



IGFAE
Instituto Galego de Física de Altas Enerxías



**XUNTA
DE GALICIA**

Service Catalogue

2022



**EXCELENCIA
MARÍA
DE MAEZTU**

Instituto Galego de Física de Altas Enerxías (IGFAE)

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WHAT IS IGFAE?

Galician Institute of High Energy Physics (IGFAE) is a common research centre linked to Universidade de Santiago de Compostela (USC) and Xunta de Galicia, created in 1999. This centre is part of CIGUS network with other Galician university research centres. It is a high-quality centre in R&D, recognized as Maria de Maeztu's excellence unity in 2017, being the unique Galician research centre owning a national excellence seal.

Mission

Our main mission is promoting and coordinate technical and scientific research in high energy physics field, particle physics, nuclear physics and related topics as astrophysics, medical physics, instrumentation, etc. For us is crucial to promote relations with big experimental facilities, such as CERN, GSI/FAIR and Pierre Auger Observatory.

Our recent activity is defined mainly by scientific production good performance, talent attraction and fundraising, international activity, especially among big experimental collaborations (LHC, GSI/FAIR, Auger...) and activating a new frame for organizing research in terms of Strategic Research Areas (SA).

We are accomplished with society, so innovation and technology breakthroughs developed here are continuously evaluated in order to transfer their potentials to the community.

Goals

- Improve scientific performance
- Explore potential synergies between IGFAE groups and other research teams
- Increase research facilities efficiency and technological capacities
- Stablish a responsible research and development strategy
- Adapt management to the best international practice

KNOWLEDGE & TECHNOLOGY TRANSFER

The IGFAE is a research reference centre with its own collective agreement that favours reconciliation of work and family life, promotion, training, and professional development, including Innovation, Knowledge, and Technology Transfer Actions. For this last purpose, the IGFAE KTT Unit ensures that any researcher joining our team will have all resources at hand. The KTT Unit supports IGFAE researchers in finding connections with industry, intellectual protection actions or spin-off/start-up creation. We have a commitment with Innovation, Technology Transfer and Entrepreneurship as one of the main ways of professional education of the university community.

The KTT Unit team is trained in identify transferable research results, assess commercial potential, IP, manage contracts for transfer results, support and advice on industrial initiatives, executive formation, and also provide training related to KTT. Additionally, our KTT Unit has a close collaboration with the USC Valuation, Transfer and Entrepreneurship Area, which is the service in charge of the dissemination and promotion of the KTT culture among the university community, among others.

For KTT inquiries, contact the Innovation Knowledge and Technology Transfer Officer [here](#).

ENVIRONMENTAL RADIOACTIVITY



IGFAE and its LAR (Laboratory for the Analysis of Radiation) count with more than 15 years of expertise analysing water environmental radioactivity, as well as that in soils and interiors for customers as city halls and other government buildings, education centers, clinics and hospitals or technology companies.

Our laboratories are equipped with most sophisticated radiation measurement devices, managed by a researchers team highly specialized with quality certification ISO 9001:2015.

Radon in Galicia

Radon is a radioactive gas, colorless, flavorless and odorless produced by uranium disintegration from the earth's crust. Inhaling this gas is the second lung cancer cause according to WHO.

European directive 2013/59/EURATOM indicates that radon concentration levels at interiors must maintain below 300 Bq/m³, which is surpassed by 12% of Galician houses according to Min. de Fomento.

Radon measurement

In LAR we offer a global service for radon gas concentration measurement and mitigation at interiors using integral cycle technics. We work in association with INTERA SL, a technology-based company participated by USC and formed by IGFAE and an engineering construction company, gaining knowledge and expertise.

We have various radon concentration measure methods at interiors: active carbon filters for immediate detection, trace detectors for average concentration measurements such that continuous measurer for time evolution conditions study.

Mitigation measures included are based in own developments such as gas entrance focus determination, such that mitigation solution proposals or initiated actions efficiency evaluation.

Radioactivity measurements in water

That LAR service offers determination of all radioactivity parameters as they're defined at Real Decreto 314/2016, current regulation for human consumption water.

We offer radon concentration measurement, tritium content and Total Indicative Dose (DIT) which guarantees adequate conditions.

Radon measurements in soils and materials

Capabilities of experts here in IGFAE include technologies relevant in building industry as:

Radon Exhalation Coefficient determination of a soil in order to know radioactivity activity on a land or plot.

Radon Diffusion Coefficient measurement at different materials for certificate them as adequate anti-radon barriers for building materials such as concrete or thermal insulation and humidity membranes.

