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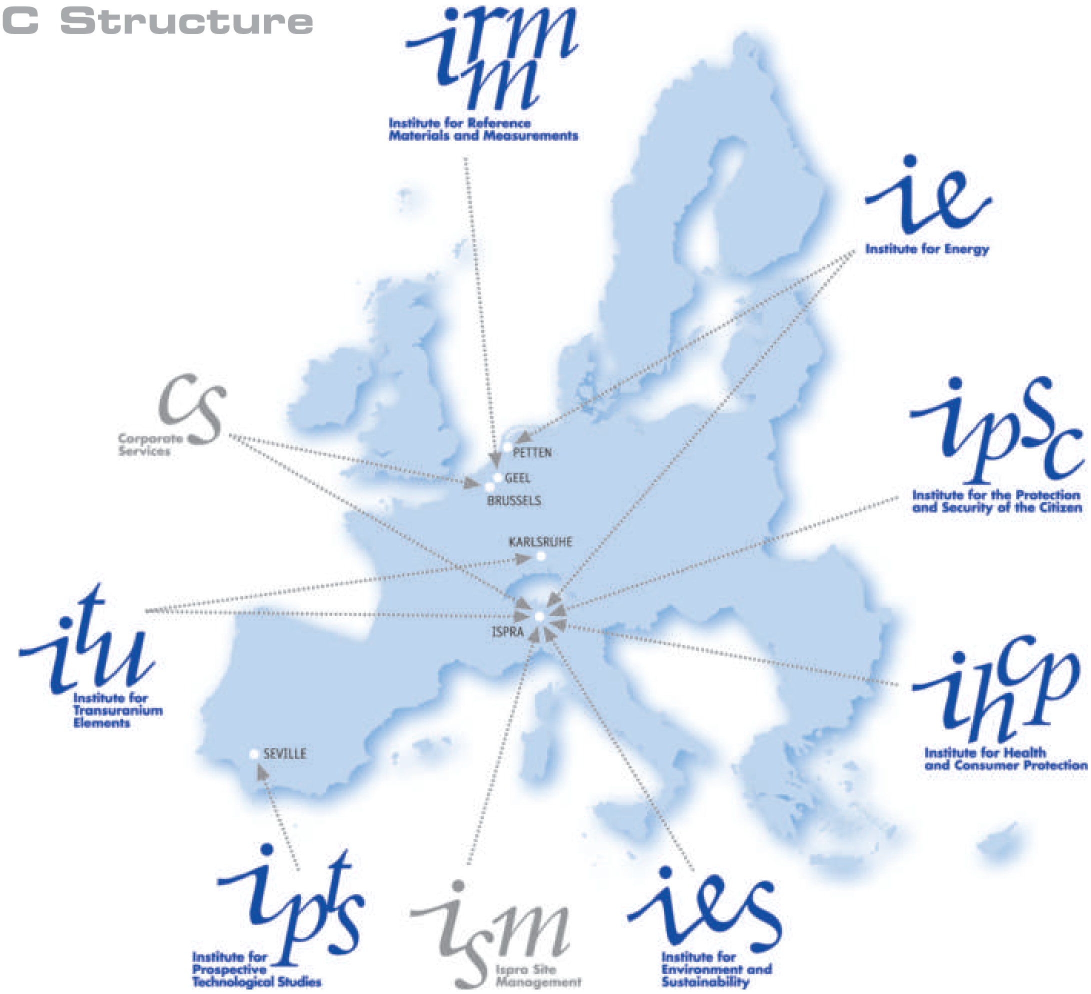
Institute for Reference Materials and Measurements

ANNUAL REPORT 2010

JRC
EUROPEAN COMMISSION

Report EUR 24820 EN

JRC Structure



The Institute for Reference Materials and Measurements

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IRMM – Confidence in measurements®

The vision for the JRC-IRMM is to be the European Commission reference, providing confidence in measurements in support of EU policies.

The mission of the JRC-IRMM is to promote a common and reliable European measurement system in support of EU policies.

Institute for Reference Materials and Measurements

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IRMM
50
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European Commission
Joint Research Centre
Institute for Reference Materials and Measurements

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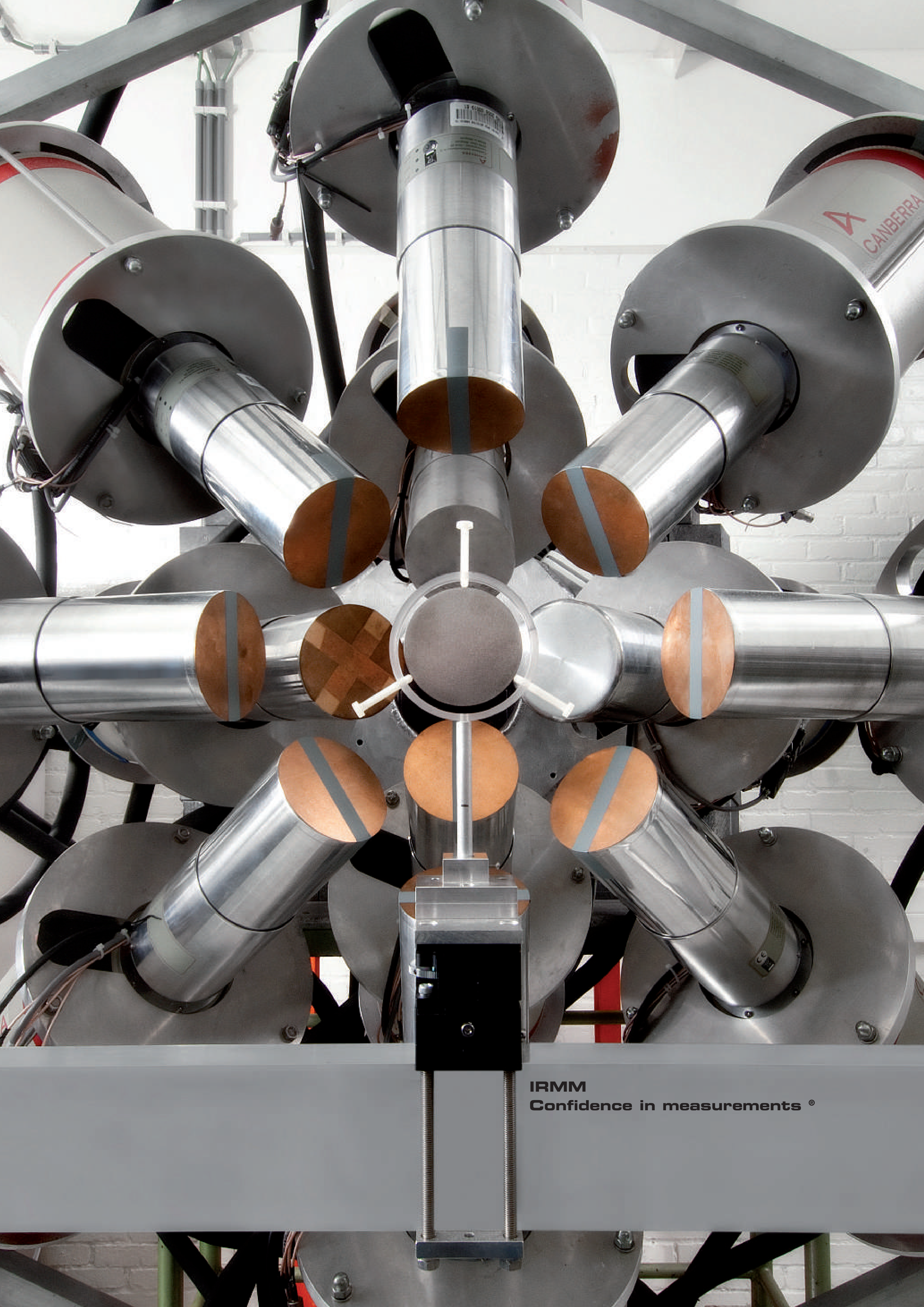

IRMM
Confidence in measurements ®

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MESSAGE FROM THE DIRECTOR

The competitiveness of the European economy and the smooth functioning of international trade depend very much on reliable measurements, which eliminate the need to duplicate or dispute testing data. Accurate and reliable measurements also enhance our quality of life – delivering better healthcare, safer food and a cleaner environment.

Recent European Commission initiatives, such as the flagship initiatives on Innovation Union and the industrial policy for the globalisation era, further highlight the need to develop a strong European standardisation system. Metrology – or the science of measurements – is typically called upon to provide the scientific basis for measurements and for improvements in standardisation.

Indeed, there are many rapidly growing areas, such as nanotechnology, biotechnology and personalised medicine, which will require the solid support of measurement standards and measurement technology to bring products to the market. Innovation can not happen without state-of-the-art measurement tools.

The JRC's Institute for Reference Materials and Measurements (IRMM) is working hard to develop measurement standards for new and challenging applications. We are also increasingly engaged in supporting policy makers on issues of measurement quality, so that EU policies are defined, implemented and assessed in an optimal manner.

The institute pursues its present-day mission with a rich scientific heritage. In 2010 we celebrated the 50th anniversary of the establishment of the institute – formerly known as the Central Bureau for Nuclear Measurements. It was an honour for us that – shortly after taking up her duties in February 2010 – the European Commissioner for Research, Innovation and Science, Máire Geoghegan-Quinn, visited JRC-IRMM and conveyed her best wishes to the institute for this special year.

During 2010, several events were organised in the frame of the 50th anniversary, including an open day in October during which members of the public were able to enter the site and learn about our activities. We also had the honour of hosting two conferences in the second half of the year under the auspices of the Belgian Presidency of the Council of the European Union.

In November, a new building for the development and production of reference materials was officially inaugurated. The inauguration ceremony was an important milestone in the development of the institute, and I'd like to pay tribute to everyone who contributed their expertise and dedication to this project over the years. I am confident that the new facility will enable the institute to remain at the forefront of reference material development and production.

Following the inauguration of the new building, an international scientific conference took place. Over 130 external participants from 26 countries participated in the event, which mapped out the current and upcoming measurement and testing needs for which challenging demands on reference materials are envisaged. The conference covered a broad range of emerging scientific areas, including health control, microbiology, biotechnology, food safety, environmental monitoring, nuclear safeguards, nanotechnology and material science.

Another highlight in 2010 was the fact that four analytical methods for food analysis developed by JRC-IRMM were adopted as standards by the European Committee for Standardization (CEN). Developing and validating accepted analytical methods is one of JRC-IRMM's central activities, and it is very gratifying when these methods are adopted at international level.

Overall, 2010 was an extremely busy and productive year for the institute. We achieved significant year-on-year increases in terms of our additional income, the number of peer-review scientific publications and our visibility in the press and media.

I'd like to thank my staff for their dedication, and I am confident that the institute will continue to make an invaluable contribution to measurement science in support of EU policies in the years to come.

