Brief History

- 1949: Institute of Physics of the Romanian Academy
- 1956: Institute of Atomic Physics (IFA)
- 1977: Central Institute of Physics (ICEFIZ)
  - IFIN (nuclear),
  - IFTAR (radiation equipment),
  - IFTM (materials),
  - CFPS (earth),
  - IGSS (space).
- 1990: ICEFIZ became IFA
- 1996: IFIN-HH

Highlights

- 1956: First electronic computer (CIFA-1) designed at IFA
- 1957: VVR-S research reactor and U-120 cyclotron (SU)
- 1962: First laser (He-Ne) put into operation at IFA
- 1974: MP Tandem Accelerator from HVEC (USA)
  - Radiosotope Production Center (UK&RO)
  - Nuclear Waste Processing Center (UK&RO)
- 2000: Multipurpose Irradiation Facility (A&HU&RO)
- 2001: EC Centre of Excellence IDRANAP
- 2002: First GRID application in Romania
- 2010: Start of the EU-NP Project

Horia Hulubei
(1896-1972)
Founder and First Director of the Institute

Contribution to the study of quantum diffusion of X-rays
Supervisor: Jean Perrin (Nobel Prize).
Chairman: Marie Curie (Nobel Prize).

www.ifin.ro
1949. The Institute of Physics of the Romanian Academy was established – which became the Institute of Atomic Physics (IFA) in 1956 – the first institute of scientific research in Romania, whose founder and director was Professor Horia Hulubei.

It was the beginning of history. A history that was to establish a brand, the Magurele National Physics Campus, still in existence and highly respected today. Likewise, the name of the founder of the Romanian school of physics continues to be present on the frontispiece of the largest research institute in the country: **The Horia Hulubei National Institute of Physics and Nuclear Engineering**. An institute standing at the forefront of the Romanian science, both in terms of research infrastructures and research personnel, providing over 10% of the national scientific output.

Following the tradition initiated by Professor Horia Hulubei, IFIN-HH addresses a spectrum of research and development activities in fundamental and applied research areas including Nuclear Physics and Astrophysics, Particle Physics, Atomic Physics, Life and Environmental Physics, Theoretical Physics, Nuclear Techniques, and Advanced Communication Systems. Featuring a variety of nation-wide-scoped facilities among which we can mention the Tandem Van de Graff Accelerator, the U120 Cyclotron, the Multipurpose Irradiation Facility Centre, the Radioactive Waste Treatment Plant, the institute is an important part of the Romanian research infrastructure.

While focusing its mission on advanced investigations in Atomic and Sub-atomic Physics, IFIN is also committed to widening the positive impact of the Nuclear on industry, other business areas, as well as on the society at large, via a diversified offer of unique professional services. Various applications of Nuclear Physics and spin-offs of basic nuclear research enable the institute not only to play the role of an active promoter of domestic progress and modernity, but also to bring a significant contribution to the public acceptance of the Nuclear. In tune with the mainstream topical research, IFIN-HH is asserting itself as a valid interlocutor and partner, in the realm of the Euro-Atlantic science and technology endeavour. A highly professional quality and proven level of performance at both individual and work-team level make IFIN-HH fully compliant with the political, scientific, and managerial requirements prevailing in the European space.

To turn its strength to the best account, the institute concentrates its resources on along two directions: (a) to steadily develop a sound in-house capability to get and stay in the forefront of the current nuclear science and technology; and (ii) to substantively participate in the European collaborative endeavours centred on Large Scale Facilities such as GSI-Darmstadt (Germany), GANIL-Caen (France), CERN (Geneva), JINR (Dubna). This is believed to be a common-sense and mitigative strategy meant to harmonize limited domestic resources with the tall orders of the contemporary, top-level nuclear physics research, and the imperative need for Continental co-operation and integration. On these lines, over the past three years IFIN-HH has successfully participated in more than 200 national projects and in 20 international projects of the European Commission’s Framework Programmes 6 and 7.

IFIN-HH will continue to develop its infrastructure, manpower, and expertise. Bringing bright young people at the frontiers of Science and blending their enthusiasm with the experience and educated tenacity of the elders is believed to make a sure recipe to guarantee a long-term sustainability of our activities.

**Acad. Nicolae Victor Zamfir**,  
Director General
Basic & Applied Research

- **Theoretical Physics**: nuclei, fields & particles, condensed matter, nonlinear phenomena, mathematical & computational physics;
- **Nuclear Physics**: structure & reaction mechanisms, hadronic matter, ion beam analysis, neutron diffraction, nuclear & atomic data, nuclear astrophysics, advanced detection systems;
- **Particle Physics**: calorimetry, Monte Carlo simulations, object oriented software, statistical data analysis, phenomenology;
- **Life & Environmental Physics**: low-dose radiobiology, nuclear risk, geophysical migration, control of soil erosion, dosimetry and radiation metrology.

Production & Services:

- Radioisotopes & Radiopharmaceuticals
- Technological Irradiations
- Radioactive Waste Treatment & Storage
- Decommissioning of Nuclear Installations

Other Activities:

- Informatics & Communications
- Training in Nuclear Activities

Large Scale Facilities

- FN-15 Tandem Van de Graaff Accelerator;
- Radioisotope Production Center
- Nuclear Waste Processing Center
- National Radioactive Waste Repository
- IRASAM - Multipurpose Irradiation Facility
- U120 Cyclotron

Staff

- 434 R&D
- 174 PhD
- 93 PhD Students
- 22 PhD Advisors
- 77 Members, Editorial Boards, ISI Journals

Publications 2008-2010

- Papers published in ISI Journals: 946
- non ISI Journals: 272

Scientific meetings organized in 2008-2010

- 20 International
- 16 National

Department of Theoretical Physics (DFT)
http://www.nipne.ro/research/departments/dft.php

Department of Nuclear Physics (DFN)
http://tandem.nipne.ro/

Department of Elementary Particles and Information Technologies (DPETI)
http://www.nipne.ro/research/departments/dfpe.php

Hadron Physics Department (DFH)
http://www.nipne.ro/research/departments/dfh.php

Department of Life and Environmental Physics (DFVM)
http://www.nipne.ro/research/departments/dfvm.php

Department of Radioisotopes and Radiation Metrology (DRMR)
http://www.nipne.ro/research/departments/cpr.php

Department of Applied Nuclear Physics (DFNA)
http://www.nipne.ro/research/departments/dfna.php

IRASAM – Radiation Processing Centre
http://www.nipne.ro/research/departments/irasm.php

Centre for Reactor Decommissioning and Radioactive Waste Management

- Department of Reactor Decommissioning (DDR)
- Radioactive Waste Management Department (DMDR)
  http://www.nipne.ro/facilities/facilities/stdr.php

Sub-Department of Library, Dissemination, Public Relations, Technological Transfer and Marketing (CBDRPTTM)
http://www.nipne.ro/community/library/

Nuclear Training Centre (CPSDN)
http://www.nipne.ro/research/departments/cpsdn.php

(see pag. 6–18)
Certified Laboratories within the IFIN-HH Departments

Ionizing Radiation Calibration Laboratory (LERI/DRMR, bercea@nipne.ro) [calibration, dosimeter/radiometric instruments; RENAR accreditation, CNCAN designation]

Ionizing Radiation Testing Laboratory (LIRI/DRMR, bercea@nipne.ro) [tests, instrument, radioactive sources (equipment), materials; RENAR, CNCAN]

Laboratory for Testing and Certification of Compliance for Radiopharmaceuticals, Radiochemicals and Radioactive Sources (CPRLAB/DRMR, catalinac@nipne.ro) [analysis radionuclides/radiochemical, radioisotopes, sealed sources of radiation, radiopharmaceuticals]

Radionuclide Metrology Laboratory (LMRE-LMRI/DRMR, msaahagia@nipne.ro) [radionuclide standards, calibration, testing-calibration, radionuclide measurements]

Laboratory for Elemental and Structural Analysis of Nanostructured Materials using Rutherford Backscattering Spectrometry (RBS) (RBSL/DFNA, ddudu@nipne.ro) [Rutherford Back Scattering, thin layers, depth profiling, interface mixing]

‘ACTIVA-N’ Materials Testing Laboratory (ACTIVA-N/DFNA, cincue@nipne.ro) [activity evaluation, elemental analysis, gamma-ray spectrometry, neutron activation, OES, XRF]

Laboratory for Biocompatibility Evaluation of Medical Materials and Devices (BIOEVAL/DFVM, mradu@nipne.ro) [biocompatibility, medical devices, cytotoxicity tests, allergenicity test]

Environmental and Personnel Dosimetry Laboratory (LDPM/DFVM, stoc@nipne.ro) [radioactivity, monitoring, dosimetry, environment, personnel]

Laboratory for α, β, γ Spectrometry and Radon Measurements (SALMROM/DFVM, rcalin@nipne.ro) [alpha, beta, gamma, radon, spectrometry, global measurements]

Whole Body Monitoring Laboratory (USCIR/DFVM, saizu@nipne.ro) [whole body counter, internal radioactive contamination monitoring, internal dosimetry]

Low Background Gamma-Ray Spectrometry Laboratory (GAMASPEC/DFN, apantel@nipne.ro) [gamma-ray spectrometry, radionuclide analysis, environmental radioactivity, NAA]

Spectroscopy Analysis Laboratory (LAS/DMDR, fdrag@nipne.ro) [spectrometry analysis, radioactive source examination, gamma-ray spectrometry]

Microbiology Laboratory (LM/IRASM, cponta@nipne.ro) [microbiological tests, validation of irradiation sterilization; RENAR, ANM authorization]

Detection of Irradiated Foods Laboratory (LDAI/IRASM, cponta@nipne.ro) [detection, irradiated foodstuff, 10 ISO standards]

Physical and Chemical Testing Laboratory (LFC/IRASM, cponta@nipne.ro) [color, mechanical tests, GC-MS, TG, DSC, DTA, FT-IR, FT-Raman, EPR, TL, OSL] (see from pag. 19)

International Collaborations

With international institutions:
- EU (Brussels, Belgium)
- IAEA (Vienna, Austria)
- INFN (Italy)
- GSI (Darmstadt, Germany)
- IN2P3 (Paris, France)
- GANIL (Caen, France)

With universities and research centers from abroad:
- Europe - 50
- USA & Canada - 11
- Asia - 3

Member of:
- JINR (Dubna, Russia)
- FAIR (Darmstadt, Germany)
- CERN (Geneva, Switzerland)

Participation in large scale international experiments:
- ATLAS, ALICE, LHC-b, DIRAC, LCG, GASp, KASCADE, SPIRAL2

and projects:
- RODOS
- EURONS
- EURISOL

IFIN-HH

30 Reactorului st.,
P.O. Box MG-6, Bucharest-Magurele,
RO-077125, ROMANIA

+(4) 021 404 2300
+(4) 021 457 4440 (Fax)

Email: dirgen@nipne.ro
secretar@nipne.ro
Directions of scientific activity

A. Nuclear Physics and Astrophysics
- Synthesis and decay of super-heavy elements, study of nuclear structure by particle emission processes, clusters and fission, exotic nuclei far from the line of stability;
- Anharmonic and multiphononic states in atomic nuclei, the heavy ion nuclear potential;
- Microscopic and phenomenological models of nuclear structure, phase transitions in finite systems, contractions of Lie groups and symmetries corresponding to the critical point of phase transition, double beta decay, statistical aspects of nuclear multifragmentation, special aspects of classical and quantum chaos in nuclear systems;
- Nuclear and subnuclear matter (phase transitions, physics of neutron stars);
- Dynamics of nuclear reactions at low, intermediate and relativistic energies (fusion, nuclear multifragmentation, stellar synthesis, transition to quark-gluon plasma).