SOLUTIONS IN RADIOACTIVE MEDIA

Electronic devices and materials used for experiments in IGFAE require a design, manufacture and study highly specialized that bears extremely radioactive medium where their projects take place.

This experience makes IGFAE researchers highly qualified professionals for problem-solving at this kind of environment.

Electronic devices characterization

Device conditions simulation while assemblage and working stage as well as detailed properties and behavior characterization including the complete cycle:

- Initial non irradiated material or device study.
- Element irradiation inside a nuclear reactor for a desired flux.
- Device's activated elements study.
- Electrical behavior device study since irradiation.
- Welding resistance study.
- Irradiated material transport and placement in safety conditions.

Structure materials and textile study

Used to aggressive work conditions of particles accelerators, IGFAE researchers are experts in materials adequate for this kind of medium, which confirms them as referents in study of structural materials of facilities in aggressive media.

This experience is directly applicable in textile and biological tissues, analysis their properties after suffering irradiation.

Clean Room

IGFAE owns a clean room ISO 8 (class 100,000), equipped with the latest technology needed for testing devices which will be installed at LHC in the future.

Available equipment includes ultrasonic automatic microwelding machine model K&S 8060, precision dynamometer (pull tester) for microwelding test, probes station for sensors and chips electrical tests, stereoscopic microscope for inspection and quality control...



3D print

Additive manufacturing let us effectively obtain pieces affording outgoes, reducing manufacturing time to a tenth part.

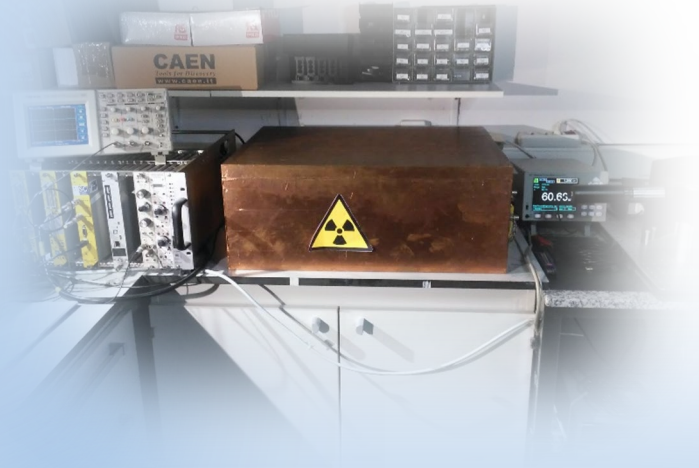
IGFAE members are experts in radioactive exposed 3D print materials as well as humidity and vacuum exposed. Thus, they are expert advisors in additive manufacturing technologies at industrial processes as well as design and optimization stage of 3D models.

LABORATORIES

Detectors development laboratory

Advanced detection systems for nuclear physics experiments are developed in this laboratory. This facility can be adapted depending on what is needed.

IGFAE members collaborate with the first experiment where relativistic heavy ions beam involved in peripheral nuclear reactions will be detected at complete kinematics. It takes part on the collaboration R3B of FAIR.



The contribution to this experiment consists in designing and build CALIFA detector, a scintillator crystal based calorimeter which can detect charged particles and high energy gamma radiation.

Our laboratory is equipped with an environmentally controlled workplace, capable of build, ensemble and characterize these detectors.

Gaseous Detectors Laboratory

The Gaseous Detectors Laboratory at IGFAE is meant for the development of several kind of gaseous detectors with numerous applications.

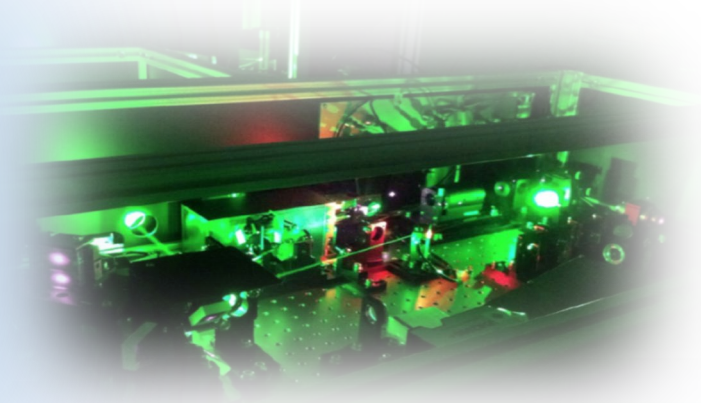
The most innovative research line addresses the development of a new concept of gaseous detectors for neutron detection with application in industrial scanners and security.

In addition, we study scintillation in high pressure gases and start-up an optical mode gas temporal projection chamber as well. These efforts contribute to neutrinos physics study lead by NEXT and DUNE experiments where IGFAE is a collaborator.

