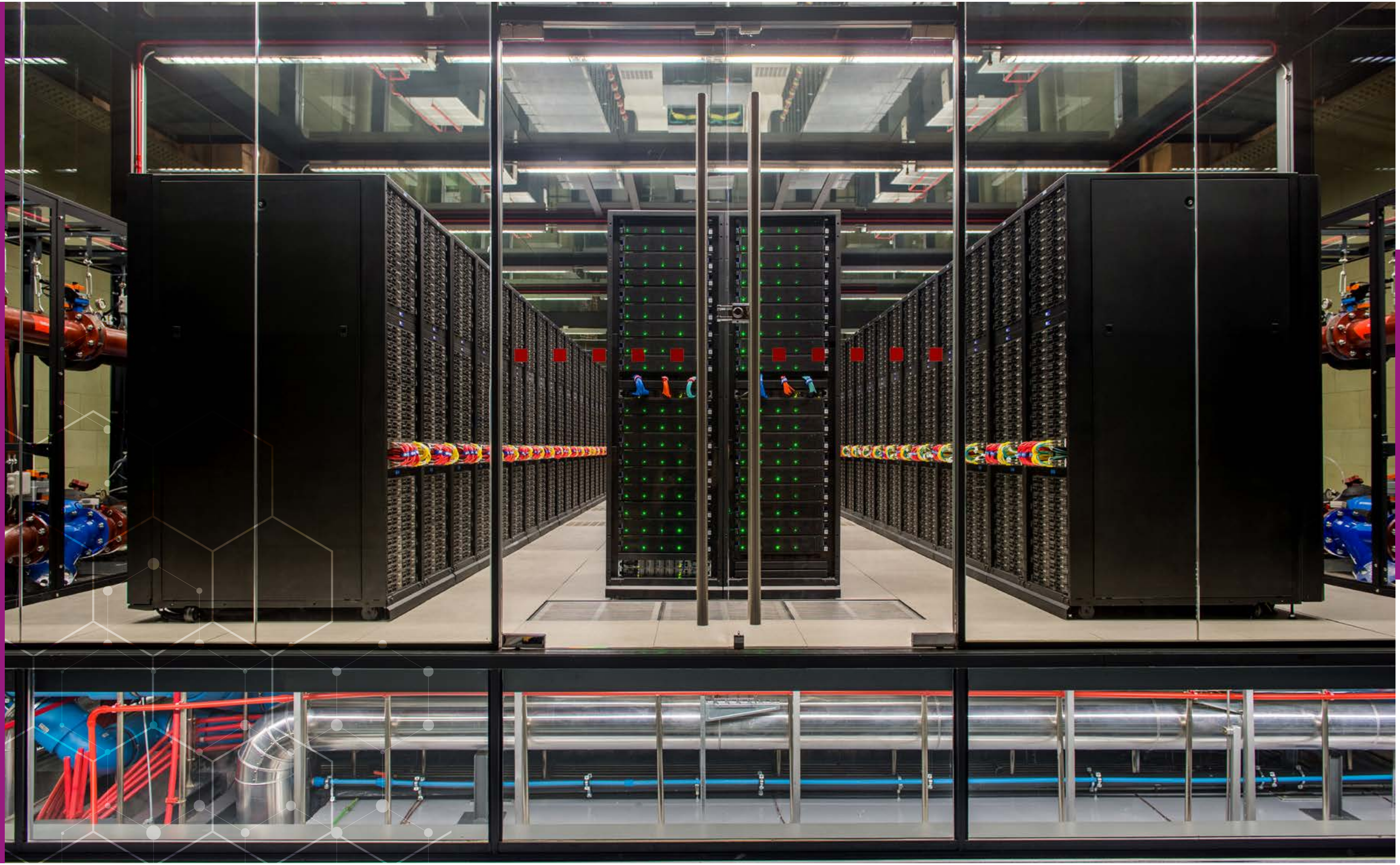


e-SCIENCE NETWORK

In the previous edition of the ICTS Map, the Advisory Committee for Unique Infrastructures (CAIS) recommended the creation of the "e-Science Network", initially made up of the **Spanish Supercomputing Network and RedIRIS**, as well as other institutions and users in this field.

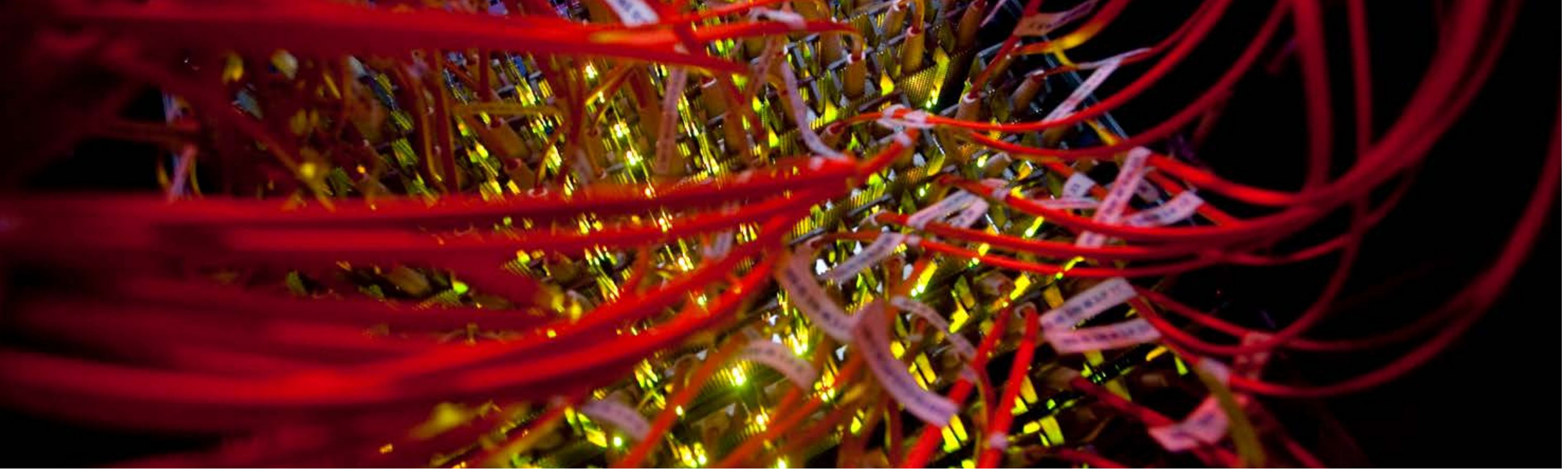
The creation of this Network of ICTShas promoted the coordination and cooperation of Spanish R&D&I infrastructures dedicated to e-Science and will advise the Ministry of Science and Innovation on these matters, which are developing so strongly in Europe and the rest of the world.

