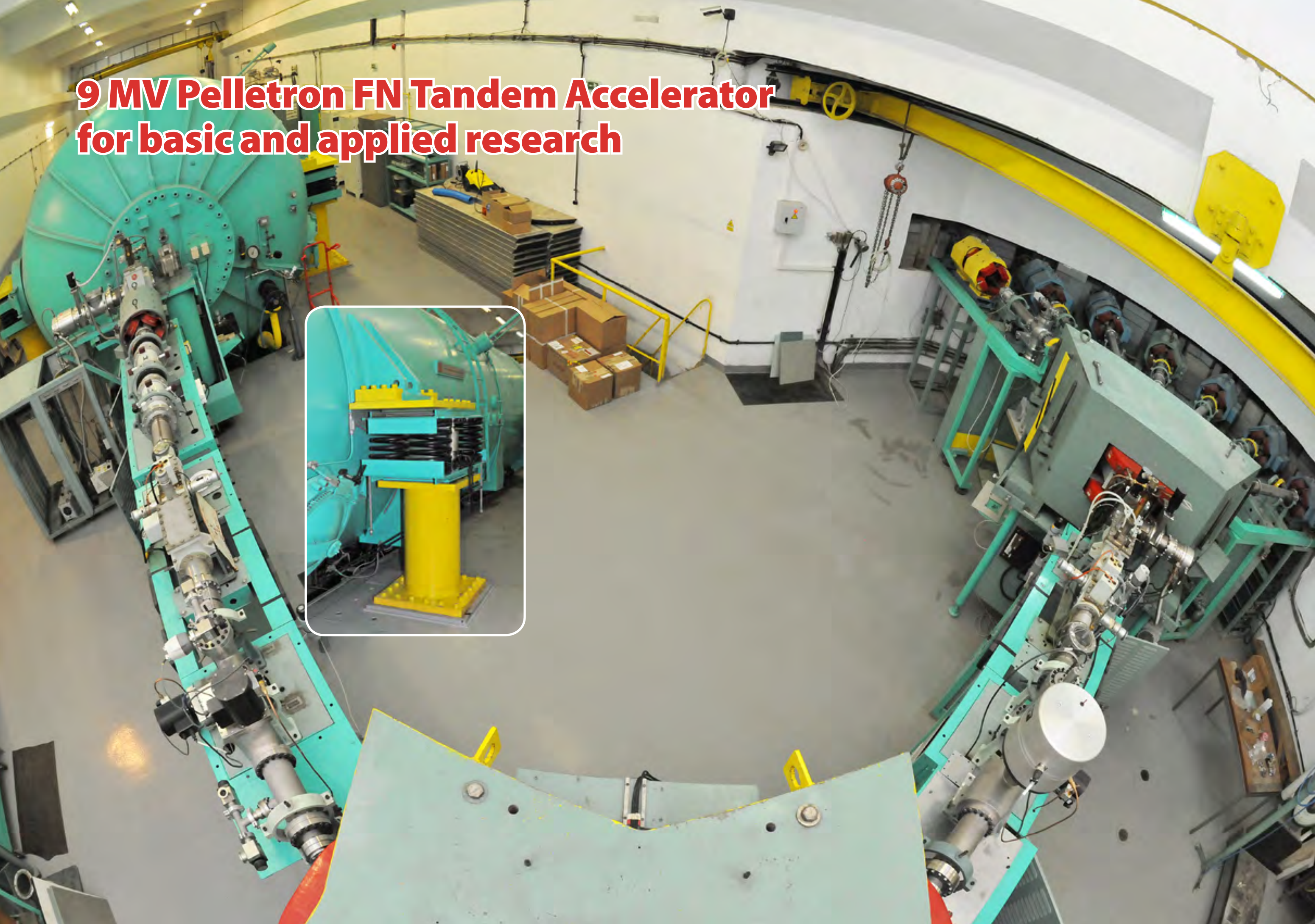

accelerating
opportunities
IFIN-HH

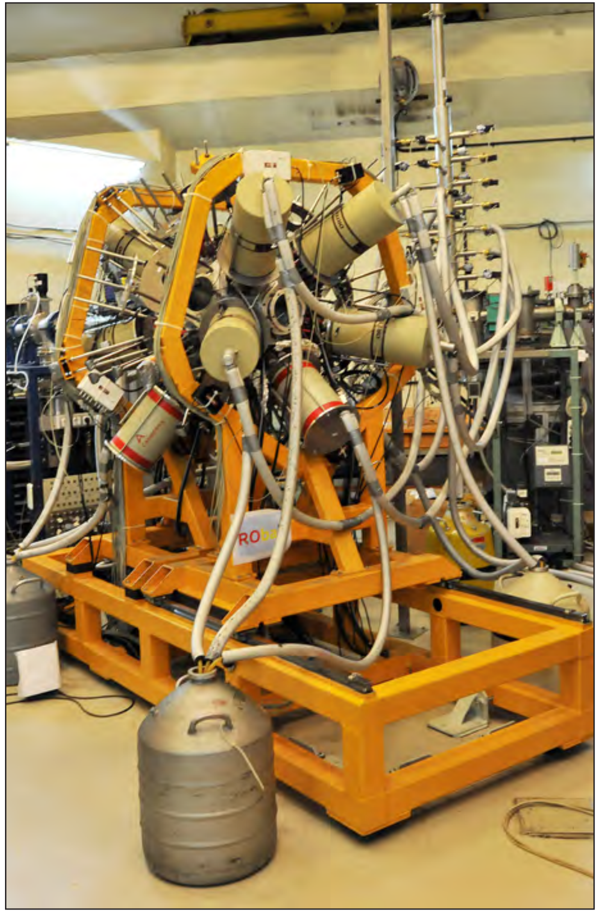

9 MV Pelletron FN Tandem Accelerator
for basic and applied research

The 9MV Tandem Accelerator has been built by the High Voltage Engineering Corporation (HVEC) in 1973 and it was later upgraded from the original terminal voltage of 7.5 MV (FN machine) to 9 MV. Recently, new improvements have been made by adding a new sputtering ion source (NEC SNICS II type) and a pulsing system in the nanosecond range. The charge transport (charging belt) system was also replaced with a Pelletron system from NEC.

The high voltage terminal of the accelerator is charged to maximum 9 million volts positive potential. The negative ions from the ion sources are accelerated by the positive potential on the terminal after a selection through the injection magnet (20 degrees bipolar magnet). The ions reaching the terminal region are stripped of electrons using thin carbon foils (5-10 g/cm^2). The ion beam becomes positive and is accelerated away by the same positive terminal voltage. The beam is then focused using magnetic quadrupole lenses and analyzed by A/q using a bipolar analyzing magnet. The path of the beam through the accelerator and onto the target is under vacuum (a level of 10^{-7} mbar is achieved using turbo pumping).

The research in our departament is structured in the following five directions:

- Nuclear structure at low energy;
- Atomic physics with accelerated beams;
- Nuclear data evaluation and measurement;
- Neutron techniques employed in condensed matter studies;