Krzysztof Maruszewski
Director JRC-IRMM

02 ABOUT THE INSTITUTE

The Institute for Reference Materials and Measurements (IRMM) is one of the seven institutes of the Joint Research Centre (JRC), a Directorate-General of the European Commission, providing independent scientific and technical support to Community policy-making. The JRC-IRMM was founded in 1957 under the Treaties of Rome and started operation in 1960 under the name of the Central Bureau for Nuclear Measurements (CBNM). Today, JRC-IRMM is one of the world's leading reference material producers, expert adviser in food safety and quality and bioanalysis as well as a valued provider of reference measurement data. Its management system is certified according to ISO 9001, ISO 14001 and OHSAS 18001 and its scientific units hold several accreditations.

(left): New mass spectrometer for certification of reference materials and nuclear safeguards measurements.

(right): The GAINS spectrometer provides neutron data for advanced reactor studies.

Mission and tasks

JRC-IRMM promotes a common and reliable European measurement system in support of EU policies. The primary task of JRC-IRMM is to build confidence in the comparability of measurement results by the production and dissemination of internationally accepted quality assurance tools. JRC-IRMM develops and validates testing methods, produces reference materials, organises measurement evaluation programmes and provides reference measurements.

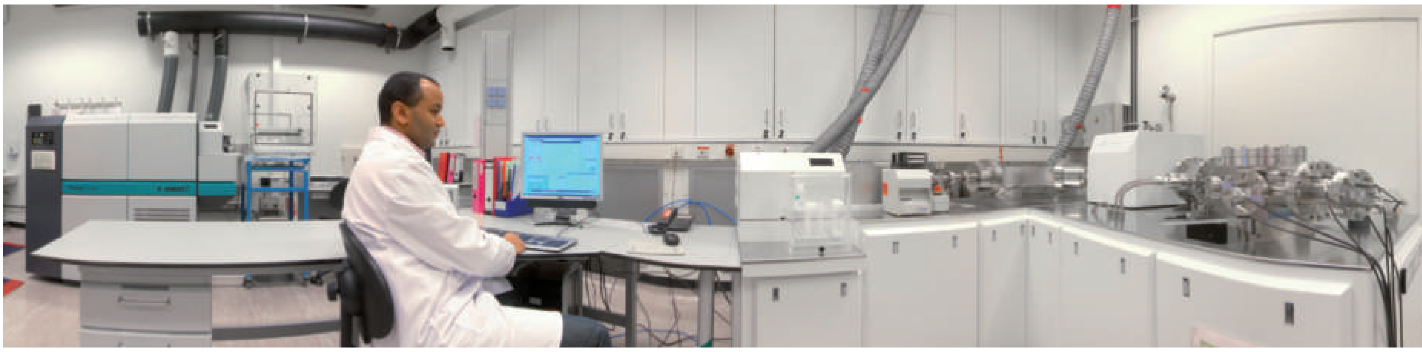
JRC-IRMM participates in the activities of the international metrology organisations such as the International Committee for Weights and Measures (CIPM) and the association of European metrology institutes (EURAMET). In collaboration with the European Co-operation for Accreditation (EA), JRC-IRMM helps to improve the measurement capabilities of hundreds of laboratories in all Member States. JRC-IRMM staff also contribute actively to the work of standardisation bodies like the European Committee for Standardisation (CEN) and the International Organization for Standardization (ISO). The JRC-IRMM operates four European Union reference laboratories (EU-RLs), formerly called Community reference laboratories.

A new facility for developing reference materials was inaugurated on 23 November 2010 by the Minister-President of the Belgian region of Flanders, Kris Peeters (centre-right), and the European Commission's Director-General for Enterprise and Industry, Heinz Zourek (centre-left).

Core competencies

The core competencies of JRC-IRMM are the development, production and distribution of reference materials, the development and validation of methods for food and feed analysis, bioanalysis, isotopic measurements, neutron physics and radionuclide metrology. These competencies are applied in a variety of research fields: food and feed safety and quality, biotechnology, sustainable agriculture, food allergen research, environment, health, nanotechnology and nuclear safety and security. The scientific knowledge base of JRC-IRMM is acquired and maintained by both fundamental and applied research in the respective areas.

JRC-IRMM staff are members of numerous committees, working groups and scientific boards of international organisations. JRC-IRMM's work in the field of metrology and standardisation is widely recognised. For instance, various technical committees of ISO use expert advice of JRC-IRMM on reference materials for their specific application fields, and JRC-IRMM experts participate actively in the work of AOAC International, Versailles Project on Advanced Materials and Standards (VAMAS), International Federation of Clinical Chemistry and Laboratory Medicine (IFCC), Codex Alimentarius, etc. Many testing methods validated by JRC-IRMM together with its collaborators have been approved as standards of CEN and ISO.



Inductively coupled plasma mass spectrometry (ICP-MS) laboratory at JRC-IRMM.

Special infrastructure

The institute's research facilities include multi-functional and adaptable laboratories for the development and production of reference materials, advanced analytical laboratories, a mass metrology laboratory and an ultra-clean chemical laboratory. The dedicated facilities for reference materials production are able to handle large amounts of various types of materials, even those hazardous for health. Controlled storage conditions for all materials are available.

In 2010, work finished on the new building at JRC-IRMM for the development and production of reference materials. The new facility – which was officially inaugurated on 23 November 2010 – comprises specialised laboratories and a versatile pilot-scale facility for material processing. The new facility will enable JRC-IRMM to remain at the forefront of reference material development and production.

The radionuclide metrology laboratory houses instrumentation for extremely accurate radioactivity measurements and small amounts of radioactive substances can be studied in the underground laboratory of JRC-IRMM located at the Belgian Nuclear Research Centre SCK•CEN in Mol, Belgium.

JRC-IRMM operates a 150 MeV linear electron accelerator (GELINA) and a 7 MV light-ion Van de Graaff accelerator. The two accelerators of JRC-IRMM, used to obtain neutron reaction data, are complementary in their experimental conditions and among the best such installations in the world. In a review of the JRC – chaired by Sir David King – the GELINA accelerator of JRC-IRMM was cited as one of the "efficient facilities absolutely necessary for the European nuclear research programme". The two accelerators can be used by scientists from other research organisations thanks to a project that facilitates access to large-scale facilities (EUFRAT).

03 MANAGEMENT TEAM

Director
Krzysztof Maruszewski

Reference materials
Hendrik Emons

Neutron physics
Peter Rullhusen

Food safety and quality
Franz Ulberth

Isotope measurements
Philip Taylor

Management support
Doris Florian

Infrastructure and site management
Marc Wellens

Safety, Health, Environment & Security
Pierre Kockerols

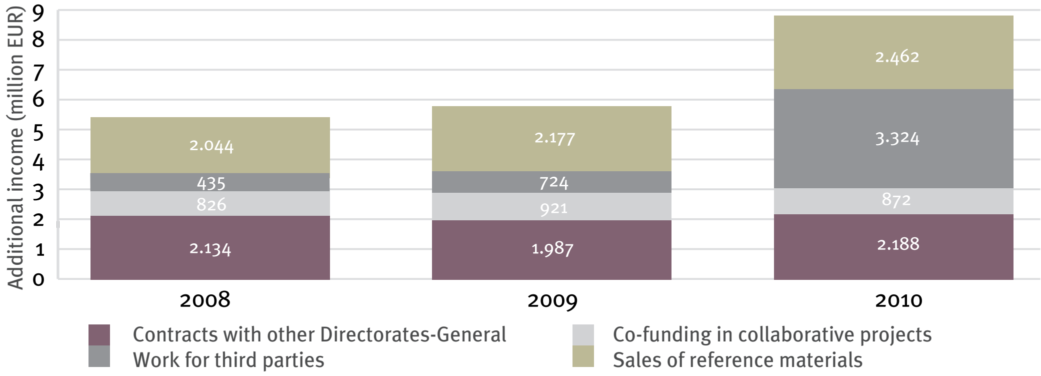
(Situation December 2010)

FACTS & FIGURES

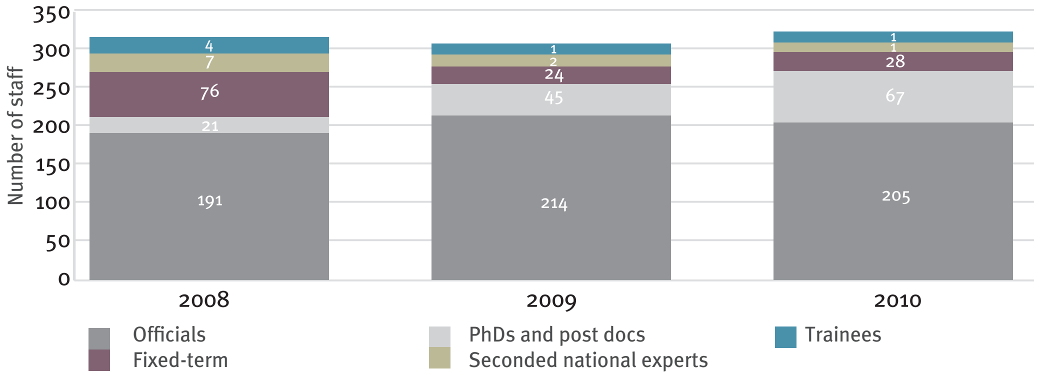
04

Budget

The majority of JRC-IRMM funding comes from the EU Framework Programmes for Research and Technological Development, both of the European Community and the European Atomic Energy Community (EURATOM). This budget is supplemented with additional income, which is detailed below:

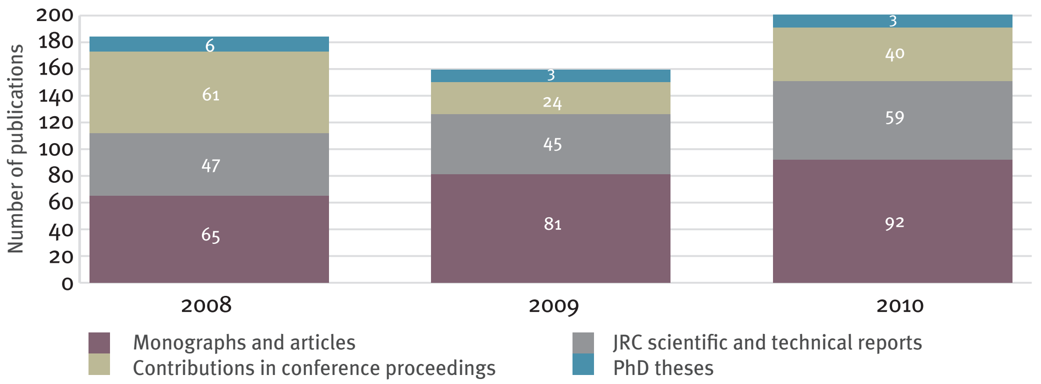


Staff



Publications

A large part of the research done at JRC-IRMM is reported in scientific publications in refereed scientific journals and conference proceedings. Additionally, valuable information can be found in the Scientific and Technical Research series which are accessible online[1]. A bibliographic list of selected scientific and technical articles and reports is given at the end of this report.