- SPANISH SUPERCOMPUTING NETWORK (RES)
- RedIRIS



SPANISH SUPERCOMPUTING NETWORK (RES)

The Spanish Supercomputing Network (RES) was created in 2006 by the then Ministry of Science and Innovation as a response to the Spanish scientific community's need for greater computing capacity and access to computationally intensive resources, regarding supercomputing resources as a decisive asset for the country's scientific and technological development. The RES is an infrastructure of supercomputers located in different locations, each of which contributes to the total processing power and storage capacity available to the users of the different R&D groups. This network not only provides supercomputing and data management resources, but also offers technical support services to users, as well as specific training and various activities with the aim of improving the efficient use of these resources and extending their use to all research areas.



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Currently, the supercomputers that are part of the RES are:

- **MareNostrum4 and MinoTauro at the Barcelona Supercomputing Center - Centro Nacional de Supercomputación (BSC-CNS, Barcelona).** This centre was officially established in 2005 by the Spanish government, the regional government of Catalonia and the Universitat Politècnica de Catalunya (UPC). Its speciality is High Performance Computing, also known as HPC. It is the coordinator of the RES and offers 40% of MareNostrum4 and 25% of MinoTauro to the RES. It also supplies 20% of its data storage capacity to the RES's open data service offer.
- **LaPalma at the Instituto Astrofísico de Canarias (IAC)**, which is integrated by the Spanish government, the regional government of the Canary Islands, the University of La Laguna and the Spanish National Research Council (CSIC). It offers 50% of its computing power to the RES. It also supplies 40% of its storage capacity to the RES open data services offer.
- **Altamira of the University of Cantabria** (UC, Santander), installed at the Institute of Physics of Cantabria (IFCA), a centre dependent on the UC and the Spanish National Research Council (CSIC). It contributes 35% of its resources to the RES.
- **Picasso at the University of Malaga (UMA)**, located in the Supercomputing and Bioinformatics Centre (SCBI) of this university, which is located in the Andalusia Technology Park. It offers 24% of its resources to RES.
- **Tirant at the University of Valencia (UV),** located on the Burjassot campus and managed by the Servei d'Informàtica de la UV (SIUV). It allocates 50% of its computing capacity to the RES.
- **Caesaraugusta at the University of Saragossa (UNIZAR)**, located at the Institute of Biocomputation and Physics of Complex Systems (BIFI), a university research institute belonging to this university. It provides 30% of its computing resources to the RES. It provides 24% of its storage capacity for the open data services offered by the RES.
- **FinisTerrae Supercomputer of the Galician Supercomputing Centre (CESGA, Santiago de Compostela)**. It is an institution co-partnered by the Xunta de Galicia and the Consejo Superior de Investigaciones Científicas (CSIC). FinisTerrae contributes 20% of its computing power to the RES. It also provides 15% of its storage capacity for the RES open data services offer.
- **Pirineus and Canigó of the Consorci de Serveis Universitaris de Catalunya (CSUC, Barcelona)**. This consortium is made up of the regional government of Catalonia and ten Catalan universities, and contributes 24% of Pirineus and 25% of Canigó to the RES. It also provides 57% of its storage capacity for the RES open data services offer.
- **Caléndula of the Supercomputing Centre of Castilla and León (SCAYLE, León)**, which is a public entity created by the regional government of Castilla and León and the University of León. It contributes 82% of its computing resources to the RES. It provides 80% of its storage capacity for the RES open data services offer.
- **Lusitania at the Computing and Advanced Technologies Foundation of Extremadura (COMPUTAEX, Cáceres)** which is the Extremadura Centre for Research, Technological Innovation and Supercomputing. It contributes 50% of its resources to the RES. It also provides 50% of its storage capacity for the RES open data services offer.
- **Cibeles of the Autonomous University of Madrid (UAM, Madrid)**, located in the Scientific Computing Centre (CCC-UAM) which provides centralised computing support to the Campus of the Autonomous University of Madrid. It contributes 58% of its computing resources to the RES.
- **Urederra, located in the data processing centre of the regional government of Navarra**, in Pamplona, is managed by Nasertic. It provides the RES with 87% of its computing resources.
- **PIC (Port d'Informació Científica)** is managed by the Institut de Física d'Altes Energies (IFAE) and the Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas (CIEMAT) and provides 66% of its storage capacity for the RES open data services offer.
- **Xula (Madrid) and Turgalium (Trujillo)** are managed by CIEMAT. They contribute 45% of their computing resources to the RES.

The RES offers high-performance computing and data management resources of about 600 million hours per year and has scientific data management and storage services for a total of 180 PB which can be accessed through an open, common and competitive access system. The application process is unique for all RES nodes and is based on criteria of effectiveness, efficiency and transparency. This common access ensures optimal use of all available network resources (computing, storage, parallelisation, etc.). The aim of the RES is to promote the advancement of science and innovation in Spain, in any of its areas of knowledge.