Laser acceleration laboratory

We count with a R&D platform for develop related femtosecond laser technology and proton and ion laser acceleration, especially for medical image radiotracers production.

This technology opens new possibilities in short mean life radiotracers dose production on demand. Its low price and high operability make them a great alternative to cyclotrons.

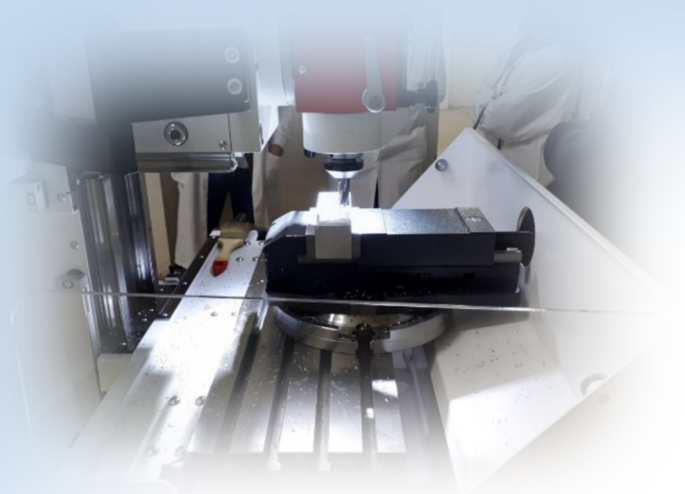


High precision micro-machining laboratory



This laboratory let us build small and median mechanical structures precise enough for making proofs of concept or constructing detector prototypes and structures.

The laboratory is dotted with numeric controled systems such a lathe EMCOMAT EM14D, a milling machine FB-3L, a Pocket NC and some 3D printers. The IGFAE personnel is specifically trained in the use and maintenance of that equipment.



DATA SCIENCE

Data science is a multidisciplinary field which joins together statistical knowledge and coding for acquire knowledge from data using traditional methods as data mining and more advanced ones as machine learning. It allows complex data treatment and low-level structured ones for patterns detection, future predictions, or processes optimization.

Acquiring and managing this huge amount of data is necessary for many companies that understand data as a main value for a company, thus exploiting data correctly is relevant for being competitive nowadays.

Here in IGFAE we gather more than 30-year experience and knowledge on the highest academic level using advanced techniques embracing the complete data lifecycle: since data capture to information extraction.

Data capture

Organizations produce data continuously no matter they measure and storage them or not. In recognition of these lost, capturing data increasingly concerns.

This process complexity is familiar for IGFAE, used to 3 Tbits/s captures rate. Our proficiencies in this topic include:

- Design, installation, calibration, high level measurers' configuration.
- Data transfer lines design for high velocity data capture management.
- Decision systems design for high volume data capture.

Data analysis and modelling

Data processing and modelling for obtaining predictive available data behaviors is an important component of IGFAE professionals' daily work.

Capabilities IGFAE embraces on this area are statistical advisory and data analysis, multivariable analysis, correlations study, inferential statistics, Bayesian analysis, experiments design, modelling, etc.

One of the applications of data mining is process mining, which allows analysing business processes from any events register and thus create a processes outline.

IGFAE's teams, used to high volume data usage, acquisition speed and variety, also can apply Big Data technics for data treatment as Grid does.

Industrial processes optimization

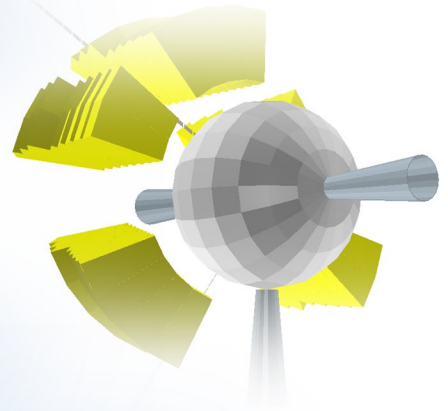
Every technic applied by IGFAE in particle physics can be used to improve industrial processes and find optimal operating points. Due to huge amounts of data to be managed and their different origin, it is not possible to execute this task with conventional techniques, but it is necessary to use an algorithm which treats the company as a whole.