1 Since March 2009, the JRC's Scientific and Technical Reports can be downloaded online at http://publications.jrc.ec.europa.eu/repository.

ERM-BF428a
Sample No: 0000
GHB119 Cotton
ERM-BF427c
Sample No: 0000
98140 Maize
ERM-BF427a
Sample No: 0000
98140 Maize
ERM-BF428c
Sample No: 0000
ERM-BF428b
GHB119 Cotton
ERM-BF427d
Sample No: 0000
Sample No: 0000

REFERENCE MATERIALS

05

5.1 Introduction

The reliability and comparability of analytical testing data depend on adequate quality assurance tools, particularly certified reference materials. These materials are needed for developing, calibrating and validating methods of analysis. Today, certified reference materials are often indispensable to fulfil the requirements of standards for the accreditation of testing and calibration laboratories.

During 2010, JRC-IRMM released 24 new reference materials in areas such as food safety and quality (including GMOs), environmental monitoring, engineered materials and clinical testing. The institute continued to make important steps forward in the field of metrology at the nanoscale. The Reference Materials Unit of JRC-IRMM achieved ISO/IEC 17025 accreditation for the measurement of the size of nanoparticles by dynamic light scattering and centrifugal liquid sedimentation. The institute also contributed to an important ISO Technical Specification defining key terms in the field (ISO/TS 80004-1:2010).

On the 23 November 2010, a new scientific facility to develop and produce reference materials was inaugurated by the Flemish Minister-President, Kris Peeters, and the European Commission's Director-General for Enterprise and Industry, Heinz Zourek (see next section).

Following the inauguration, the institute hosted an international scientific conference entitled "The Future of Reference Materials – Science and Innovation". The conference was held under the auspices of the Belgian Presidency of the Council of the European Union. Over 130 participants from 26 countries got together to discuss the upcoming measurement and testing challenges for which reference materials need to be developed.

The Director of JRC-IRMM, Krzysztof Maruszewski, welcomes the participants of the international conference: "The Future of Reference Materials – Science and Innovation", 23 November 2010, which was organised under the auspices of the Belgian Presidency of the Council of the European Union.

5.2 A world first for nanoparticle size measurements

In 2010, JRC-IRMM released the world's first certified nanoparticle reference material based on industry-sourced nanoparticles. This new material will help ensure the comparability of particle-size measurements worldwide, thereby facilitating trade and ensuring compliance with legislation.

Nanotechnology offers a range of benefits over traditional materials and enables the development of innovative applications and products. However, there are often concerns about safety aspects and to what extent these have been investigated. High-quality measurements are the basis for reliable safety assessments, process improvement, quality control and the development of new nanotechnology applications.

Until now, no certified benchmarks incorporating industrial nanoparticles were available. Some synthetic materials were available, but they were not fully representative of real test samples. For this reason, JRC-IRMM developed the world's first certified reference material based on industry-sourced nanoparticles. The material (ERM®-FD100) consists of silica nanoparticles of a nominal diameter of 20 nanometres.

This material provides a basis to check that nanomaterials conform to the internationally accepted definition of a nanomaterial[1]. It will enable producers of nanoparticles to monitor production quality over time against a stable reference point, and to assess the impact of process improvements. Furthermore, the certified reference material will contribute to establishing market confidence by confirming that nanomaterial products meet customers' technical requirements.

The release of this certified reference material concludes several years of product development, in which the homogeneity and stability of the material were assessed. Particle size was measured in collaboration with 33 laboratories from 11 different countries in Europe, America and Asia. Particle size was measured by dynamic light scattering, electron microscopy, centrifugal liquid sedimentation and small-angle x-ray scattering, and certified values were assigned individually for each measurement method.

A) JRC-IRMM produced the world's first certified reference material for nanoparticle size measurements based on industry-sourced nanoparticles.

B) In 2010, JRC-IRMM examined the feasibility of preparing biodiesel reference materials.

5.3 Towards international measurement standards for biofuels

There is an increasing demand to accurately measure the quality of biofuel products (biodiesel and bioethanol), particularly in view of the European directives promoting renewable energies[2] and setting out fuel quality requirements[3].

Until now, however, there is no international consensus on the technical specifications of biofuels, nor is it fully clear what measurement standards and quality control tools in the form of reference materials are needed to meet legislative requirements.

In 2010, an international project on biofuel reference materials involving JRC-IRMM reported its final results. The project demonstrated that it is feasible to prepare biodiesel and bioethanol reference materials with reference values traceable to the international system (SI) of units for a range of parameters. However, further research is needed for several parameters such as for glycerides in biodiesel and acidity in bioethanol.

The project also carried out inter-laboratory comparisons using biodiesel and bioethanol test materials prepared within the project. The exercise showed that the measurement capabilities of the field laboratories were often good in the case of biodiesel, although the availability and use of certified reference materials will certainly enhance the comparability of measurement results for many parameters. For bioethanol, the consensus values for density, ethanol and water were in very good agreement with the reference values. However, several other

1 Nanotechnologies - Terminology and definitions for nano-objects - Nanoparticle, nanofibre and nanoplate, International Organization for Standardization: ISO/TS 27687:2008, ISO, Geneva (2008)

2 Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC

3 Directive 2009/30/EC of the European Parliament and of the Council of 23 April 2009 amending Directive 98/70/EC as regards the specification of petrol, diesel and gas-oil and introducing a mechanism to monitor and reduce greenhouse gas emissions and amending Council Directive 1999/32/EC as regards the specification of fuel used by inland waterway vessels and repealing Directive 93/12/EEC

parameters, such as electrolytic conductivity and acidity, exhibited poor measurement reproducibility. Overall, there is a pressing need for (certified) reference materials to improve measurement reproducibility.

In this project [4], JRC-IRMM participated together with five other organisations: the National Institute of Standards and Technology (NIST, USA), the National Institute of Metrology, Standardization and Industrial Quality (INMETRO, Brazil), the Dutch National Metrology Institute (VSL, the Netherlands), the National Physical Laboratory (NPL, UK) and LGC Ltd (UK). The final summary report of the project is available online [5].

5.4 Detecting the presence of GMO foodstuffs more accurately

Legislation in the European Union calls for food and feed products containing more than 0.9 % of genetically modified organisms (GMOs) to be labelled accordingly . Most of the measurement results for control purposes are expressed as mass fraction, whereas a subsequent recommendation stipulated that the copy number ratio should be used .

For this reason, existing certified reference materials (CRMs) for GMO analysis with a known mass fraction of GMO were further certified for their copy number ratios.

Three sets of CRMs – each consisting of a matrix CRM produced from seed powder and a calibrant of plasmid DNA – were certified for the maize events NK603 and 98140, and the soya event 356043.

The three matrix materials (ERM®-BF415e, ERM®-BF425c and ERM®-BF427c) were certified for copy number ratio, as measured by a defined quantitative polymerase chain reaction (PCR) method, and calibrated with the corresponding plasmid DNA materials (ERM®-AD415, ERM®-AD425 and ERM®-AD427). The certified values were obtained on the basis of a collaborative trial that involved extensive analysis of datasets obtained from specialised laboratories world-wide.

The three plasmid DNA materials are certified for the number of DNA fragments per plasmid: one specific transgenic and one taxon-specific sequence. They are intended to be used for the calibration of the event-specific method for the quantification of the NK603, 98140 and 356043 in food or feed samples.

Each matrix CRM (used for quality control) and corresponding plasmid DNA CRM (used for calibration) form – together with the event-specific PCR method – a reference system for the expression of the measured GM quantity in copy number ratios.

JRC-IRMM has developed certified reference materials for measuring GM quantity in terms of copy number ratios.

4 BIOREMA (Reference materials for biofuel specifications) was funded under the Seventh Framework Programme of the European Community for research, technological development and demonstration activities (2007-2013), project number 219081.

5 http://ec.europa.eu/energy/renewables/biofuels/doc/liquid_biofuels/publishable_summary.pdf

5.5 Quality control materials for environmental monitoring

A safe and healthy environment is the common goal of several Community directives and regulations, and to this end, water, air and soil have to be regularly monitored and assessed. In 2010, JRC-IRMM released eight new certified reference materials (CRMs) for the accurate measurement of inorganic and organic pollutants in various environmental matrices. These materials are primarily intended for the performance assessment and validation of analytical measurement methods in support of environmental legislation.

JRC-IRMM produced three new water-based CRMs (ERM®-CA616, ERM®-CA408 and ERM®-CA615), intended as quality control tools for laboratories carrying out measurements required under the Water Framework Directive[6]. This legislation sets out a long-term perspective for the management and protection of EU inland and coastal waters, including mandatory monitoring of the so-called priority substances comprising a wide range of compounds and elements. ERM®-CA615 is a groundwater material, certified for the mass concentrations of a range of trace metals. The mass concentrations of four metals were chosen to reach specific European environmental quality standards[7]. ERM®-CA616 and ERM®-CA408 are groundwater and simulated rainwater materials, respectively, certified for the mass concentrations of the main components and for pH and conductivity. Consequently, these materials carry certified values for some cations (ammonium, calcium, magnesium, potassium, sodium) and anions (chloride, fluoride, nitrate, ortho-phosphate, sulfate).

Two new CRMs were developed to match the testing requirements of European air quality legislation[8], in particular, the type of matrix (including the particle size) and the type and content of the certified analytes. ERM®-CZ100 and ERM®-CZ120 were produced from fine dust that was processed in such a way as to resemble particulate matter with an aerodynamic diameter below 10 microns (so-called PM10) as closely as possible. ERM®-CZ100 is certified for a range of polycyclic aromatic hydrocarbons and ERM®-CZ120 is certified for four trace elements (arsenic, cadmium, nickel and lead).

A further three CRMs for environmental analysis were released in 2010. These materials were natural loam soil and rye grass certified for the mass fractions of a range of trace metals (ERM®-CC141 and ERM®-CD281, respectively) and fish oil certified for the mass fractions of 18 chemicals related to polychlorobiphenyls (ERM®-BB350).

A) In 2010, JRC-IRMM released eight new certified reference materials for the accurate measurement of inorganic and organic pollutants in various environmental matrices.

B) In 2010, JRC-IRMM released a reference material certified for cystatin C – a marker in human plasma of the proper functioning of kidneys.

5.6 Harmonising clinical measurements of cystatin C

In 2010, JRC-IRMM released a reference material certified for cystatin C. Cystatin C in human plasma is a marker of the proper functioning of kidneys, and can be used for testing children, elderly, patients with low muscle mass, and those in the early stages of kidney problems. Cystatin C is also employed as a marker for cardiovascular risk and pre-eclampsia.

