Nuclear Science Instrumentation Laboratory

International Atomic Energy Agency
Department Nuclear Sciences & Applications
Division Physical & Chemical Sciences
Physics Section
Further Information: nsil@iaea.org & physics@iaea.org

International Atomic Energy Agency

Widely Known as the world's "Atoms for Peace" organization within the United Nations family, the IAEA is the international centre for cooperation in the nuclear field.

The Agency works with its Member States and multiple partners worldwide to promote the safe, secure and peaceful use of nuclear technologies.

Three Pillars - Main Areas of Activity

Safeguards & Verification

Safety & Security

Science & Technology

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Department of Nuclear Sciences and Applications

This Department covers a broad range of socio-economic sectors, from health, food and agriculture to the environment, water resources and industry.

It assists Member States meet their development needs through nuclear science, technology and innovation.

It also works with laboratories, universities and research facilities worldwide through the IAEA Collaborating Centre scheme.

Areas of Activity

Food & Agriculture

Promoting food security and sustainable agricultural development

Science & Industry

Providing knowledge & expertise for science & industry

Environment

Understanding and protecting the environment

Human Health

Improving the diagnosis and treatment of diseases and nutrition

Water Resources

Making more, and cleaner water available to more people

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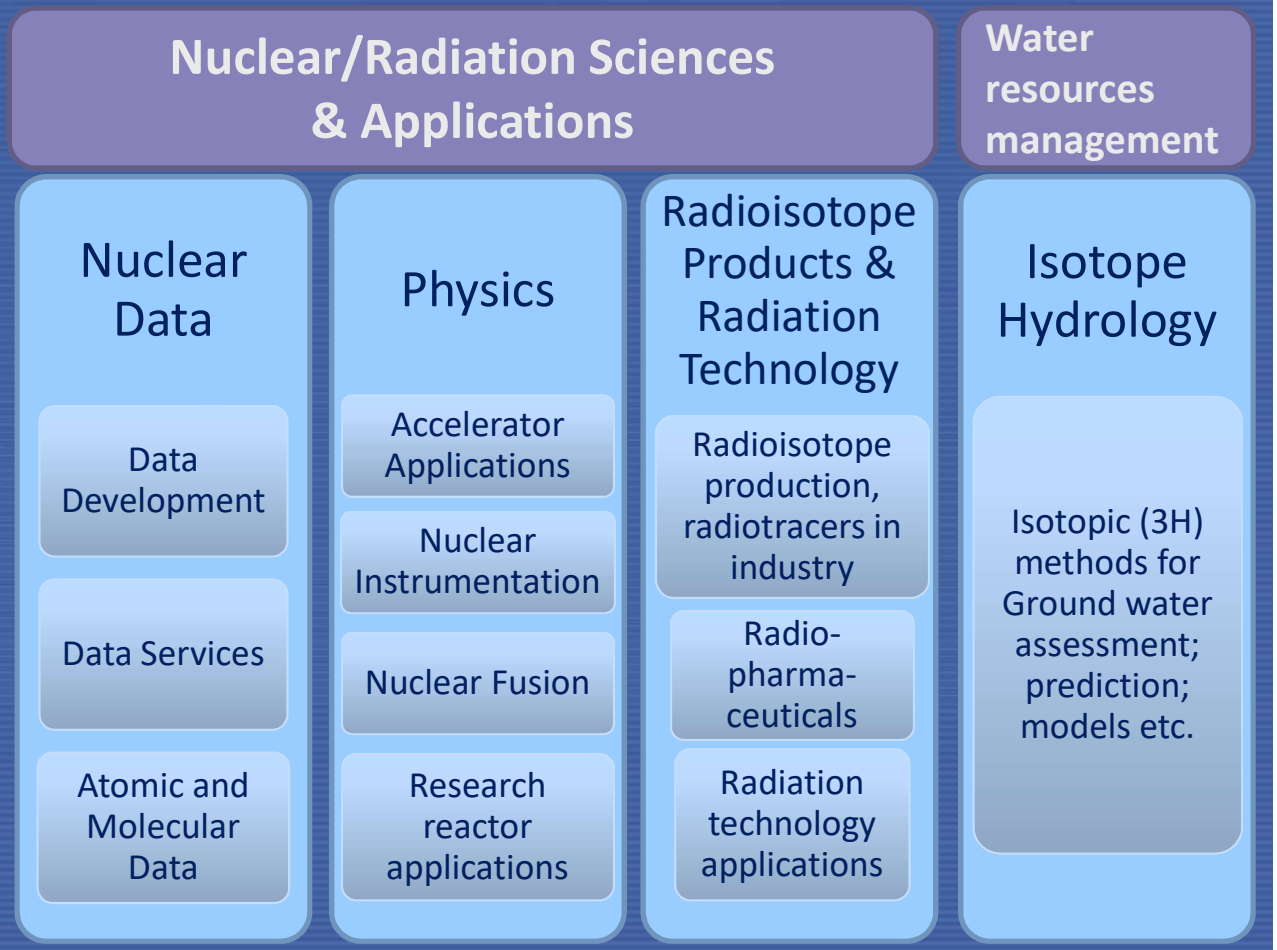
Division of Physical & Chemical Sciences