MODELLING AND SIMULATION

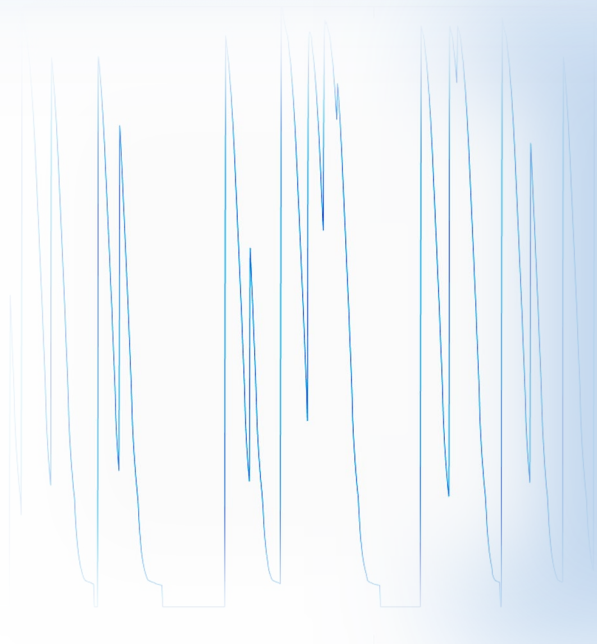
Physicists and specifically those working on particle phenomenology are distinguishable by modelling and simulating any type of system, from tiniest to biggest one in the universe.

Modelling consists in represent a system taking account only what is of interest for problem-solving. Meanwhile, simulating means reproduce a system over time in order to predict and describe behaviors.



Here in IGFAE we create new knowledge for high performance modelling and simulating based on our experience in numerical analysis, algorithm design and physical processes modelling.

Systems and processes modelling as well as computer simulations are both high demanded services by industry with applications on different sectors as aeronautics, automotive, navy, aggro food, biomedicine, economy, finance, energy, environment, telecommunications, logistic, transport, materials or construction.



R&D

IGFAE is an international reference centre in research and development due to three decade accumulated experience on developing leading projects as well as about 150 professionals that take part on it publishing 130 peer-reviewed scientific papers per year.

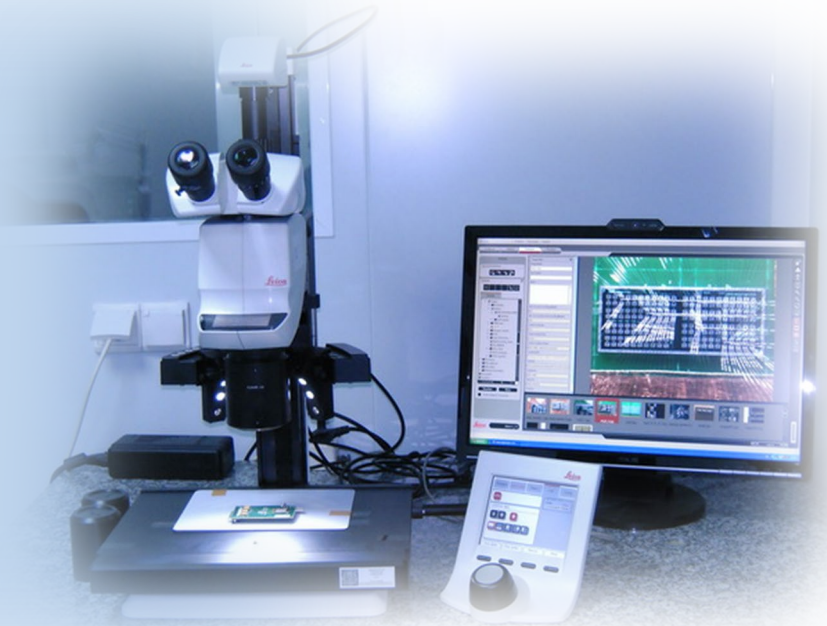
Recognized as María de Maeztu's excellent unity in 2017, we count with knowledge, expertise, high technology facilities and equipment necessary for collaborate in R&D projects and in numerous working lines.

Micro-radiography and micro-tomography

Ultra power X-ray production (up to order of TW) and ultra short (up to order of fs) using laser offers a broader potential for phase contrast based image new technologies' development due to its high bright and low aperture.

Microelectronics

Experiments researching into new phenomena and yet unknown subatomic particles requires devoted detectors. These need to be developed for experimental setups such as of the LHCb experiment at CERN, nuclear experiments like R3B at FAIR, and of astrophysics experiments (dark matter, neutrino experiments).