6 Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for community action in the field of water policy.

7 Directive 2008/105/EC of the European Parliament and of the Council of 16 December 2008 on environmental quality standards in the field of water policy.

8 Directive 2004/107/EC of the European Parliament and of the Council of 15 December 2004 relating to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air & Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe.

The usefulness of cystatin C assays in clinical chemistry has been hampered by the lack of standardisation: the same samples gave different results when measured by different methods. Furthermore, the cystatin C values obtained by various methods were not stable over time. This causes problems for the interpretation of large-scale population studies running over a long period of time.

JRC-IRMM's new certified reference material (ERM®-DA471/IFCC) was produced in collaboration with the International Federation of Clinical Chemistry and Laboratory Medicine (IFCC), which actively supports standardisation in clinical chemistry. The reference material was produced to support the implementation of the EU legislation on *in vitro* diagnostic medical devices, which requires traceability of calibrators and control materials to reference measurement procedures and/or reference materials of a higher order [9].

The availability of a certified reference material for cystatin C will reduce the problems resulting from the use of different cystatin C calibrators and non-agreeing determination methods, thus improving non-invasive testing of the capacity of the kidneys to filter plasma.

5.7 Detecting banned antibiotics in meat

Chloramphenicol is an antibiotic that can be used against a wide range of disease-causing bacteria, and it is highly effective against many pathogenic bacteria such as *Salmonella or Clostridia*. It was used in veterinary practices since the 1950s. However, concerns about serious haemotoxic effects in humans, such as leukaemia, led to an EU ban in 1994 on chloramphenicol as a veterinary medicinal product for animals in the food chain [10].

EU legislation also specifies the required sensitivity of analytical methods used by food-testing laboratories, and a minimum required performance limit (MRPL) of 0.3 µg/kg has been set for residues of chloramphenicol in different food matrices, including meat [11].

In 2010, JRC-IRMM released a new reference material which will assist food-testing laboratories in reliably detecting and quantifying chloramphenicol in meat – enabling them to verify whether their methods comply with the MRPL.

The reference material, ERM®-BB130, is intended to be used for method validation purposes (including trueness estimation) and method performance control. The certified value is based on an inter-laboratory characterisation study based exclusively on gas chromatography-mass spectrometry and liquid chromatography-tandem mass spectrometry confirmatory methods, all of which complied with performance criteria stipulated in EU legislation [12].

Chloramphenicol is banned in the EU as a veterinary medicinal product for animals in the food chain (©2001 image100 ltd).

9 Directive 98/79/EC of the European Parliament and of the Council of 27 October 1998 on in vitro diagnostic medical devices.

10 Commission Regulation (EC) 1430/94 of 22 June 1994 amending Annexes I, II, III and IV of Council Regulation (EEC) No 2377/90 laying down a Community procedure for the establishment of maximum residue limits of veterinary medicinal products in foodstuffs of animal origin (text with EEA relevance).

11 Commission Decision 2003/181/EC of 13 March 2003 amending Decision 2002/657/EC as regards the setting of minimum required performance limits (MRPLs) for certain residues in food of animal origin.

12 Commission Decision 2002/657/EC of 14 August 2002 implementing Council Directive 96/23/EC concerning the performance of analytical methods and the interpretation of results.

A so-called commutability study was conducted to prove that the material can also be applied as a quality-control tool for widely used screening methods. The study involved five commercially available rapid immunochemical tests and one biosensor assay. The results of the study demonstrated that ERM®-BB130 is sufficiently commutable with the tests examined. Laboratories using one of these tests therefore benefit from using ERM®-BB130 to demonstrate the correctness of their results.

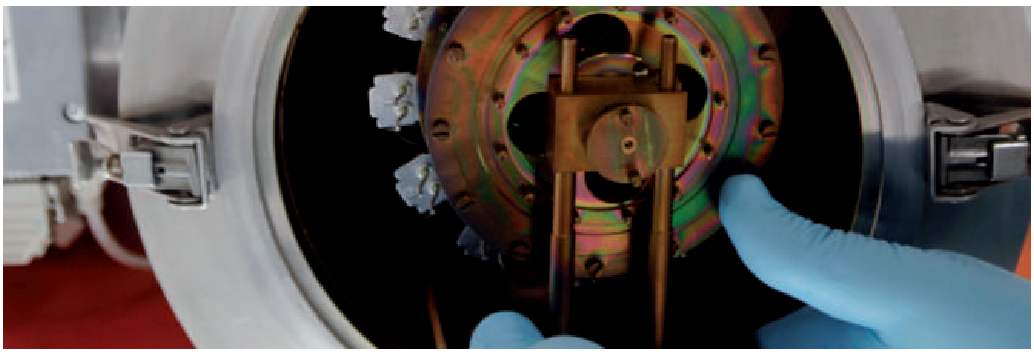
5.8 Accurate analysis and control of nuclear material

In 2010, JRC-IRMM released a new batch of large-sized dried spikes for the measurement of uranium and plutonium (IRMM-1027n). These reference materials are used to measure the uranium and plutonium content of dissolved fuel using isotope dilution mass spectrometry. The materials are provided to the European Commission's Directorate-General for Energy as a fundamental part of the fissile material control of irradiated nuclear fuel at the on-site laboratories in Sellafield (UK) and La Hague (France).

Another new uranium reference material (IRMM-3100a) was released in 2010, which is suitable for verifying the calibration of multi-collector mass spectrometers, especially those equipped with multiple-ion counting systems. Such systems are typically used in measurements of uranium in nuclear safeguards and earth sciences. The uranium isotopic reference material is an equimolar mixture with isotope amount ratios of ^{233}U, ^{235}U, ^{236}U and ^{238}U close to 1:1:1:1 (a so-called QUAD isotopic reference material).

Furthermore, one of JRC-IRMM's reference materials dating from 1995 (IRMM-046b), was re-certified for isotope amount content and isotopic composition. The re-certification follows a calibration campaign linking several of IRMM's plutonium reference materials on a metrological basis, and using state-of-the-art measurement procedures. The new reference values have considerably smaller measurement uncertainties – further increasing confidence in control measurements of fissile material amongst European and international safeguards authorities.

A paper published in 2010 reported a significant advancement in the 'fingerprinting' of plutonium contamination. Using a technique known as thermal ionisation mass spectrometry, the ratio of plutonium isotopes was measured with unprecedented accuracy in reference samples obtained from the International Atomic Energy Agency and the National Institute of Standards and Technology. Soil and moss samples collected from the site of the Chernobyl accident were also analysed. The measurements yielded considerably low uncertainties not only for the isotope ratio of $^{240}Pu/^{239}Pu$, but also – for the first time – for the ratios of $^{241}Pu/^{239}Pu$ and $^{242}Pu/^{239}Pu$. The results confirmed the suitability of the measurement technique, and the researchers could identify with confidence whether the environmental contamination originated from reactor-grade or weapons-grade plutonium.



Nuclear mass spectrometry: by measuring isotope ratios, scientists can determine whether environmental plutonium contamination is of civil, military or illicit origin.


Control Sample
ERM-BE375
Sample n. 3
REP 1
Control Sample
ERM-BE375
Sample n. 3
REP 2
Control Sample
ERM-BE375
Sample n. 3
REP 3
EUROPEAN COMMI

06 SPECIAL FEATURE: NEW FACILITY FOR DEVELOPING AND PRODUCING REFERENCE MATERIALS

The processing hall provides for parallel material handling, thanks to movable walls and separate air-handling systems which can divide the hall into four separate areas.

The processing hall

The building features a material-processing hall that provides for parallel material handling, thanks to movable walls and separate air-handling systems which divide the hall into up to four separate areas. Consequently, four different reference materials can be processed at a time without any risk of cross-contamination. This facility is unique amongst the major producers of reference materials worldwide.

Moreover, a number of dedicated rooms adjacent to the processing hall allow a logical sequence of activities and equipment to support the main processing areas like washing and handling of glassware, capping and labelling of vials and a process control laboratory incorporating microscopy, particle size analysis and measurements of water content.

Worldwide, there is an increasing demand for new reference materials for a broadening range of applications and a greater variety of analyte-matrix combinations. In striving to meet this demand, reference material producers have to handle a wider variety of less stable materials, especially those of biological origin, often running a greater risk of cross-contamination during processing. For this reason, the JRC decided several years ago that new facilities were needed for its reference material programme, in order to be able to adapt the targeted measurement benchmarks in response to changing requirements. The construction work began in August 2008 and the new facility was officially inaugurated on 23 November 2010.

The end result is a scientific and technical facility with specialised laboratories and a versatile pilot plant for material processing. The new processing hall bridges the gap between laboratory and industrial scale, and it will enable JRC-IRMM to remain at the forefront of reference material development and production. The facility will be used to develop reference materials in support of EU legislation that provide laboratories around the world with benchmarks to deliver accurate, harmonised and traceable results.

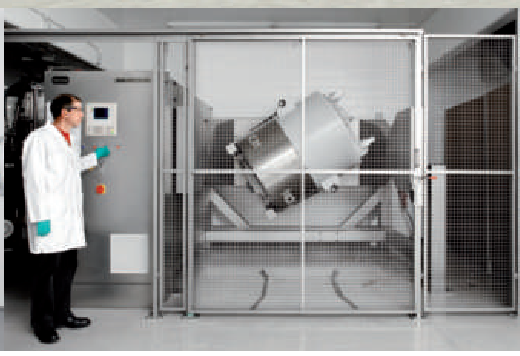
The new building in figures

Total cost:	11 million
Building footprint:	120 x 20 m (approx)
Processing hall:	4 areas of 100 m² each
Total number of labs:	14
Bio-safety labs:	140 m²
Auditorium:	160 m², seating 85