B. Elementary Particle Physics and Field Theory
- Symmetries and conservation laws on curved spaces, quantum effects in gravitational interaction and mathematical modeling in astrophysics and cosmology;
- Electroweak and strong interactions within the standard model and effective theories;
- High energy physics;
- Exploring physics beyond the standard model, investigation of generalized field theories (noncommutative theories, strings etc).

C. Atomic Physics, Condensed Matter Physics, Photonics
- Condensed matter theory, matter aggregation, phase transitions, statistical physics and physics of complex phenomena: quantum statistics, nanophysics, nanostructures, energy and particle flows, high temperature superconductivity, physical systems on finite lattices;
- Nonlinear phenomena: spatiotemporal optical solitons in dissipative systems, inelastic collisions.

D. Mathematical Physics and Physics of Quantum Information
- Advanced computational methods in nonlinear photonics, Bose-Einstein condensate in quantum and nuclear processes (numerical methods and high performance software, including by parallel and distributed Grid computing on multicore systems)
- Dissipative phenomena in open systems, role of quantum decoherence in quantum information processing and transmission, quantum entanglement, Gaussian quantum channels;
- Mathematical physics studies related to the standard model of elementary particle interactions (including gravity); new extensions of the causal approach in perturbative quantum field theory, coherent state type group representations: study of the relationship between Jacobi group and squeezed states;
- Study of nonlinear geometric equations of Ricci flow type on manifolds and supermanifolds, multisoliton solutions for supersymmetric integrable systems, algebraic geometry methods for studying integrability of discrete equations; study of nonlinear dynamics for dusty plasma.

Organized by:
- Romanian Academy
- University of Bucharest
- Horia Hulubei National Institute of Physics and Nuclear Engineering
- Institute of Atomic Physics
- Academy of Romanian Scientists
- Abdus Salam International Centre for Theoretical Physics

http://3ntctp_st.nipne.ro/

June, 10-13, 2008, Hotel "Alexandros", Busteni, ROMANIA

CONTACT
Dr. Aurelian ISAR
Phone: (+4) 021 404 6254
Fax: (+4) 021 457 5332
Email: isar@theory.nipne.ro
The scientific activity of the Department of Nuclear Physics (DFN) is mostly experimental, being focused on basic research in nuclear and atomic physics. The high level of know-how and the advanced equipment of this department allow a variety of nuclear physics studies, applications and multidisciplinary research. These studies are conducted using the accelerated beams obtained at the 9 MV Tandem Van de Graaff accelerator and at the most important European nuclear facilities (GSI – Germany, ISOLDE/CERN – Switzerland, GANIL – France, LNL/INFN – Italy).

The main research directions are:
- studies of nuclear structure and interactions between nuclei;
- atomic physics studies using accelerated ion beams;
- measurement and evaluation of nuclear data for the design of future nuclear energy production systems;
- study of cosmic rays;
- multidisciplinary research and applications of ion beams for the characterization and modification of materials, performed in collaboration with researchers from other fields: solid state physics, environmental studies, medicine, archeology, etc. Such studies benefit from the special sensitivity of the analysis methods that are possible only at a Tandem accelerator, such as:
  - PIXE (Proton-Induced X-ray Emission)
  - PIGE (Proton-Induced Gamma-ray Emission)
  - CPAA (Charged Particle Activation Analysis)
  - RBS (Rutherford Backscattering) and RBS-channeling
  - NRA (Nuclear Reaction Analysis)
  - ERDA (Elastic Recoil Detection Analysis)
  - AMS (Accelerator Mass Spectroscopy)

Characteristics of the Tandem electrostatic accelerator, a unique installation in the South-eastern Europe:
- Terminal voltage: between 1.5 and 9 MV (Pelletron charging system)
- Type of accelerated ions: 28 species accelerated until now, from proton to gold, depending on user demands
- Beam energy: tens of MeV, depending on ion charge state
- Energy resolution: $10^{-4} - 10^{-5}$
- Time structure of beam: 1 ns pulses up to a continuous beam
- Beam intensity: up to a maximum of a few μA, depending on the type of accelerated ion
- Number of experimental rooms (lines): 2 (7)
- Clean vacuum system based on turbopumps in the range of $10^{-7}$ mbar
- Earthquake protection system

The experimental equipment in the Department of Nuclear Physics is actual, comparable to that in advanced nuclear physics laboratories from Europe. For gamma radiation detection, there are over 20 high-purity Ge detectors which can be arranged in different experimental configurations, and 8 LaBr₃:Ce detectors with fast response of tenths of nanoseconds. These detectors are being used for gamma-ray spectroscopy experiments both at our TANDEM accelerator and at CERN/ISOLDE or other European facilities. Detectors of various types and sizes for the detection of charged particles and heavy ions, which can be used independently or in correlation with gamma or neutron detectors are also available in DFN. A modular system with 80 elements (plastic scintillators) for neutron detection was also built in the department and is currently used to study correlations between neutrons emitted during nuclear fission. The electromagnetic calorimeter WILLI, also built and presently operated in DFN, is used for the detection of atmospheric muons.

CONTACT
Dr. Nicolae MĂRGINEAN
Phone: (+4) 021 404 2329
Fax: (+4) 021 457 4111
Email: nmarg@nipne.ro
The Department of Elementary Particles and Information Technologies (DPETI) develops a wide range of interdisciplinary studies on internal structure of matter as well as basic research in elementary particle physics which combines phenomenological studies, advanced technologies for particle detection and Grid technology-based distributed computing systems.

**The ATLAS Experiment @ LHC-CERN**

ATLAS experiment aims to fully exploit the potential for new discoveries of the LHC accelerator. The main goals of the scientific programme of the ATLAS collaboration cover high accuracy measurements of the Standard Model (SM) parameters and search for new phenomena. Moreover, the nucleus-nucleus collisions will offer a unique opportunity to study the properties of matter under extreme energy density conditions and the possible transition of hadron matter to the so-called quark-gluon plasma.

**Recent results**
- monitoring and testing functionality of the Tile-Cal Calorimeter
- phenomenological studies on accurate predictions of the Standard Model
- study of the discovering potential for new physical phenomena predicted by the theoretical models that extend the Standard Model
- improvement in scalability performance of software infrastructure for the acquisition system

**The SIDDHARTA Experiment @ DAΦNE**

SIDDHARTA (Silicon Drift Detectors for Hadron Atom Research by Timing Application) continues the scientific direction and technological developments achieved by the DEAR experiment (DAΦNE Exotic Atom Research) at the Frascati National Laboratory (Italy). The SIDDHARTA is devoted to measuring the Kα line shift – due to strong interaction – in kaonic hydrogen and kaonic deuterium, using Silicon Drift Detectors (SDD) with an accuracy of 1eV.

**Recent results:**

**The PANDA Experiment @ FAIR**

The experiment PANDA aims at testing the possibility of replacing the PMTs designed to be used in the structure of the time of flight (TOF) system - used to identify the pions, kaons and protons emitted forwards - with SiPM detectors. Because a temporary resolution of about 50 ps is being required for separating particles emitted forward and a part of the TOF system is installed inside a dipole with B = 0.8 T, it is desired testing of several types of SiPM along with the development of an ultra-fast reading electronics.

**Recent results:**
- Implementation of event generators to simulate the anti-proton collisions with protons and nuclei in the PANDA experiment.

**ILC (International Linear Collider)**

The ILC is the next particle accelerator after LHC. The ILC will accelerate e+ and e− with high luminosity, up to a centre-of-mass energy of 500 GeV in the initial phase, expected to increase afterwards to 1 TeV. IFIN-HH Group participates in FCAL (very forward region of the ILC), part of the ILD detector (International Large Detector) whose Letter of Intent has been recently approved by the international experts.

**Recent results:**
- Expected electromagnetic and neutron doses for the BeamCal at OLD, High-Performance Computing System for High Energy Physics, accepted for publication in Romanian Journal of Physics.
The mission of the Information Technology Group (GTI) in DPETI is to manage, develop and maintain computing and communications infrastructure of IFIN-HH by providing reliable technical support for national and international scientific collaborations. The GTI strategy is to implement top-level information technologies and to provide high quality services in order to support research into advanced fields of physics. The activity of the other departments largely depends on the electronic communication means managed by GTI. In this respect, over the last years, the priority directions for applied research and technological development have focused on high speed data networks, Grid technology and high performance computing for modeling and simulation of complex physical systems.

Grid Technologies
- GTI coordinates the activity of the Romanian Tier-2 Federation (RO-LCG), the entity that represents Romania in the LCG Worldwide collaboration (WLCG) initiated by CERN and groups five research institutes participating in the LHC Computing Grid (LCG). The Romanian Tier-2 Federation (RO-LCG) contributes to providing the data storage and analysis infrastructure required for the ALICE, ATLAS and LHCb experiments at the LHC accelerator. Therefore, the Grid Centre of GTI makes available to WLCG 950 logical CPU (core) and 150 terabytes for data processing and storage.
- Implementation of national computing Grid in physics and engineering.
- Web-based solutions for data Grids, Globus technology.
- Investigation into securing Grid communications by quantum methods of information encryption.

Recent results:

High Performance Computing
GTI has developed the infrastructure for parallel and distributed computing in the institute, building and optimizing server clusters based on Ethernet/Myrinet/Infiniband technology, and conducted MPI performance tests on these systems, in cooperation with LIT-JINR Dubna.

Recent results:
- IBM BladeCenter cluster, 4 TFLOPS (Infiniband) biocomputing cluster, 2.7 TFLOPS (Myrinet)
- Performance assessment of the SIMFAP parallel cluster at IFIN-HH Bucharest, RJP 53, No. 5-6, 2008

Modeling seismic process in Vrancea area
GTI has developed an advanced computing algorithm for modeling seismic process in Vrancea area. This algorithm enables the investigation of complex and quantitative properties of seismogenic system and its evolution on seismic cycle scale by advanced computing techniques, using Grid services. The algorithm models a percolative process with constraints that gives the possibility to simulate the earthquake-generating phenomenon starting from the history of geophysical observations in the region. The study is carried out in cooperation with the Seismological Laboratory, Reno, USA.


Study of protein structure by molecular dynamics simulations
GTI is currently investigating, in cooperation with the Department of Physiology and Biophysics at the University of California-Irvine, the mechanism of proton-transfer under the influence of light into retinal proteins. The numerical study of the inhibition of proton pump mechanism into sensory rhodopsin II (SR II) is conducted using GTI’s own advanced computing, with the simulation and analysis programs CHARMM, VMD and NAMD - whose scalability was previously tested in order to optimize the number of processors and decrease the simulation time.


CONTACT
Dr. Mihnea DULEA
Phone: (+4) 021 404 62 62
Fax: (+4) 021 457 48 56
Email: mid@nipne.ro

Information Technology Group (DPETI)
Hadron Physics Department (DFH)

Hadron Physics Department (HPD) was founded in 2007, based on the existing structure of the NIHAM (Nuclear Interactions and HAdrononic Mater) Centre of Excellence of Nuclear Physics Department. The group has a long tradition in tackling some of the great challenges related to nuclear structure and dynamics, nuclear interactions, hadron matter.

HPD Research Topics

- Microscopic description of nuclear properties at low energies:
  - exotic structure and dynamics, issues of nuclear astrophysics, and fundamental interactions, symmetries and exotic phenomena expected near the drip lines.
  - systematic construction of effective nuclear forces linked to realistic interactions, tailor-made to be used with our state-of-the-art variational approaches (VAMPIR).