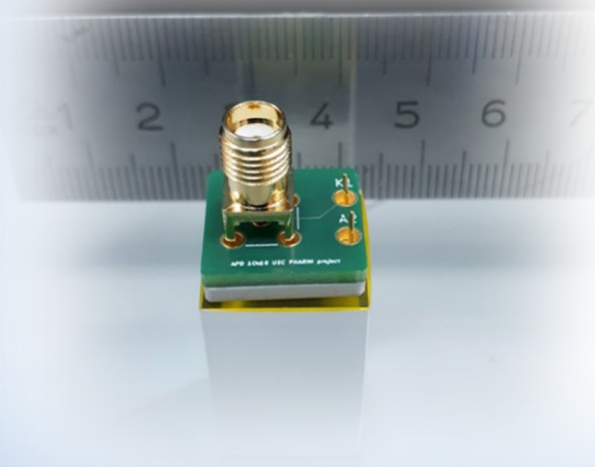
For the future, the institute is contributing to the high luminosity run of the LHC (HL-LHC) (LHCb Upgrade phase II) and is planning on contributing to the instrumentation of gravitational waves experiments.

In the IGFAE we have infrastructures to design, prototype and test once produced electronics for all these types of research programs.

There is a laboratory for the characterization and construction of silicon detectors. It has a clean room (30 m2 upgradable, class 100000) with a wedge bonding machine and different equipment to test silicon sensors. A second laboratory devotes to develop micro-electronics (SMD population and reworking laboratory) and a third laboratory to readout systems development, equipped with state of the art DAQ systems and oscilloscopes.

Design and creation of specific sensors and radiation detectors

IGFAE professionals account more than 30-year experience in design, construction, characterization and operation of any kind of sensors and particle and radiation detectors at huge international collaborations with organizations as CERN, GSI, FAIR, Auger or Next. For several years, many systems designs, developed or built at IGFAE were successfully installed and operated in a big variety of facilities, experiments and environments, such as the Cosmic Ray detector operated at the "Juan Carlos I" Spanish Antarctic Base.



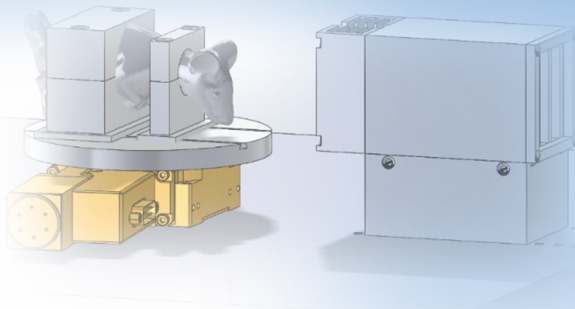
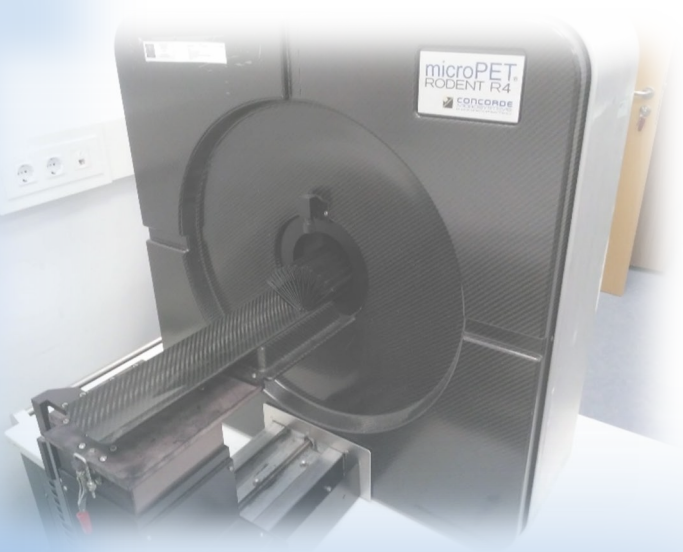
High performance data networks

Particle physics experiments currently need high speed data acquisition and storage. In order to satisfy these requirements, acquisition system's hardware and firmware must have specific characteristics not present in commercial products.

Here in IGFAE we offer possible collaborations with companies and institutions due to develop new hardware or high-performance data acquisition systems.

PET facility

Positron Emission Tomography is a technique based in particle physics applied to medical image. Within the IGFAE research area "Nuclear Physics from the Lab to Improve People's Health" we develop and design novel detectors for this application and compare their performances with a commercial system.



Besides our own developments, In the PET laboratory we operate a Siemens Microsystems MicroPET Focus 220 for preclinical purposes, in collaboration with the Molecular Medical Imaging group of the Vall d'Hebron Institut de Recerca.

TRAINING

Most of permanent IGFAE members are Professors of Universidade de Santiago de Compostela. We contribute not only on academic formation (degree, master, PhD) but also IGFAE offers high level training courses in subjects as quantum computer or data management.



In addition, we regularly offer training courses, outreach activities and workshops to the high school students and teachers in Galicia and beyond.



PARTNERSHIPS