Additional laboratories and equipment

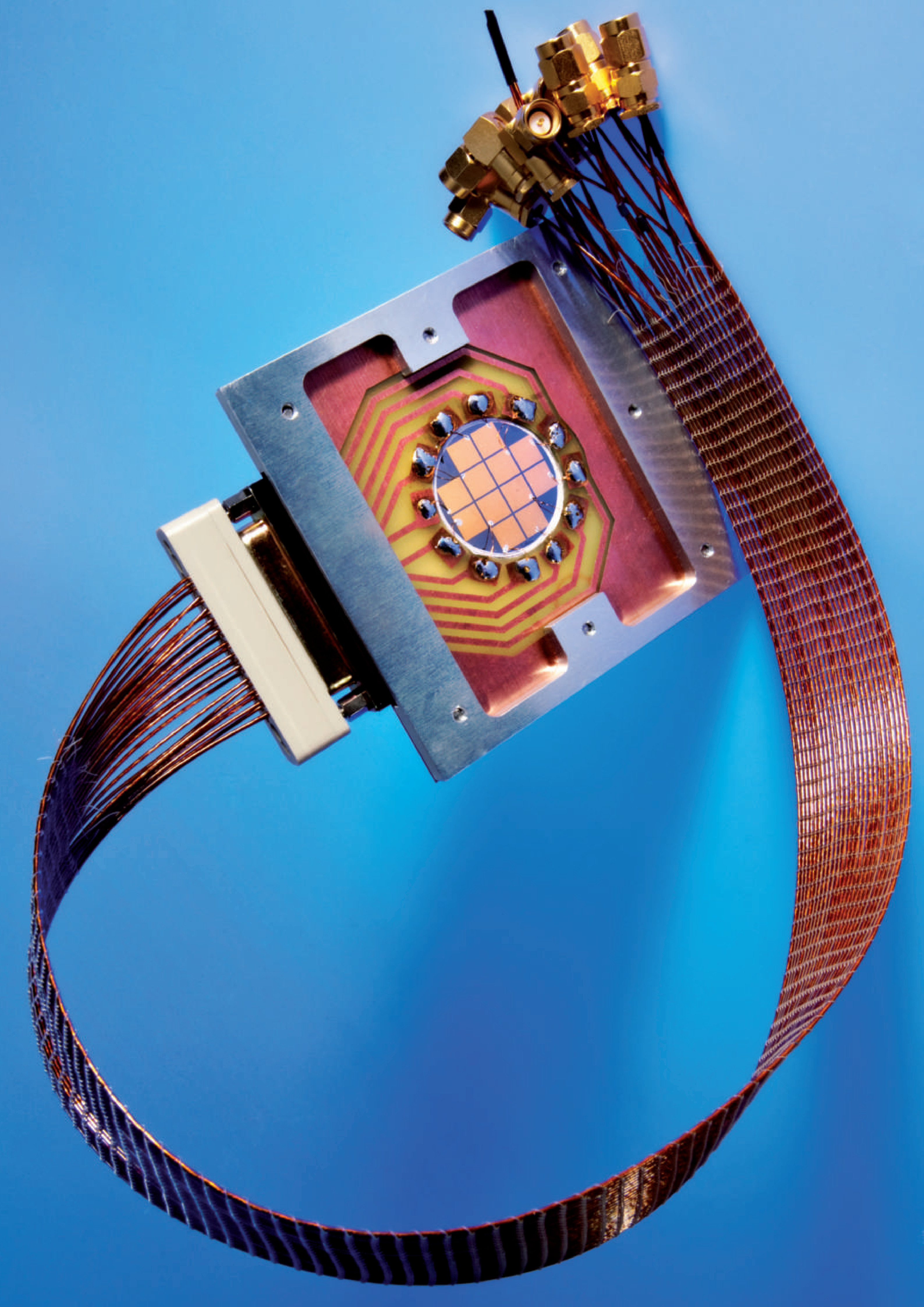
The new building houses bio-safety laboratories (level class 3) which equip the European Commission with an in-house facility for the safe handling of potent human pathogens (bacteria and viruses). A sequence of six laboratories has been designed to host microbiology and protein chemistry using, for instance, high resolution organic mass spectrometry. Access to bio-safety cabinets, a waste autoclave and a cool-cell make these labs also highly suitable for supporting the developments in the field of clinical reference materials. The building includes three laboratories for element analysis. Sample preparation is located in one laboratory with access to metal-free clean benches and fume hoods together with high-capacity digestion systems for mineralisation of samples. Two instrumental laboratories currently house an inductively coupled plasma mass spectrometer, a solid sampling atomic absorption spectrometer and an inductively coupled plasma optical emission spectrometer, mainly for the measurement of trace elements. The facility includes equipment for manipulating and stabilising slurries and pastes for the provision of solid but wet reference materials.

The processing hall contains a new freeze dryer with a 100 kg ice condenser capacity.



This large-scale mixer in the processing hall can mix powders up to 550 L or 400 kg during reference material preparation.

The building contains a new laboratory for producing water reference materials, consisting of 4 x 500 litre drums which can be made into one volume of 2000 litre thanks to the inert pumps that re-circulate water in the system.



NUCLEAR PHYSICS

7.1 Introduction

Opposite page: Fission detector built from artificial diamond with a thickness of 180 microns, used in the measurement of prompt fission gamma rays.

Many issues related to nuclear safety and security involve calculations using accurate nuclear data. Measurements of neutron-induced reactions and cross-section standards, and absolute measurements of radiation i.e. radionuclide metrology, have been key activities of the JRC-IRMM since it started operation in 1960. JRC-IRMM focuses on neutron data for standards, safety of operating reactors, handling of nuclear waste and waste transmutation and investigating alternative reactor systems and fuel cycles.

Measurements carried out at its linear electron accelerator facility (known as GELINA) and the Van de Graaff facility have played a significant role in establishing and improving the evaluated nuclear data files maintained at the databank of the Nuclear Energy Agency (NEA) of Organisation for Economic Cooperation and Development (OECD).

Additionally, the JRC-IRMM participates in competitive projects. The EUFRAT project[1] facilitates access to the nuclear data facilities of JRC-IRMM, Following a third call for proposals in 2010, 31 experiments at GELINA and the Van de Graaff accelerator have been approved to date. A new project called ERINDA (European Research Infrastructures for Nuclear Data Applications) started on 1 December 2010. The project brings together major players in Europe in terms of nuclear data measurement facilities, working towards improved nuclear data in line with the Strategic Research Agenda of the Sustainable Nuclear Energy Technology Platform.

During 2010, JRC-IRMM organised two workshops as part of the JRC's "Enlargement and Integration" initiative. The first was on nuclear fission dynamics and the emission of prompt neutrons and gamma rays was organised in Sinaia, Romania bringing together the leading experts in the field of fission theory. A second workshop was organised in Krakow, Poland on nuclear measurements, evaluations and applications.

On 9 December 2010, JRC-IRMM hosted a high-level conference entitled "Research in nuclear sciences: impact on the citizen", under the auspices of the Belgian Presidency of the Council of the EU. The event was co-organised by the Belgian Nuclear Society, in association with the Belgian Nuclear Research Centre (SCK•CEN) and the Institute for Radioelements (IRE). The conference brought together Belgian stakeholders to discuss the future of nuclear research, and was therefore a fitting way to close the 50th anniversary year of the institute.

JRC-IRMM hosted a conference in December 2010 entitled "Research in nuclear sciences: impact on the citizen". During lunch, the 50th anniversary cake was cut by the Belgian Federal Minister, Sabine Laruelle, and Philippe Busquin – former European Commissioner, former Member of the European Parliament, and currently Chairman of the Board of IRE.

1 The project, European Facility for innovative reactor and transmutation neutron data (EUFRAT), is funded under the EU 7th Framework Programme of the European Atomic Energy Community (contract number 211499), http://irmm.jrc.ec.europa.eu/eufrat

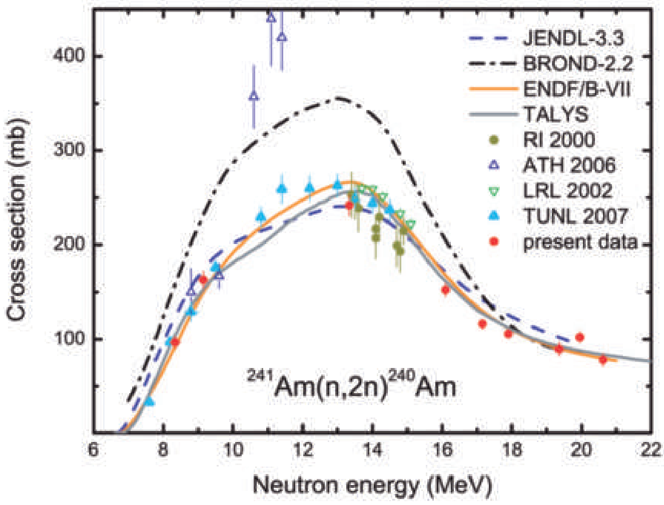
7.2 High-resolution measurements of the $^{241}Am(n,2n)$ cross section

The nucleus ^{241}Am is one of the most abundant isotopes in spent nuclear fuel, and is one of the most highly radiotoxic among the actinides. For this reason, accurate data are required to study the possible transmutation of long-lived radioactive waste with advanced high-neutron-energy reactors.

For the study, samples of $^{241}AmO_2$ were fabricated and characterized at JRC's Institute for Transuranium Elements and then irradiated at the 7-MV Van de Graaff accelerator at JRC-IRMM, in order to investigate the $^{241}Am(n,2n)$ reaction cross section. The work was performed as part of a collaboration between the JRC, French laboratories from Centre national de la recherche scientifique (CNRS) and the Commissariat à l'énergie atomique (CEA).

The $^{241}Am(n,2n)$ reaction cross section was measured at energies above 15 MeV for the first time. The new data are in good agreement with predictions obtained with a model developed at CEA. Measurements at energies below 15 MeV were performed in order to compare the new experimental data with previously published data, and good agreement was observed.

The data were disseminated through the EXFOR [2] database and are included in the latest release of the European (JEFF-3.1.1) and United States evaluated data files (ENDF/B-VII.1).



The JRC data (red) for the $^{241}Am(n,2n)\,^{240}Am$ reaction compared with data from earlier work, a new model calculation by CEA Bruyères-le-Châtel and earlier model calculations.

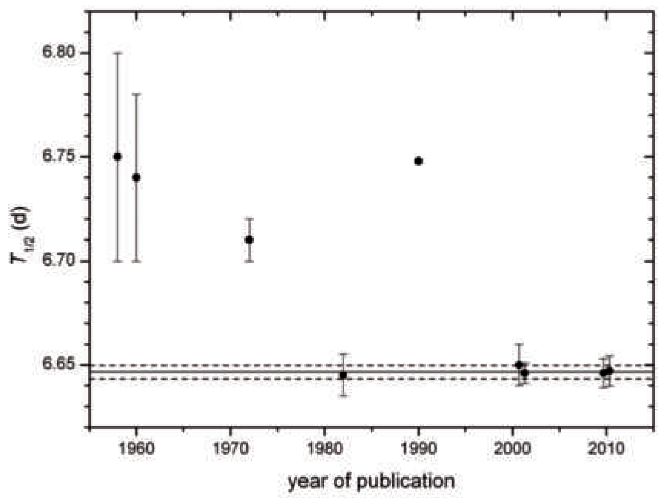
2 EXFOR = Experimental Nuclear Reaction Data: a database maintained by the Nuclear Energy Agency (NEA) of Organisation for Economic Cooperation and Development (OECD), http://www.oecd-nea.org/dbdata/x4/

7.3 Improved decay data for ^{177}Lu

The radionuclide ^{177}Lu has received attention as a potential therapeutic radiopharmaceutical in the nuclear medicine community, as it meets a number of important selection criteria. The mean beta energy of 134 keV is suitable for radiotherapy, and the half-life of around 6.6 days allows ample time for shipping, labelling, purification and application. The presence of low-energy gamma emission enables gamma imaging and personalised dosimetry prior to administration of a therapeutic dose.