Collaborations: NUSTAR (HISPAC-DESPEC), DFG, ISOLDE, ENSA N-JRA10 (NuThEN), N-NA07 (RIBTHENET).

- Dynamics of Nuclear Collisions at Low, Intermediate and Relativistic Energies

Over the years, the research groups in HPD have been involved in several international collaborations with contributions recognized by the international community:

- DRACULA (Device for Reaction Analysis based on a Complex and Unsurpassed on-Line Acquisition system) experiment was designed and built by DFH members. It was successfully operated between 1991 and 1998 for systematic study of dissipative processes in light heavy ion reactions.

- CHIMERA (Charged Heavy Ion Mass and Energy Resolving Array) experimental device installed at LNS – Catania. Some of the Physics topics addressed by DFH members are: isospin dependence in the dynamical formation and evolution of the “neck” in peripheral collisions, cluster production in central collisions, dynamical fission and the influence of nuclear matter viscosity on the time scale.

- The 4π - FOPI experiment from SIS18 - GSI Darmstadt, designed and built with significant contribution of DFH members, used to study the properties of baryon matter at densities of 2-3ρ0, and temperatures of about 50-80 MeV. The Physics topics undertaken by HPD members include: multidimensional analysis of the transition energy, azimuthally symmetric flow in highly central collisions, azimuthal dependence of collective expansion for symmetric heavy ion collisions, isospin effects and equation of state of baryon matter. One should mention that the third phase of FOPI upgrade was based on a new type of architecture for RPC detector, proposed and developed as prototype in DFH.

- ALICE (A Large Ion Collider Experiment) is the only heavy ion-dedicated experiment at LHC-CERN, which will explore the baryon free nuclear matter phase supposed to have existed several microseconds after Big Bang. The experiment, ready for the first p-p collisions, has already successfully collected the first data in December 2009 confirming the performance of LHC and ALICE experiment. ALICE will be fully operational by the end of 2010 when it will run at energies of 5.5 A•TeV for Pb-Pb. Based on the contributions of our group to the R&D activities, we received the challenging task of building the ALICE – TRD (Transition Radiation Detector) sub-detector together with GSI-Darmstadt, JINR-Dubna, IF-Frankfurt and PI-Heidelberg. In the end, DFH realized 130 ALICE-TRD chambers, covering an area of 167m² and having 253000 read-out channels (24% of the ALICE-TRD). Completed in October 2008, this is the most important achievement of a Romanian research institute within such a large international collaboration as ALICE. Our group highly contributed to the design of ALICE-TRD front-end electronics. DFH members are currently involved in data analysis and interpretation of the first results from p + p collisions at 0.9 and 2.36 TeV.

- CBM (Compressed Baryon Matter) experiment at the future FAIR – GSI Darmstadt, scheduled to come into operation in 2015-2016, will use beam energies between 10 and 40 A•GeV and will study baryon matter phase diagram and related phase transitions at high densities and low temperatures, as it may exist in neutron stars. The multiplicity conditions and high counting rates CBM will operate at require development of a new generation of detection and identification systems. New generations of TRD and RPC detectors are presently under construction and testing in DFH. The first RPC prototype of TRD front-end electronics for high counting rates has been developed by DFH group. This is the first CHIP of such complexity designed in Romania.

DFH Research Infrastructure

- Detector Laboratory
- Electronics Laboratory (CADENCE AND OrCAD infrastructure)
- GRID

NIHAM Centre of Excellence has been a member of the ALICE GRID since November 2002 (the first international GRID application in Romania). At present, NIHAM consists of ~1000 CPU cores, 2GB RAM/core, ~800 TB dedicated storage, 1 Gbit/sec internal network, 10 Gbit/sec uplink, 3 cooling units (industrial grade), 3 x 80 kVA UPS, Diesel generator – 600 kVA. NIHAM Data Centre of DFH is one of the most efficient components of the ALICE GRID: http://pcalimonitor.cern.ch:8889/show?page=index.html.

CONTACT
Prof. Dr. Mihai PETROVICI
Phone: (+4) 021 404 61 35
Fax: (+4) 021 457 44 32
Email: mpetro@nipne.ro
http://niham.nipne.ro
The Department of Applied Nuclear Physics (DFNA) focuses on scientific research in designing experimental facilities and measurement and survey methodology.

At present, the main fields of activity are:

- Nuclear analysis surveys and development of facilities
  - Accelerator mass spectrometry (AMS) – Figure 1
  - Archaeometry (XRF PIXE, X-ray tomography) – Figure 2
  - Nuclear applications in medicine – Figure 3
  - Positron spectroscopy and RBS – Figure 4
  - Studies on certified materials and biomaterials – Figure 5
- Advanced detection systems
  - Detection and acquisition systems
  - Innovative techniques for particle detection – Figure 6
  - Custom-design radiation safety systems – Figure 7

The Department operates a Cyclotron, a type of particle accelerator that is unique in Romania. This can provide proton and deuteron beams and alpha particles with energy up to 13 MeV/amu at a maximum intensity of 50 μA and indirectly, intense fields of fast neutron – Figure 8.

Two certified laboratories operate in the Department of Applied Nuclear Physics:

- ACTIVA-N Materials Testing Laboratory
- Laboratory for Elemental and Structural Analysis of Nanostructured Materials using Rutherford Backscattering Spectrometry (RBS)

CONTACT
Dr. Florin CONSTANTIN
Phone: (+4) 021 404 2342
Fax: (+4) 021 457 4440
Email: fconst@nipne.ro
The Department of Radioisotopes and Radiation Metrology carries out its activity in 3 buildings:
• **CPR Building** - the only facility in the country equipped with: shielded hot cells with remote manipulators; sealed enclosures for radiochemistry works; lockers connected to the ventilation of the building; clean areas for production of oral radiopharmaceuticals, analysis and control laboratories; facility for ventilation and general and technological air conditioning outfitted with air intake and exhaust; storage facility for liquid effluents and water certainly radioactive under suspicion of being radioactive; dosimetry facility for gamma radiation monitoring; radioactive gaseous effluent monitor (131I); fire plant with detectors and protective systems; heating system; ventilated air cooling facility; electrical and automation facilities; distribution networks: heat, natural gas, compressed air; control room for monitoring vital installations;
• **CMRID Building;**
• **Calibration Hall.**

All the units have authorization to carry out nuclear activities, health permits and manufacturing authorizations.

**CONTACT**
Dr. Dana Niculae
Phone: (+4) 021 404 2350
Email: dana.niculae@nipne.ro

The department has also 3 laboratories with RENAR accreditation / CNCAN notification:
• Laboratory for Testing and Certification of Compliance for Radiopharmaceuticals, Radiochemicals and Radioactive Sources (CPRLAB);
• Radionuclide Metrology Laboratory (LMR);
• Group of Radiation Metrology-Testing-Dosimetry (CMRID).

The activities of DRMR cover areas related to:

1. **Research**
   • Development of advanced radiopharmaceuticals intended for imaging, early diagnosis or targeted radiotherapy of cancer;
   • Ionizing radiation and radionuclide metrology;
   • Radiotracers.

2. **Production**
   • Production of oral radiopharmaceuticals:
     - Radioactive iodine capsules (131I) with activity of 3.7, 1.85, 0.925 MBq / capsule, at reference date and time for diagnostic use;
     - Radioactive iodine solution (131I) with radioactive concentration of 0.37-3.7 GBq/cm³, for oral administration, bottles of 0.5-9 cm³ solution and activity on bottle of 0.185 - 33.3 GBq at reference date and time;
   • Production of sealed 192Ir radioactive sources used in gammagraphy and defectoscopy; other sealed radioactive sources: 60Co, 137Cs etc.
   • Transfer of radioactive sources;

3. **Expertise and services**
   • for radiopharmaceuticals, radiochemicals, radiotracers, radioactive sources used in medicine, industry, agriculture, biology etc.;
   • Expertise and certification of radioactive sources from medicine and industry; various samples certainly radioactive under suspicion of being radioactive;
   • Verification of removable surface contamination and tightness of sealed radioactive sources;
   • Transport of radioactive material by authorized vehicles;
   • Physical-chemical, radiochemical, radionuclide analyses;
   • Advisory service offered to nuclear units under decommissioning / upgrading by contamination measurements, gamma spectrometry analysis and preparation of documents for release of used equipment / materials from regulatory control;
   • Metrological verification and certification of activity measuring equipment (radioisotope calibrators, contamination meters and standard radioactive sources);
   • Calibration, metrological testing of radiometry, dosimetry devices and alpha, beta and gamma-ray contamination meter.
The Department of Life and Environmental Physics (DFVM) is organized on a multidisciplinary structure in line with the addressed diversity of the areas. The development of nuclear power and ionizing radiation applications in Romania, especially in medicine, has determined the need for research groups in IFIN-HH to cover a rather wide range of aspects concerning the ionizing radiation impact on the environment and biological systems. Starting from the expertise accumulated in this field, the activities of this department have been diversified by approaching also connected areas, not necessarily involving ionizing radiation.

In this context, the activities in the department address basic research, applied research and services to various customers.

**Basic research**
- effects of ionizing radiation on biological systems (at molecular, cellular or whole body level);
- biochemical mechanisms involved in pathologies of wide impact, pathologies which have in common the occurrence of oxidative stress processes (diabetes, atherosclerosis, cancer etc.);
- membrane biophysics studies (channel-forming proteins, receptors, model membrane);
- quantum biology studies
- dynamic modelling of radionuclides transfer in different ecosystems, as for example H-3 and C-14 transfer in the atmosphere – soil – vegetation – animals (terrestrial and aquatic animals, domestic and wild animals, birds) – human continuum.
- advanced radioecology studies for complex ecosystems (development of techniques and advanced models for atmospheric parameters assessment using input data given by Meteorological Tower);
- studies on nuclear physics measurements in ultra-low background areas

**Applied Research**
- use of radioisotopes as tracers in studies on environmental evolution;
- development of computer models and tools for decision support in case of accidents involving radiological and chemical pollution;
- development of specialized technologies for detection of low concentrations of some substances in biological or environmental samples (technical RIA / ELISA);
- measurements of radioactivity in biological and environmental samples;

**Services** (performed in authorized laboratories):
- monitoring of environmental radioactivity in Magurele area
- radioactivity measurements (alpha, gross alpha-beta, gamma spectrometry) in environmental and food samples;
- determination of tritium content in environmental samples;
- individual occupational exposure dose assessment (dosimetry film, TLD, whole-body counter)
- biocompatibility evaluation of medical materials and devices;

**Research groups**
- Group of Biophysics and Radiobiology;
- Group of Environmental Physics;
- Group of Radioactivity Measurements in Environmental and Biological Samples

**Authorized laboratories**
- Environmental and Personnel Dosimetry (LDPM / DFVM, stoc nipne.ro)
- α, β, γ Spectrometry and Radon Measurements (SALMROM / DFVM, rcalin@nipne.ro)
- Whole Body Monitoring – Whole Body Counter (USCIR / DFVM, saizu@nipne.ro)
- Biocompatibility Evaluation of Medical Materials and Devices (BIOEVAL / DFVM, mradu@nipne.ro)

**CONTACT**
Dr. Nicolae MOCANU
Phone: (+4) 021 404 6204
Fax: (+4) 021 457 4439
Email: mocnic@nipne.ro
The Reactor Decommissioning Department (DDR) is part of the Centre for the Management of Decommissioning and Radioactive Waste and carries out nuclear activities in compliance with an authorized Quality Management System.