The Division assists Member States with capacity building, research and development in the nuclear sciences and supports them in using nuclear methods for a variety of practical industrial applications.

It supports needs-based development efforts through Coordinated Research Projects (CRPs)

and provides assistance on scientific and technical aspects of IAEA Technical Cooperation projects.



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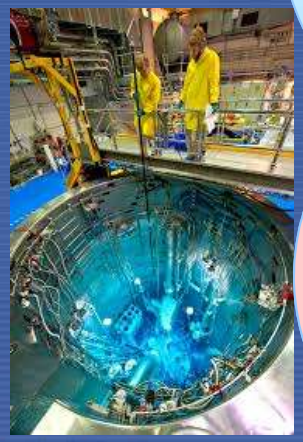
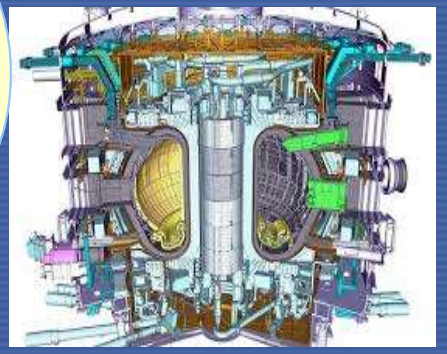
Physics Section: Main areas of Activity

Key work areas include, among others, the utilization of particle accelerators, applications of research reactors, nuclear instrumentation, and nuclear fusion research and technology. The Section's activities are part of the IAEA's nuclear power, fuel cycle and nuclear science programme.





Accelerators

Instrumentation

Research Reactor (Applications)

Fusion

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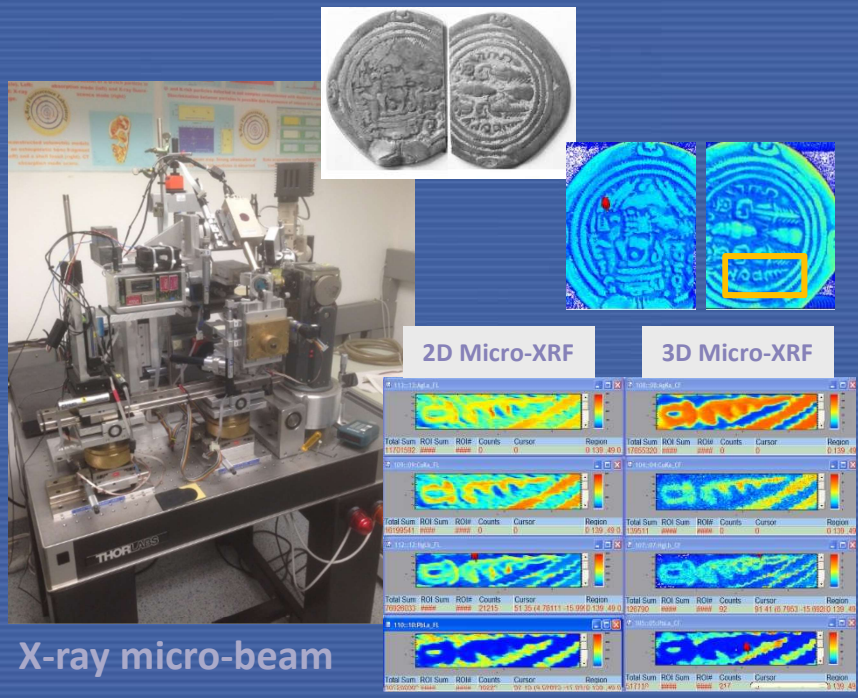
Role of Nuclear Science & Instrumentation Laboratory