To minimise the uncertainty of dose calculations when such radiopharmaceuticals are applied to patients, the decay parameters of radionuclides must be well known. The physical half-life of the radionuclide is an important feature, because it should match with the rates of biological uptake and clearance of the radiopharmaceutical to maximise the dose delivered to target tissue and minimise the burden on normal tissue. JRC-IRMM therefore measured the half-life of ^{177}Lu with state-of-the-art accuracy, and the results were compared to other measurement results in literature.

The half-life of ^{177}Lu was measured by both an ionisation chamber and a liquid scintillation counter over periods of 85 days and 42 days respectively. Both measurements were corrected for background and a minor ^{177m}Lu activity contribution. A value of the ^{177}Lu half-life of 6.6465 (35) days was obtained by a least-squares fit of two exponentials and a constant to the experimental data.



Overview of the measured values of the ^{177}Lu half-life and the respective year of publication. The solid lines represent the weighted mean and the dashed lines the standard deviation derived from the best data.

This result is in good agreement with three out of seven previously published measurement results and the current recommended value of 6.645 (4) days. Four measurements made between 1958 and 2000 have been shown to be significantly overestimated, and should be disregarded. Based on a weighted mean of the new results and a selection of literature data, a new value of 6.6465 (27) is recommended.

A paper describing the work has been accepted for publication in the journal Applied Radiation and Isotopes.

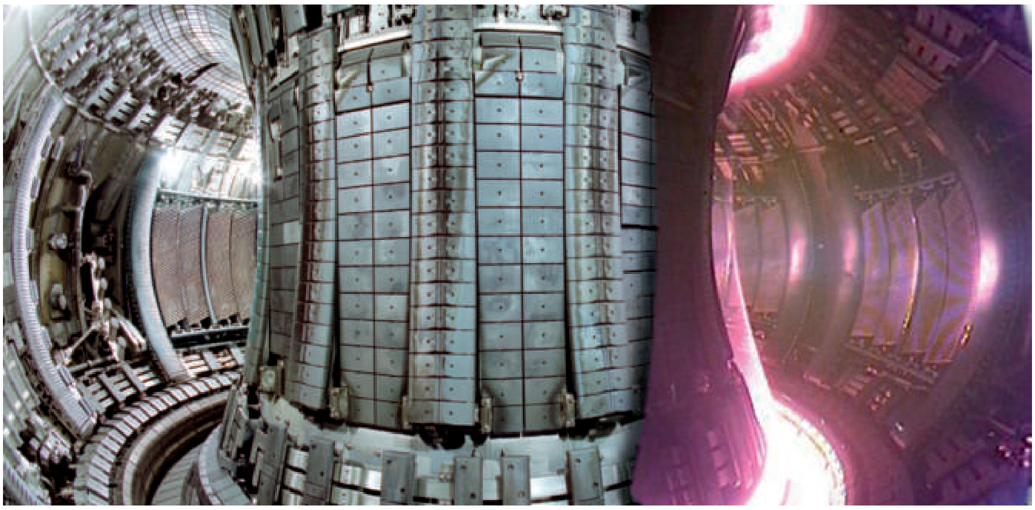
7.4 Charged-particle diagnostics in the JET Tokamak

The confinement time for a fusion plasma is mainly determined by the rate of loss of charged particles across the magnetic field. Charged particles in the MeV range are produced in large quantities in fusion reactors, and the leakage of these particles is a potential hazard to the reactor walls and the material structures that contain the fusion plasma. Because of the extreme conditions inside the Joint European Torus (JET) [3] tokamak, there is still no standard technique to analyse the leakage of charged particles from the plasma.

A promising solution is to place samples of different materials inside the tokamak and to subsequently analyse the activation products. In previous work, JRC-IRMM showed that the angular distribution of protons inside a tokamak could be measured.

In 2010, JRC-IRMM co-authored a paper describing the first ever experimental determination of the ratio of 3 MeV and 14.7 MeV protons. This was accomplished by placing several thin pieces of boron carbide in a stack and measuring the production of ^{7}Be in each of the small pieces. The 3.0 MeV protons activated the upper piece but only the 14.7 MeV protons activated the lower pieces in the stack.

It was confirmed that the flux of 14.7 MeV protons is larger than the flux of 3 MeV protons, which is expected from the confinement of protons in the plasma. Furthermore, information was obtained about the angle of incidence and the attenuation of the proton flux with the position of the samples. There are now plans to perform more experiments to develop the technique further and inclusion in the ITER[3] design is being considered.



Interior view of the JET vacuum vessel with a superimposed image of an actual JET plasma Image: EFDA-JET)

In 2010, JRC-IRMM co-authored a paper describing the first ever experimental determination of the ratio of 3 MeV and 14.7 MeV protons.

3 The Joint European Torus (JET) tokamak is the largest in the world, and it is the only operational fusion experiment capable of producing fusion energy. The successor machine, ITER, is currently under development: http://www.jet.efda.org, http://www.iter.org.

7.5 Neutron-based analysis of a Bronze Age sword

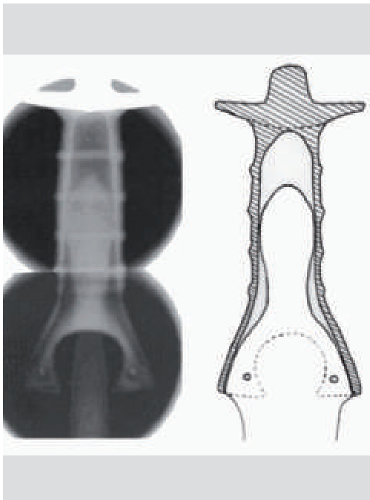
Scientists at JRC-IRMM studied the composition of a precious Bronze Age sword using pulsed neutron beams as part of the European-funded project called ANCIENT CHARM[4]. The sword dates from 1300 – 1100 BC, and was found near the village of Buggenum in the Netherlands.

In close collaboration with scientists from the Delft University of Technology, ten scientific institutes and museums collaborated to improve and develop certain neutron-based analytical and imaging methods for cultural heritage objects.

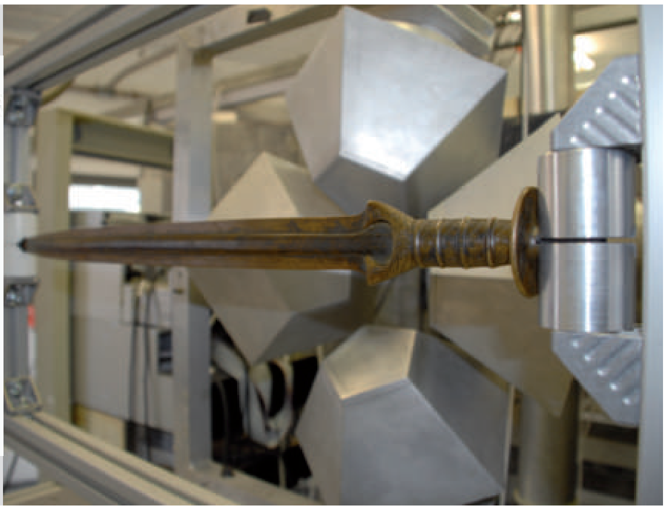
By precisely measuring the ratio of copper to tin along the length of the sword, the researchers gained an insight into the craftsmanship of the sword, and determined that the blade and the hilt were cast separately with different bronze compositions. The presence of cobalt in the composition supports the assumption that the sword originates from the North Alps-Danube region. A radiograph of the sword's hilt revealed in unprecedented detail how the blade and the hilt are connected.

The sword also underwent time-of-flight neutron diffraction at the Rutherford Appleton Laboratory in the UK. These measurements indicated successive annealing and working cycles, for the purpose of hardening the blade. This indicates that although the sword is considered a ceremonial object, it was manufactured as a potentially functional weapon.

The results of the sword measurements were published in a peer-reviewed journal[5], and a paper describing the technique of neutron resonance capture and transmission analysis has been published in the Encyclopedia of Analytical Chemistry[6].



A radiograph and drawing of the hilt of the Buggenum sword, which reveals how the blade and the hilt are connected. The blade has a tongue which extends far inside the hilt, and is attached to the hilt with the aid of two rivets.



The Buggenum sword, dating from 1300-1100 BC, was measured at JRC-IRMM. Using a technique called "neutron-resonance capture analysis", the composition and structure of the precious Bronze Age artefact was determined.

4 ANCIENT CHARM stands for "analysis by neutron resonant capture imaging and other emerging neutron techniques: new cultural heritage and archaeological research methods". The project was funded under the EU 6th Framework Programme (contract number 15311), http://ancient-charm.neutron-eu.net.

5 Journal of Radioanalytical and Nuclear Chemistry, 383(2010) p.641, available online at: http://www.springerlink.com/content/7242u32726211687/

6 http://www.mrw.interscience.wiley.com/emrw/9780470027318/eac/article/a9070/current/abstract

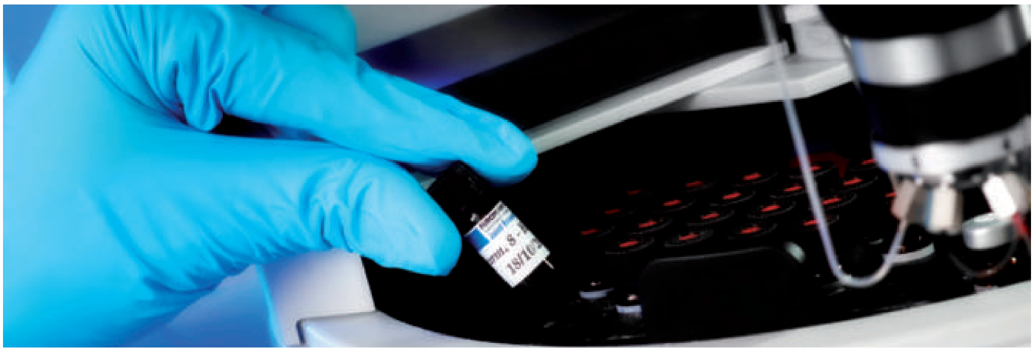
08 FOOD SAFETY AND QUALITY

8.1 Introduction

JRC-IRMM's food safety and quality activities aim at providing fit-for-purpose, validated analytical methods to testing laboratories. The institute also organises interlaboratory comparisons to benchmark the capabilities of official and private food control laboratories across the EU. Together, these activities aim at ensuring the comparability of testing results to provide the basis for the harmonised implementation of EU food and feed safety regulations. The institute also provides measurement-related expert advice to other Commission services dealing with food and feed safety and quality.