DDR’s mission is to decommission the VVR-S Nuclear Research Reactor and safely manage the spent nuclear fuel resulted from a 40-year period of reactor operation, constantly monitoring the protection of personnel, population, environment and property.

In the framework of the national and international projects, DDR personnel conduct studies and research on the improvement of decommissioning techniques and technologies:

• Spent nuclear fuel management;
• Radiological characterization;
• Techniques and technologies for free release of materials;
• Techniques and technologies for demolition and decontamination;
• Dismantling techniques and technologies.

Main projects run by DDR:

• HEU Fuel Repatriation Project - Russian Research Reactor Fuel Return (RRRRFR) finished in June 2009;
• EU PHARE Project RO 2006/018 - 411.03.04, partially finished in July 2009;
• IAEA Technical Cooperation Project – ROM 04-029, finished in November 2008;
• US Argonne National Laboratory Technical Assistance Project BOA 3J-00201, finished in September 2007;
• National Research-Development Projects – EMIT, TISADIN.

Potential customers: RP0 Zero Power Reactor; Helen Sub-critical Assembly; IFIN-HH Radiological Facilities requiring decommissioning.

CONTACT
Radu DEJU
Phone: (+4) 021 404 2300
(extension 5001)
Email: radudeju@nipne.ro
Radioactive Waste Management Department (DMDR)

The Radioactive Waste Management Department (DMDR) consists of two national-interest facilities:

- Radioactive Waste Treatment Plant

The two radiological facilities provide the management, at national level, of the institutional radioactive wastes which arise from the applications of nuclear techniques and technologies in fields such as education, medicine, agriculture, industry (off-nuclear fuel cycle), in order to assure the radiation safety of the operating personnel, population and environment.

DMDR is authorized for:

- collection and field transport of radioactive waste by authorized vehicles and specialized personnel;
- confinement-conditioning, storage and disposal of radioactive waste;
- gamma spectrometry characterization of radioactive waste within the Spectroscopy Analysis Laboratory (LAS).

DMDR develops and implements radioactive waste management technologies for those radwastes which do not meet the acceptance criteria for disposal (WAC), according to the current regulatory requirements, and technologies for long-term storage of disused sealed sources containing long-lived isotopes.

In the framework of the national and international projects, DMDR personnel conduct studies and research on the improvement and optimization of the applied technologies, development of new ones, as well as studies on behaviour in time of radioactive waste-embedding matrices.

CONTACT
Dr. Felicia DRĂGOLICI
Phone: (+4) 021 404 2353
Fax: (+4) 021 457 4440
Email: fdrag nipne.ro
The IRASM Centre offers a wide range of services for industry and research-development and consists of the following subunits:
- Irradiation Facility
- Dosimetry Laboratory
- Microbiology Laboratory
- Physical and Chemical Testing Laboratory
- Laboratory for Detection of Irradiated Food

All services offered by the IRASM Centre to industry are performed in the frame of its quality management system and in compliance with the applicable international standards.

IRASM competences are recognized through certifications, authorizations, accreditations or notifications. Thus, all IRASM customers, particularly those working in the fields of pharmaceuticals or medical devices:
- may prove the fulfillment of legal obligations on the outsourcing of treatment services (e.g., sterilization),
- may get and maintain the EC mark.

The Quality Management System meets the requirements of SR EN ISO 9001, SR EN ISO 13485 and ISO 11137 standards and has been continuously certified by DQS – Germany since 2002.

**Services:**
- Sterilization of medical devices, laboratory devices and pharmaceutical packaging;
- Microbial control for pharmaceutical raw materials, cosmetics and food supplements;
- Validation of irradiation sterilization;
- Microbiological, dosimetry, physical-chemical testing;
- Identification of irradiated foodstuffs.

To provide the medical device manufacturers with full services, the IRASM Center works in close relationship with the Laboratory for Biocompatibility Evaluation - DFVM. The laboratories’ structure and equipment, the design and working possibilities of the irradiation facility enable IRASM to promote the irradiation technologies in industry and to provide proofs of substantiality/justification of treatment parameters.

**Special services for cultural heritage:**
Disinsectization and disinfection of the wooden, paper, leather or parchment objects coming from museums, churches, monasteries, archives, libraries or private collections.
The National Library of Physics is located in a building restructured in line with the needs of user specific requirements. It includes book and journal storage, reading rooms with internet access to ‘online’ databases and collections, meeting rooms. There are over 400 000 books and journals available in this library. Unique collections such as Physical Review from 1908 up to present days, Journal of Applied Physics etc. can be found here. Existing books cover a wide range of subject areas, including general and specialized physics (nuclear physics, optics, materials physics, atomic physics), physics-mathematics, chemistry, many of these books representing one of a kind. The library provides ‘online’ access (up-to-date and archives) to general and specialized journals like those of the American Institute of Physics, Elsevier, Springer, Institute of Physics, but also to the Web of Science.

The Sub-Department contributes to disseminating the results of the Institute by designing and producing posters, ads, books with summaries, CDs etc. for all the scientific events organized by IFIN-HH.

The Sub-Department also deals with editing the materials intended for the publication of the two ISI-quoted scientific journals, namely Romanian Journal of Physics and Romanian Reports in Physics.

The Sub-Department performs monitoring and logistics activities for the international collaborations of the Institute. The technological transfer and marketing activities have been reorganized and will aim to disseminate the activity carried out by IFIN-HH, with a view to binding it to economy and incorporating it into the interdisciplinary activities.
Nuclear Training Centre (CPSDN)

Services
• Post-secondary and post-graduate training for the personnel involved in practices with ionizing radiation sources or advanced physical techniques
• Radiation protection training of occupationally exposed workers
• Specializations for personnel involved in nuclear research

Programmes curricula are constantly sized to training objectives, knowledge level of participants, specific regulatory requirements. Training courses may be conducted at beneficiary’s site.

Training Activities
• Current Training Programmes
  - Radiation protection in use of nuclear gauges
  - Radiation protection in use of radiological equipment for package control
  - Radiation protection in diagnostic and interventional radiology
  - Radiation protection in Nuclear Medicine
  - Radiological Safety in Radiotherapy
  - Radiological Safety in use of sealed / unsealed radiation sources
  - Knowledge upgrade on Radiological Safety in use of sealed / unsealed radiation sources and radiation generators.
  - Radiation safety in mining and processing of uranium and thorium ores
  - Applications of radioisotopes and nuclear radiation sources (complex programme)
• Training on request
  - Radiation protection in decommissioning of nuclear facilities
  - Transport of radioactive materials
  - Radioecology
  - Other special applications

Resources
• Properly equipped classrooms
• Laboratories for practical training in dosimetry
• Experts and specialists as lecturers

Member
• EUTERP (European Training and Education in Radiation Protection)
• ENEN (European Nuclear Education Network)

Brief History
• 1970: Establishment of Nuclear Workers Training Centre (CPSCDN)
• 1996: CPSCDN became department within IFIN-HH
• 2007: CPSCDN became Nuclear Training Centre (CPSDN)

Important achievements (1970 - 2009)
• Post-graduate specialization program on the safe use of radioactive isotopes
• Training for personnel involved in activities with ionizing radiation sources
• Specialization programs for personnel involved in nuclear power program (for Cernavoda NPP Unit 1)
• Special training on decommissioning of WWR-S Research Reactor
• Certification of CPSDN Quality Management System according to EN ISO 9001:2000, by TÜV HESSEN, in 2007
• Development of a dedicated website: cpsdn.nipne.ro
• Shot balance 1970-2009: over 780 training programs and 19000 graduates

CONTACT
Gabriel STANESCU
Phone: (+4) 021 457 42 79
(+4) 0726 793 435
Fax: (+4) 021 457 42 79
Email: cpsdn@nipne.ro
stanescu@nipne.ro
Ionizing Radiation Calibration-Testing Laboratory

Radioisotopes and Radiation Metrology Department

Radiation Metrology, Testing and Dosimetry Group (CMIRD) of DRMR in IFIN-HH conducts research into development of calibration methods and measurement means in the field of ionizing radiation (dosimetry and related fields). Moreover, the staff also develops testing methods for devices with built-in ionizing radiation sources or devices intended for ionizing radiation applications (industry, medicine, environment, national defence and security etc.


IFIN-HH, via CMRID, is an institute designated at EURAMET (European Collaboration in Measurement Standards), and in 2010 is an institute associated to this EU body.

The group is organized in two laboratories:
- Calibration Laboratory
- Testing and Nuclear Expertise Laboratory

Both laboratories are designated by CNCAN as notified laboratories (LE 05/2009), (LI 06/2009) and accredited by RENAR (certificate of accreditation LE 011 – Calibration, certificate of accreditation LI 777 – Testing).

Calibration

Calibration of radiometry and dosimetry devices
- Alpha, beta, gamma-ray contaminometers;
- Absorbed dose, X/gamma-ray dosimeters;
- Dose equivalent, X/gamma-ray dosimeters;
- X/gamma exposimeters;
- Absorbed dose, X/gamma-ray ratemeters;
- Dose equivalent, X/gamma-ray ratemeters;
- Beta-ray dose ratemeters;
- Exposure, X/gamma-ray dose ratemeters
- Beta, gamma/X-ray thermoluminescence dosimetry systems;
- Global alpha and/or beta measurement systems.

Calibration of ionizing radiation sources
- Gamma/X-ray emitting sources for absorbed dose rate at 1m distance;
- Gamma/X-ray emitting sources for dose equivalent rate at 1m distance;
- Gamma/X-ray emitting sources for kerma rate at 1m distance;
- Gamma/X-ray emitting sources for exposure rate at 1m distance;
- X-ray generating installations.

Calibration of devices used in medicine for checking the parameters of radiological installations.

Testing

1. Tests for ionizing radiation detectors and dosimeters/dose ratemeters at dose/dose rate values of ionizing radiation less than, equal to or higher than the natural background;
2. Tests for materials by exposure to ionizing radiation;
3. Determining radiological characteristics of X-ray generating equipment;
4. Area dosimetry measurements;
5. Tests and measurements specific to air filtration systems and clean rooms;
6. Mechanical tests (vibrations, free fall on flat surfaces or targets, rolling, overturn, crushing, measurements of noise level, weight, sizes, time);
7. Climatic tests (temperature, humidity, pressure, airflow);
8. Electrical tests (for the following parameters: current, absorbed power, variations of supply voltage and frequency, voltage stability, electromagnetic disturbance, insulation resistance, dielectric rigidity, electric security conditions, case protection, protection against water penetration);
9. Tests for determining some characteristics for:
   - Radiation sources;
   - Detectors and transducers;
   - Dosimetry and radiometry devices;
   - Contaminometers and contamination monitors;
   - Gamma spectrometers;
   - Contamination measurements;
   - Monitors for liquid and gaseous effluents, aerosols and tritium;
   - Radioisotope industrial applications;
   - Radiochemicals and radiopharmaceuticals;
   - Protective containers for transport, storage and handling;
   - Radiation measurement systems;
   - Defectoscopy equipment.

CONTACT
Phone: (+4) 021 404 2338
Fax: (+4) 021 404 6189
Email: bercea@ifin.nipne.ro
Testing and Certification of Compliance of Radiopharmaceuticals, Radiochemicals and Radioactive Sources

Laboratory (CPRLAB) assesses and certifies the compliance of radiopharmaceuticals, radiochemicals and radioactive sources by appropriate nuclear testing methods.

The main goal of CPRLAB activity, which is given constant attention, is to properly perform the tests so that they meet:
- the requirements of SR EN ISO/IEC 17025:2005 standard – General Requirements for the competence of testing and calibration laboratories, national regulatory bodies or the organizations giving the recognition for ensuring the quality requirements for those radioactive products tested in the laboratory,
- the clients’ needs according to their requirements and declared methods.