NETWORK OF ICTS

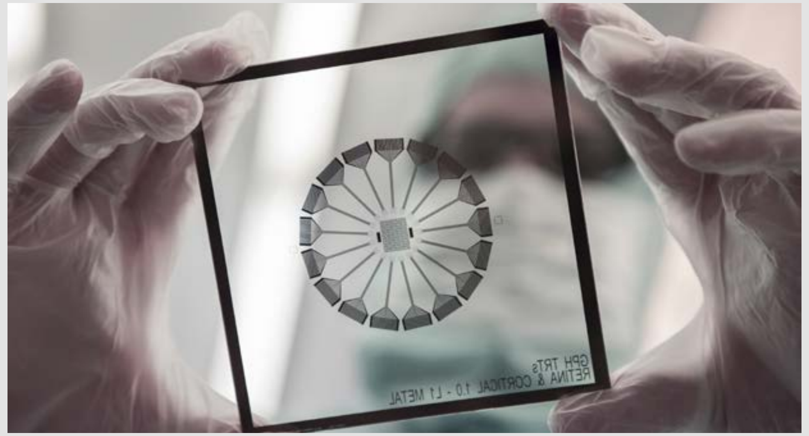
RedIRIS

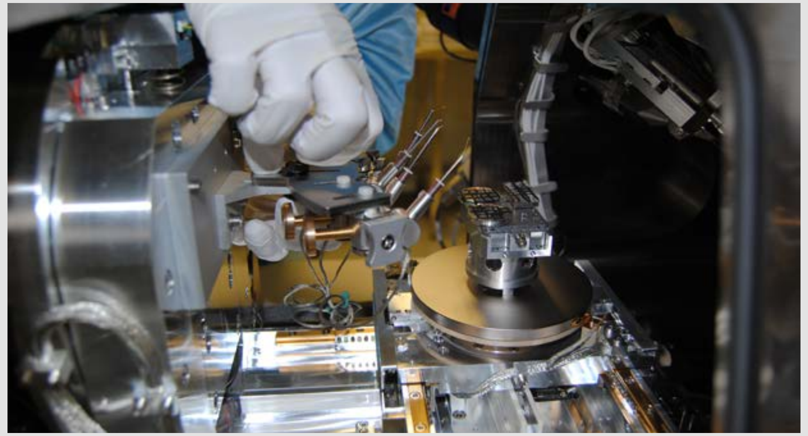
RedIRIS is the Spanish academic and research communications network and offers advanced communications services to more than 500 institutions in the scientific and academic community (mainly universities, scientific centres and ICTS). The RedIRIS headquarters is located in Madrid.

RedIRIS is an infrastructure owned by the Ministry of Science and Innovation, which has delegated the powers regarding RedIRIS to Red.es, a public entity under the Ministry of Economic Affairs and Digital Transformation.

RedIRIS was launched in 1988 with the aim of providing universities and scientific centres with their own communications backbone, through which they could transfer large amounts of information in a controlled, efficient and secure manner, thus facilitating remote collaboration between these centres and their participation in national and international projects, in particular e-science projects, which require massive data transfers.

DISTRIBUTED ICTS





SPANISH ANTARCTIC FACILITIES (BAES)

Spanish infrastructures in polar areas are limited to those that operate in the Antarctic, namely the Juan Carlos I Spanish Antarctic Station (BAE JCI) and the Gabriel de Castilla Spanish Antarctic Station (BAE GdC). Both are located in the South Shetland Archipelago and are seasonal bases, operating only during the austral summer. The coordination of activities at both bases is carried out under the authority of the Spanish Polar Committee, with the Marine Technology Unit of the Spanish National Research Council (UTM-CSIC) being responsible for the management and execution of the logistical coordination.

- The BAE JCI is located on the Hurd Peninsula of Livingston Island (62° 39′ 46″ S, 60° 23′ 20″ W). UTM-CSIC manages this base and provides the necessary technical support for the development of scientific activities in Antarctica.
- The BAE GdC (62° 55′ S, 60° 37′ W) is located on Deception Island and is managed by the Army for operational aspects and the UTM-CSIC for the provision of scientific instrumentation.

The South Shetlands Islands and the Antarctic Peninsula are located in one of the areas of the planet where the temperature has increased the most and the fastest, rising by 2.5°C in the last few decades. It is essential to study the effects of climate change in the areas where it may have the greatest magnitude and, in the case of the polar regions, where it may have a global influence. Thus, both bases carry out research in areas such as atmosphere, glaciology, climate, global change, geomagnetism, biodiversity, natural hazards, volcanic monitoring, astrobiology, geology, and ecology.

SPANISH OCEANOGRAPHIC FLEET (FLOTA)

The ICTS FLOTA is made up of a group of oceanographic vessels, all of which are technically managed and financed by the Spanish government. These oceanographic vessels mainly provide services to the campaigns carried out within the framework of the Spanish Science, Technology and Innovation Strategy and the European Union's framework programme, as well as the responsibilities assigned to the different Public Research Organizations of the General Secretariat for Research. Technical support on board of the oceanographic vessels in the campaigns regulated by the Commission for the Coordination and Monitoring of Oceanographic Vessel Activities (COCSABO) is provided by the Marine Technology Unit of the Spanish National Research Council (CSIC) and/or by personnel from the vessels unit of the Spanish Institute of Oceanography (IEO) in their campaigns.

At present, the following are considered essential facilities of the ICTS FLOTA:

- The Spanish Navy's oceanographic research vessel BIO Hespérides, which carries out its activity mainly in support of polar research.
- The global and regional oceanographic vessels managed by the UTM of the CSIC, R/V Sarmiento de Gamboa and R/V García del Cid.
- The regional oceanographic vessels managed by the IEO vessels unit, R/V Ramón Margalef and R/V Ángeles Alvariño.
- The state-of-the-art oceanographic equipment and instrumentation on board the vessels, including the ROV LIROPUS and seismic systems, among others.

Other coastal vessels also support the activities of the ICTS FLOTA.

The **BIO Hespérides** entered service in 1991 and has since conducted more than 120 oceanographic campaigns in the Antarctic, Arctic, Pacific and Atlantic Oceans. It plays an important role in oceanographic research. It was recognised in 1995 as a Large Scientific Facility by the Advisory Commission for Large Scientific Facilities, currently known as Unique Scientific and Technical Infrastructures (ICTS). The BIO Hespérides is a ship integrated in the Spanish Navy's Maritime Action Force (FAM), based in Cartagena, Murcia. Its scientific equipment is fully managed by the Marine Technology Unit of the CSIC.

Its hull is reinforced to navigate in the polar areas of Antarctica and the Arctic. Its main activity is centred on the southern summers, when it carries out scientific campaigns in the Antarctic and occasionally collaborates in the support of Spanish Antarctic bases, as well as in research projects programmed there. During the rest of the year, its activity is mainly in the Atlantic, Pacific and Mediterranean, supporting different scientific campaigns, as well as the Ministry of Defence's Exclusive Economic Zone mapping programme. It is a global research vessel with instrumentation and laboratories that allow it to investigate natural resources and risks, global change, marine resources, global ocean circulation and marine biodiversity.

The **R/V Sarmiento de Gamboa** was launched in 2006 and is focused on the study of global ocean circulation, marine biodiversity, fishery resources and climate change. It has scientific and technical equipment to carry out work in geophysics, oceanography, marine biology and geochemistry. It also has advanced technologies in terms of navigation systems (such as dynamic positioning) and was the first Spanish oceanographic vessel in which it was possible to work with Remote Operated Vehicles (ROVs). It is currently the vessel in the fleet with the capacity to carry out geophysical campaigns in accordance with the current standards of the prospecting industry.

