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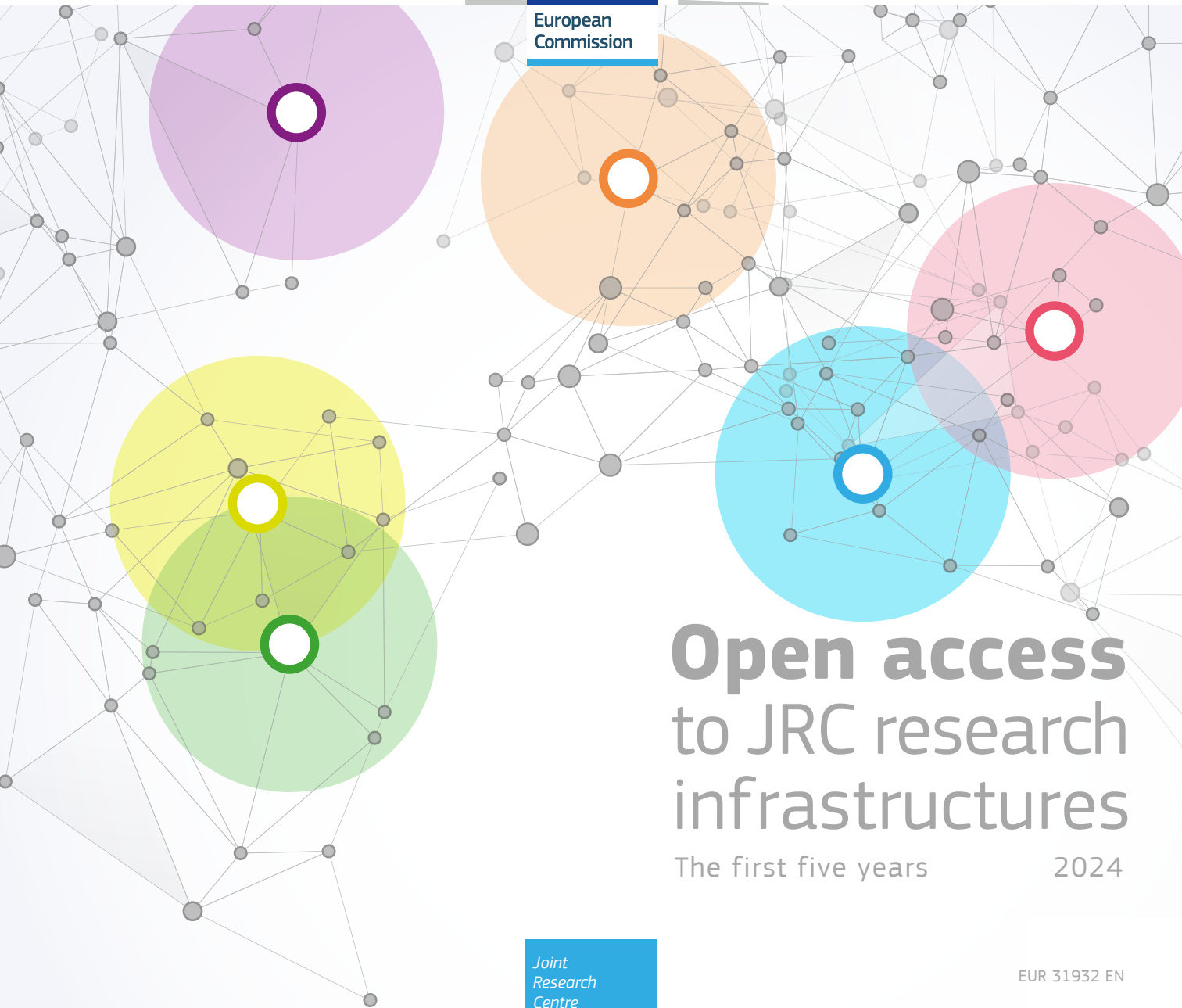

European Commission

Open access to JRC research infrastructures

The first five years 2024

Joint Research Centre

EUR 31932 EN

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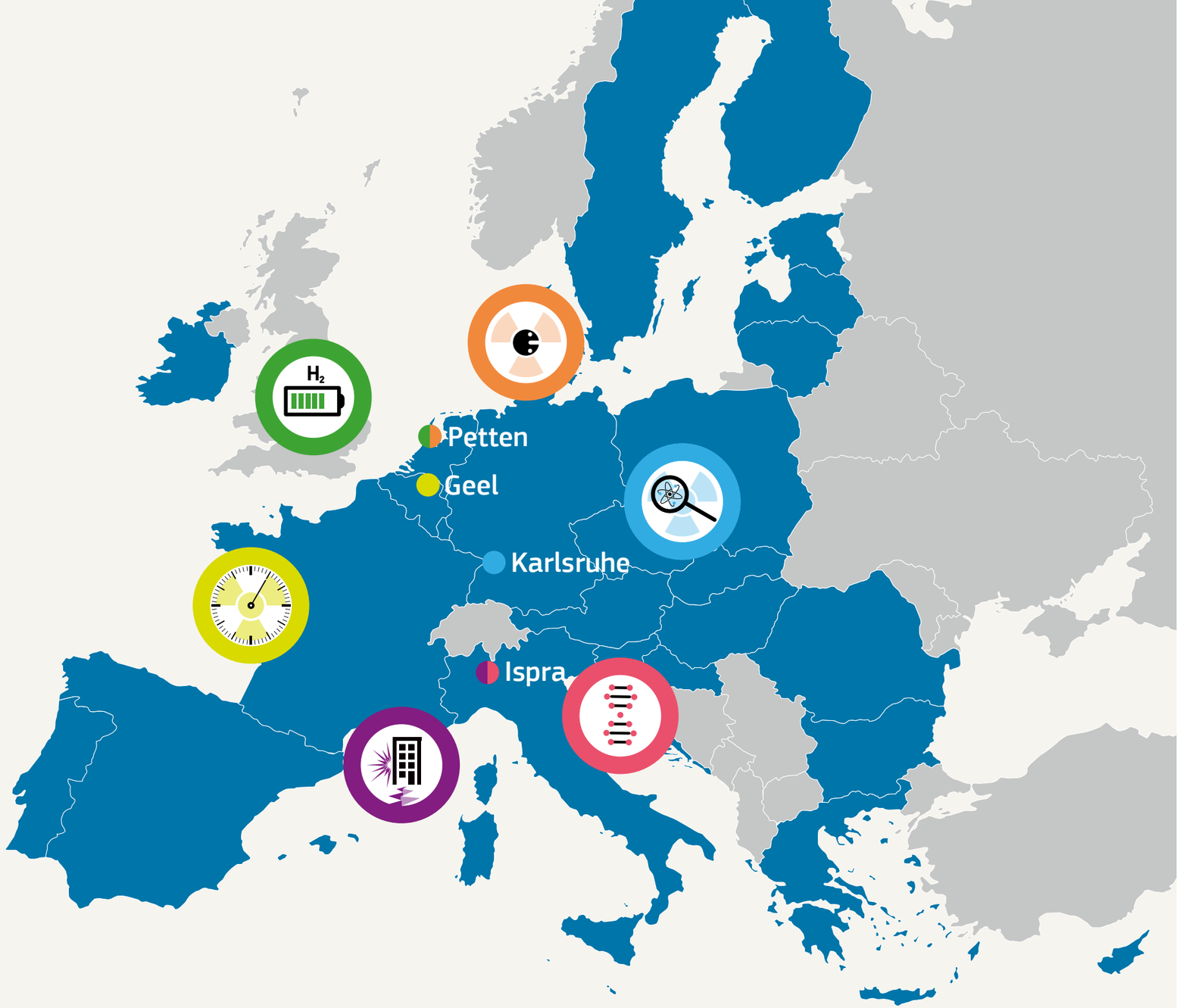
CONTENTS

Open access to JRC research infrastructures

The European Commission's Joint Research Centre (JRC) gives leading researchers from across Europe and beyond access to its world-class facilities and laboratories, enabling state-of-the-art experimental research, collaboration and capacity building with a European dimension. It does so through the programme for open access to JRC research infrastructures.

The JRC is the science and knowledge service of the European Commission. The JRC employs scientists to carry out research providing independent scientific advice and support to EU policy, tackling the big challenges our societies are facing today.



The JRC hosts 53 high-value research infrastructures, most of which are unique at European and international level. Of these, 36 can open access to external users in various fields of science: nuclear and radiological; chemistry; biosciences and life sciences; physical sciences and ICT. JRC's research infrastructures are located in Ispra (Italy), Geel (Belgium), Karlsruhe (Germany) and Petten (The Netherlands). These infrastructures (i.e. laboratories) are fit for experimental work generating data for users' analyses.

The main objectives of opening access to JRC research infrastructures are to:

- Establish a fair, clear and transparent procedure for giving access to external users of the JRC's physical research infrastructures;
- Maximise the use to the full potential of JRC physical research infrastructures in collaboration with researchers and industry.

Benefits of accessing JRC research infrastructures

Granting access fulfils scientific needs and provides benefit to the research of external users accessing JRC facilities. These can be summarised as follows:

- Access to JRC research infrastructures based on open calls for competitive access allows European users not traditionally engaged with the JRC to have access through a transparent procedure;
- Research infrastructures attract talent and stimulate innovation and development. Enabling access to JRC research infrastructures enhances competitiveness, through pre- and co-normative research, and contributes to bridging the gap between research to industry, e.g. through the setting up of demonstration projects for product validation;
- Access to JRC research infrastructures contributes to the dissemination of knowledge, improves related methods and skills, provides educa-

tion and training and fosters collaboration at European level;
- Granting access within a structured framework maximises the return on taxpayers' funded investment that the JRC has made on its research infrastructures, making them available to external users in view of the limited resources now existing in Europe.

Modes of access to JRC research infrastructures

The JRC opens its research infrastructures to users from academia and research organisations, industry, small and medium enterprises (SMEs), and more in general to the public and private sector from institutions located in EU Member States and countries associated to the EU Research Programme Horizon Europe (for nuclear, countries associated to the Euratom Research Programme).

Access is offered in two access modes: relevance-driven and market-driven.
The **relevance-driven mode** is mainly opened to academia and SMEs following a peer review selection of proposals responding to an open call. Users pay the additional costs of access and the generated data is opened for free dissemination after an 18-month embargo period.

Proposals in the relevance-driven access mode are peer-reviewed by a User Selection Committee composed of experts from academia and research institutions at European level. The evaluation is carried out with regard to scientific implementation, collaboration and access to new users, strategic relevance to the JRC and strategic importance for Europe. The procedure for submission and evaluation of proposals is published in https://joint-research-centre.ec.europa.eu/tools-and-laboratories/open-access-jrc-research-infrastructures/framework-access-infrastructures_en

The **market-driven mode** is mainly directed to industry. The calls are opened on a continuous basis and proposals are selected by the JRC. Users pay the full costs of access and data are not openly disseminated.

The JRC facilitates access in the relevance-driven mode

The JRC waives the access costs to non-nuclear research infrastructures, under certain conditions, to institutions located in countries eligible for widening actions under the Horizon Europe specific objective "Widening participation and spreading excellence". Access to nuclear research infrastructure is free of charge.
The JRC also supports the travel and subsistence of users visiting JRC research infrastructures, subject to the availability of funds, personnel and other resources:
- For non-nuclear research infrastructures, to users from institutions located in countries eligible for the widening actions under the Horizon Europe specific objective "Widening participation and spreading excellence";
- For nuclear research infrastructures, to users from institutions located in Members States and countries associated to the Euratom Research Programme, as part of the pilot action on open access to JRC research infrastructures in the field of nuclear safety.

Training and capacity building at JRC research infrastructures

The JRC provides training and capacity building to researchers and technicians from institutions in Member States and countries associated to the EU Research Programme Horizon Europe. It does so through the opening of calls for proposals internally selected by the JRC.

Successful proposals allow users to visit JRC research infrastructures for short periods to be trained by JRC staff on the operation, use and capabilities of its non-nuclear research infrastructures.

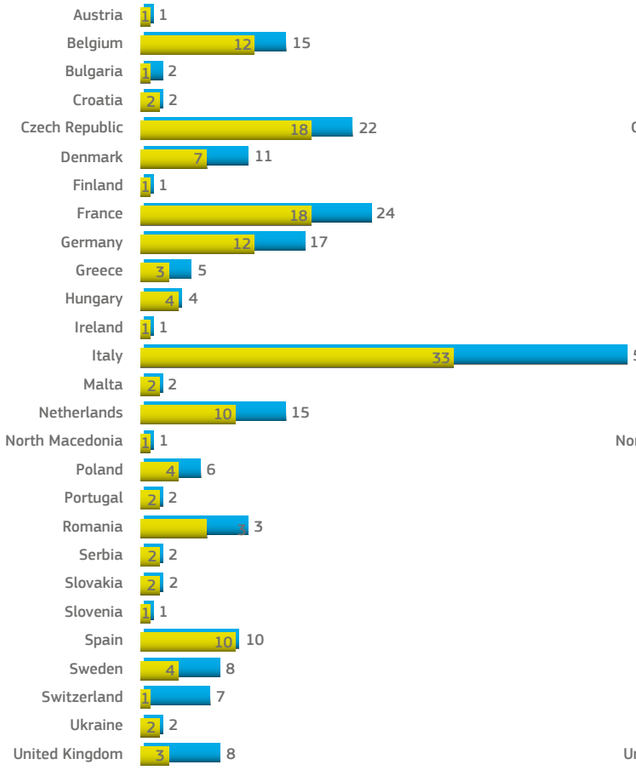
The programme enhances the skills of users from institutions operating or planning to build or upgrade research infrastructures similar or complementary to those of the JRC. The programme also creates awareness for potential users to submit proposals to carry out experimental research under the programme for open access to JRC research infrastructures.

Access for training and capacity building is free of charge and the JRC provides support for travel and subsistence under the same conditions as for the open access programme.