Fostering the effective use of nuclear instrumentation and related capacity building

The Nuclear Science & Instrumentation Laboratory (NSIL)
helps Member States to **establish, operate, maintain and utilize** nuclear instrumentation and spectrometry techniques
in support of a wide range of applications :

- Health care
- Food
- Agriculture
- Environment
- Forensics
- Cultural heritage
- Material science



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Four keys areas

Nuclear Instrumentation

Successful use of nuclear technology depends on reliable instruments, monitoring and diagnostic equipment.

Standard and High-tech instrumentation for natural and man-made radiation measurement

Nuclear Spectrometry

Nuclear analytical techniques for comprehensive characterization of materials.

Versatile, high precision, non-destructive, low cost techniques

Support
to Member States

In situ techniques

Portable instruments with high level of analytical performance.

Fast determination of contaminant and their spatial distribution, identification of hot spots

Access to accelerator facilities

Facilitate access to accelerator facilities through practical arrangements and Coordinated Research Projects, in particular for researchers from Member States without such capabilities.

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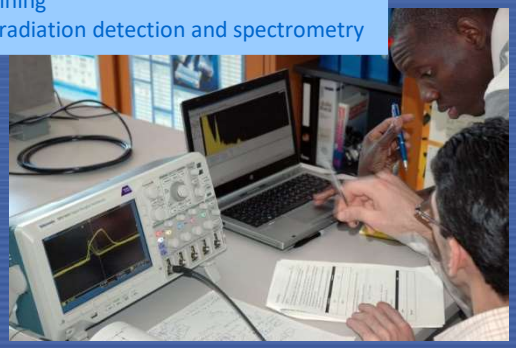
Key Activities

- **NSIL assists Member States' laboratories in designing, installing, operating and maintaining nuclear instrumentation** adapted to their applications & research activities.
- **NSIL supports the utilization of Member States' existing infrastructure and assists with planning for future facilities.**
- **NSIL coordinates proficiency tests complying with ISO17043 requirements for analytical laboratories**, which help to maintain their quality assurance and quality control programmes or seek for accreditation

Training
on radiation detection and spectrometry



- **NSIL organizes hands-on training courses and provides capacity building** at NSIL, through collaborating institutions in Member States, and on-site, at national laboratories.
- **Make available E-learning tools for both self-learning and teaching**.

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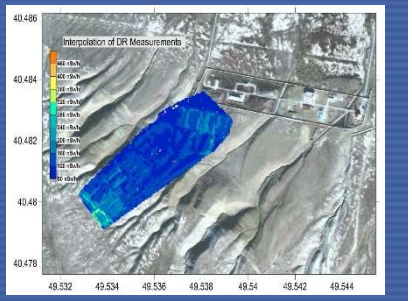
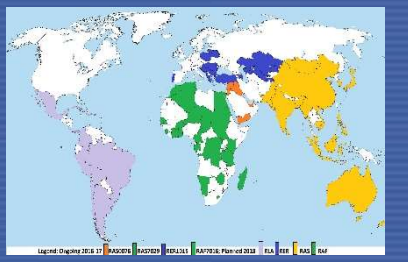
Recent Success Stories