This Laboratory performs tests for:
- Radioactive products (radiopharmaceuticals, radiochemicals and radioactive sources) produced in DRMR of IFIN-HH;
- New radiopharmaceuticals under research or validation;
- Surveys of radioactive sources and radioactive waste upon customer’s request;
- Monitoring and survey: liquid effluents certainly radioactive or under suspicion of being radioactive, arisen from nuclear practices; waters from the cooling pond for spent nuclear fuel rods resulted from the 2MW VVR-S Nuclear Research Reactor (currently under decommissioning) in IFIN-HH.

As a result of the tests performed here, CPRLAB issues laboratory reports, laboratory notes, certificates of quality and declarations of conformity.

CPRLAB is currently recognized by CNCAN (the National Commission for Nuclear Activities Control) by notification LI 14/2007 and RENAR (Romanian Accreditation Association) by certificate of accreditation LI 731.

The activities of CPRLAB cover the following areas:
- Quality control for the products of the Production Group in the Department (sealed radiation sources, radiopharmaceutical);
- Physical-chemical and radiochemical analysis for the products under study in the research contracts in progress in the Department;
- Services on testing and certifying the compliance of radiopharmaceuticals, radiochemicals and radioactive sources;
- Advisory service on: characterizing the materials by gamma spectrometry, preparing documentation, getting the necessary approvals from CNCAN (the National Commission for Nuclear Activities Control) to release from regulatory control the materials, equipment etc. from the controlled areas of the nuclear facilities (for those nuclear facilities under rearrangement, decommissioning, reauthorization);
- Monitoring the quality of water in the storage ponds for radioactive fuel from the VVR-S Nuclear Research Reactor of IFIN-HH.

CPRLAB mainly conducts the following analyses:
- Radionuclidic purity determination by gamma spectrometry;
- Leakage testing for sealed radioactive sources;
- Radioactivity determination;
- pH;
- Conductivity determination;
- Qualitative and quantitative determination of microelements by atomic absorption spectrometry;
- Radiochemical purity determination of Na131I by high-performance liquid chromatography (HPLC);
- chemical concentration determination by UV/VIS spectrometry;
- Gamma radio chromatography;
- Measurement of removable radioactive surface contamination;
- Measurement of dose equivalent rate;
- Other tests by analytical methods upon request of beneficiaries.
IFIN-HH is designated by the Romanian Bureau of Legal Metrology (BRML) as the owner of the Primary Standard of Activity (Becquerel), according to the List of signatory institutes of the Agreement of the International Committee of Weights and Measures – Mutual Recognition Arrangement (CIPM-MRA).

Its representative in the field involved is the Radionuclide Metrology Laboratory (LMR), which provides the Equivalence of the Primary Standard of Activity, via participation in the Key and Supplementary Comparisons organized by the International Bureau of Weights and Measures (BIPM) according to Appendix B of CIPM-MRA: Key Comparison Data Base (KCDB).

LMR also provides the international representation of IFIN-HH in the following bodies:
- IFIN-HH is a member of the Consultative Committee for Ionizing Radiations, Section II, Radionuclide Measurement, [CIPM-CCRI(II)];
- IFIN-HH is a member of the International Committee for Radionuclide Metrology (ICRM), [http://www.physics.nist.gov/icrm]

LMR has implemented the Quality Management System, approved by the Technical Committee - Quality (TC-Q) of EUROMET. 34 files of Calibration and Measurement Capabilities in the field of radionuclide measurement are internationally recognized and published. Appendix C of CIPM-MRA: Calibration and Measurement Capabilities, CMCs.

National certifications
- Notified as Calibration Laboratory for Activity (Bq), according to SR EN ISO/IEC 17025:2005, CNCAN notification LE 05/2009.
- RENAR-Accredited Laboratory, according to SR EN ISO/IEC 17025:2005;
  - Calibration Laboratory in the field of Activity (Bq), certificate LE 013/2009;

Services and products:
- Calibration of radioactive sources and solutions produced in IFIN-HH or imported;
- Calibration of activity measuring devices: radionuclide calibrators, radiochromatographs, LSC counters, gamma spectrometry systems;
- Measurement of the activity of low-level radioactive samples from: environment, food chain, industry;
- Organization of interlaboratory comparisons (proficiency testing) on the measurement of the activity of food, environmental factors, radiopharmaceuticals;
- Production and delivery of radioactive standards:
  - Standard radioactive solutions of 10 radionuclides;
  - Alpha and beta point or area sources;
  - Gamma point or volume sources, with matrices: water equivalent, soil, zeolite.

Equipment:
- Equipment for absolute standardization by 4πPC-γ coincidence method;
- Equipment for absolute standardization by liquid scintillation method (LSC-DCR);
- Equipment for calibration by gamma spectrometry method, with GeHP detector;
- Equipment for relative calibration by the method of pressurized ionization chamber
- Analytical balances and microbalances.

Customers:
- Research Institutes and Universities;
- Nuclear Power Plant in Cernavoda;
- Nuclear Medicine Units in Hospitals;
- County Directions: Public Health, Sanitary-Veterinary, Food Safety, Environmental Protection.

CONTACT
Phone: (+4) 021 404 6163
Fax: (+4) 021 457 4945
Email: msahagia@nipne.ro
Principle:
An ion scattering experiment can determine the mass of the target nucleus (using the conservation of energy and momentum K), the depth of the target nucleus (using the energy loss as a function of depth in the target dE/dx), and the concentration of the target using the calculated cross-sections δσ/δΩ).

Equipment:
Different beams (He, D, N) delivered by the U-120 Cyclotron with energies of 1.8MeV up to 10MeV are transported via beam line with ion optics at the end station (reaction chamber) provided with two goniometric systems, target holder, two particle detectors and corresponding electronics (spectrometric chain and data acquisition).

Field of interested users: R&D laboratories involved in nanostructured materials, semiconductor industry, micro and nanoeengineering companies.

Specific analyses performed (examples)

Composition analysis:
Experimental (red) and simulated (blue) RBS spectra for a Ti_{0.47}Ni_{0.43}Nb_{0.10} alloy having properties of shape memory. (individual simulated spectra for constituent elements are shown on the bottom with colored lines). Surface contaminated layer with light elements (C, O) analyzed with deuteron beams had 90nm thickness and 65% carbon with 35% oxygen composition.

Depth profiling of elemental concentration:
Experimental and simulated RBS spectra (left, middle) and corresponding calculated concentration (right) for a buried oxygen layer in Si before and after thermal annealing at 1000°C.

Thickness of nanostructured layers:
Experimental and simulated spectra for RBS analysis for 5 pairs of ZrN/TiN layers having 15nm/layer deposited on Si with a Ti buffer layer of 300nm obtained using 2.7MeV He beam (left) and 9.65MeV N beam (right); the use of N beam leads to better mass separation as well as better depth resolution.

CONTACT
Phone: (+4) 021 404 2367
Fax: (+4) 021 457 4440
Email: ddudu@nipne.ro
‘ACTIVA-N’ Materials Testing Laboratory
Applied Nuclear Physics Department

The ‘ACTIVA-N’ Materials Testing Laboratory has developed in the field of applied research focused on the use of nuclear and atomic techniques that imply detection and analysis of gamma rays (γ) and optical and X-ray fluorescence, respectively (XRF).

The implementation of the Quality Assurance System in our current activity, according to the ISO 17025 Standard, as trained by the IAEA lecturers within the framework of the Regional RER 02-004 project in the period 1999-2003 was appreciated by the internationally authorized expert - Auditor who visited us on the occasion of the official assessment in 2003, and placed us in the arena of the "technical performance competition"; the official assessment (accreditation) was successfully achieved in May 2004. Since then, getting and ensuring performance at the European competitive level has become a permanent goal of the Laboratory’s activity.

At present, the Management System is currently applied in compliance with the SR EN ISO/CEI 17025:2005 Standard, which ensures the validity of our experimental results by validation of the analytical methods employed, traceability of the physical measurements to the International System of Units, and evaluation of the measurement uncertainty according to the International Standards and Guidelines requirements.

Specific Applications

- Determination of activity /Monitoring of activity/ Control of radioactive contamination of samples by the Gamma-ray spectrometry (‘Gamma - Spec’) technique using the ISSA installation in laboratory;
- Determination of the elemental composition of materials by the Instrumental Neutron Activation Analysis (INAA) - the instrumental version of NAA which relies on the gamma-ray spectrometric analysis of samples irradiated in the nuclear reactor TRIGA (14 MW), and/or by the atomic spectrometry techniques based on the Optical Emission (OES) and the X-ray Fluorescence radiation.

Analytical Services

A - Activity Determination:
- Identification of the gamma-ray emitting nuclides in the environmental samples (aqueous solutions of 100 ml, and soil of ~100 g) and in small samples (ø≤8mm) analyzed by INAA, and determination of their activity values by ‘Gamma-Spec’ applications in Laboratory;
- Control of the radioactive contamination in environmental samples by in-situ analyses, in measurement geometries identical to those used in laboratory, by similar ‘Gamma-Spec’ applications, using the ‘Gamma-Port’ spectrometer.

B - Elemental Analysis
Analysis of the elemental composition of metallic materials (steels, metallic biomaterials, other alloys) on small samples (ø ≤ 8 mm) using the INAA technique and CRM (Certified Reference Materials), or the ‘k0’ method, and/or using of the atomic spectrometry techniques (OES, XRF) applied on metallic samples having 'disk' geometry.

C - Advisory Service
Offered to the analysts who work and use Gamma-ray Spectrometry technique in laboratories for the control of radioactive contamination of water (networks of the Ministry of Health and Environment) or/and of other radioactive materials.

Equipment/Calibration
- The ‘ISAA’ and ‘Gamma Port’ spectrometry installations (ORTEC type) have HPGe detectors with the following characteristics: high-resolution of 1.9 keV at the 1332.5 keV energy of 60Co, 30% relative efficiency, dedicated software (recent versions), and Pb shield to reduce the γ-ray background present in the environment.
- The OES and XRF Spectrometers have been calibrated with MRC materials on the basis of a software system developed by the producer (Oxford Instruments) before delivery (October 2007).

Traceability
The spectrometry equipment was calibrated with radioactive sources produced by institutes acknowledged by BIPM, and our balance was calibrated by the National Institute of Metrology (INM); all these and the use of Certified Reference Materials (CRM) produced by European Reference Institutes ensure a direct traceability of the activity and elemental concentrations to the International System of Units.

Detection Limits
- Minimum detectable activity (MDA): Range of the MDA in solutions: (5 - 1) Bq/kg Range of the MDA in soil: (0.5 - 0.2) Bq/kg
The minimum activity values depend on the specific spectra of gamma radioactive nuclides in the analyzed samples, matrix characteristics and sample’s mass.
- Minimum elemental concentration: (1 - 0.1) ppm/g. The minimum values of the element concentrations additionally depend on the nuclear characteristics of the activation reactions and on the irradiation conditions.

Validity of results is assured by:
- Annual assessment of Laboratory’s performance by participation in international Proficiency Testing exercises;
- Cooperation with laboratories and experts from UK, Poland, Netherlands, Belgium, Sweden, IAEA (Vienna);
- Communication of results in international Conferences/Workshops, followed by the publication in ISI-quoted journals dedicated to nuclear field;
- Certification of the laboratory’s head by the European Organization of Quality (EOQ)-Vienna (2008) on assessment of experimental data and personnel training by doctoral studies and training courses.