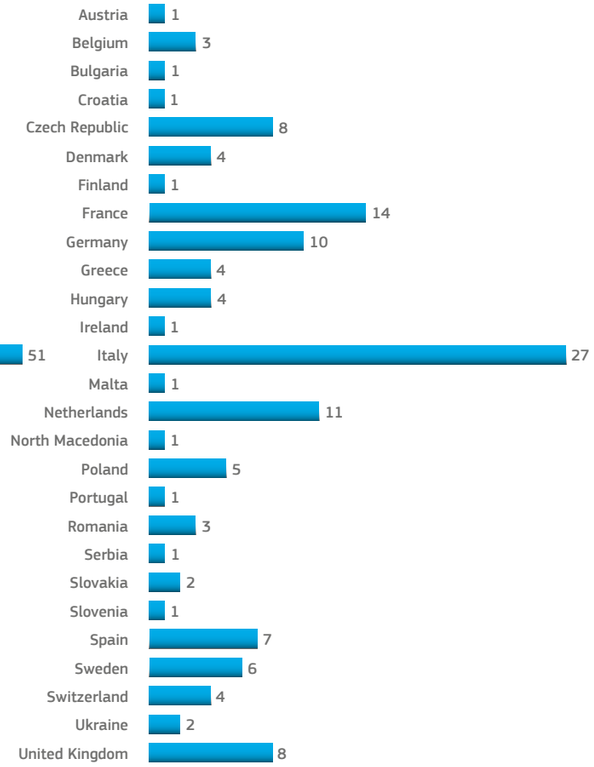
Access to JRC research infrastructures from 2017 until end of 2023

Number of projects per country

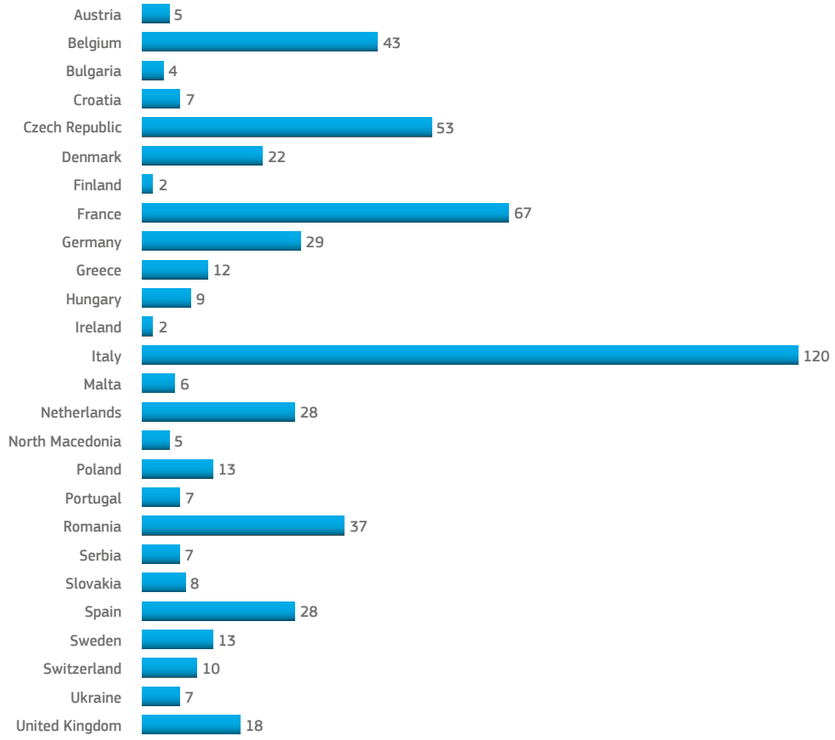
Only lead user
Countries from consortium members



Number of institutions per country



Number of users per country of applicant institutions



Open access to JRC research infrastructures

Implementing the programme

Since 2017, 17 research infrastructures in the non-nuclear and nuclear fields have opened access to external users at the JRC sites of Ispra, Karlsruhe, Petten and Geel. They are:

Laboratories with expertise in biosciences, life sciences and interdisciplinary sciences (NanoBiotech, Ispra)

- Nanobiotechnology laboratory

European Laboratory for Structural Assessment (ELSA, Ispra)

- Reaction Wall (ELSA-Reaction Wall)
- Hopkinson bar facility (ELSA-Hop-Lab)

Battery and hydrogen technologies research infrastructures (Energy Storage, Petten)

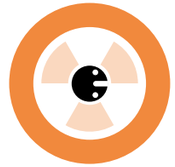
- Battery energy storage for safe electric transport (BESTEST)
- Electrolyser Testing Facility (ELTEST)
- High-pressure gas testing facility (GASTEF)

European research infrastructure for nuclear reaction, radioactivity, radiation and technology studies in science and applications (EUFRAT, Geel)

- Neutron time-of-flight facility for high resolution neutron measurements (GELINA)
- Underground Laboratory for ultra-low-level gamma-ray spectrometry (HADES)
- Tandem accelerator based fast neutronsource (MONNET)
- Radionuclide metrology laboratories (RADMET)

Actinide User Laboratory (ActUsLab, Karlsruhe)

- Properties of actinide materials under extreme conditions (PAMEC)
- Fuels and material research (FMR)
- Hot cell laboratory (HC-KA)



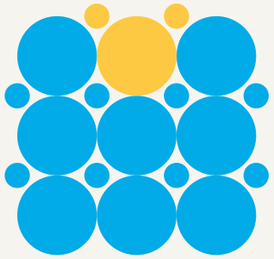
Laboratory for environmental & mechanical materials assessment (EMMA, Petten)

- Assessment of nuclear power plants core internals (AMALIA)
- Liquid Lead Laboratory (LILLA)
- Micro-Characterisation Laboratory (MCL)
- Structural materials performance assessment laboratories (SMPA)

Statistics of the selected projects

User institutions: countries associated to Horizon Europe vs. EU Member States

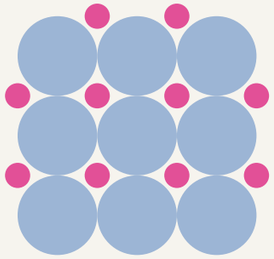
12 % Institutions from countries associated to Horizon Europe



88 % Institutions from EU Member States

Type of institution

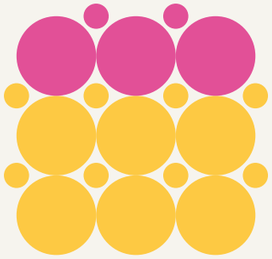
10 % SME/Industry



90 % Academia/Research institutions

User distribution by gender

32 % Female



68 % Male

To date the JRC has launched 68 calls in the relevance-driven mode and 5 calls in the market-driven mode. Proposals are submitted to the JRC by a consortia of one or more user institutions, each coordinated by a lead user institution. Consortia of selected proposals sign a research infrastructure access agreement with the JRC that regulates the access conditions, rights and obligations between the JRC and the user institutions.

279 eligible proposals submitted to the JRC
213 selected proposals
164 lead users signed agreements with the JRC
132 user institutions from the proposals having signed agreements with the JRC
562 users from the proposals having signed agreements with the JRC
33 countries from the proposals having signed agreements with the JRC
104 user access projects that have been completed
32 % of female applicants
10 % of business participation
12 % countries associated with Horizon Europe

Training and capacity building

In 2019 the nanobiotechnology laboratory launched its first call under the 'framework for training and capacity building at JRC research infrastructures'. In 2023, the European Laboratory of Structural Assessment joined the initiative and started to offer training and capacity building at their Hopkinson bar and Reaction wall facilities.
In total, seven training calls have been launched so far, which resulted in 41 proposals from 53 institutions out of 24 countries. A total of 139 lab personnel received training on specialized lab equipment and experimental designs.
32 % of successful applications are coming from female applicants and a third of the application originate from associated countries to the Horizon Europe Research programme.
The open access initiative is an initiative associated to Portfolio 33.

List of JRC Portfolios that use open access laboratories

The JRC organizes its work in portfolios, which are groups of different scientific disciplines that work together on common themes or issues. This helps them to create new knowledge and methods and better support policymakers in addressing Europe's challenges. The portfolios will change over time and the JRC will work with external partners on them. The JRC research infrastructures are central to the portfolios as they are the meeting place to collaborate. This way of working helps the JRC to stay true to its values of trust, collaboration, and transparency.

European Green Deal		https://joint-research-centre.ec.europa.eu/jrc-science-and-knowledge-activities/...
3	Hydrogen	... hydrogen_en
4	Safe nuclear technology	... safe-nuclear-technology_en
5	Small modular reactors	... small-modular-reactors_en
7	Cities and buildings	... cities-and-buildings_en
9	Zero pollution	... zero-pollution_en
11	Sustainable food systems	... sustainable-food-systems_en
12	Sustainable materials	... sustainable-materials_en
Europe fit for the digital age		
15	Trustworthy AI	... trustworthy-artificial-intelligence-ai_en
16	Cybersecurity	... cybersecurity_en
Economy working for people		
26	Future risks & opportunities	... risks-and-opportunities-future_en
European way of life		
25	Crises management	... crisis-management_en
27	Health crises responses	... health-crises-response_en
28	Life and health sciences	... life-and-health-sciences_en
29	Cancer & non-comm. diseases	... cancer-and-non-communicable-diseases_en
30	Science for security	... science-security_en
31	Nuclear compliance assurance	... nuclear-compliance-assurance_en
European democracy		
33	Innovative policymaking	... innovative-policymaking_en

- Nanobiotechnology laboratory
- European Laboratory for Structural Assessment
- Battery and hydrogen technologies research infrastructure
- Nuclear reaction, radioactivity, radiation and technology studies in science and applications
- Actinide User Laboratory
- Laboratory for environmental & mechanical materials assessment

Nanobiotechnology laboratory

Portfolios: 9/11/15/16/27/28/29

The JRC nanobiotechnology laboratory has state-of-the-art facilities for interdisciplinary studies, with a special emphasis on the characterisation of nanomaterials, nanomedicines, advanced materials, and micro(nano)plastics. Our institutional work focuses on developing a science-based understanding of the physico-chemical properties of these materials and their interactions with biological systems.

We have a multidisciplinary team of scientists, including chemists, physicists, biologists, and materials scientists with extensive experience in the fields of physico-chemical characterisation of materials and nanobiosciences.
User institutions can conduct a range of research activities, from experimental proof-of-concept studies to the testing/optimisation of developing technologies.
The laboratory is also the pilot facility for the training and capacity building programme.

Open access to NanoBiotech: https://youtu.be/HauMN49GAIg

Single-use plastic bottles used for food packaging not only raise questions about their sustainability within a circular economy but might also present potential health risks due to ingestion of plastic particles.
A team from the University of Milan came to the JRC Nanobiotechnology laboratory to investigate the release of nanoplastic particles from water bottles during cap opening and closing cycles.
The lessons learnt and the developed measurement strategies support pre-normative research needed to fulfil future standardisation needs.

> The two most remarkable aspects of the access to the research infrastructure were, in my opinion, the complementarity of the available techniques and the competences of the researchers/officers. Thanks to this very special combination, the period I spent at the JRC was so fruitful and motivating that I wished I could work more and for a longer period in such a context.

The nanobiotechnology laboratory
Acronym: NanoBiotech
Priority topics

- Detection and characterisation of micro(nano)plastics in media contributing to human exposure (such as food, air and water in the domestic water supply chain).
- Detection and characterisation of advanced materials such as nanomaterials (including ingredients, additives and supplements in food) within various matrices (e.g. food, food packaging) and their interactions with biological systems.
- Characterisation of liposomal based products and m-RNA lipid nanoparticles systems. Bio-macromolecules characterisation and interaction studies.

Applications: diagnostics, treatment, detection of diseases and pathogens

Virtual tour NanoBiotech: https://visitors-centre.jrc.ec.europa.eu/en/media/virtualtours/take-virtual-tour-nanobiotechnology-laboratory

User institutions

- Autonomous University of Madrid
- Babes-Bolyai University
- Basque Research and Technology Alliance - Cidetec
- British National Physical Laboratory
- Catholic University of Portugal
- Charles University
- CNR Faenza - Institute of Science and Technology for Ceramics
- CNR Milan - Institute for Genetic and Biomedical Research
- CNR Milan - Institute for Macromolecular Studies
- CNR Palanza - Water Research Institute
- CNR Pisa - Institute of Biophysics
- CNRS - Lyon Institute of Nanotechnology
- Ghent University
- Italian National Institute of Health
- ITENE Packaging, Transport and Logistics Research Center
- Jagiellonian University
- Karolinska Institute
- NanGenex - Druggability Technologies
- Polytechnical University of Milan
- University College Dublin
- University College London
- University of Belgrade
- University of Bologna
- University of Brescia
- University of Ferrara
- University of Insubria
- University of Kent
- University of Malta
- University of Milan
- University of Milan-Birocca
- University of Miskolc
- University of Modena and Reggio Emilia
- University of Nice Sophia Antipolis
- University of Novi Sad
- University of Siena
- University of Turin
- University of Utrecht
- University Ss Cyril and Methodius - IZIIS
- Vita-Salute San Raffaele University

Training and capacity building:

- AIMPLAS
- Anadolu University
- Atlantic Technological University
- Aversi Clinic
- Catholic University of Croatia
- Georgian Technical University
- Ghent University
- Hacettepe University
- ICFC - Innovation Center of the Faculty of Chemistry
- Institute of Bioenergetics Technologies
- Institute of Food Biotechnology and Genomics (NAS)
- Institute of FoodTechnology in Novi Sad
- Institute of Soil Science
- Istrian University of Applied Sciences
- Juraj Dobrila University of Pula
- Moldovan State University for Medicine and Pharmacy
- NAS - Palladin Institute of Biochemistry
- National Environmental Agency
- NIMP - National Institute of Material Physics
- Taras Shevchenko National University of Kyiv
- Technical University of Moldova
- TMI - G.Tsulukidze Mining Institute
- University Educons
- University in Osijek
- University Metropolitan
- University of Belgrade
- University of Geneva
- University of Novi Sad
- University of Sarajevo
- University of Vienna
- Yerevan State University

European Laboratory for Structural Assessment

Portfolios: 7/26/30

The European Laboratory for Structural Assessment (ELSA) offers two facilities as part of the programme for open access to JRC research infrastructures:

- the world's largest Hopkinson bar facility (HopLab), which is used to study materials and structural components to very fast dynamic loads, such as those due to blasts and impacts, where knowledge of the material behaviour under high strain-rates is necessary; and
- the ELSA Reaction Wall (Europe's largest), which is used to test the vulnerability of buildings to earthquakes and other threats to structural stability.

ADOBE Finding a safe, strong building solution: https://youtu.be/GypN316FALw

Researchers from the Netherlands came to the JRC to run experiments at the HopLab. They needed this machine to test the resistance of adobe 'mud brick' materials against blasts or explosions. Adobe structures are found all over the world, especially in places involved in military conflicts or prone to natural hazards. With the results of their experiments, the researchers can help give soldiers on peacekeeping missions more information on how well the buildings they are operating in can protect them.

Hopkinson bar facility
Acronym: ELSA HopLab

The Hopkinson bar facility is used for the study of materials and structural components to very fast dynamic loads, such as those due to blasts and impacts, where knowledge of the material behaviour under high strain-rates is necessary.

The laboratory has unique features with respect to the magnitude of the applied forces and the large size of the specimens to be tested.