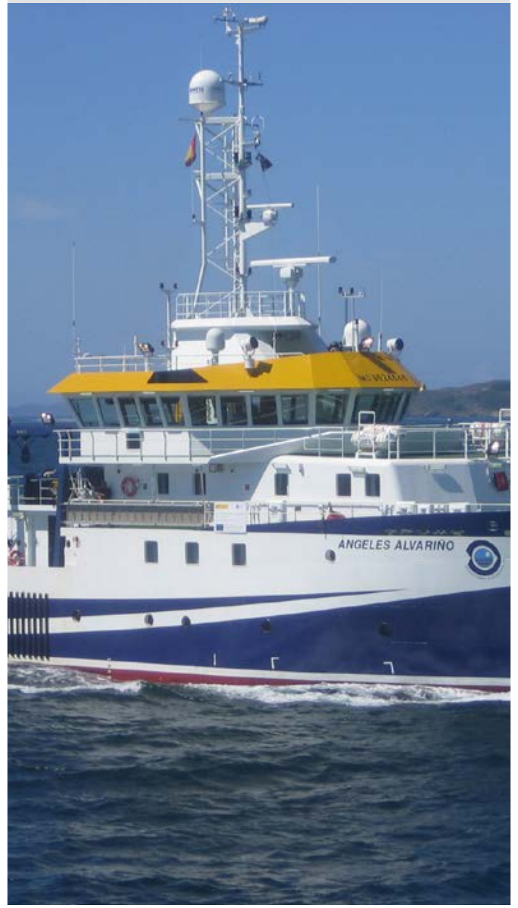
The **R/V García del Cid** was launched in 1979. It is a vessel used specifically for marine scientific research and is at the service of national or international scientific groups carrying out oceanographic research. Its main areas of work are the Western Mediterranean, the Iberian area of the Atlantic and the Canary Islands. It is based in the port of Barcelona. The ship's equipment allows it to carry out marine research in the fields of oceanography, geology and geophysics, as well as experimental fishing research with benthic and pelagic gear, or research into phytoplankton, zooplankton and ichthyoplankton. The vessel is equipped with wet and dry laboratories, a stern gantry and winches for work on deck (20 m^2), and various acoustic equipment, and has a good manoeuvring capacity for anchoring and collecting buoys, current meters, sediment traps, etc.

The **R/V Ramón Margalef** was delivered in 2011 and is specially designed for oceanographic and fisheries research, including the integrated study of ecosystems. Due to its dimensions and capabilities, it is classified as a regional vessel. It has 10 days of autonomy and space for 11 researchers and technicians, in addition to its 14 crew members. It operates nationally and in adjacent seas and is equipped with cutting-edge technology to study marine geology, physical and chemical oceanography, marine biology, fisheries and environmental control.

The **R/V Ángeles Alvariño** was delivered in 2012. This vessel provides the national and European oceanographic fleet with a floating laboratory equipped with the latest technology. It is also classified as a regional vessel, like the previous one, and both have the capacity to use the ROV LIROPUS; it has the capacity to accommodate 13 researchers and technicians, in addition to its 14 crew members. It also has a design that ensures low levels of noise radiated into the water, allowing it to work without disturbing the natural behaviour of marine fauna. Its advanced technology allows it to study marine geology, physical and chemical oceanography, marine biology, fisheries and environmental monitoring.

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

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



DISTRIBUTED BIOMEDICAL IMAGING NETWORK (ReDIB)

This distributed ICTS is composed of four nodes:

- The **Advanced Translational Imaging Infrastructure (TRIMA)**. This is located at the Centro Nacional de Investigaciones Cardiovasculares Carlos III (CNIC, Madrid) and has been in operation since 2010. It is organised into three platforms: Molecular and Functional Imaging, Advanced Imaging and High Performance Imaging. It is a translational infrastructure with state-of-the-art technologies to advance the study of different cardiovascular diseases and pathologies from the molecular level to the tissue level, for preclinical studies in small animals, and can also be applied to humans.

- The **Molecular and Functional Imaging Platform** is an integral part of the Biomaterials Cooperative Research Centre (CIC biomaGUNE, San Sebastian), opened in 2006. It has been designed, built and equipped to carry out longitudinal and multimodal research projects in the preclinical field, as well as to develop applications in the areas of Preclinical Molecular and Functional Imaging and Nanomedicine.

- The **Bio-imaging Unit at the Complutense University of Madrid (BiolmaC)** is composed of the Nuclear Magnetic Resonance and Electron Spin Resonance, Brain Mapping and Diagnostic Imaging facilities.

- The **Medical Imaging Unit of La Fe University and Polytechnic Hospital**, in Valencia, comprising the Biomedical Imaging Research Group, GIBI230, and the Platform for Experimental Radiology and Imaging Biomarkers, PREBI, whose mission is to promote and develop the use of imaging techniques and biomarkers to optimise the diagnostic and therapeutic efficiency of medical imaging through a multidisciplinary and multimodality approach, in clinical care research and animal experimentation.

The equipment, personnel and organisation of this infrastructure constitute a dynamic whole for serving the scientific community in the field of molecular and functional imaging and advanced imaging. It includes state-of-the-art technologies and resources to serve researchers in the field of biomedical imaging.

DISTRIBUTED ICTS

INTEGRATED INFRASTRUCTURE FOR ELECTRON MICROSCOPY OF MATERIALS (ELECMI)

This distributed ICTS includes four infrastructures:

- **National Centre for Electron Microscopy (CNME)** in Madrid, whose management is regulated by the General Foundation of the Complutense University of Madrid (UCM) and by the Vice-rectorate for Research and Science Policy of the UCM. It is located in the Faculty of Chemical Sciences of the UCM.
- **Advanced Microscopy Laboratory (LMA)** in Zaragoza, administratively dependent on the University of Zaragoza through the Institute of Nanoscience of Aragon and is located on the Río Ebro Campus in Zaragoza.
- **The Electron Microscopy Division of the University of Cádiz** is located on the Puerto Real Campus of the University of Cádiz and is part of this university's Central Scientific and Technological Research Services.
- **The Electron Microscopy applied to Materials Unit of the University of Barcelona** is located in the Barcelona Science Park and is part of this university's Scientific and Technological Centres (CCiT).

Together, they offer microscopy equipment with unique design factors that make them complementary in applications ranging from crystallochemical characterisation of materials to catalysis, materials for energy, functional and communications. They aim to develop, implement and offer the scientific community and industry, both nationally and internationally, the most advanced methods and techniques in electron microscopy that allow the observation, analysis, characterisation and manipulation of materials, whether inorganic and organic, with atomic resolution. It includes a wide range of transmission, scanning, microwave and force microscopy equipment and is equipped with state-of-the-art microscopes with aberration correctors.