Authorizations
- CNCAN authorization: ST 014/008;
- Designation as Notified Testing Laboratory by CNCAN notification LI 12/2008.
BIOEVAL is part of the Life and Environmental Physics Department in IFIN-HH and has applied a quality management system for testing laboratories, according to SR EN ISO/IEC 17025:2005 (General Requirements for the competence of testing/ calibration laboratories) and ISO 10993 documents used in the evaluation of effects of medical materials and devices upon human body. By following the compliance with these EU standards, BIOEVAL makes available to the customers a working structure that may offer valid results in the biocompatibility evaluation of medical materials and devices.

Biocompatibility is defined as the compatibility with the living tissue or a living system by lack of toxicity, injury or physiological reactivity and without causing immune rejection. In the case of medical devices which come into contact with the human body, for treatment, diagnosis or prosthesis, it is highly important to make sure all the contact points do not cause irritation, changes in blood composition or do not present toxicity.

Biocompatibility evaluation of medical materials and devices represents an essential control of the products widely used in medical practice. This evaluation is made before the clinical studies – as part of the global characterization process of the safety of a device or material. The best start point for understanding the biocompatibility requirements is ISO 10993 standard.

Capabilities

With a proper infrastructure, state-of-the-art equipment and qualified personnel, BIOEVAL performs high technical level analyses, testing medical materials and devices in accordance with the requirements of SR EN ISO 10993-5:2003 - In vitro cytotoxicity tests and SR EN ISO 10993-10:2002 – Irritation and retard effect hypersensitivity tests.

BIOEVAL has an area dedicated to cell cultures, with clean rooms providing separation and control of material and personnel flows. BIOEVAL has also a proper animal housing unit that ensures the micro and macroclimate for experimental animal research.

BIOEVAL provides expertise for:
• Cytotoxicity testing (SR ISO 10993-5): cytotoxicity, a standardized and fast test, is a very sensitive and low cost method to determine whether materials contain significant amounts of harmful extracts and what their effect upon cell components would be. Cytotoxicity is investigated by in vitro tests observing the cell viability and morphology after exposure of L-929 cell cultures to agent.
• Irritability and allergenicity testing (SR ISO 10993-10): adverse effects occurring on experimental animal when exposing the animal to the device material or when the extraction liquid of a medical device is topically applied on animal. Biocompatibility evaluation by in vivo tests can be done by estimating the potential of a medical device, materials or their extracts to elicit contact dermal allergies in animals.

Services

BIOEVAL provides services on some of the specific test required to evaluate the biocompatibility of medical materials and devices;
In vitro methods for testing cytotoxicity:
• Evaluation of cell cultures by agar diffusion;
• Evaluation of cell cultures by elution test.
In vivo method for testing irritability and delayed hypersensitivity:
• Guinea pigs maximization test.

Potential customers

Validation of medical materials and devices has become more problematic than ever because of many new materials and stricter post-processing. Wide use of medical materials and devices in medical practice, without an auditing and certification system, is not recommended for patients (Directive 93/42/CEE on medical devices) since they may affect physical integrity and even, in extreme situations, patients’ lives.

To understand the essential control of products and to avoid the danger for patients, the medical materials and devices must be properly tested, in accordance with ISO 10993, before they are marketed.

The services provided by BIOEVAL focus on EU directives and regulations which affect the economic agents involved in research, development, manufacture or distribution of products and services for diagnosis, treatment and prevention of medical diseases and disorders.
Environmental and Personnel Dosimetry Laboratory
Life and Environmental Physics Department

Environmental and Personnel Dosimetry Laboratory (LPDM) is part of the Life and Environmental Physics Department and consists of four distinct units:
- Personnel monitoring unit with thermoluminescent dosimeters (USD-TL);
- Personnel monitoring unit with photodosimeters (USF);
- Gamma spectrometry analysis unit (UMAP);
- Environmental radioactivity monitoring unit (UMRM).

LDPM is accredited by RENAR (certificate of accreditation LI 680/2008) and renotified by CN-CAN (certificate of designation LI 07/2009) for each unit.

Personnel monitoring unit with thermoluminescent dosimeters (USD-TL)

USD-TL delivers monitoring services for people working in authorized nuclear facilities, providing logistics: thermoluminescent detector-based dosimeter, delivery and communication of results, data archiving. Measurement range of dose equivalent – H(10) – is 10μSv-100mSv, with uncertainty of maximum 12%. USD-TL makes the data available to any beneficiary who requested them, these data being achieved for a minimum 30-year period. USD-TL also provides specialized assistance on optimizing the workplaces in order to mitigate the dose received by the personnel by mapping the doses in the working points.

Personnel monitoring unit with photodosimeters (USF)

USF provides services with respect to: dosimetric film-based monitoring for the personnel occupationally exposed to ionizing radiation, gathering monitoring data and archiving dosimetry reports and samples.

USF cooperates with USD-TL for intercomparison of results of the personnel simultaneously monitored by both methods. USF’s activity is carried out in three areas especially designed for personnel monitoring under quality conditions: customer service, technological area for chemical processing of photographic film and archives.

Gamma spectrometry analysis unit (UMAP)

UMAP performs high resolution gamma spectrometry.

The installation for measuring the activity by gamma spectrometry consists of:
- ORTEC Hp-Ge semiconductor detector, rel.eff. 35% HV=2000V, with built-in preamplifier and cooled FET;
- DigiDart monoblock system for data acquisition and processing;
- PC and MAESTRO software.

The energy range of this installation is: (50...2000) keV.

Environmental radioactivity monitoring unit (UMRM)

UMRM provides collection, processing and measurement of:
- Environmental samples: soil, sediment, water (surface, underground, sea and drinking water), vegetation (spontaneous and cultivated), air (aerosols fixed on filters);
- Food samples;
- Industrial samples (building materials, waste arising from technological processes etc.).

The Laboratory also provides monitoring of environmental radioactivity using the Thermoluminescent Dosimetry System for Environment – SDTM. The ambient dose equivalent - H*(10) given by photon radiation, at 1m above the soil, is also determined. Passive dosimeters with LiF-based thermoluminescent detectors (e.g. LiF: Mg, Cu, P) are used in this laboratory. The detectors have the following characteristics: integrating-type, negligible information loss for a monitoring period ranging between 1-90 days.

The data are recorded, gathered and archived. Upon request, they may be made available to the competent environmental monitoring institutions from home and abroad.

Gross alpha, beta and gamma measurements are performed.

CONTACT

LDPM, USD-TL, UMRM
Phone: (+4) 021 404 6224
Fax: (+4) 021 404 6190
(+4) 021 457 4439
E-mail: stoc@ifin.nipne.ro

USF
Phone: (+4) 021 404 6194
E-mail: fmihai@ifin.nipne.ro

UMAP
Phone: (+4) 021 404 2358
E-mail: romulus@ifin.nipne.ro
Capabilities

SALMROM is a competent testing laboratory whose activity is carried out in accordance with SR EN/ISO 17025: 2005 standard, in IFIN-HH, Life and Environmental Physics Department – DFVM. Set-up of workplace and provision of laboratory with modern research equipment were achieved within the CEEX Project, Module 4, Contract 108/2006. Our work team consists of specialists with wide experience in: developing ionizing radiation detectors – ionization chambers – validated and patented, complex measurement and monitoring systems, spectrometry systems, systems for monitoring atmospheric Radon and alpha radioactive gases, measuring the parameters for radiation detectors/transducers for industrial, medical, laboratory or research applications.

SALMROM is outfitted with portable and laboratory devices, high performance equipment for a wide range of spectrometric measurements, tests, in line with the European directives and national legislation and in compliance with the requirements of SR EN ISO 17025: 2005 standard.

Testing range

- Measurement of activity in environmental sample using the MPC 2000 gross alpha/beta system. Measurement range for alpha: 0.001-10⁵ Bq. Measurement range for beta: 0.5-10⁵ Bq.
- Measurement of the activity of radon and radioactive alpha gases in environmental samples using the Pylon AB-5 system. Measurement range for radon: 0.01-1.000.000 pCi/l (3.7×10⁵ Bq/l).
- Measurement of the activity of gamma emitting radionuclides in environmental samples and radioactive material samples. Measurement range: background – 10⁴ Bq.
- Measurement of activity in environmental samples using the OCTETE alpha spectrometry system. Measurement range: background-10⁴ Bq.

Other activities

- Measurement of the volumic activity of radon and radioactive alpha gases in environmental samples using the CIS-Rn-XX system;
- Ionizing radiation detectors (pressurized ionization chamber) for industrial applications;
- Repairing/reconditioning radiation detectors for industrial applications.

Equipment

- α, β, γ cotaminometer for radioactive materials and environmetal measurements, with accessories, BERTHOLD Umo LB123 Universal Monitor;
- Low-background gross α-β measuring system, with accessories, ORTEC PROTEAN MPC-2000-DP model;
- Portable system for the measurement of atmospheric radon and thoron, with accessories, PYLON AB-5 model;
- Multidetector/analyzer alpha spectrometer with the following accessories:
  - Integrated alpha spectrometry system;
  - ORTEC OCTETE multichannel alpha spectrometer.
- Portable multichannel/analyzer gamma spectrometer with GeHP detector, with accessories, ORTEC DigiDART model;
- Keithley electrometer;
- Complex system for monitoring atmospheric radon concentration.

Potential Customers

Romanian Civil Protection/General Inspectorate for Emergency Situations, Ministry of Environment, CNCAN, Nuclear Power Plant in Cernavoda, National Uranium Administration, Institute for Balneary and Climatic Medicine and Physics and Physical Recovery (IMFBRM), National Agency for Export Control (ANCEX), National Institute for Earth Physics and Seismology (INCFPS), Manufacturers/suppliers of building materials, chemical fertilizer facilities, salt and gold mines.


CNCAN Notification - No. LI 09/2008, issued by the National Commission for Nuclear Activities Control.

RENAR Certificate of accreditation - No. LI817/09, issued by the Romanian Accreditation Body.

CONTACT

Phone: (+4) 021 404 6199
Fax: (+4) 021 457 4439
Email: rcalin@nipne.ro
http://salmrom.nipne.ro/
Whole Body Monitoring Laboratory (USCIR-CCU) is part of the Life and Environmental Sciences Department.

USCIR-CCU’s activity is carried out according to the Quality Assurance documents that comply with the national and international standards in the field, into force, belonging to CNCAN, IAEA, ICRP, ISO CEI (SR EN ISO IEC 17025:2005).

Since 2000, USCIR-CCU has been successively notified and designated by CNCAN as Personal Dosimetry Body to perform intake and dose evaluation from occupational monitoring data (certificates Nr.01/2000, ODA 01/2005, ODA 01/2008).

USCIR-CCU provides periodical and special monitoring of occupational internal radioactive contamination of whole body and thyroid, for the personnel working in nuclear units from hospitals, industry, research, national security, radiopharmaceutical production centers, industrial irradiation centers, radioactive waste collection and treatment centers with potential risk of internal exposure to ionizing radiation.

USCIR-CCU also provides special monitoring of internal contamination for people from the general public, in case of nuclear accident.

The current monitoring equipment – Whole Body Counter, shielded tilted-chair geometry, is a spectrometry system equipped with high-efficiency NaI(Tl) scintillation detectors for detecting incorporated gamma emitting radionuclides, with energy ranging between 100 keV and 1500 keV and activity between 370 Bq and 2.5 MBq. The detector-associated electronics comprises NIM standard modules and the Silescin emulation program of Multichannel Analyzer, implemented on PC through a dedicated Silena interface board.