Priority topics

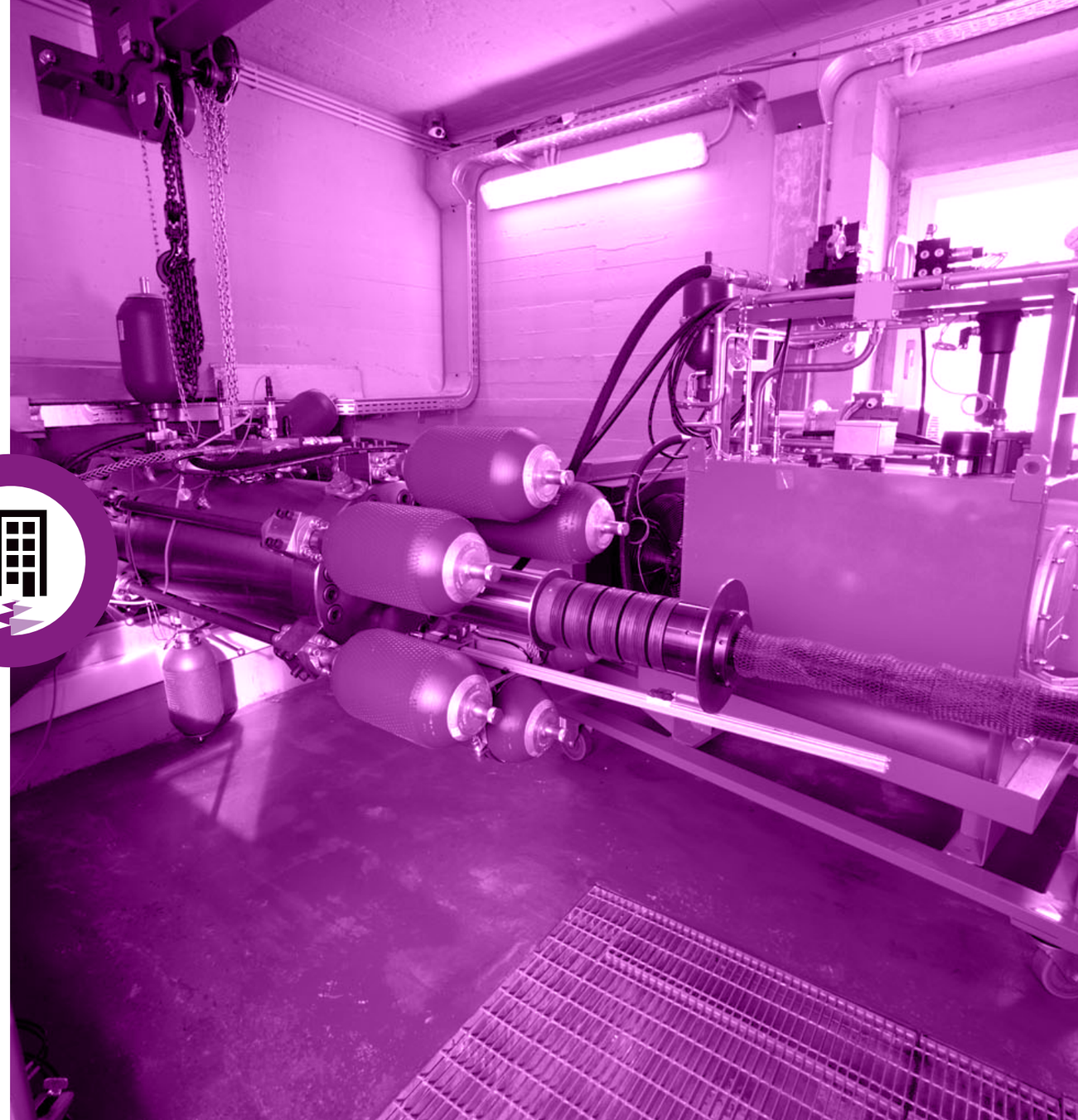
- Security of buildings, transport infrastructure and public spaces concerning the threat of fast dynamic loading
- Dual-use applications
- Circular materials and manufacturing processes
- Material/structural component testing at high loading-rate conditions (blast, impact) and high/low temperatures

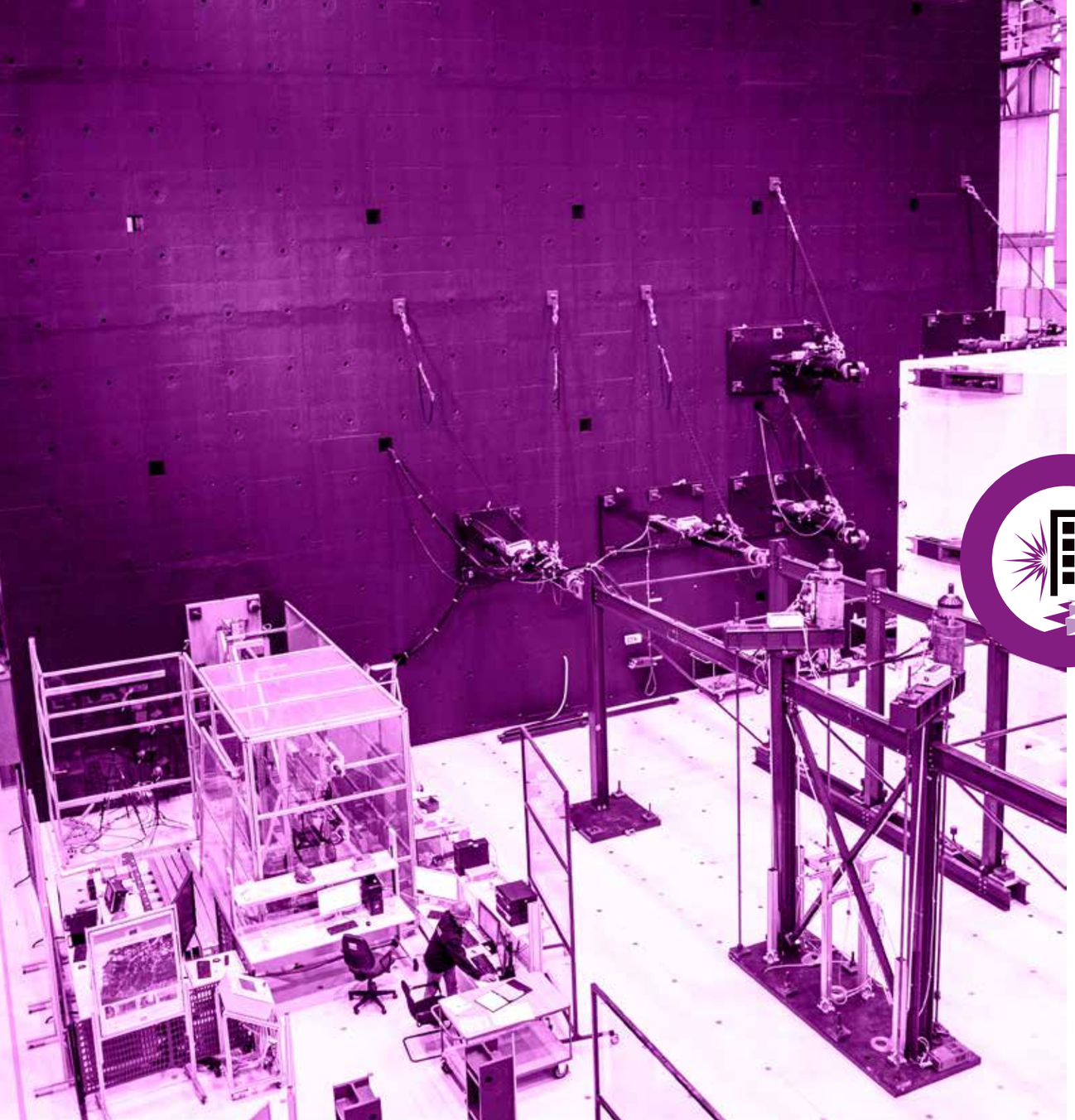
User institutions

- CERN - European Organization for Nuclear Research
- Delft University of Technology
- ENSTA Bretagne
- ETH Zurich
- I-Cube Research
- Imperial College
- Netherlands Defence Academy
- Netherlands Ministry of Defence
- Rolls Royce
- Ruhr-University Bochum
- TNO Defence Safety and Security
- University of Applied Sciences and Arts of Southern Switzerland
- University of Edinburgh
- University of Oxford

Training and capacity building

- Charles III University of Madrid
- Construction Institute
- Democritus University of Thrace
- Georgian Aviation University
- Ghent University
- Helmut-Schmidt-University
- National Aviation University
- National Institute for Aerospace Research “Elie Carafoli”
- Politechnical University of Milan
- STRAERO - Institute for Theoretical and Experimental Analysis of Aeronautical - Astronautics Structures
- TMI - G.Tsulukidze Mining Institute
- University of Maribor
- Vilnius Gediminas Technical University





Reaction Wall

Acronym: ELSA Reaction Wall

The central feature of the European Laboratory for Structural Assessment is the Reaction Wall. It consists of a reinforced concrete vertical wall and a horizontal floor rigidly connected together to test the vulnerability of buildings to earthquakes and other threats to structural stability.

The unique dimensions and testing capabilities of the Reaction Wall permit bi-directional testing of real size multi-storey buildings and critical elements of even larger structures, such as bridges.

Priority topics

- Safe and green renovation of buildings for the New European Bauhaus
- Design and retrofit for resilience (e.g., modular construction, damage-free structures, influence of non-structural elements, cumulative damage, ageing construction)
- Safety of built infrastructure against multiple hazards
- New materials and technologies (e.g., design for deconstruction, multifunctional building envelopes, structural glass, biodegradable and sustainable materials, advanced manufacturing)

User institutions

- HINFRA SRL
- M.M. srl a socio unico
- Polytechnical University of Milan
- Polytechnical University of Turin
- University of Lisbon

Training and capacity building

- ASDEA Engineering
- Construction Institute
- Polytechnical University of Catalunya
- Trinity College Dublin
- Universitv of Napoli Federico II
- University of Pardubice
- University of Patras
- University of Sannio

Battery and hydrogen technologies research infrastructures

Portfolios: 3/12

Energy storage has been part of the energy system for decades, but it is with the emergence of new storage technologies and the need to integrate more renewable energy sources into the power system that the sector is faced with new challenges – and opportunities. Research and technological development and innovation are needed to anticipate future trends and to enable the wider application of energy storage technologies. Scientists at the JRC are determined to support these developments to facilitate the transition towards a low-carbon energy system.

The share of renewable energy in the European electricity sector is expected to increase from 27% today to close to 50% in 2030. Large quantities of renewable energy of fluctuating and intermittent nature – like wind and solar power – will need to be produced if Europe is to reach its energy and climate commitments. Electrolysers and batteries presents one of the solutions to managing the excess energy, making it possible to store electricity during low electricity.

Battery energy storage testing
Acronym: BESTEST

The laboratory is situated at the JRC site of Petten (The Netherlands). It features state-of-the-art equipped facilities for analysing the performance of battery materials and cells. The capabilities include cell preparation, pre- and post-test battery cell tear-down, cell cycling under controlled temperature (in combination with impedance spectroscopy) and post-mortem diagnosis.

Within the frame of open access, the following facilities may be accessed:

- Temperature (or climate) chambers that allow cell storage and cell cycling under controlled temperature (or controlled temperature and humidity). Battery testers with different specifications and frequency response analysers are available for cell cycling;
- A micro X-ray computed tomography system (including data evaluation) is available for analysis of cells or battery electrodes.