One of the measures for ensuring that legislation is properly implemented across EU countries was the setting up of a number of European Union reference laboratories. Four such laboratories are now operated by JRC-IRMM in the following areas; feed additives, mycotoxins, polycyclic aromatic hydrocarbons and heavy metals in feed and food. In 2010, the institute organised a scientific forum for all EU reference laboratories to share experiences after five years of operation.

The institute also co-organised an event on pyrrolizidine alkaloids, together with the Directorate-General for Health and Consumers, and produced a special review of analytical methodology for these contaminants in feed and food.



Liquid chromatography – time of flight mass spectrometry is used for metabolomics and food authentication studies.

8.2 Four new international standards adopted

Developing and validating internationally accepted analytical methods is one of JRC-IRMM's central activities. The culmination of this work is when such methods are adopted by international standardisation bodies. In 2010, four methods developed by JRC-IRMM were adopted as standards by the European Committee for Standardization (CEN).

Two of the standards were analytical methods to determine the levels of the mycotoxins zearalenone and aflatoxin B1 in cereal products for infants and young children (EN 15850 and EN 15851 respectively). These toxins can enter the food chain as a result of crops infected by fungi, either by being directly consumed by humans, or by being used as feed for animals. Because of their relatively high intake of certain foodstuffs compared to their body weight, infants and young children are more vulnerable than adults to many toxic substances. For this reason, European legislation stipulates lower maximum limits for toxins in certain foods intended for infants and young children.

The third standard adopted in 2010 by CEN was a method to determine patulin in fruit juice and fruit purée (EN 15890:2010). Patulin is a mycotoxin produced by a variety of moulds, in particular, *Aspergillus and Penicillium*. It is commonly found in rotting apples, and the amount of patulin in apple products is generally viewed as a measure of the quality of the apples used in production. A number of studies have shown that it is genotoxic, which has led to some theories that claim it may also be a carcinogen. European legislation [1] sets a limit of 50 micrograms per kilogram (µg/kg) in both apple juice and cider, and 25 µg/kg in solid apple products and 10 µg/kg in products for infants and young children.

The fourth standard was a method for detecting nine different sweeteners in soft drinks and canned and bottled fruits (EN 15911:2010). This quantitative method uses high-performance liquid chromatography with evaporative light-scattering detection (HPLC-ELSD), to measure levels of sweeteners in foodstuffs. The method enables the simultaneous determination of six authorised sweeteners, namely acesulfame-K, aspartame, cyclamic acid, saccharin, sucralose and neohesperidine dihydrochalcone, as well as three non-authorised sweeteners: neotame, alitame and dulcin.

In 2010, four methods developed by JRC-IRMM were adopted as standards by the European Committee for Standardization (CEN).

Furthermore, a method to measure the feed additive, semduramicin, in poultry feed has also been accepted as a candidate CEN standard. Semduramicin is a member of the group of compounds known as coccidiostats, which are used to inhibit parasites that cause coccidiosis in farm animals. The conditions of use of this feed additive, including the authorised concentration range, are specified in European legislation [2]. JRC-IRMM developed a method consisting of a common sample preparation and then analysis of semduramicin by liquid chromatography coupled to either mass spectrometry detection or UV detection using post-column derivatisation. The approach was the subject of a collaborative study, which demonstrated the fitness for purpose of both methods.

8.3 Inter-laboratory comparison for heavy metals in seafood

In 2010, JRC-IRMM published the results of an inter-laboratory comparison which benchmarked the abilities of laboratories around the world to measure heavy metals in seafood.

In Europe, maximum levels for lead, cadmium and total mercury in food are laid down in legislation, varying from 0.5 to 1.0 mg/kg for different seafood. No maximum level exists for the methylmercury form of mercury, as its measurement requires specific analytical equipment not routinely present in testing laboratories. However, methylmercury is the main source of human intake of mercury in fish and fishery products, and is of particular interest due to its high toxicity compared to inorganic mercury.

No maximum levels for arsenic have been laid down in European legislation either, due to a lack of information about reliable analytical methods for determining inorganic arsenic in different food commodities, and measurement values of inorganic arsenic are generally believed to be method-dependent.

1 Commission Regulation (EC) No 1881/2006 of 19 December 2006 setting maximum levels for certain contaminants in foodstuffs.

2 Commission Regulation (EC) No 1443/2006 of 29 September 2006 concerning the permanent authorisations of certain additives in feedingstuffs and an authorisation for 10 years for a coccidiostat.

The inter-laboratory comparison was, therefore, extended to include methylmercury and inorganic arsenic, in order to investigate the issues that laboratories encounter in measuring these substances.

The inter-laboratory comparison was organised in support of the European Cooperation for Accreditation (EA), the Asia Pacific Laboratory Accreditation Cooperation (APLAC) and the national reference laboratories associated to the European Union reference laboratory for heavy metals in feed and food. Fifty-seven laboratories from 29 countries volunteered to put their measuring competence to the test.

The outcome of the exercise was generally positive. All of the 57 laboratories that registered reported results. The share of satisfactory scores ranged between 80 % and 96 %. Participants tended to underestimate the content of total arsenic, and to a lesser extent total cadmium. Unlike in a previous exercise (IMEP-107 on total and inorganic arsenic in rice), the values reported for inorganic arsenic showed a large spread. This indicates that the matrix (in this case, seafood), has a major influence on the analytical determination of inorganic arsenic. This is a crucial consideration for legislators, when specifying a maximum level of inorganic arsenic in seafood.

8.4 Proficiency test to determine 3-MCPD in edible oil

In 2010, JRC-IRMM published the results of a proficiency test on the determination of 3-monochloropropane-1, 2-diol (3-MCPD) esters in edible oils.

The substance 3-MCPD is the most common member of a group of chemical contaminants known as chloropropanols. It is a contaminant by-product of a flavour enhancer known as acid-hydrolysed vegetable protein (HVP), which is commonly added to commercially produced food products to make them taste more savoury. 3-MCPD is most frequently found in soy sauce.

3-MCPD is of concern owing to its toxicological properties. It can cause cancer in laboratory animals when fed in large amounts over their lifetime. Although human consumption of these substances is at lower levels, there is still concern that they may present a risk to health. Accordingly, EU legislation sets a maximum level of 20 µg/kg for 3-MCPD in HVP and soy sauce [3]. Recently, some Member States' authorities have found 3-MCPD esterified to partial glycerides (bound 3-MCPD) in edible oils and products made thereof (margarine, mayonnaise, etc). Experiments in animals point to the fact that 3-MCPD is released from the esters in the intestine due to the action of certain digestive enzymes.

JRC-IRMM was requested by the Directorate-General for Health and Consumers to conduct a proficiency test on 3-MCPD in edible oils. The participants were asked to determine the amount of 3-MCPD in two samples (palm oil and extra virgin olive oil – in which 3-MCPD esters were added), and also to provide details about the analytical methods they used. In total, 34 laboratories representing official control laboratories, industry and other interested parties reported results.

The substance 3-MCPD is a contaminant by-product of a flavour enhancer known as acid-hydrolysed vegetable protein, and has been found in edible oils.

3 Commission Regulation (EC) No 1881/2006 of 19 December 2006 setting maximum levels for certain contaminants in foodstuffs.

The percentage of laboratories with a satisfactory performance was 85 % for the extra virgin olive oil sample, but only 56 % for the palm oil. The lower scores for the palm oil sample are probably due to the transformation of glycidyl esters to 3-MCPD. The laboratories that treated the sample with acid at the beginning of the sample preparation performed better, presumably because of the complete degradation of the glycidyl esters. The study concluded that the critical steps in the analysis of 3-MCPD esters in oil are linked to the method of esters hydrolysis and instrument calibration. It was also recommended to develop methods that measure the 3-MCPD esters directly, to avoid artefact formation during ester hydrolysis and derivatisation.

8.5 New international guidelines for reliable food allergen measurements

Around 2 % of adults and 8 % of children suffer from food allergies worldwide. Food allergy is responsible for the majority of anaphylactic reactions in children. Even with the best available allergen management programme, accidental reactions to ingested food may occur.

To reliably detect the presence of food allergens, scientists have to target certain protein markers in food samples. The targeted proteins have to meet multiple criteria, such as the efficiency with which they are extracted from the food sample and the ability to withstand food production processes, such as roasting and extrusion.

A new set of guidelines co-authored by JRC-IRMM aims at better protecting consumers by promoting harmonised, accurate and reliable measurements of food allergens in food products by analytical laboratories.

While there were a number of publications in the area of method validation and numerous publications on validation of so-called ELISA testing methods (enzyme-linked immunosorbent assay) for food contaminants and residues, the new guidelines address for the first time the validation of ELISA testing methods for food allergen analysis in a harmonised way.

The guidance document – which was published in the Journal of AOAC International – was developed by a collaboration of research institutions, experts from regulatory agencies and food allergen test-kit manufacturers, under the auspices of the AOAC Presidential Taskforce on Food Allergens.

A) To reliably detect the presence of food allergens, scientists have to target certain protein markers in food samples.

B) Samples of animal feed: the development of species-specific detection of animal proteins is a main condition for lifting the extended feed ban.

8.6 Detecting species-specific animal proteins in animal feed

The feed ban is a preventive measure against transmissible spongiform encephalopathy (TSE) and consists of a ban on the use of processed animal protein in feed for farmed animals to avoid spreading bovine spongiform encephalopathy (BSE). The development and validation of analytical methods for the species-specific detection of the presence of animal proteins in animal feed was described in the European Commission's TSE roadmap as the main condition for lifting the extended feed ban.

The European project SAFEED-PAP (Detection of presence of species-specific processed animal proteins in animal feed) aimed at developing and validating species-specific methods and measurement strategies in order to fulfil the conditions for a possible lifting of the extended feed ban. JRC-IRMM conducted two collaborative studies to validate methods developed in the project.

A near infrared microscopy (NIRM) method for the detection of animal products in feedingstuffs was validated via a collaborative study in which seven laboratories from four EU Member States plus one laboratory from China participated. The method is based on the evaluation of near-infrared spectra obtained from individual particles and delivers qualitative results in terms of presence / absence of animal particles in feed. In sedimented samples, the limit of detection is 0.1 % meat and bone meal in feed, as for the European official method, while in samples that were not sedimented, the limit of detection is 2 % meat and bone meal in feed. The method demonstrated to be fit for the intended purpose.

The second collaborative study aimed at the validation of a real-time polymerase chain reaction (PCR) method for the detection of cattle DNA in feed and gathered results from laboratories in Europe and Japan. The results demonstrated that the limit of detection is well below the target level of 0.1 %, thus demonstrating that the method is fit for the intended purpose.