DISTRIBUTED ICTS

INTEGRATED INFRASTRUCTURE FOR THE PRODUCTION AND CHARACTERISATION OF NANOMATERIALS, BIOMATERIALS, AND SYSTEMS IN BIOMEDICINE (NANBIOSIS)

This distributed ICTS is made up of

- The **Center for Biomedical Research Network (CIBER)**, in its area of Bioengineering, Biomaterials and Nanomedicine (CIBER-BBN). CIBER is a consortium that depends on the Instituto de Salud Carlos III (Ministry of Science and Innovation), was created in 2006 and is organised into thirteen thematic research areas. The CIBER-BBN area currently brings together 44 research groups selected throughout Spain on the basis of their scientific excellence, with the aim of carrying out translational research in Bioengineering, Biomaterials and Nanomedicine and transferring the results to industry.
- The **Jesús Usón Minimally Invasive Surgery Centre (CCMIJU)**, a public research centre, whose strategic mission is to contribute to increasing knowledge and use of technologies related to biomedicine and minimally invasive surgery. It is located in Cáceres.
- **BIONAND** was established in 2011 through an alliance between the Andalusian Regional Government and the University of Malaga, with the aim of bringing nanotechnology to the field of health by generating new systems for the diagnosis, prevention and treatment of diseases through the creation and development of devices and materials on a nanometric scale. BIONAND has recently integrated with the Biomedical Research Institute of Malaga(IBIMA), a Health Research Institute created in 2010 through an agreement between the Health Department of the Andalusian Regional Government and the University of Malaga, becoming part of the new IBIMA Institute - BIONAND Platform from 2022.

The ICTS NANBIOSIS is organised into five platforms: 1-Production of biomolecules, 2-Production of biomaterials and nanomaterials, 3-Preclinical validation: characterisation of tissues, biomaterials and surfaces, 4-Preclinical validation: bioimaging and 5-High-performance computing that integrates 26 complementary and coordinated units, located in different centres in Andalusia, Aragon, Catalonia, Galicia, Extremadura, Madrid and the Basque Country.

NANBIOSIS, through a one-stop system, provides integrated, tailor-made solutions to the challenges faced by researchers in nanomedicine, medical diagnostics and tissue engineering and regenerative medicine devices, including the design and production of bio-/nanomaterials and their nanoconjugates, and the characterisation of these and of medical tissues and devices, from a physicochemical, functional, toxicological and biological point of view until the preclinical *in vivo* validation. It offers solutions in multiple fields of application and its configuration allows for multidisciplinary cutting-edge studies.

INFRASTRUCTURE FOR OMICS TECHNOLOGY (OMICSTECH)

This infrastructure is made up of the following facilities:

- The **Sequencing Platform of the National Centro Nacional de Análisis Genómico (CNAG-CRG)** and the **Proteomics Platform of the Centre for Genomic Regulation (CRG)**. The CNAG-CRG has a fleet of second- and third-generation DNA sequencers capable of producing more than 10,000 Gigabases of sequence per day, which is equivalent to 100 complete human genomes every 24 hours. It is the largest genomics centre in Spain and one of the infrastructures with the highest sequencing capacity in Europe. The CRG Proteomics Platform is located at the Parc de Recerca Biomédica de Barcelona and owned by the Pompeu Fabra University. It has the most advanced mass spectrometers and offers complete proteomics services through quantitative techniques based on mass spectrometry that complement the genomics services offered by the Sequencing Platform.

- The **Metabolomics Platform of the Centre for Omic Sciences (COS)** is owned by the Rovira i Virgili University and managed by the Eurecat Technology Centre. This platform has a complete infrastructure with various mass spectrometry equipment coupled to both liquid and gas chromatography for a complete analysis of the metabolome, and also has the capacity to perform this by nuclear magnetic resonance. In addition, the integration of multiple technologies in genomics, metabolomics and proteomics allows the use of the most suitable ones, or a combination thereof, in order to more accurately determine the metabolic profile of a biological system. Metabolome studies aim to improve the diagnosis, prevention and monitoring of various diseases through the metabolic profiling of any sample of biological origin. The COS metabolomics platform is an analytical facility designed to offer state-of-the-art metabolomics services to researchers in various scientific fields (basic research, health and biomedicine, animal and human nutrition, pharmaceutical and environmental industries, etc.).

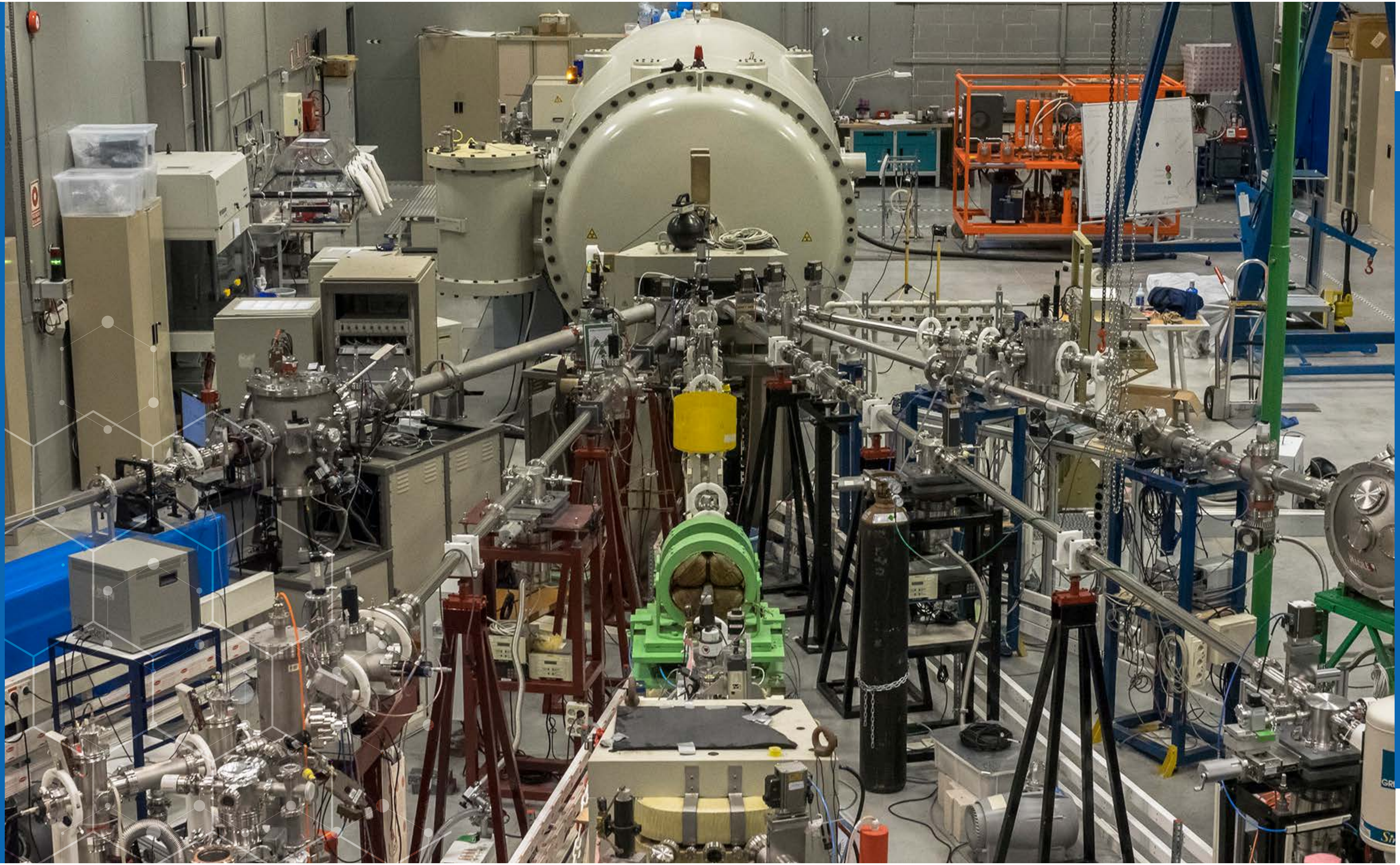
As a whole, this ICTS has the full spectrum of technologies needed to analyse all the elements that make up biological systems, including DNA, RNA, epigenomic markers, proteins, metabolites and structural elements such as membranes.