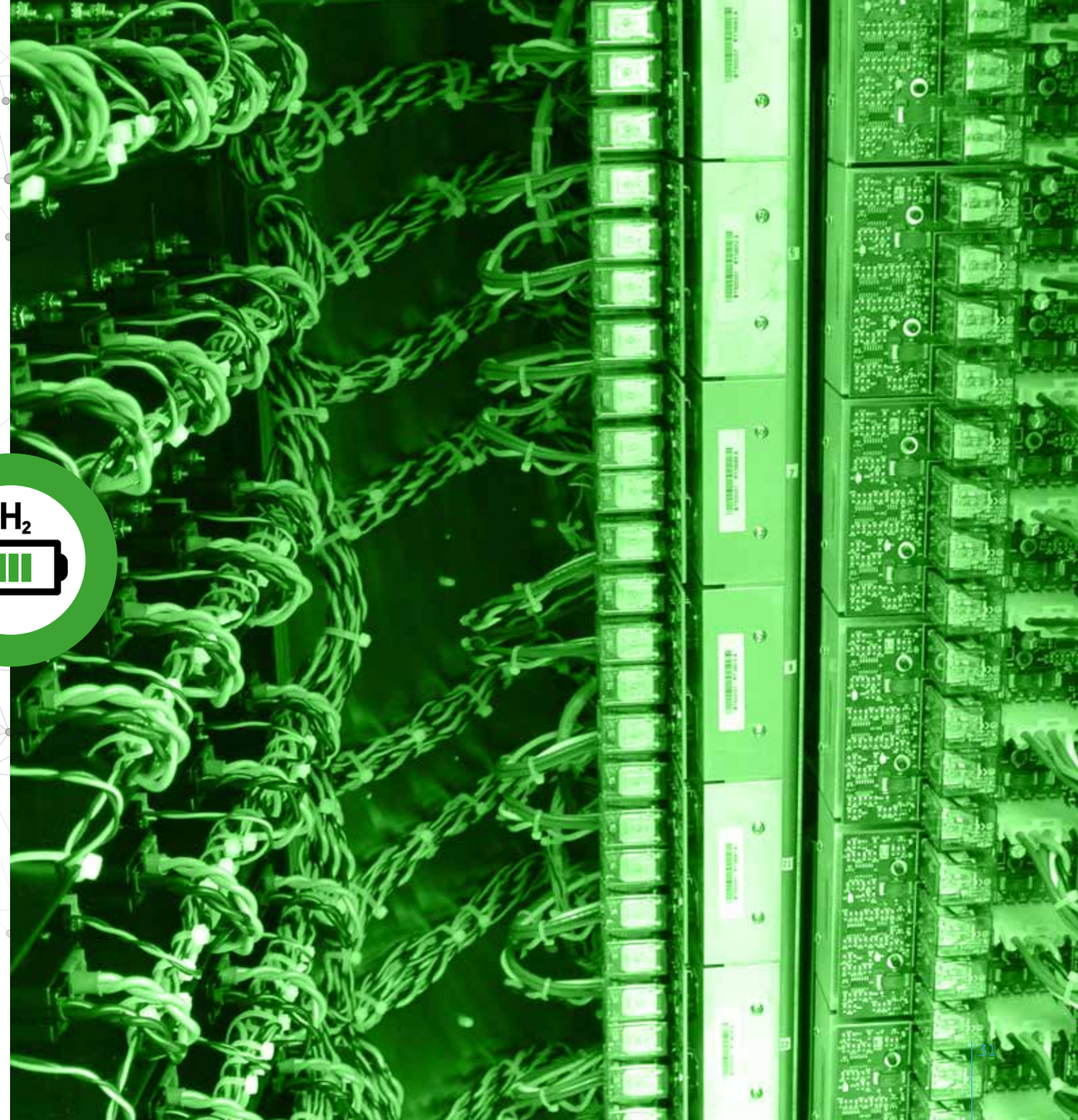
Priority topics

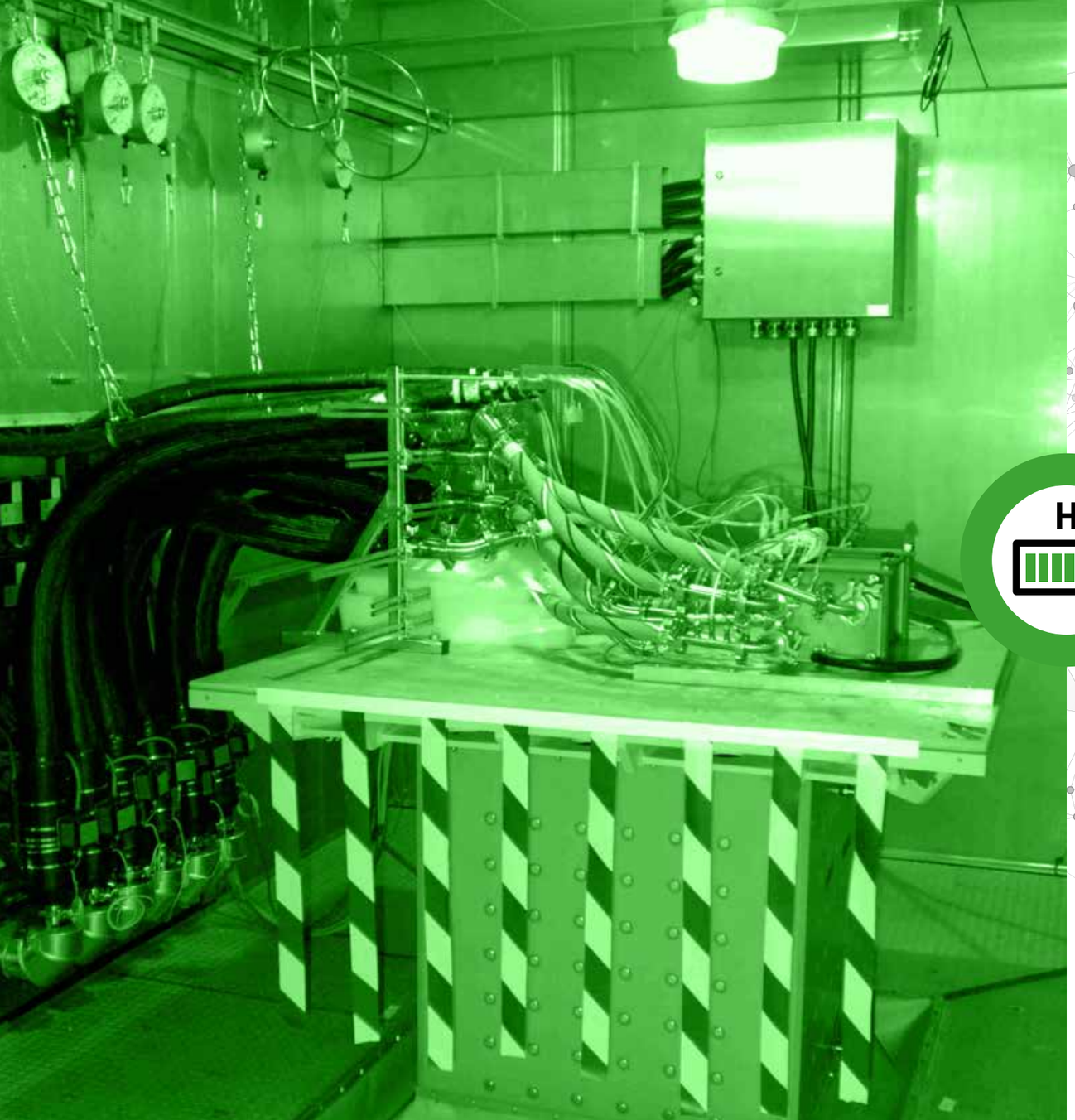
- Performance analysis of cells (in combination with impedance spectroscopy)
- Micro X-ray computed tomography of cells or electrodes

User institution

- E-magy B.V.

Virtual tour BESTEST: https://visitors-centre.jrc.ec.europa.eu/en/media/virtualtours/take-virtual-tour-battery-testing-facilities-laboratory





Virtual tour ELTEST (formerly FCTEST): https://visitors-centre.jrc.ec.europa.eu/en/media/virtualtours/explore-fuel-cells-and-electrolyser-testing-laboratories-360deg

Electrolyser testing facilities

Acronym: ELTEST

The electrolyser and fuel cells testing facilities are located at the JRC site of Petten. This laboratories support developments in regulation, codes and standards through the validation of testing procedures and measurement methodologies for the performance assessment of electrolysers and fuel cells.

ELTEST is also involved with the Clean Hydrogen Join Undertaking for pre-normative research and harmonisation of electrolyser and fuel cell test protocols and testing methodologies and their experimental validation.

ELTEST allows testing of low and high temperature polymer electrolyte membrane (PEM) fuel cell stacks, com- ponents and entire systems for up to 84 kW electrical power in stationary and transport applications. In addition, it is possible to test PEMWE and AEMWE electrolyser stacks (up to 30 kW and 30 bar) as well as electrolyser single cells and short stack up to 500 W. For high temperature solid oxide materials it is possible to test SOFC/SOEC cells and short stacks up to 500 W and SOFC stack up to 5 kW . The facility also has capabilities for testing under simulated environmental conditions including temperature, relative ambient humidity (up to 95 %), and vibrations and shocks.

Priority topics

- Testing of electrolyser and/or fuel cells (single cells, stacks and small systems)
- Performance and degradation tests of electrolysers including electrochemical test
- Testing of electrolyser components, sub-systems and systems at extreme controlled environmental conditions and/or vibration

User institutions

- BluEnergy Revolution
- Fincantieri
- University of Genoa
- University of Seville

High-pressure gas tank testing facility

Acronym: GASTEF

The high-pressure gas testing facility is located at the JRC site of Petten. It is dedicated to perform safety and performance evaluation of real size components such as hydrogen pipelines and on-board storage systems GASTEF is designed to:

- Perform dynamic tests of gas pipelines to verify their lifetime performance under hydrogen by subjecting them to pressure cycles with different patterns and ambient conditions simulating the grid operation;
- conduct “pneumatic cycling performance test” of the type approval regulations for hydrogen vehicles (UN Regulation 134-ECE “GTR Nr-13”);
- simulate a hydrogen refuelling station in its main components (compressor, hydrogen cooler, dispenser, metering devices) and the interaction with high pressure on-board storage, which allows evaluating from a safety point of view the effect of different refuelling conditions on high pressure components.

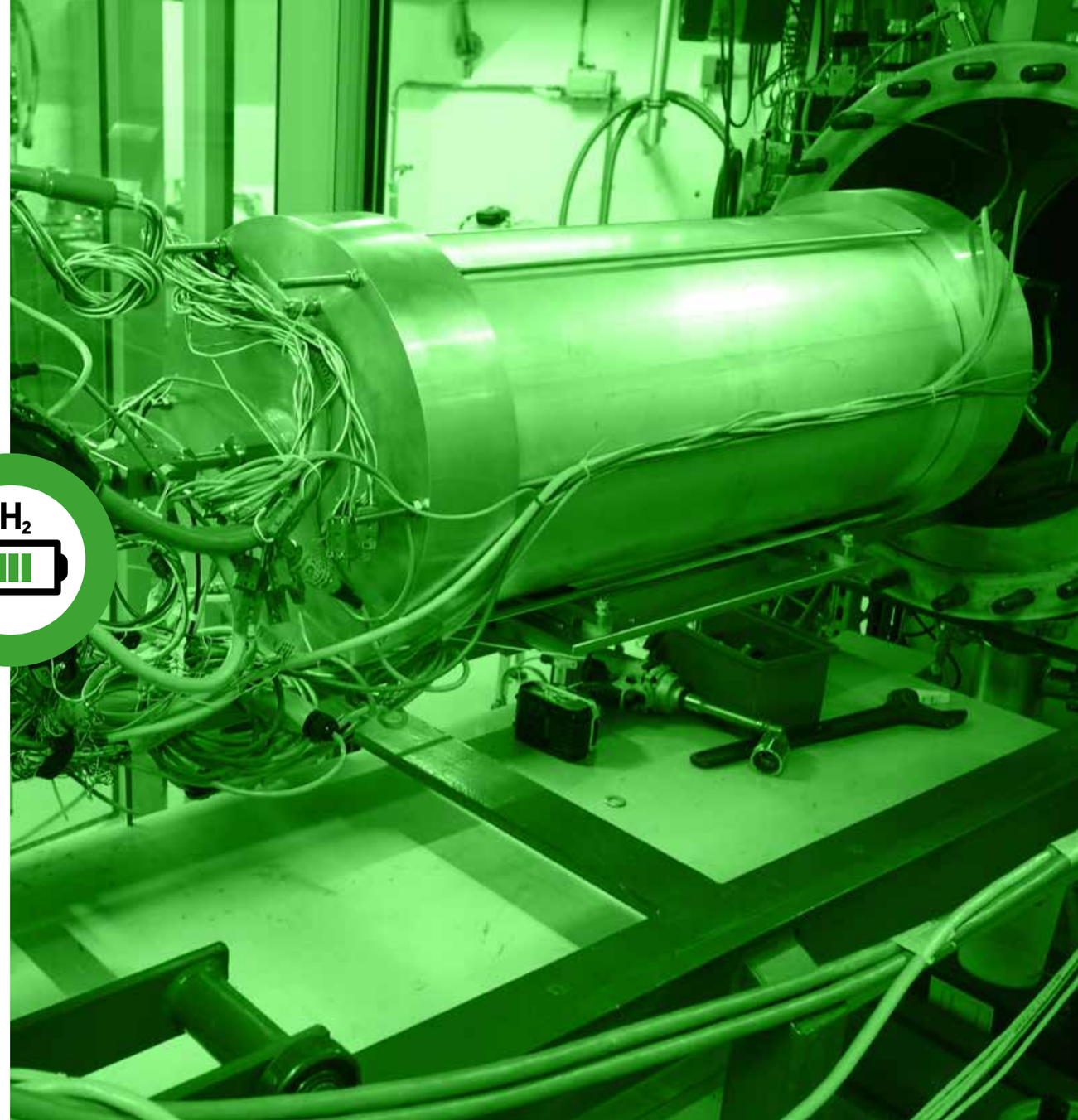
Priority topics

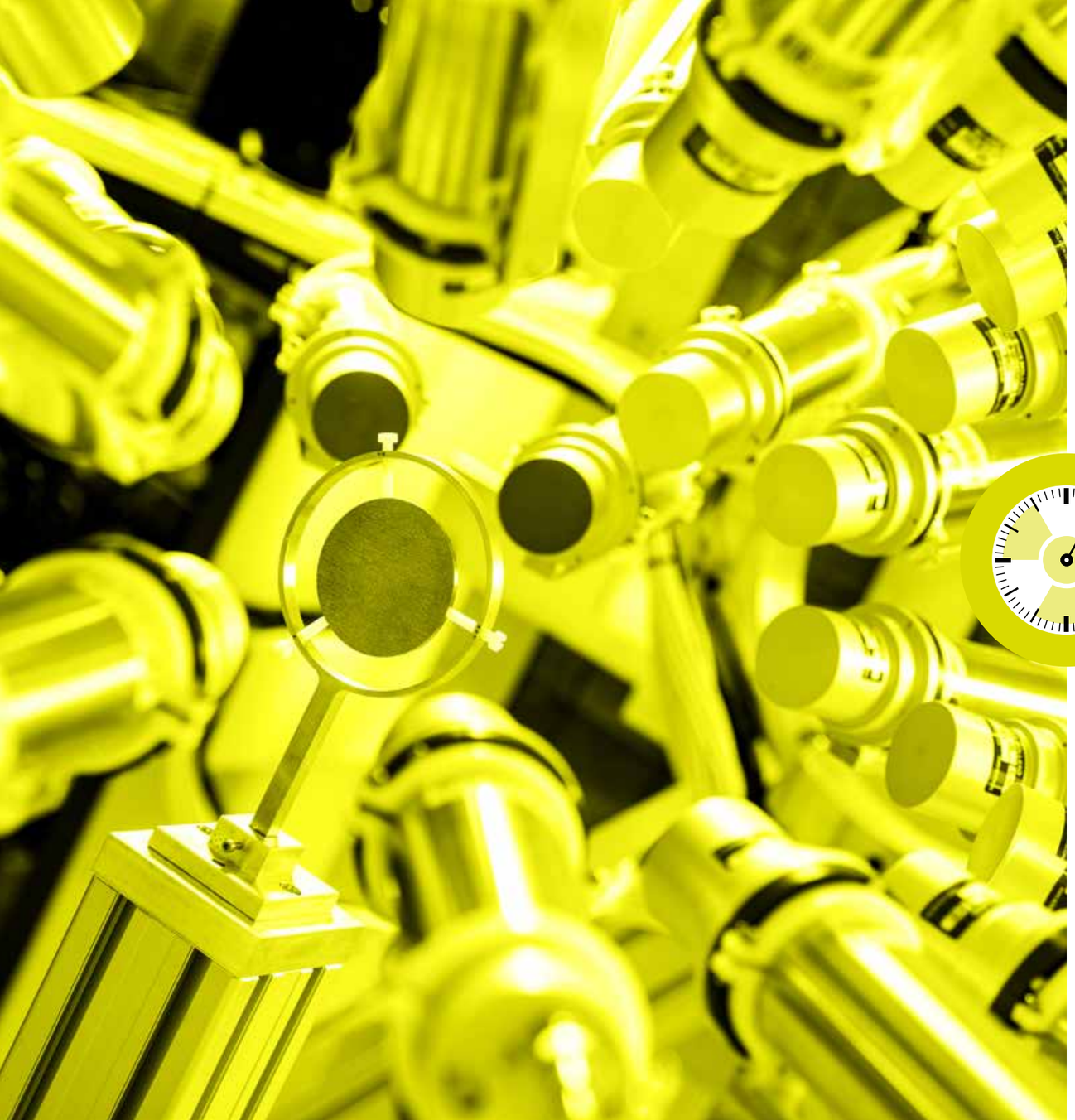
- Safety and performance assessment of natural gas pipelines repurposed for the transmission of hydrogen
- Assessment of component’s compatibility with high pressure hydrogen
- Safety and performance assessment of new concepts of compressed hydrogen storage tanks
- Assessment of hydrogen refuelling-strategies: optimised fuelling protocols; less demanding pre-cooling needs, consequences of out-of-specification fuelling

User institutions

- APRAGAZ
- ULLIT S.A.