8.7 Analytical methods to control feed additives

Feed additives are an integral part of modern animal husbandry which aims to improve animal production, performance and welfare. Such additives may not be put on the EU market without authorisation by the European Commission.

The JRC-IRMM operates the European Union reference laboratory for feed additives, which checks the appropriateness of analytical methods to monitor the correct use of these substances. In so doing, it supports the European Food Safety Authority (EFSA) in conducting its scientific evaluation of the additive prior to authorisation.

About 2,800 feed additives are currently authorised, but most of them have been evaluated according to an old procedure, which was replaced in 2004 by a legislative framework in which risk assessment and risk management are separated. The new legislation required industry to submit applications for all feed additives considered important to be kept in the feed additive register by November 2010.

Throughout 2010, the EU-RL processed around 380 applications from industry (from a total number of around 440), corresponding to more than 1000 feed additives, and 68 dossiers were evaluated.

The final objective is to maintain an up-to-date register of authorised feed additives, which have been evaluated against criteria laid down in legislation and for which appropriate analytical methods are available.

Suitable analytical methods have to be available before feed additives can be authorised for use in animal feed.

8.8 Towards a common European denaturant in alcohol

Alcohol (ethanol) for human consumption is subject to excise duties while ethanol for industrial purposes, such as screen-wash, paints, etc, is not. To prevent the latter from being illicitly consumed, European Member States apply a wide range of strong-smelling and bitter-tasting agents, called denaturants. The resulting denatured alcohol is unfit to drink.

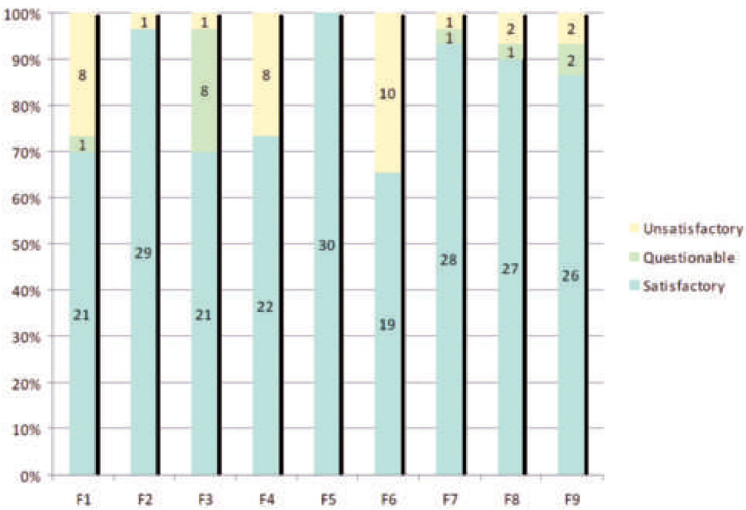
Not all of the denaturants used in Europe are simple to detect though, and their sheer number (120 in total) adds a hefty administrative burden to the customs laboratories, making controls more difficult. This situation potentially opens the door to fraud - especially for those denaturants that can be easily removed. Furthermore, there are concerns that some of the denaturants on the market are not environmentally friendly.

Recognising the problem posed by number and variety of denaturants used in Europe, the European Commission's Directorate-General for Taxation and Customs Union requested the JRC to investigate the possibility of establishing an easily detectable and reliable "euro-denaturant" that could be used throughout the EU and which fulfils the requirements stipulated in the REACH regulation for chemicals. The aim is to have a voluntary transition over time to the new denaturant in order to harmonise European practices for denaturing alcohol.

In cooperation with the European Commission's Directorate-General for Taxation and Customs Union, the JRC-IRMM developed a database of the 120 denaturants currently in use within the EU for customs laboratories. Based on a number of stringent criteria, five potential "euro-denaturants" were shortlisted.

To ensure that control laboratories can measure these denaturants in several formulations, the JRC-IRMM organised a proficiency test, where the laboratories could use their method of choice on a number of samples of denaturant concentrations (unknown to the laboratories). All 31 laboratories that registered for participation submitted results. In terms of measuring the alcoholic strength, the laboratories performances appear to be good when the concentrations of alcohols other than ethanol were low, but the performances decreased with formulations containing higher concentrations of IPA. The reason is related to the analytical method used by the laboratories. A detailed analysis of the laboratories ability to measure different concentrations of various denaturants was performed.

Summary of laboratories' performance in a proficiency test to determine the alcoholic strength of nine different denatured samples.



METROLOGY IN EUROPE

9.1 Measurement Science in Chemistry

Training and knowledge transfer are essential to the JRC-IRMM's mission of promoting a common and reliable European measurement system in support of EU policies. A high-quality, well-functioning measurement infrastructure in Europe depends on the availability of trained and competent practitioners.

JRC-IRMM previously took the initiative to bring together a consortium of nine universities located in seven different European countries (Estonia, Poland, France, Portugal, Finland, Bulgaria and Slovenia). Together, these universities offer the harmonised Master's degree "Measurement Science in Chemistry", which received the "Euromaster" quality award in 2008. On 26 October 2010, the first group of 33 graduates received their European Diploma Supplements at JRC-IRMM.

The degree was developed from a training programme launched in 2001 by JRC-IRMM called TrainMiC®. This programme aims at the harmonised interpretation of the metrological requirements of ISO/IEC-17025 – the main standard for chemical and bio-analytical testing laboratories in different sectors such as environment, food or consumer protection. Today, the training programme supports Commission initiatives such as the 2020 Strategy Initiative, "Agenda for new skills and jobs". In 2010, around 600 people received training at 25 events in 17 different countries, bringing the cumulative total number of persons trained through the TrainMiC® programme since 2001 to over 5800.

A): The first group of graduates of the Master's degree, "Measurement Science in Chemistry", received their diplomas at JRC-IRMM on 26 October 2010.

B) Training at JRC-IRMM in the sample preparation of aflatoxins and ochratoxin A in some spices.

9.2 Pre-accession assistance to Turkey

The project "Europe and Metrology in Turkey" (EMIT) entered its implementation phase on 1 January 2010. The main purpose of the project – which was set up between the EU Delegation in Ankara and JRC-IRMM – is to enhance institutional and measurement capacity in chemical and ionising radiation metrology for the main beneficiaries, the National Metrology Institute of Turkey (TÜBİTAK UME) and the Turkish Atomic Energy Authority (TAEK). The aim is to ensure that Turkish laboratories are able to produce traceable and comparable measurement results – leading to improvements in quality of life and facilitating the free movement of goods. During the course of 2010, experts at JRC-IRMM arranged and provided short-term training of Turkish scientists. This training took the form of six scientific study visits to JRC-IRMM or national metrology institutes, the preparation of one conference, attendance of one EU conference, two university networking meetings, six scientific workshops, two scientific seminars and four technical advice visits. Moreover, JRC-IRMM hosted ten long-term trainees (from the beneficiary institutes) for 12-month traineeships, four of whom have recently returned to begin transferring their knowledge to their home institutes.

10 SPECIAL FEATURE: THE INSTITUTE'S 50TH ANNIVERSARY

Introduction

The year 2010 marked the 50th anniversary of the establishment of the JRC's Institute for Reference Materials and Measurements (IRMM) – formerly known as the Central Bureau for Nuclear Measurements – in Geel, Belgium. Over the years, the institute has remained true to its founding principle of scientific meticulousness in the provision of accurate reference data and measurements.

1960-2010 IRMM 50 Institute for Reference Materials and Measurements

Brief history of the institute

The origins of the institute are found in the Treaty establishing the European Atomic Energy Community (Euratom), which was signed on 25 March 1957. The idea of the Euratom Treaty was to enable the Member States to produce energy of nuclear origin, to control the entire industrial cycle (including research, training and production), to provide for the supply of natural uranium and special fissile materials, and to lay the foundations for the vital task of supervising this particularly sensitive sector.

The Euratom treaty also laid down the initial research and training programme of the Joint Research Centre, calling for "a bureau of standards specialising in nuclear measurements for isotope analysis and absolute measurements of radiation and neutron absorption". This is the legal basis which led to the establishment of the Central Bureau for Nuclear Measurements (CBNM) in Geel, Belgium.

Signing of the Treaty of Rome on 25 March 1957 by the six founding nations: Belgium, France, the Netherlands, Germany, Luxembourg and Italy.

It was originally intended to construct a nuclear reactor at CBNM. However this plan was changed in favour of a linear accelerator, a Van De Graaff accelerator and specialised nuclear materials laboratories. All activities were part of a single goal, namely neutron cross-section measurements needed for the development of thermal and fast fission reactors.

The CBNM grew and expanded to meet the changing needs for neutron data. There was also an increased focus on nuclear measurements, the metrology of radionuclide decay and on neutron flux and dose studies as well as on absolute measurements of isotopes.

Expertise in the preparation and characterisation of sophisticated materials, needed for the accurate determination of parameters relevant for the nuclear industry, would ultimately expand into non-nuclear reference materials.

New Commissioner conveys best wishes for 50th anniversary

A few weeks after taking office, the Commissioner for Research, Innovation and Science, Máire Geoghegan-Quinn, visited JRC-IRMM on 25 February 2010. In her first visit to a JRC institute, she conveyed her best wishes to JRC-IRMM during the year of the institute's 50th anniversary, and met with the JRC Board of Governors.

Commissioner Máire Geoghegan-Quinn and the JRC Board of Governors at JRC-IRMM, 25 February 2010.

A banner marking the 50th anniversary of the institute was placed on the facade of the Commission's Berlaymont building in Brussels during 29 October – 7 November 2010. The tagline of the banner was "Providing measurement solutions – for tomorrow's challenges: life sciences, nanotechnology and nuclear safety".

JRC-IRMM Open Day 2010

As part of the 50th anniversary celebrations, JRC-IRMM opened its doors to the public on 3 October 2010. The activities included a historical exhibition comprising a series of archive photos, old measuring devices and early informatics equipment. The 2010 open day attracted a record number of visitors in one day: 702 visitors with 31 different nationalities (75 % Belgians). Around 23 % of visitors were under the age of 18, whilst 17 % of visitors were 65 or over.

Open day activities: separating compounds using thin-layer chromatography (left), and measuring the caffeine content in drinks (right).

50th Anniversary Competition for Schools

How do measurements influence our daily life? That was the subject of a school competition to mark the 50th anniversary of the institute. Pupils from primary and secondary schools were challenged to make a multimedia presentation, poster or collage about the importance of accurate measurements in our society. The three winning entries were selected by the IRMM's Scientific Committee on the basis of the originality and the scientific value of the contributions. The winning pupils had the opportunity to visit the institute, perform hands-on experiments and "be a scientist for a day".

1 http://irmm.jrc.ec.europa.eu/about_IRMM/50/Documents/irmm_50th_brochure_web.pdf

ANNEX: SELECTED PUBLICATIONS IN 2010

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Abstract
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