MARITIME AGGREGATED RESEARCH HYDRAULIC INFRASTRUCTURES (MARHIS)

MARHIS (Maritime Aggregated Research Hydraulic Infrastructures) is a distributed ICTS that aims to increase the competitiveness and efficiency of Spanish ICTSs in the field of maritime hydraulic engineering (coastal, port and offshore) by offering its infrastructures and associated technological services in a coordinated way. It is made up of:

- **Gran Tanque de Ingeniería Marítima de Cantabria / Cantabria Coastal and Ocean Basin (GTIM-CCOB)**, located in the Parque Científico y Tecnológico de Cantabria (PCTCAN, Santander) and managed by the Environmental Hydraulics Foundation.
- **Integrated Coastal Infrastructures for Experimentation and Modelling (iCIEM)**, managed by the Laboratorio de Ingeniería Maritima, a specific research centre of the Universidad Politécnica de Cataluña BarcelonaTech (LIM/UPC) and distributed in different locations in the coastal area of Barcelona.
- **El Pardo Hydrodynamics Experiences Centre (CEHIPAR)**, which depends on the Instituto Nacional de Técnica Aeroespacial (INTA) and is located in El Pardo (Madrid).
- **The Biscay Marine Energy Platform (BiMEP)**, a public company of the Ente Vasco de la Energia (EVE) and the Instituto para el Ahorro y la Diversificación Energética (IDEA), located in the open sea, has a restricted navigation area of 5.3 km^2 in the open sea off the coast of Armintza (Lemoiz, Biscay).
- **Test site of the Oceanic Platform of the Canary Islands (PLOCAN)** managed by the PLOCAN Consortium (co-financed in equal parts by tSpanish government and the Canary Islands regional government), located in the open sea in the municipality of Telde (Northeast of the Island of Gran Canaria) in a 23 km^2 area reserved for scientific and technical experimentation.

Among the different European policies aimed at combating climate change, those aimed at substantially reducing CO^2 emissions stand out, and these are also accompanied by policies linked to the "blue economy". In this sense, facilities such as MARHIS are essential to support and enable the development of technological innovations for generating electricity using clean energies.



INFRASTRUCTURE FOR ACCELERATOR-BASED APPLICATIONS (IABA)

It provides the scientific and industrial community with the best set of instruments in the field of linear accelerators, covering biomedicine, material sciences, pharmacology, environmental sciences, nuclear physics and instrumentation, among other areas. It consists of two nodes:

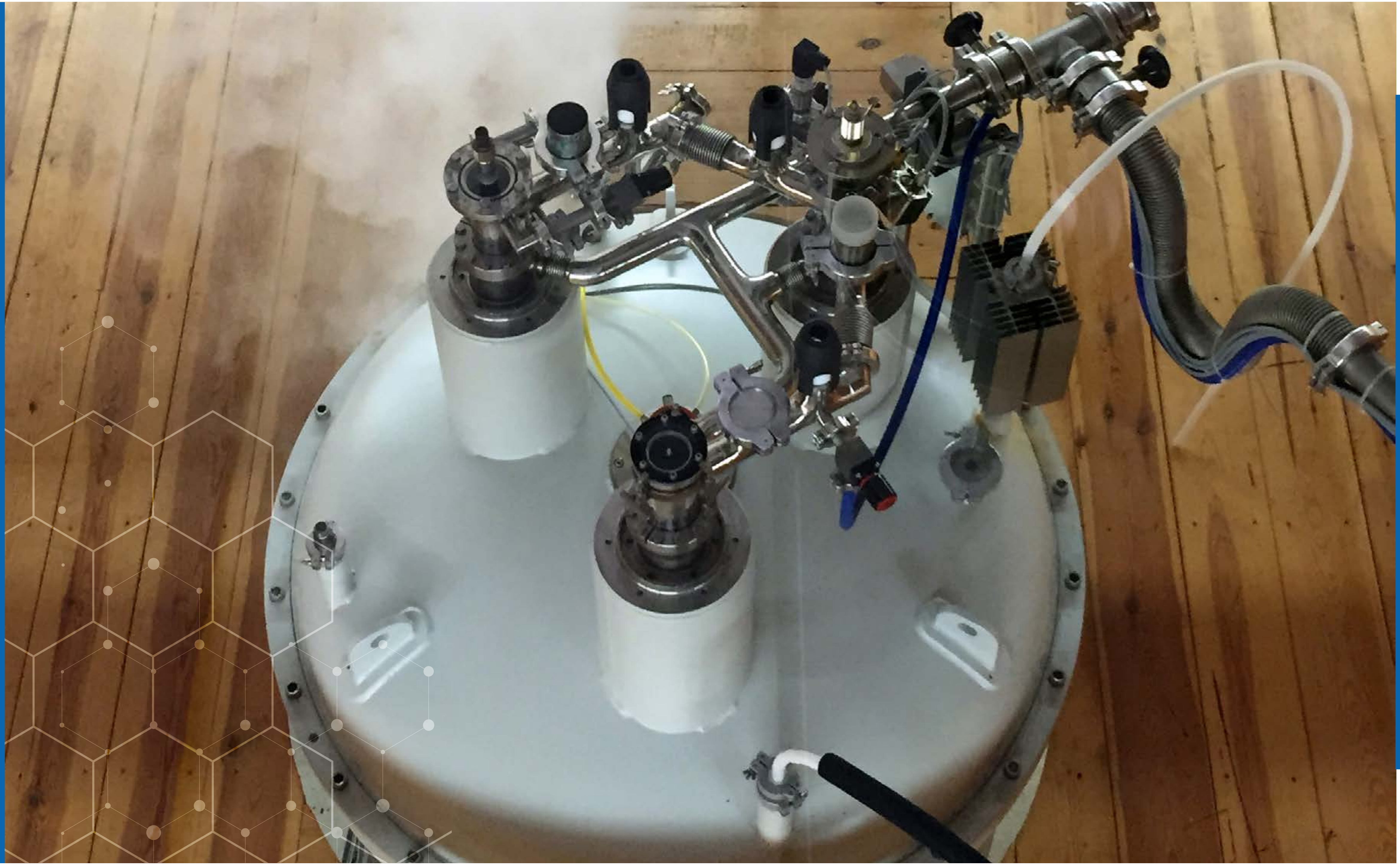
- The **National Accelerator Centre (CNA)** emerged in 1998, being the first Spanish research centre with particle accelerators. Located in the Cartuja Science and Technology Park, it is a joint centre of the University of Seville, the Regional Government of Andalusia and the Spanish National Research Council (CSIC). It has six facilities. Four accelerators: a 3-MV Tandem van der Graaff type for the application of analysis techniques, with an associated measurement service using IBA (Ion Beam Analysis) techniques; a 1-MV Tandem Cockcroft-Walton type Tandetron for the application of the accelerator mass spectrometry technique (AMS); a dating system called MiCaDaS (Mini Carbon Dating System) that reduces, cheapens and simplifies ^{14}C dating analysis, and is unique in our country; and a cyclotron that provides protons of up to 18 MeV with two different uses, irradiation of materials and production of radioisotopes. A PET/CT scanner for humans makes it possible to carry out studies with short half-life radiopharmaceuticals that could not be carried out in any other way. It also has a ^{60}Co irradiator, which is currently the most intense nationally and one of the most versatile irradiators available today.
- The **Centre for Micro Analysis of Materials (CMAM)** is a research centre belonging to the Autonomous University of Madrid (UAM), the result of an initial project funded through the ERDF programme, assisted by an Advisory Committee made up of prominent members of the Spanish scientific, cultural and academic community. CMAM's main experimental tool is an electrostatic ion accelerator with a maximum terminal voltage of 5 million volts, which is dedicated to the analysis and modification of materials. CMAM operates its accelerator with six beamlines, complemented by several auxiliary scientific tools and laboratory support spaces. These lines are available for materials analysis and modification: Standard Multipurpose Line (STD), External Microbeam Line (EuB), Time-of-Flight Line (ERDA-TOF), Nuclear Physics Line (NUC), Implantation Line (IMP) and Femtosecond Laser and Internal Microbeam Line (IuB).

DISTRIBUTED ICTS

NETWORK OF HIGH BIOSAFETY LEVEL LABORATORIES (RLASB)

This network includes High BiosafetyLevel Laboratories that are open to the scientific community at national and international level and which, due to their size and/or the characteristics of their facilities, offer a unique opportunity to carry out studies that would not be feasible in other conventional centres. The network is made up of two facilities:

- High Biosafety Laboratory of the Animal Health Research Centre (CISA) located in Valdeolmos (Madrid). It belongs to the National Institute for Agricultural and Food Research and Technology (INIA/CSIC), a public research body under the Ministry of Science and Innovation. It occupies 10,824 m^2, with 40 BSL-3 (WHO) laboratories and 2 BSL-4 (OIE) laboratories. The NCB4 laboratories (OIE) are unique in Spain and are designed for studies with infectious agents that could affect humans. It has 19 experimental animal house rooms and auxiliary areas, 4 of them at BSL-4 (OIE) level, designed to house anything from fish to large animals. It is the only Spanish facility authorised to use the foot-and-mouth virus *in vivo*. It is a reference for the FAO in Biosecurity. CISA participated very actively in the fight against the COVID-19 pandemic and continues to play an important role, also in the R&D on SARS-CoV-2 in the framework of collaborations between CISA groups and external groups from different sectors, human, animal and environmental, involving public entities, different institutions and universities and private companies.