Virtual tour GASTEF: https://visitors-centre.jrc.ec.europa.eu/en/media/virtual-tours/take-virtual-tour-gas-testing-laboratory





European research infrastructure for nuclear reaction, radioactivity, radiation and technology studies in science and applications

Portfolios: 4/5/25/29/31

The JRC offers open access to four nuclear laboratories, which allow studies of neutron-induced reactions, irradiations in well-characterised neutron and gamma fields and accurate measurements of radioactivity for science and technology applications:

- A high-resolution neutron time-of-flight facility (GELINA, Geel)
- An Underground Laboratory for ultra-low level gamma-ray spectrometry (HADES, Geel)
- A tandem-accelerator-based fast-neutron source (MONNET, Geel)
- Radionuclide metrology laboratories (RADMET, Geel)

These EUFRAT laboratories offer unique measurement and training opportunities to both young and experienced nuclear scientists and engineers, as well as to SMEs. So far, more than 100 researchers from EU Member States have participated in experiments from the open access programme, 25% of which were young students.

Neutron Data: https://youtu.be/sI7LnW-Lzyc

Scientists from France and Romania used GELINA facility to study inelastic scattering reactions with high-energy neutrons, which play an important role in fast nuclear reactor systems. Results from these experiments are essential for the successful development of this new generation of reactors. These advanced nuclear systems have the potential to drastically increase the efficiency of nuclear energy production and significantly reduce the level of nuclear waste produced. Researchers from SCK-CEN testify that new results at GELINA are helping them to develop new technologies for future reactors, the transmutation of nuclear waste and the production of radioactive isotopes for medical applications.

> “The most remarkable aspect of the programme is the straightforward way to access the infrastructure and the willingness of the local scientific personnel in helping with the experiment.”

High-resolution neutron time-of-flight facility
Acronym: GELINA

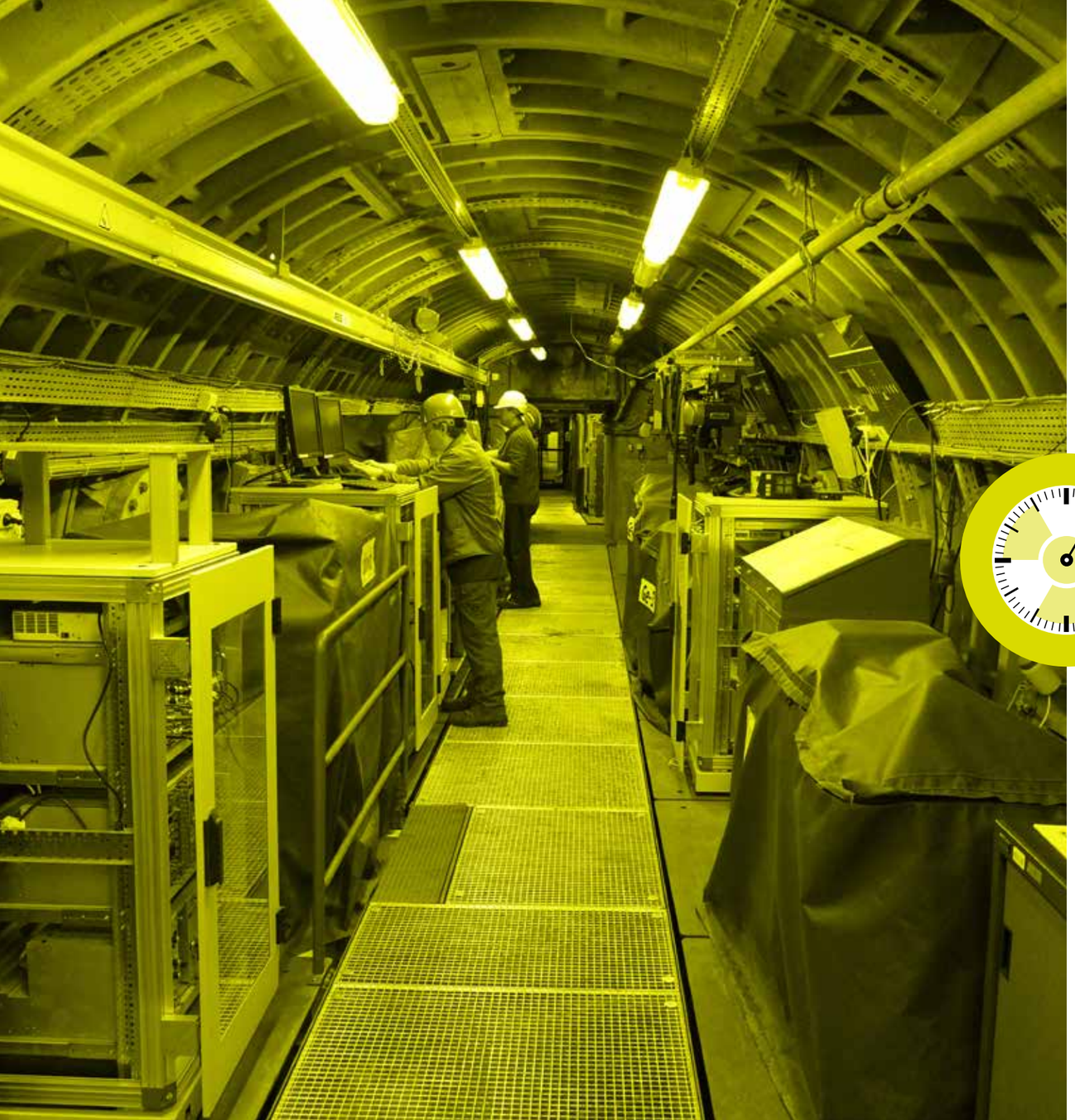
GELINA is a strong, pulsed neutron source, producing neutrons over a broad energy spectrum. The neutron source is driven by a 150 MeV electron linear accelerator. The excellent timing characteristics of the facility and an array of flight paths up to 400 m long, allow high-resolution neutron time-of-flight measurements. As many as 10 experiments with neutron beams can be carried out simultaneously.
GELINA also allows using the high-intensity neutron and gamma radiation fields close to the neutron source. Direct irradiations with the electron beam are another possibility.

Priority topics

- Neutron cross-section measurements for safety assessments
- Measurements of nuclear data standards
- Integral experiments for the validation of nuclear data libraries and testing of nuclear transport codes
- Investigations of the nuclear fission process
- Development of advanced detection methods
- Basic physics: nuclear reaction theory, nuclear astrophysics
- Characterisation of materials and objects by neutron resonance analysis
- High-intensity neutron and gamma-ray fields for radiation hardness testing and single event upset (SEU)
- Cross-section measurements and feasibility studies for medical radionuclide production

User institutions

- Aristotle University of Thessaloniki
- BAS - Institute for Nuclear Research and Nuclear Energy
- Belgian Nuclear Research Centre
- CEA Cadarache
- CERN
- CIEMAT
- CNR Milan
- CNRS - Hubert Curien Multi-disciplinary Institute
- ELI NP
- ENEA
- Helmholtz-Zentrum Dresden-Rossendorf
- Horia Hulubei National Institute
- IN2P3 - Orsay Nuclear Physics Institute
- INFN - National Institute of Nuclear Physics
- IRSN
- KIT - Karlsruhe Institute for Technology
- KU Leuven
- LPC Caen
- NAS Hungary - Centre for Energy Research
- National Technical University of Athens
- PTB
- University of Bologna
- University of Groningen
- University of Lodz
- University of Milan-Birocca
- University of Perugia
- University of Strasbourg



Underground Laboratory for ultra-low level gamma-ray spectrometry Acronym: HADES

The JRC operates a lab for ultralow-level radioactivity inside the 225 m deep HADES underground lab at the Belgian Nuclear Research Centre.

In HADES, muon flux is 5000 times less than above ground, minimizing cosmic rays' impact on gamma-ray spectrometry, and the flux of protons, neutrons and electrons are reduced to an insignificant level.

This allows detection of radioactivity in the sub mBq range using eleven high purity germanium detectors.

A scanning station assesses HPGe-detectors' deadlayers' homogeneity.

Examples of topics

Ultra low-level gamma-ray spectrometry for:

- Characterisation of reference materials for their radioactive content;
- Tracing processes in nature like ocean currents and uptake in the food chain;
- Radioecological studies;
- Basic physics experiments in astrophysics and neutrino physics;
- Characterisation of HPGe-detectors for deadlayer homogeneity.

Report with case-stories from HADES: https://ec.europa.eu/jrc/en/publication/jrc-serving-policy-science-hades-underground-research-facility-case-book

User institutions

- Canfranc Underground Laboratory
- Comenius University Bratislava
- DTU
- Geological Survey of Denmark and Greenland
- PAN Institute of Nuclear Physics
- LPD KINR Institute for Nuclear Research
- National Centre For Scientific Research – Demokritos
- National Museum of Denmark
- POLATOM - National Centre for Nuclear Research
- Ruđer Bošković Institute
- FOI
- Swedish Radiation Safety Authority
- Technical University Dresden
- UK Atomic Energy Authority
- University of Bremen
- University of Muenster

HADES: https://europa.eu/!WX48NU

The JRC runs a lab for ultralow-level radioactivity inside the 225 m deep HADES underground lab at SCK-CEN premises.

Tandem-accelerator-based-fast-neutron source
Acronym: MONNET

MONNET is a high-intensity fast neutron source, driven by a vertical 3.5 MV Tandem accelerator producing either continuous or pulsed beams of protons, deuterons or helium ions. Quasi monoenergetic neutrons are generated in the energy region 0 - 24 MeV by using lithium, deuterium or tritium targets. MONNET may also be used as a photon source or for studies requiring proton, deuteron or alpha beams without the emphasis on neutron production.

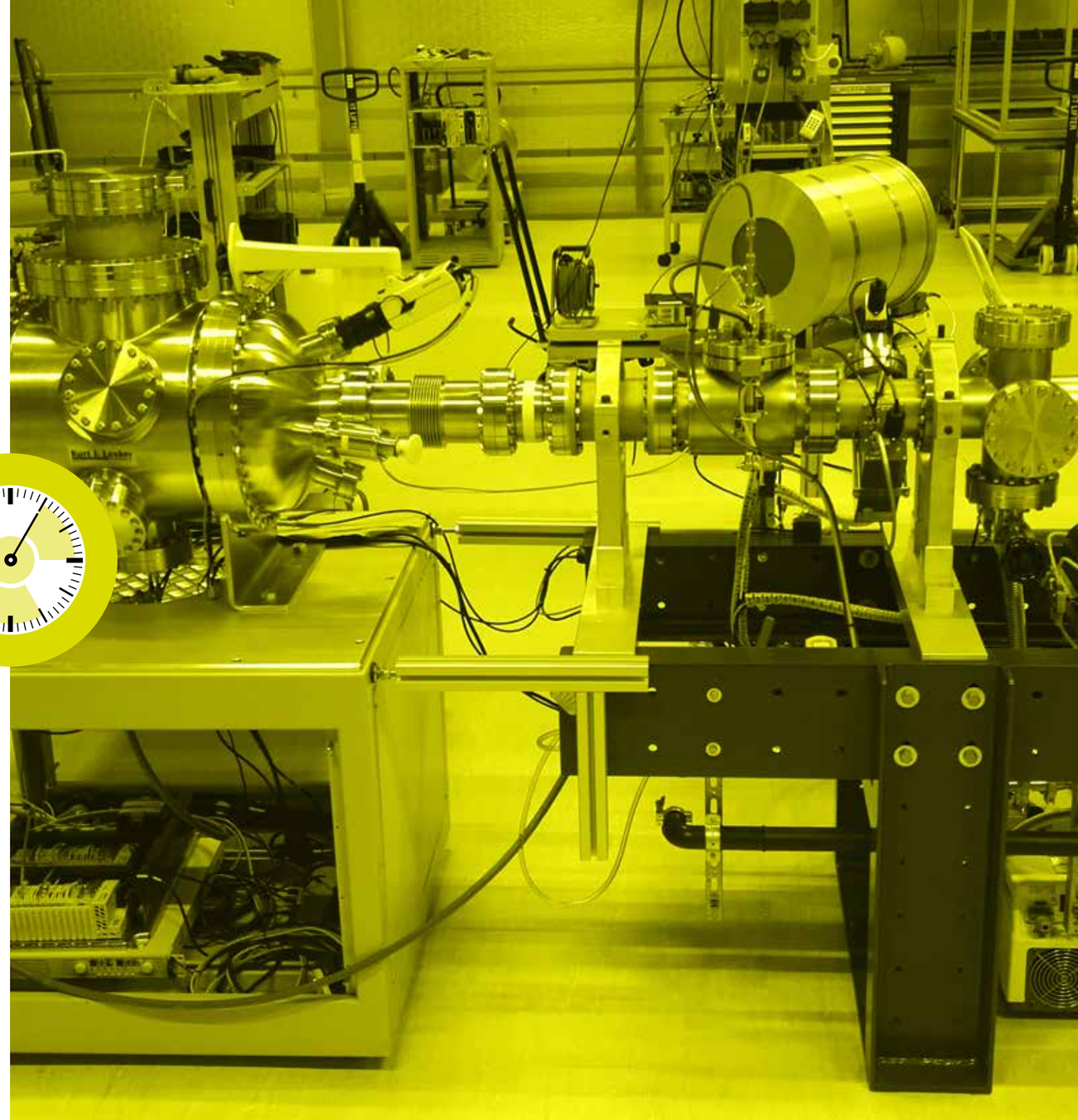
> "JRC Geel's innovation-driven spirit, state-of-the-art equipment and methods, and experienced staff have been integral to advancing our projects significantly."