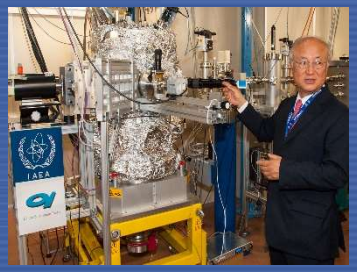
- Development, in cooperation with other IAEA units, of **mobile gamma spectrometry capabilities**, for radiological monitoring related to environmental assessment and remediation projects (on Member States' request : Argentina, Azerbaijan, Gabon, Indonesia, Kyrgyzstan, Mexico, Uzbekistan and Zambia).



- IAEA Regional Technical Cooperation projects aiming at **monitoring air quality**, identifying sources of air pollution and trajectories of transboundary migration of air particulate matter (> 80 Member States involved).



- **Agreement with ELETTRA Synchrotron** (Trieste, Italy):
  - Implementation of a Ultra High Vacuum Chamber for X-ray analysis
  - Since 2014, researchers from 18 Member States have used this equipment
  - Studies related to materials for energy storage and conversion technologies; environmental monitoring; elemental distribution/speciation on plant organs; preventive conservation of cultural heritage; food products security and authenticity.



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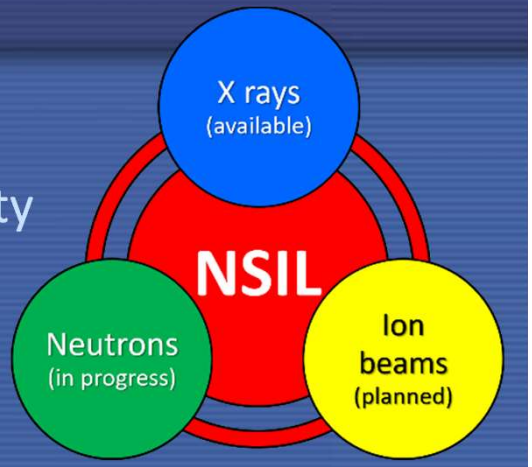
Future developments



- NSIL/Physics Section aims to enhance the in-house capacity in available laboratory facilities and instrumentation
- Objective is to operate three complementary probes for irradiation and analysis :
  - **X-rays**, using existing equipment (including Energy Dispersive X-ray Fluorescence) enriched by Wavelength Dispersive X-ray Fluorescence analysis in 2019
  - **Neutrons**, by the establishment of a neutron science facility with D-D and D-T neutron, to be completed in 2019-2022
  - **Ion-beams**, through the planned establishment of an ion-beam accelerator facility.
- This will allow expanding IAEA's support to Member States in:
  - Capacity building through education and training,
  - Facilitation of applied research, and
  - Provision of specialized services both to internal and external users.

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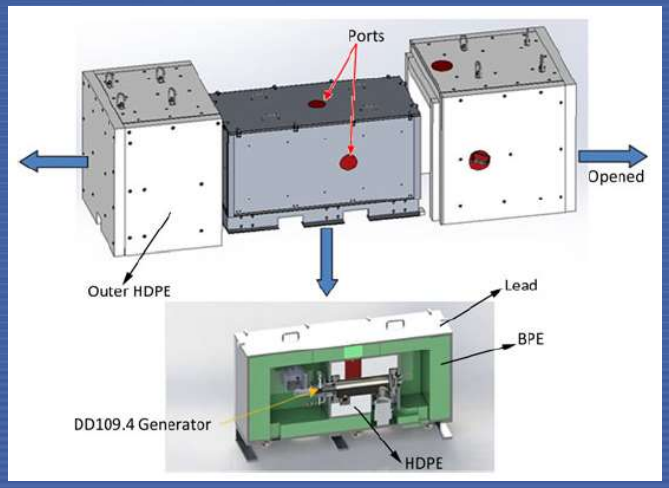
Neutron Science Facility at Seibersdorf

Objectives :

Enhanced capacity of NSIL by the establishment of neutron science facility, using 1 x 10^8 n/s source intensity through:

D+D reaction → 2.45 MeV neutron source, comparable to fission neutrons (procurement of generator under ReNuAL/ReNuAL+)

D+T reaction → 14 MeV neutron source, comparable to fusion neutrons (donation of generator by Australia)



Example of DD-type generator, with compact shielding

Example of DT-type generator, with massive shielding

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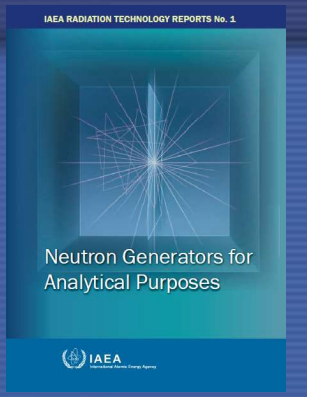
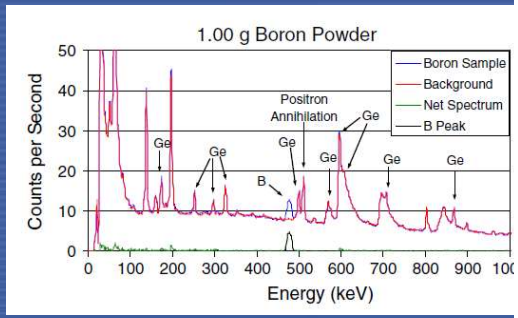
Neutron Science Facility at Seibersdorf

Benefit to Member States

Expanded IAEA's support to its Member States using neutron science facility in the area of capacity building through education and training, facilitation of applied research and provision of specialised services such as:

- ✓ Neutron physics with 14MeV, fast and thermal neutrons
- ✓ Neutron Activation Analysis & Prompt Gamma Activation Analysis
- ✓ Neutron radiography *(and tomography)*
- ✓ Non-destructive testing using active interrogation
- ✓ Demonstration of radiotracer production and usage
- ✓ Radiation protection with neutron and gamma fields
- ✓ O&M of neutron laboratory based on DD/DT generators
- ✓ Neutron instrumentation relevant to reactor I&C systems





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Ion Beam Accelerator Project at Seibersdorf

- **Comprehensive review conducted in 2018: high interest from the user communities** (Member States and internal to IAEA) :
  - **Training** in Accelerator technology and applications,
  - **Services** relevant to ion beam and nuclear microprobe analysis,
  - **Enhanced access** to Ion Beam Analysis techniques.

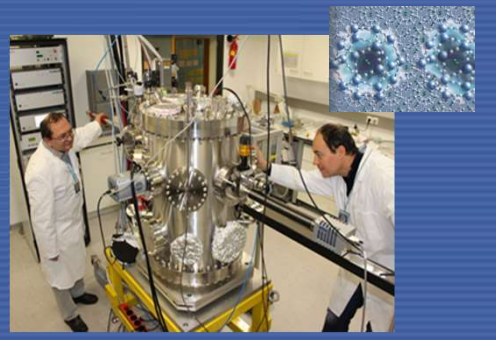
- **Feasibility study showing that,** to match the NSIL's mission and IAEA Member States and internal IAEA users' needs, **two optimal and cost effective technology options can be considered: a 1.7 MV Tandem or a 3 MV Tandem.**

1.7 MV Pelletron® Accelerator Lab.
East Carolina University, Greenville, USA

Both accelerators cover a broad area of MeV ion beam applications, 3 MV one with further enlarged capabilities.

- **Total investment cost, including building and infrastructure: 2.8 M€ for 1.7 MV and 5 M€ for 3 MV accelerators.**

  Staff required 3 to 5 persons (upon accelerator and beam lines)
  Annual operating cost : 100 to 150 k€ (respectively)



Call for Extrabudgetary support from Member States for the Accelerator Project

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Contact information: nsil@iaea.org & physics@iaea.org

Thank you!

Surface of Silver coins from the Sasanian Empire

From XRF measurements,
presence of Hg and Pb was detected

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