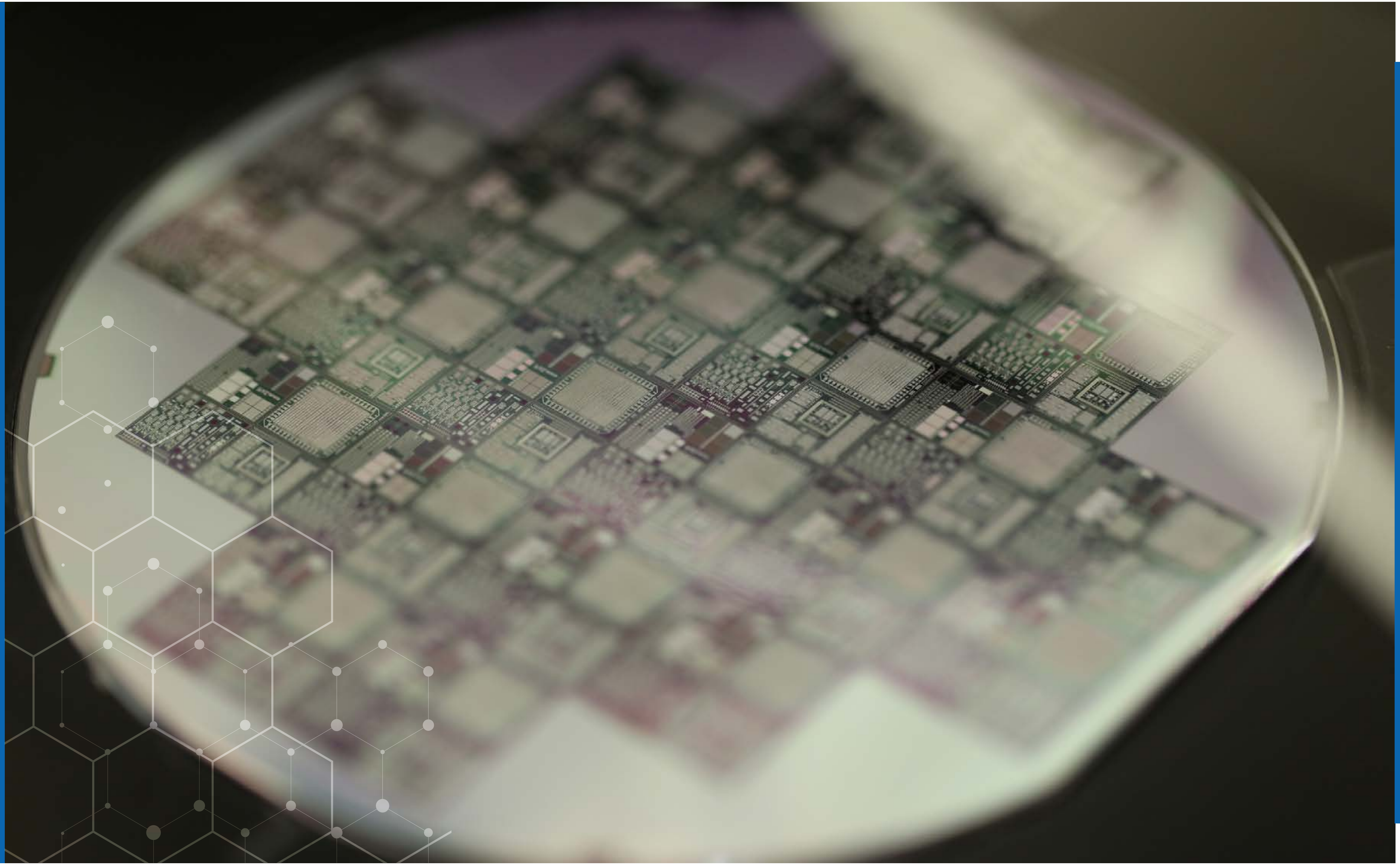
BIOMOLECULE NUCLEAR MAGNETIC RESONANCE LABORATORY NETWORK (R-LRB)

This ICTS is made up of three facilities:

- **The Barcelona Nuclear Magnetic Resonance Laboratory (LRB)**, installed in the Barcelona Science Park and part of the Scientific and Technological Centres (CCiT) of this university. It is located in a 722 m^2 space specially designed to house high-field Nuclear Magnetic Resonance (NMR) spectrometers, with a vibration-free environment, thermally regulated to ensure high stability and low magnetic interference. The facility has been in operation since 2000.
- **The Manuel Rico Nuclear Magnetic Resonance Laboratory (LMR)** of the Rocasolano Institute of Physical Chemistry of the Spanish National Research Council (CSIC), located in Madrid. It began its activity in 1964, when it acquired its first Nuclear Magnetic Resonance (NMR) spectrometer, being a pioneer in this respect in Spain.
- **The Basque Nuclear Magnetic Resonance Laboratory (LRE)** of the Cooperative Research Centre in Biosciences (CIC-bioGUNE) located in the Biscay Technology Park in Derio, opened its facilities in 2005.

This ICTS brings together the facilities with the most advanced NMR equipment in Spain, open to the entire scientific, technological and industrial community. It has a wide range of instruments with fields between 18.8-11.7 Tesla corresponding to proton frequencies between 800 and 500 MHz. The installation of two new 23.5 T instruments (1 GHz proton frequency) and the extension of the solid NMR capabilities are planned.

NMR is used to study a wide range of areas such as the structure and dynamics of biomolecules, functional biology (*in vivo* NMR), drug identification and optimisation in pharmaceutical research, including drug release, structural identification in organic and inorganic chemistry, food technology and new materials.



MICRO AND NANOFABRICATION CLEANROOMS NETWORK (MICRONANOFABS)

MICRONANOFABS is a distributed facility dedicated to Micro-Nano Fabrication and Photonics, three areas of activity that have been considered Key Enabling Technologies (KETs) by the European Commission for their key contribution to the development of innovative products for our daily life.

This distributed ICTS provides the scientific community and industry with more than 2,000 m^2 of Clean Room area (class 10-100-1,000), together with associated laboratories for the encapsulation and characterisation of systems and devices. In recent years, thanks to ERDF funding, the equipment is being upgraded to process 15 cm and 20 cm wafers and to meet new challenges such as quantum computing and communications, advanced applications in photonics and 2D materials.

The MICRONANOFABS facilities are distributed in the following nodes:

- **Integrated Micro and Nano Fabrication Clean Room of the National Microelectronics Centre (SBCNM)**, which depends on the Spanish National Research Council (CSIC) and is managed as part of the Barcelona Microelectronics Institute, located in Bellaterra.
- **Centre for Technology of the Institute of Optoelectronics Systems and Microtechnology (CT-ISOM)**, a University Research Institute attached to the Polytechnic University of Madrid (UPM), located at the School of Telecommunications Engineering in Madrid.
- **Micro and Nanofabrication Infrastructure of the Nanophotonics Technology Centre of Valencia (INF-NTC)**, attached to the Polytechnic University of Valencia (UPV).

The three facilities provide services in the fields of micro and nanoelectronics. They develop and apply innovative technologies in almost all scientific areas, such as health, biomedicine, environment, food, energy, mobility, security, communications, and consumer electronics.

Each Micronanofabs node has special characteristics and complementary research lines in the field of micro- and nanotechnology, nanoscience, optoelectronics, photonics, nanophotonics and characterisation of devices and materials. To this end, the nodes are coordinated to have a global technology offer operating in a distributed manner. Contracting distributed services provides global access to facilities in a combined access to technologies and equipment from two or three nodes or from a single node.

MICRONANOFABS belongs to the European nanofabrication network EUROnanoLAB.

Publication included in the 2023 Editorial Program of the Ministry of Science and Innovation.

General catalogue of official publications https://cpage.mpr.gob.es

The authorship of this publication corresponds to the Ministry of Science and Innovation.
General Secretariat for Research
General Sub-directorate for Large Scientific-Technical Facilities

We are grateful for the collaboration of all Unique Scientific and Technical Infrastructures (ICTS) and the entities that have made this document possible.

Edited by: General Technical Secretariat of the Ministry of Science and Innovation.

Design: Fundación Española Para la Ciencia y la Tecnología (Spanish Foundation for Science and Technology)

NIPO: e.831230297

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