Priority topics

- Neutron cross-section measurements for safety assessments of present-day and innovative nuclear energy systems
- Measurements of nuclear data standards
- Investigations for a better understanding of the nuclear fission process
- Materials research and radiation-induced damage studies
- Advanced methods in nuclear technologies, safety and security
- Development of advanced detection methods and scientific concepts in nuclear technology
- Dosimetry
- Basic physics

User institutions

- BAS - Institute for Nuclear Research and Nuclear Energy
- CEA Cadarache
- Dynaxion
- ELI NP - Extreme Light Infrastructure Nuclear Physics
- ENEA
- IN2P3 - Bordeaux-Gradignan Centre of Nuclear Studies
- IN2P3 IJCLab - Laboratory of the Physics of the two Infinities Irène Joliot-Curie
- KTH - Royal Institute of Technology
- TU/e - Eindhoven University of Technology
- University of Ioannina
- Uppsala University



Radionuclide metrology laboratories
Acronym: RADMET

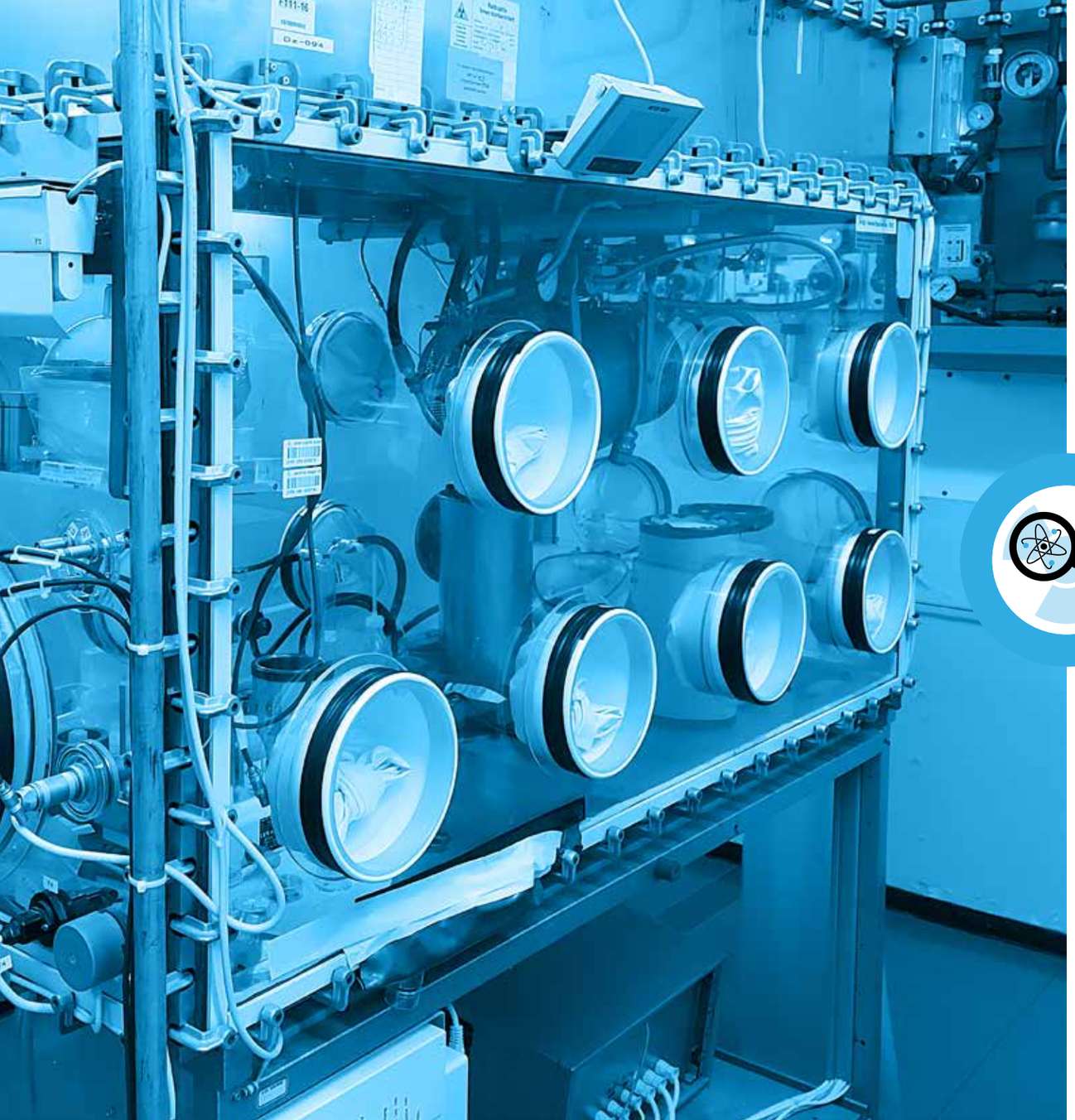
The Radionuclide metrology laboratories are equipped with a broad set of instruments used for nuclear decay measurements, determination of related nuclear data and radiological characterisation of samples and materials. The set-ups, many of them unique in their kind, are used to perform high accuracy measurements of radionuclides in diverse samples ranging from reference materials for environmental monitoring to solutions for primary standardisation of activity. RADMET is among the few laboratories worldwide to provide reference data to the international reference system (SIR) on the most relevant radionuclides. This enables international equivalence and traceability to the SI. In connection to these measurements the lab is well equipped for preparing sources dedicated to specific measurements.

Priority topics

- Primary standardisation of radioactivity (the most accurate type of measurements) independent of any other radioactivity standard
- Radiological characterisation of materials and samples (i.e. determination of radionuclides and their activity), e.g. reference materials
- Decay data measurements that are essential for calibrations in routine laboratories, applications in nuclear medicine and many other scientific uses of radionuclides
- Testing of radiological instruments and methods and standards
- Measurements in support of important policy domains like radioactive waste management, decommissioning of nuclear facilities, metal scrap industry, NORM industry and early warning monitoring networks
- Development and testing of procedures and instruments for nuclear security and detecting illicit trafficking of nuclear materials

User institutions

- SCK-CEN
- Chalmers University of Technology
- Eötvös Loránd University
- National Centre For Scientific Research – Demokritos
- Paul Scherrer Institute
- University of Hasselt



Actinide User Laboratory

Portfolios: 3/4/5/29

> “We appreciated the competences and expertise present in the ActUsLab, combined with up-to-date analytical instruments to provide an all-round characterization of the materials produced in the available facilities.”

Only a few facilities are available worldwide where actinide materials can be safely investigated. Among these, a prominent position is occupied by the Actinide User Laboratory (ActUsLab) operated by the JRC in Karlsruhe. Actinides are heavy elements at the end of the periodic table. They are the backbone of nuclear fission technologies for electricity supply, with important applications in other strategic fields, from water management to space exploration and human health.

Actinides exhibit very peculiar, diverse and complex chemical and physical properties, they can in particular display multiple allotropes (different structural forms), remarkable orders (magnetic, multipolar, hidden, topological...), unconventional super-conductivity and many other phenomena at the forefront of current scientific knowledge.

Innovative targets for the production of medical isotopes against cancer:
https://www.nature.com/articles/s41598-021-87621-0

Scientists from University of Padoa and Legnaro National Laboratories of INFN have studied innovative target materials for the production of radionuclides, in particular Actinium-225, a rare isotope that showed to be very promising in medical applications for the treatment of cancer. Thorium carbide nanoparticles targets prepared from different starting materials (graphite and graphene oxide) have been tested and compared in PAMEC and FMR laboratories. The results clearly indicate that the ThC2 targets using graphene exhibit much better properties for the ISOL (Isotope Separation On-Line) method and could therefore be used as highly efficient targets for producing Actinium-225, a much needed isotope for so-called Targeted Alpha Therapy. This cancer treatment selectively destroys tumour cells wherever they are in the body, including at a metastatic stage when surgery or radiotherapy are no more possible.

> Unique experimental station for sputter deposition and spectroscopy of actinide systems. The local staff, both scientific and technical, is of very high standard

Properties of actinide materials under extreme conditions

Acronym: PAMEC

The laboratory consists of an ensemble of state-of-the-art installations designed for preparation and studies of actinide materials.

The facility includes devices for measurements of crystallographic, magnetic, electrical transport, and thermodynamic properties as well as facilities for Np-237 Mössbauer spectroscopy, and a modular surface science spectroscopy station allowing photoemission, atomic force microscopy, and electron scattering measurements.

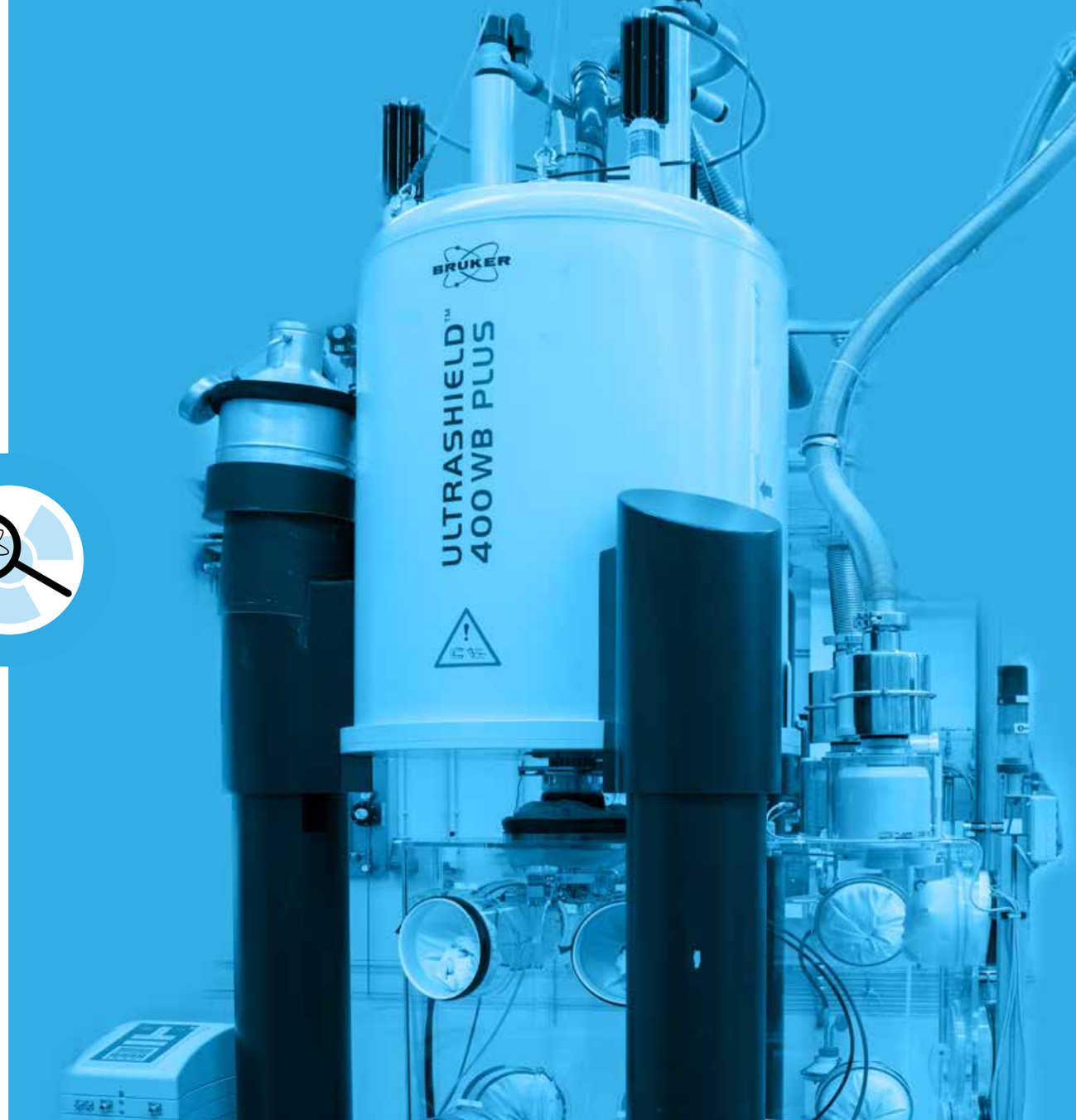
Several physical properties can be measured under extreme conditions of temperature, pressure, external magnetic field and chemical environment to ensure safety of current and future nuclear civil applications. This allows exploring actinide materials in multiple dimensions with the aims to improve nuclear safety, underpin theoretical models and contribute to non-power applications.

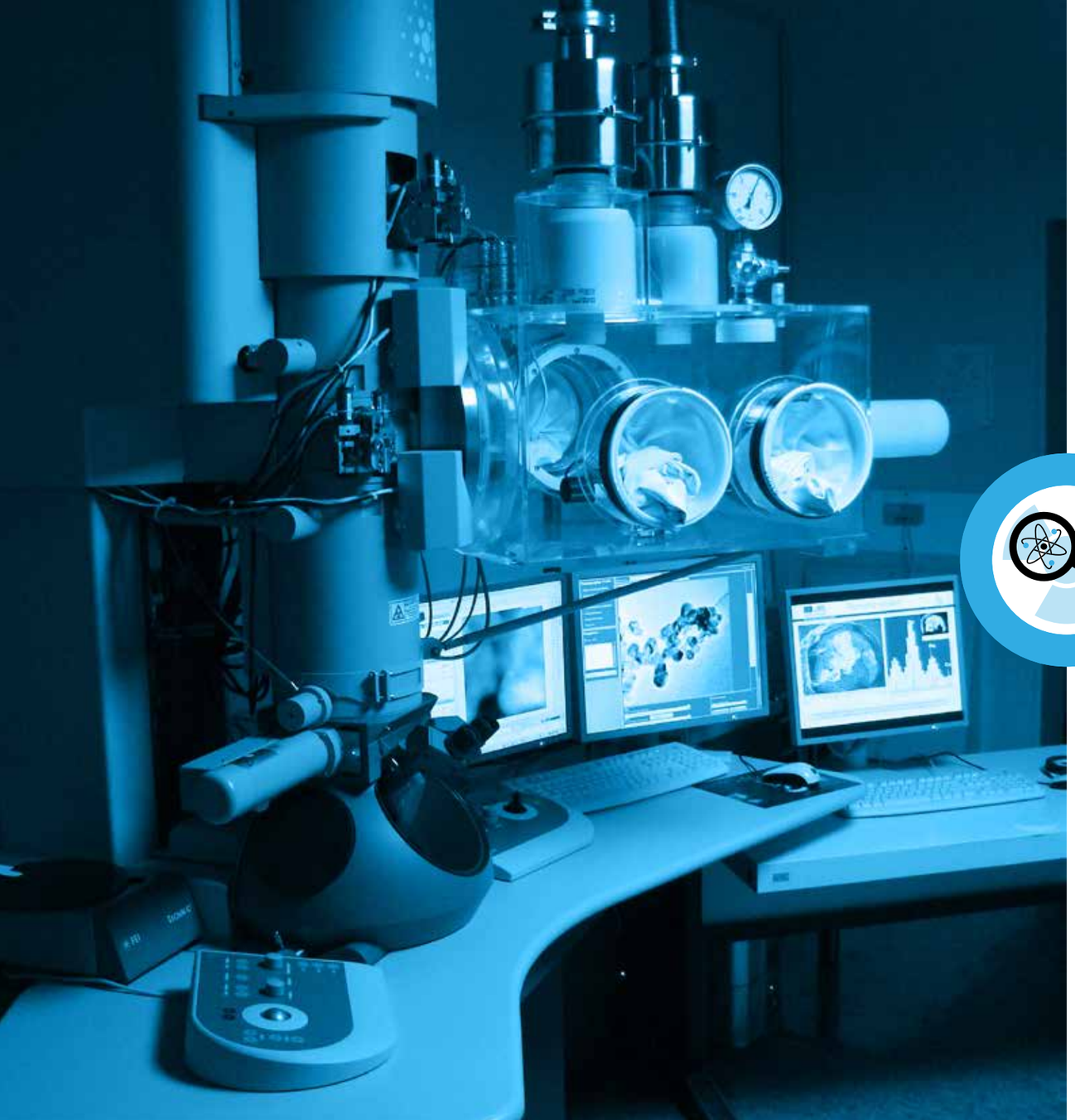
Priority topics

- Preparation of actinide compounds in various forms (thin film, bulk polycrystal, single crystal) and small quantities, for physical measurements
- Characterisation of actinide materials by X-ray diffraction
- Measurements of their physical properties by microscopic and macroscopic techniques under extreme conditions of temperature, magnetic field and pressure
- Preparation of samples for external measurements in large facilities (synchrotrons, neutron sources, accelerators)
- Fundamental research on materials and methods related to nuclear safety
- Development of targets for production of radionuclides for non-power applications such as medical applications.
- Surface studies of actinide-based samples (thin films preparation and interaction studies) linked to nuclear fuel safety, waste management (corrosion) and hydrogen production.