A new, state-of-the-art Whole Body Counter will be available soon. This Counter is equipped with Ge-Hyperpure detector (ORTEC), Carbon window and special geometry for volume radioactive sources. It will enable the detection of X and gamma rays of incorporated radionuclides in the energy range 10keV to 2500keV, with excellent resolutions of 600 eV at the energy line 14.4 keV of Co-57 and 1.90 keV at the energy line 1332 keV of Co-60. The HPGe detector-associated electronics has the following characteristics: state-of-the-art, digital full control of all the functions of the Multichannel Analyzer with a maximum number of 16384 acquisition channels, full control of detector polarization parameters, signal amplifying and shaping parameters. Moreover, this Whole Body Counter provides data safety and their fast transfer to spectrum processing program, Renaissance-32 (ORTEC).

The estimates of intake in terms of activity, of the radionuclide retention at different times after intake and of the equivalent and effective doses are performed by IMBA (HPA) software, a specialized program that comprises the latest metabolic and biokinetic models recommended by ICRP for most of the radionuclides.

CONTACT
Phone: (+4) 021 404 6200
Fax: (+4) 021 457 4439
Email: saizu_ang@yahoo.com
Low Background Gamma-Ray Spectrometry Laboratory
Nuclear Physics Department

The laboratory works in accordance with Notification No. LI 016/2007 issued by the National Commission for Nuclear Activities Control in Romania (CNCAN), based on SR EN ISO/IEC 17025 quality standard.

Activity field
- Testing of radionuclide content and activity by qualitative and quantitative analysis of environmental samples (soil, sediment, effluents, surface water and vegetation) and VVR-S nuclear reactor decommissioning samples, by low-background gamma-ray spectrometry.
- Neutron activation analysis: elemental analysis using thermal neutron activation of samples at TRIGA Nuclear Reactor of SCN Pitesti and then measuring the samples by gamma-ray spectrometry.

Equipment: Low-background gamma-ray spectrometry system, with HPGe Ortec detector (relative efficiency 30 % and 1.85 keV resolution at 1332 keV of 60Co), placed inside a lead shield.

Analytical performances
1. Radionuclides investigated in environmental samples by gamma-ray spectrometry:
   - Artificial radionuclides: $^{137}$Cs, $^{60}$Co, $^{241}$Am, etc.
   - Natural radionuclides: $^{238}$U-$^{226}$Ra and $^{232}$Th radio-active series progenies; $^{238}$U; $^{40}$K; $^{18}$F.
   - Mass of sample: ~ 30-200 g (solid samples);
   - Volume of sample: 100mL-1L (liquid samples).
2. Elements investigated in environmental samples by neutron activation analysis: Ag, As, Au, Ba, Br, Ca, Cd, Ce, Co, Cr, Cs, Eu, Fe, Hf, Hg, K, La, Lu, Mo, Na, Nd, Ni, Rb, Sb, Sc, Se, Sm, Sr, Tb, Th, U, W, Yb, Zn.
   - Mass of sample: ~ 50-150 mg (environmental samples).
   - Note: Neutron activation analysis can be applied in correlation with the operating periods of TRIGA nuclear reactor at SCN Pitesti.

Minimum detectable activity (MDA) for radioactivity analysis:
- 0.090 Bq $^{137}$Cs in water of 1 L volume (Marinelli geometry);
- 0.072 Bq $^{137}$Cs in water of 150 cm$^3$ volume.

Detection limits for neutron activation analysis: 10 µg/kg–10g/kg (10 ppb–1%), depending on the element type and sample matrix.

Method description
Gamma-ray spectrometry is a nuclear technique used to analyse gamma-ray emitting radionuclides present in various types of samples.

Analytical stages:
- radionuclide identification (qualitative analysis);
- activity/specific activity determination of the identified radionuclides, expressed in Bq, Bq/kg or Bq/l (quantitative analysis).

Neutron activation analysis of elemental concentrations in samples is based on simultaneous formation, by nuclear reactions with neutrons, of a big number of radionuclides on certain elemental nuclei present in the sample.

Analysis of natural radioactivity in environmental samples by low-background gamma-ray spectrometry
The laboratory’s natural background gamma-ray spectrum is mainly due to gamma-emitting radionuclides of uranium-radium ($^{238}$U-$^{226}$Ra) and thorium ($^{232}$Th) radioactive series, as well as $^{40}$K radionuclide.

Aleatory temporal variation of the radon's activity inside the laboratory requires an alternately counting of the investigated samples and natural background, especially for low level radioactivity samples.

To determine radium, the samples are sealed and measured after 3-4 weeks to permit establishing the radioactive equilibrium between $^{226}$Ra and its gaseous radioactive progeny $^{222}$Rn (radon). Then, $^{214}$Pb and $^{214}$Bi radon’s radioactive progenies are measured by gamma-ray spectrometry.

U, Th and K concentrations can be determined by measuring uranium ($^{238}$U), thorium ($^{232}$Th) and potassium ($^{40}$K) radioactivity in the sample.

Quality control is performed by:
- using certified reference materials;
- periodical participation in international intercomparison exercises for reference materials certifying, organized by the International Atomic Energy Agency (IAEA) Vienna, and Institute of Nuclear Chemistry and Technology (INCT) Warsaw, Poland;
- periodical participation in proficiency tests organized by IAEA Vienna.

Customers/Potential customers
- Enterprises manufacturing: phosphatic fertilizers, building materials, electrical energy (coal-fired power plants, nuclear power plants), metalurgical slag;
- Environmental Protection Agencies.
Spectrometric Analysis Laboratory (LAS) is part of Radioactive Waste Management Department (DMDR) within IFIN-HH.

The laboratory has the ability and has been notified by CNCAN to carry out the followings:

- Preparing and analyzing the environment samples (soil, sediments, vegetation, water) by gamma spectrometry;
- Examining sealed gamma radioactive sources;
- Measuring unfixed contamination (gamma emitting radionuclides);
- Determination of gamma emitting radionuclides activity from type A packages (or other packages) filled with radioactive waste;
- Determination of gamma emitting radionuclides activity from historical packages and containers filled with historical waste;
- Global alpha and beta activity measurements in low background
- Examining radioactive sources and radioactive wastes can be done at owners’ headquarters by means of ORTEC portable device and by own means of conveyance authorized by CNCAN.

The laboratory is outfitted with 3 gamma spectrometric equipments with high resolution HPGe detectors:

- CANBERRA DSA 1000, outfitted with GENIE 2000 spectra acquisition and analysis software;
- ISOCART – ORTEC outfitted with Gamma VISION and ISOTOPIC spectra acquisition and analysis software;
- Trans – SPEC 100 – ORTEC outfitted Gamma VISION and ISOTOPIC spectra acquisition and analysis software.

The laboratory is also outfitted with a global alpha and beta radioactivity measurement system, in low background, ORTEC – Protean type, MPC-2000-DP model.

Quality Management System was implemented to SAL according to SR. EN ISO/CEI 17025:2005 and in 2006 has been notified by the National Commission for Nuclear Activities Control (CNCAN) to carry out its activity as notified laboratory in compliance with notification no. LI 01/2009.

The laboratory carries out gamma spectrometric analysis for monitoring the controlled areas both at Baita Bihor National Radwaste Repository and Radioactive Waste Management Department (DMDR) within IFIN-HH.

The laboratory carries out research activities by participating in research projects within national and international programs and by presenting scientific papers and communications in specialized publications, conferences and symposiums.

The permanent inter comparisons made between the results obtained by LAS and the results obtained by other laboratories in the field, assures the checking up and the maintenance of high level quality analysis.

The Spectrometric Analysis Laboratory participates in competence tests organized at international level by the International Atomic Energy Agency.
Microbiological Tests

- Total microbial count in/on:
  a. pharmaceuticals in any form – tablets, dragees, capsules, gels, powders, solutions;
  b. raw materials and pharmaceutical packaging (made of glass or plastic materials);
  c. purified water;
  d. production environment (air, surfaces);
  e. alimentary supplements;
  f. cosmetics: raw materials and finished products (creams, ointments, gels);
  g. single-use medical devices (made of plastic, metal or textile).

- Total number of yeasts and molds for products mentioned above (point a) to g))

- Detection of *Escherichia coli* in products mentioned above (points a), b), e) and f); (applied methods: enrichment in selective media and multitest gallery method);

- Detection of *Pseudomonas aeruginosa* in products mentioned at points a), b), e) and f); (applied methods: enrichment in nonselective media method and transfers in selective media, multitest gallery method, MIDI fatty acids profiling method);

- Detection of *Staphylococcus aureus* in products mentioned at points a), b), e) and f); (applied methods: enrichment in nonselective media method and passages in selective media method, multitest gallery method, MIDI fatty acids profiling method);

- Detection of *Salmonella sp.* in products mentioned at points a), b), e) and f); (applied methods: enrichment in nonselective media and transfer in selective media, multitest gallery method);

- Detection and counting of enterobacteria and other gram-negative bacteria in products mentioned at points a) b), e) and f);

- Sterility test on products mentioned at points a), b), e) and f);

- Detection of *Legionella Sp.* in water by Polymerase Chain Reaction technique (PCR);

- Detection of *Legionella pneumophila* in water by PCR technique.


License No. 2L/2007 issued by The National Medicines Agency – ANM (www.anm.ro)

Certificate of Accreditation No. LI 675/2008 issued by The Romanian Accreditation Association – RENAR (www.renar.ro)

The laboratory was built in order to comply with the basic principles of EAL–G18 normative document issued by the European Accreditation: material flow, personnel flow, avoiding cross-contamination, surfaces quality, air purifying filter systems, as well as key parameters supervision in IVAC system.

The design and the global organization are specific to a Third Party Microbiology Laboratory. Providing equipment (e.g. PCR and Real-Time PCR, GC-MS for MIDI identification technique), selecting and motivating the personnel (young Ph.D. students), surpass this condition and allow approaching very modern research fields as well.

The total surface of the laboratory is 150 m². There is a special room for every preparatory operation, incubation, biologically active waste neutralization, keeping the reference microorganisms as well as a 4 clean rooms assembly.

The know-how allows approaching various fields:
- validation of irradiation sterilization for medical devices factories;
- routine microbiological controls for medicine factories;
- advanced research in molecular biology field.

The Microbiology Laboratory is part of IRASM – Radiation Processing Center. IRASM Quality Management System, which includes activities developed within the Microbiological Laboratory, is in compliance with ISO 9001, ISO 13485 and ISO 11137 and has been certified in 2002 by DQS – Germany.
Detection of Irradiated Foods Laboratory  
IRASM – Technological Irradiations Department

EU and Romanian Regulations with regard to the irradiation of food

**Framework Directive 1999/2/EC:**
- general and technical aspects;
- labeling of irradiated food;
- conditions for authorizing food irradiation.

**Implementing Directive 1999/3/EC:** the list of the foodstuffs and food ingredients which may be treated with ionising radiations: dried aromatic herbs, spices and vegetable seasonings.


“Order concerning the approval of the list of foodstuffs and food ingredients and the maximum doses at which they may be treated with ionizing radiation in order to obtain the license to bring them into the market”- MSP Order No. 870/10.07.2006 published in the Official Journal, Part I, No. 632/21.07.2006 (dried aromatic herbs, spices and vegetable ingredients).

The strategy proposed for the EU large positive list with regard to the irradiated food (2000)
The foodstuffs proposed to be included in the positive list are:
- frozen aromatic herbs, dried fruits, cereal flakes, chicken organs, egg white and arabic gum, frog legs and peeled shrimps.