User institutions

- Brandenburg University of Technology Cottbus-Senftenberg
- CEA Valduc
- CERN
- Charles University
- CNRS
- Czech Academy of Sciences
- Delft University of Technology
- European Synchrotron Radiation Facility
- FZJ - Research Centre Jülich
- Gdansk Technical University
- GSI - Helmholtz Centre for Heavy Ion Research
- Institute of separative chemistry in Marcoule
- Institut Laue Langevin
- INFN - National Institute of Nuclear Physics
- Kharkov Institute of Physics and Technology
- Technical University Vienna
- University of Copenhagen
- University of Florence
- University of Genoa
- University of Mainz
- University of Padova





Fuels and material research

Acronym: FMR

The FMR laboratories provide the scientific basis for the objective assessment and modelling of the safety-related behaviour of nuclear materials, with emphasis on nuclear fuels under normal and abnormal operating conditions, serving European and international authorities as well as academic and research organisations. The main activities of the FMR laboratories involve the synthesis and characterisation of actinide-bearing materials (including plutonium and minor actinides). Standard and advanced methods are employed, such as sol-gel precipitation, powder blending and pressing, conventional and spark plasma sintering, encapsulation techniques, x-ray diffraction, vibrational spectroscopy (Raman and infrared), electron microscopy (scanning, transmission, and focused ion beam), drop and differential scanning calorimetry, Knudsen effusion mass spectrometry, dilatometry, indentation, laser heating/laser flash for the measurement of thermophysical properties including melting.

Priority topics

- Synthesis and characterisation of actinide-bearing materials relevant for the assessment of nuclear safety standards (oxides, ceramics, etc...)
- Safety characterisation of new forms of nuclear fuels, including molten salts
- Laboratory simulation of nuclear power plant severe accident conditions
- Advanced methods for the synthesis of nuclear material assemblies, for Generation IV nuclear power plants, including transmutation targets, or for space applications
- Exploratory research for the development of new scientific concepts, testing of new equipment or materials

> “It’s a nice working environment with a lot of technical equipment and experienced workers.”

User institutions

- CEA Marcoule - Institute for Separation Chemistry
- Charles University
- Czech Technical University
- Delft University of Technology
- FZJ-Research Centre Jülich
- GSI - Helmholtz Centre for Heavy Ion Research
- Helmholtz-Zentrum Dresden-Rossendorf
- KIT - Karlsruhe Institute of Technology
- Masaryk University
- SCK-CEN - Belgian Nuclear Research Centre
- University of Hasselt
- University of Lisbon
- University of Mainz
- VTT - Technical Research Centre of Finland

Hot cell laboratory

Acronym: HC-KA

The Hot cell laboratory in Karlsruhe is a unique facility in Europe and an ensemble of state-of-the-art installations designed for research on analyses and behaviour of nuclear spent fuel and radioactive waste. It consists of 24 shielded hot cells where highly radioactive materials can be received, handled, examined and returned to their owners.

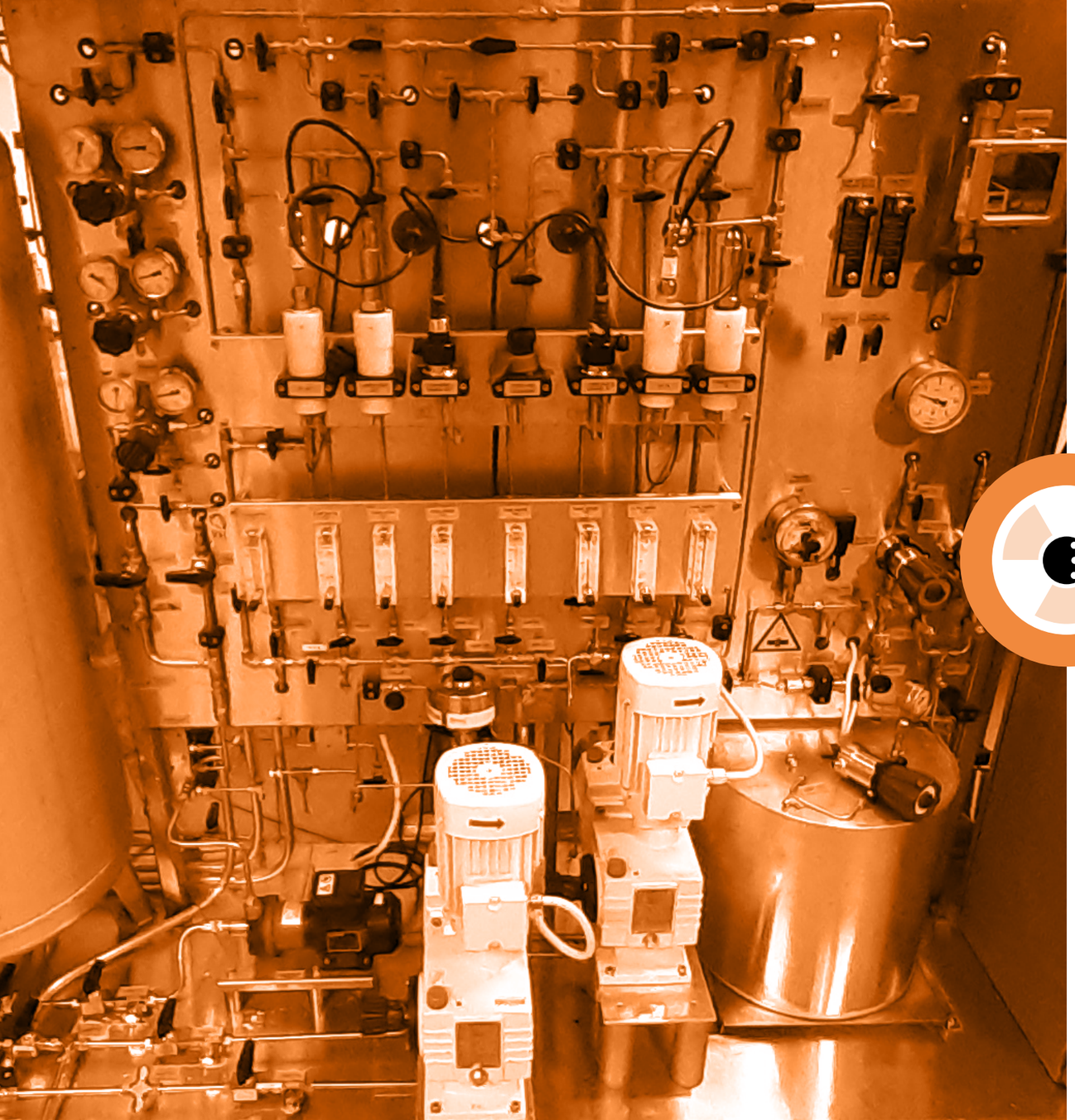
The team that manages the Hot cell laboratory conducts R&I activities jointly with the Member States in the field of nuclear safety of spent fuel, radioactive waste and decommissioning. It supports the Member States with frontier infrastructure and scientific-technical expertise, contributing to the implementation of safe, cost effective solutions leading to green field sites, encompassing innovative recycling and robust long-term storage of waste, and providing knowledge transfer to present and future generations.

Priority topics

- Applied research on materials and methods related to the spent fuel nuclear safety
- Spent fuel long term mechanistic release process of interest for geological disposal
- R&I activities for the characterisation of radioactive waste including new waste forms
- R&D on the stability and safe conditioning of damaged fuel (“corium”)

User institutions

- CIEMAT – Research Centre for Energy, Environment and Technolog
- IRSN – Insitute for Radioprotection and Nuclear Safety



Laboratory for environmental & mechanical materials assessment

Portfolios: 4/5

To ensure safe operations, it is crucial that nuclear reactor components like reactor vessels, heat exchangers, pipes and fuel claddings are able to function reliably for very long time during operation of a nuclear reactor. Material testing is central to demonstrate safety and is by necessity generally based on accelerated tests with higher loads, temperatures or more aggressive environments than encountered during operation of the reactor, while at the same time using also small material samples.

The JRC's environmental and mechanical materials assessment (EMMA) facilities in Petten, the Netherlands, support the development of European and International codes & standards for components and materials used in current and next-generation nuclear reactors.

The EMMA facilities focus on material testing at high temperatures and in corrosive environments using test samples from the micro to the macro-scale. Most of the research is linked to international and European projects involving national research laboratories, academia as well as industry. The development of a European standard for the miniature test, "EN 10371 metallic materials — small punch test method", led by EMMA scientists, is an example of a recent achievement. The open access to the EMMA facilities started in 2020.

Assessment of nuclear power plants core internals

Acronym: AMALIA

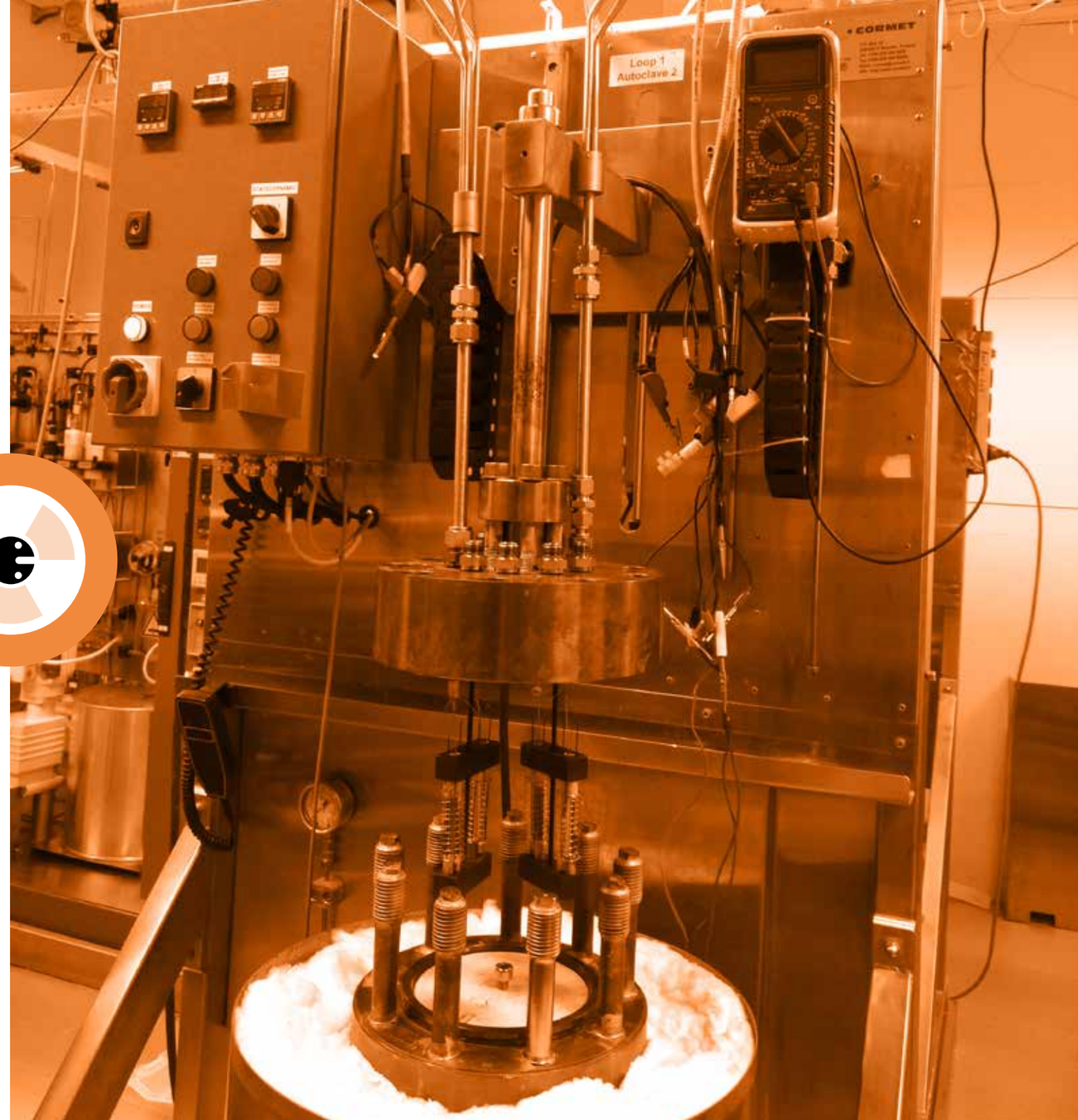
AMALIA consists of five water loops providing and analysing water for AMALIA autoclave test facilities. The water loops include state-of-the-art water chemistry sensors such as conductivity, pH, dissolved oxygen and hydrogen sensors. Furthermore, it provides a low and high pressure pump including back-pressure regulators and pulsation dampeners to provide water circulation and needed water pressure for test facilities.

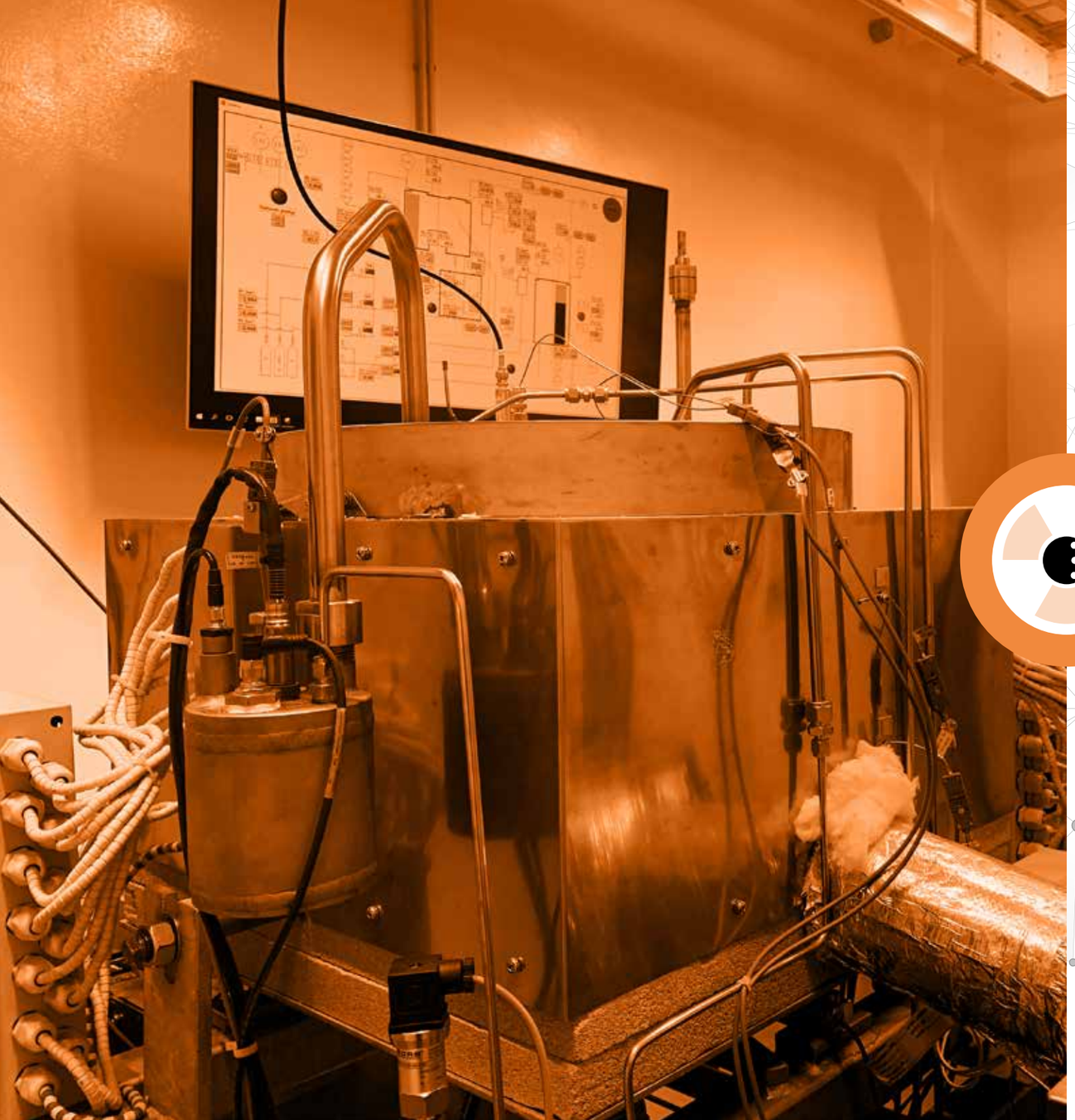
Priority topics

- Safety and reliability of nuclear components for current and future nuclear systems
- Support to the development and adaptation of European codes and standards
- Development of advanced test methods for material characterization
- Characterisation of mechanical properties of candidate and new corrosion-resistant high-temperature materials, including surface modifications and welded joints
- Prediction of design life of new materials, remaining life of service-exposed materials including welded joints subjected to operational conditions by mechanical tests, modelling and microstructural analysis
- Characterisation of tensile and creep properties using standard and sub-size specimen and small punch tests
- Characterisation of ageing effects for key material properties

User institutions

- ALVEL a. s.
- CIEMAT
- CSIC - Spanish National Research Council
- Czech Academy of Sciences
- Czech Technical University
- UJP Praha a.s
- UJV Rez
- University of Chemistry and Technology





Liquid Lead Laboratory

Acronym: LILLA

Liquid Lead Laboratory is specially designed for mechanical tests of materials in liquid lead with controlled dissolved oxygen concentrations for temperatures up to 650°C.

It gives the possibility to study liquid metal embrittlement phenomena / environmentally assisted cracking, and the effect of stress, temperature and oxygen content in lead on corrosion mechanisms, as well as to test lead chemistry instrumentation.

Supporting 3D profilometry, microstructural analysis (light optical microscope, scanning electron microscope with energy dispersive X-ray spectrometry, and Vickers micro hardness (0.1 kg – 20 kg) are also offered.

Priority topics

- Safety and reliability of nuclear components for future nuclear systems
- Support to the development and adaptation of European Codes and Standards
- Characterisation of mechanical properties of candidate and new corrosion-resistant high-temperature materials, including surface modifications and welded joints
- Development of test and assessment methods as well as instrumentation to achieve easier and more reliable estimates of material properties using sub-size or miniaturised specimens
- Imaging techniques for opaque medium

User institutions

- Belgian Nuclear Research Centre
- Slovak University of Technology

Micro-Characterisation Laboratory
Acronym: MCL

The Micro-Characterisation Laboratory is dedicated to the experimental investigation of materials performance in terms of microstructure and micro-mechanics. The lab provides insight into the complex coupling between microstructure, its defects and the mechanical behaviour of small volumes of metals, ceramic materials, polymers and composites of interest to the safe operation of nuclear installations. MCL installations also support the production of radio-isotopes for non-power nuclear applications through the development and characterisation of nanomaterials-based irradiation targets prepared via spark ablation technology.

Priority topics

- Microcharacterisation of materials of nuclear interest
- High temperature nanoindentation of metals, alloys and composites
- Development of new micro-mechanical testing methodologies
- Support to the development of predictive mechanism-based multiscale models of material behaviour
- Effects of material degradation sources in nuclear environments (irradiation, high temperature, corrosion)
- Understanding of small scale plasticity
- Physical methods of producing nanoparticles for non-power nuclear applications

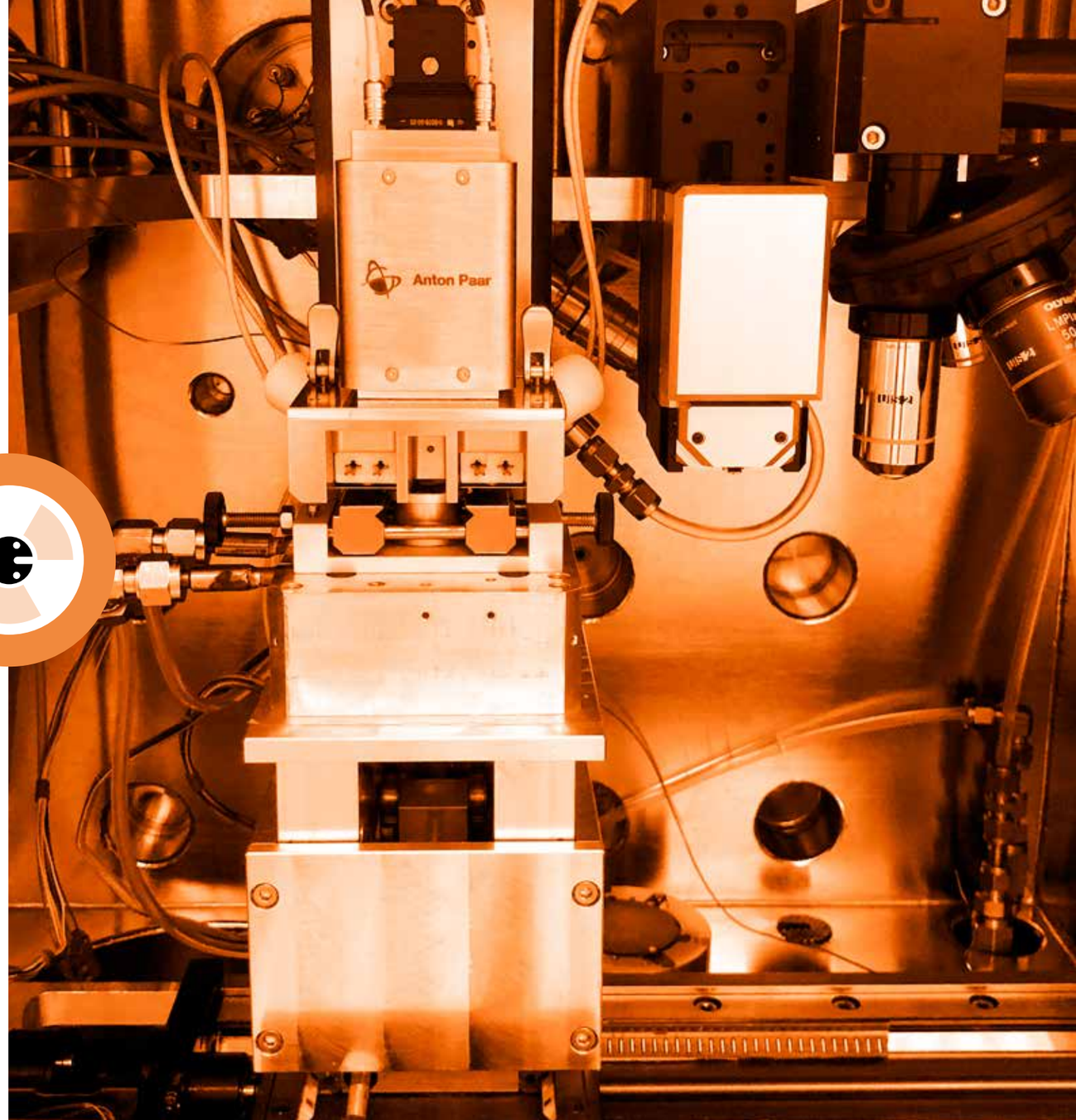
User institutions

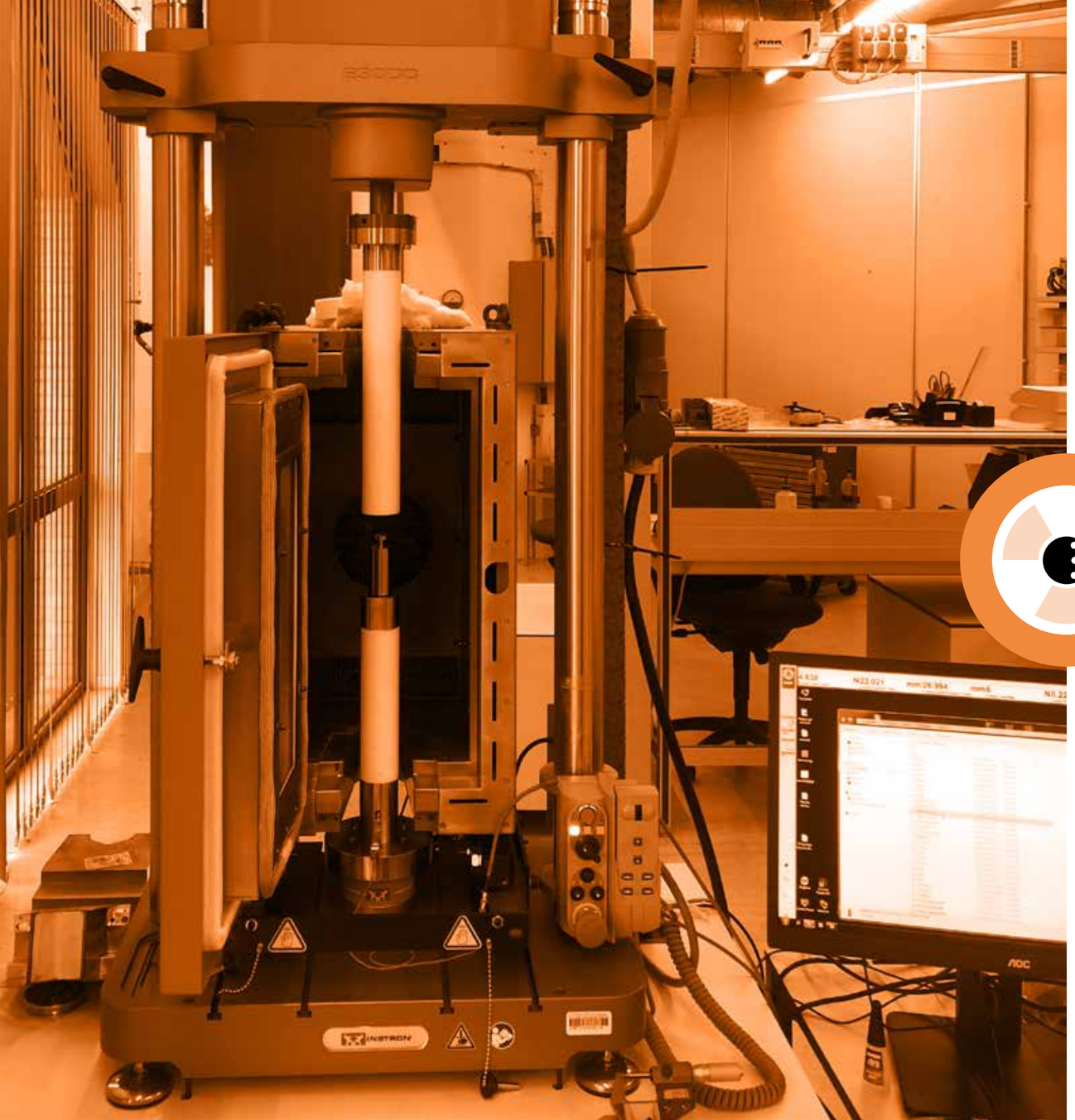
- Belgian Nuclear Research Centre
- UJP Praha a.s
- University of Bologna

> “At the heart of the lab are exclusive characterisation equipment, a highly skilled staff, and a pleasant working environment. There is no other way to combine a keen investigation of the mechanical properties of thin-rolled metal foils and a very inspiring experience!”

https://hdl.handle.net/2268/306095

The NIFEM project conducted high-temperature nanoindentation tests on pure iron and Eurofer97 steel in ion-irradiated and reference states at the MCL lab in JRC-Petten. The data obtained was used to simulate the nanoindentation process and validate the constitutive laws in these materials. These tests were part of Tymofii Khvan’s Ph.D. thesis on “Nanoindentation for sub-miniaturized testing of irradiated materials: FEM analysis and experiments”.





> “At the SMPA lab, under the friendly support of the JRC staff, the initial research ideas developed during the visit from ‘just ideas’ to full featured science”

Structural materials performance assessment laboratories

Acronym: SMPA

Structural materials performance assessment laboratories include the following test machines: Universal test machines for tensile, fatigue, fracture, creep-fatigue, slow strain rate tensile (SSRT), creep-fatigue crack growth, small punch, and small punch creep testing. The lab also has Charpy impact hammers for fracture toughness testing and uniaxial creep test machines. Moreover, following post-test equipment is available: 3D profilometry, SEM (EDX, WDX), optical microscope, X-ray diffraction (XRD), and Vicker’s micro hardness (0.1kg – 20kg).

Priority topics

- Safety and reliability of nuclear components
- Support to the development and adaptation of european codes and standards
- Development of test procedures and instrumentation with available test equipment to achieve simpler, more reliable or non-standard tailored data and estimates of material properties
- Data in support of model development and validation for prediction of design life of new materials and remaining life of service-exposed materials including welded joints
- Characterisation of tensile and creep properties by uniaxial and small punch tests and creep-fatigue properties of new and service-exposed materials using standard and miniaturised specimen tests

User institutions

- Belgian Nuclear Research Centre
- CIEMAT
- Czech Technical University
- RATEN ICN - Institute for Nuclear Research

https://dx.doi.org/10.5290/180001

Scientists from SCK-CEN conducted a small punch test program using the European reference material BCR661 (Nimonic 75). The test data, available through the MatDB database, will be used to create a guideline to support the development of the SP test method by providing an initial set of test curves with a detailed analysis. This work aims to establish a well-established material properties database by analyzing data, quantifying data scatter, and assessing the impact on estimated properties, leading to recommendations for an inter-laboratory round-robin.

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Science for policy

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