The foodstuffs which were not proposed to be included in the positive list:
- fresh fruits and vegetables, cereals, tubers, fish, raw milk camembert cheese, casein, rice flour, blood products, fresh meat and poultry.

### Tests for identifying irradiated foodstuffs

<table>
<thead>
<tr>
<th>Standard</th>
<th>Standard Title</th>
<th>Applicability</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>SR EN 1787</td>
<td>Foodstuffs. Detection of irradiated food containing cellulose by ESR spectroscopy.</td>
<td>Foodstuffs containing cellulose. Validated for pistachio shells, paprika and strawberry seeds.</td>
<td></td>
</tr>
<tr>
<td>SR EN 1788</td>
<td>Foodstuffs. Thermoluminescence detection of irradiated food from which silicate minerals can be isolated.</td>
<td>Foodstuffs from which silicate minerals dust can be isolated. Validated for herbs, spices, fresh and dried fruits and vegetables and crustaceans.</td>
<td>Confirmation method</td>
</tr>
<tr>
<td>SR EN 13708</td>
<td>Foodstuffs. Detection of irradiated food containing crystalline sugar by ESR spectroscopy.</td>
<td>Foodstuffs containing crystalline sugar. Validated for raisins, dried figs, dried mango and dried papaya.</td>
<td></td>
</tr>
<tr>
<td>SR EN 13751</td>
<td>Foodstuffs. Detection of irradiated food using photostimulated luminescence.</td>
<td>Foodstuffs containing minerals (dust). Validated for herbs, spices, vegetable seasonings and crustaceans.</td>
<td>Screening method</td>
</tr>
<tr>
<td>SR EN 13783</td>
<td>Foodstuffs. Detection of irradiated food using Direct Epifluorescent Filter Technique/Aerobic Plate Count (DEFT/APC).</td>
<td>Vegetable origin foodstuffs with high microbial load. Validated for black pepper, white pepper, paprika, basil, marjoram, cardamom, cinnamon, ginger, thyme and oregano.</td>
<td>Screening method</td>
</tr>
<tr>
<td>SR EN 13784</td>
<td>Foodstuffs. DNA Comet Assay for the detection of irradiated foodstuffs</td>
<td>Vegetal or animal origin foodstuffs from which cells can be isolated. Validated for chicken bone marrow, chicken, pork, figs, almonds, lentils, rose pepper, soya beans and sesame seeds, linseed and sunflower seeds.</td>
<td>Screening method</td>
</tr>
<tr>
<td>SR EN 14569</td>
<td>Foodstuffs. Microbiological screening for irradiated food using LAL/GNB procedures</td>
<td>Animal origin foodstuffs. Validated for chicken.</td>
<td>Screening method</td>
</tr>
</tbody>
</table>
Physical and Chemical Testing Laboratory
IRASM – Department for Technological Irradiations

**Chromatographic tests**
Screening of volatile and semivolatile organic compounds (VOC & SVOC) by GC/MS:
- fatty acids profiling from microbial, biological and organic matrices which contain fats by using Sherlock Microbial Identification System (MIS) gas chromatographic method produced by MIDI, Inc.;
- identification of hydrocarbons and 2-allylcyclobutenones (2-ACB) for the detection of irradiated foodstuffs which contain fats (EN 1784 and EN 1785);
- screening for VOC and SVOC emissions from materials by direct thermal desorption hyphenated with capillary GC/MS (TD/cGC/MS);
- VOC and SVOC molecular structure characterization and identification by spectral and retention index matching with NIST 2005 mass spectral library acquired by electron ionization at 70 eV;
- characterization and identification of pyrolysis gases evolved from the sample during thermogravimetric analysis (TGA/cGC/MS);

**Screening of non-volatile organic compounds by HPLC**
HPLC methods with UV-VIS diode array (DAD) detection (under development).

**Thermal analysis tests**
Thermogravimetry (TGA):
- determination of oxidation and thermal decomposition temperatures (ISO 11358-1);
- determination of material composition (ISO 11358-1; EU Pharmacopoeia v 6.1, chapter 2.2.34.);
- determination of volatile organic additives concentration and their molecular structure characterization and identification by coupling techniques (TGA-IR and TGA/cGC/MS);
- plastic materials identification based on pyrolysis products fingerprint (coupling techniques).

**Differential Scanning Calorimetry DSC** (ISO 11357-1, EU Pharmacopoeia v 6.1, chapter 2.2.34.):
- determination of melting and crystallization/solidification temperatures (ISO 11357-3);
- determination of glass transition temperature (ISO 11357-2).

**Spectroscopic tests**
Identification and quantitation of organic substances and materials fingerprinting based on FT-IR and FT-Raman spectra interpretation:
- FTIR-TRANS (transmission FT-IR) method of recording spectra in transmission for solid samples embedded in a KBr disc (1 mg of sample to 300 mg of KBr) in the 7500 – 400 cm⁻¹ spectral range (EU Pharmacopoeia v 6.0, chapter 2.2.24.);
- Non-destructive Variable Angle Reflectance IR (FTIR- VARI) and FT-IR diffuse reflectance (DRIFT) spectroscopic methods of recording spectra in the 4500-650 cm⁻¹ spectral range (EU Pharmacopoeia v 6.0, chapter 2.2.24.);
- Non-destructive Raman spectrometry methods of recording spectra in the 3500-50 cm⁻¹ spectral range (chapter 2.2.48., EU Pharmacopoeia v 6.0).

**Chromatographic equipment:**
GC 6890N gas chromatograph coupled with 5975 Inert MSD mass spectrometric detector, manufactured by Agilent Technologies, USA, with the following specs:
- autosampler for liquid injection;
- Sherlock software for fatty acids profiling and microbial identification, manufactured by MIDI Inc., USA;
- coupling for transferring the pyrolysis gases from thermogravimetric analysis into PTV injector (TGA/cGC/MS) with cryogenic cooling (LN2);
- UNITY thermal desorber equipped with Peltier cold trap, manufactured by Markes International; manual head space accessory for UNITY (H5/cGC/MS) thermal desorber;
- mass spectrometer with quadrupolar mass analyzer, electron ionization source (EI, 70eV) and NIST 2005 MS library.

**High Performance Liquid Chromatograph**, manufactured by Beckmann Coulter, USA, with the following specs:
- Rheodyne Manual Injector;
- Beckmann Cuaternary Pump;
- Beckmann 600 channels diode array UV-VIS spectrometer;
- JASCO fluorescence detector.

**Thermal analysis equipment:**
STA 409 PC Luxx Simultaneous Thermal Analyzer, manufactured by NETZSCH, Germany, with the following specs:
- sample is purged with inert, oxidizing or reducing atmospheres;
- weighing range between 1- 18000 mg, with a mass resolution of 0,002 mg in the full weighing range;
- DSC resolution < µW (depending on sensor);
- TG/DSC sample carrier for simultaneous thermogravimetry (TG) and differential scanning calorimetry (DSC);
- TG/DTA sample carrier for simultaneous thermogravimetry (TG) and differential thermal analysis (DTA);
- online coupling with FT-IR and GC-MS for structural characterization of pyrolysis gases.

**Spectroscopic equipment**
Vertex 70 class FT-IR and FT-Raman spectrometer, manufactured by Bruker Optics, Germany, with the following specs:
- FTIR-TRANS in KBr pellets on the 7500-400 cm⁻¹ spectral range, with an optimum resolution of 4 cm⁻¹;
- probe for non-destructive FTIR-VAR in the 4500-650 cm⁻¹ spectral range;
- Raman module (RAM II) and Raman probe for non-destructive analysis of solid and liquid samples with a 1064 nm Nd:YAG-LASER excitation source on the 3500 – 50 cm⁻¹ spectral range and an optimal resolution of 4 cm⁻¹;
- TGA-IR accessory for online coupling with thermogravimetry and software for 3D chromatographic FT-IR data analysis.
Mechanical tests

Tensile test: spontaneous tensile stress and breaking stress; spontaneous deformation and failure force; Young’s Modulus; Poisson’s Ratio; tensile yield limit.

Steel, non-ferrous materials, plastic materials, composite materials, wood, paper, textile fabrics.

Peeling Test: peeling limit; spontaneous deformation and breaking deformation; spontaneous force and failure force.

Steel, non-ferrous materials, plastic materials, composite materials, wood, paper, textile fabrics.

Tear Test: spontaneous unit stress and breaking stress; tearing limit; spontaneous deformation and breaking deformation; spontaneous force and failure force.

Steel, non-ferrous materials, plastic materials, composite materials, wood, paper, textile fabrics.

Flexure test: spontaneous unit flexure stress at constant bending deflection and at breaking; spontaneous and conventional deflection; flexure deformation and breaking deformation; elastic modulus in flexure.

Steel, non-ferrous materials, plastic materials, composite materials, wood, cardboard.

Compression test: spontaneous compression unit stress at 40% CV40 and at breaking stress; spontaneous deformation and breaking deformation; spontaneous force and failure force.

Steel, non-ferrous materials, plastic materials, composite materials, wood, cardboard.

Puncture resistance: spontaneous deformation and breaking deformation; spontaneous force and failure force.

Steel, non-ferrous materials, plastic materials, composite materials, wood, cardboard.

Impact: impact energy; spontaneous force and maximum impact resistance force; spontaneous deformation and breaking deformation.

Steel, non-ferrous materials, plastic materials, composite materials, wood.

EPR (ESR) spectroscopy

- Identification and characterization of free radicals and paramagnetic defects produced by irradiation;
- Identification and characterization of paramagnetic centers containing transition elements (Fe²⁺, Cu²⁺, Mn²⁺, V⁴⁺);
- Detection of irradiated foods containing bone, crystalline cellulose and crystalline sugar.

EPR (ESR) spectroscopy – Equipment

Spectrometer EPR (ESR) MiniScope MS 200 manufactured by Magnettech GmbH, Germany
- Microwave frequency: 9.3 – 9.55 GHz (X band);
- Microwave power: 100 µW – 50 mW;
- Magnetic field range: 0 – 450 mT;
- Resonator: TE₀₁;
- Sensitivity: 8 x 10⁸ spins / 0.1 mT;
- Measurement temperature: room temperature and 77K.

Equipment

Statical tests

- Z005 universal testing machine (Zwick-Roell)
- Transducer cell of 5kN, 20 N maximum force
- BTC-EXLONGS 013 (Zwick-Roell) Extensometer
- Mechanical clamping jaws
- Adjusting devices for Tensile Test, Compression Test, Flexure Test, Tear Test, Peeling Test and Puncture Test
- TestXpert Software (Zwick-Roell Germany).

Shock dynamic tests

- Zwick-Roell B5113 Impact Tester
- 50j, 25j Charpy Pendulum
- 22j, 11j Izod Pendulum

Sample Preparation

- ZCP 020 (Zwick-Roell) sample cutting press
- ISO (34 type A, 37 type 1, 527-2 type 1A, 527-2 type 1B) sample cutting die.

Colour characteristics

The reflected colour as well as the colour indices can be measured:

- Whiteness Index: parameter used to evaluate paper’s quality;
- Yellowness Index: parameter associated with the degradation of plastics.

Equipment

Portable spectrocolorimeter Miniscan XE Plus
- geometry: diffuse / 8°
- port diameter / view diameter: 6.0 / 4.0 mm
- spectral range: 400 – 700 nm;
- reporting interval: 10 mm
- photometric range: 0 – 150 %

CONTACT

Dr. Mihalis CUTRUBINIS
Phone: (+4) 021 404 6183
Fax: (+4) 021 457 5331
Email: v_moise@irasm.ro, vmoise@nipne.ro, d_negut@irasm.ro, dnegut@nipne.ro