- Applications of the charged particle beams in solid state physics, ecology, biology, medicine and archeometry; low-background gamma-ray spectrometry and neutron activation analysis.



3 MV Cockroft-Walton Tandem Accelerator for Ion Beam Analysis

The facility is custom built by High Voltage Engineering Europe B.V, Amersfoort, Netherlands. The installation is a T-shape Crokroft-Walton tandem accelerator type with two stripping systems using gas or carbon foils. The accelerator is equipped with two types of negative ion sources: a duoplasmatron for delivery of beams (mainly H, He and D) from gasses, with sodium charge exchange for helium beams, a Cs sputter ion source for a large range of ions species and a 90° analyzing magnet. After tank a switching magnet can deflect the beam in two beamlines ended each with a dedicated interaction chamber. The machine is designed for both basic and applied research in atomic and nuclear physics.

The two end station corresponding to the beam lines are dedicated for implantation and IBA.

1. The implantation end station consists of one carousel for samples with temperature control for the sample holders and beam sweep system.

2. The ion beam analysis/ion microprobe end station consists of an experimental analysis chamber with multiple target holder and motion control on 4 axis, charged particle detector, CCD camera, retractable HPGe X-ray detector for PIXE, retractable HPGe gamma-ray detector for PIGE and all necessary electronic equipment.

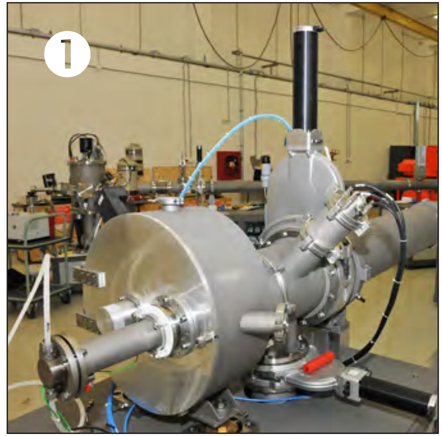
IBA Techniques

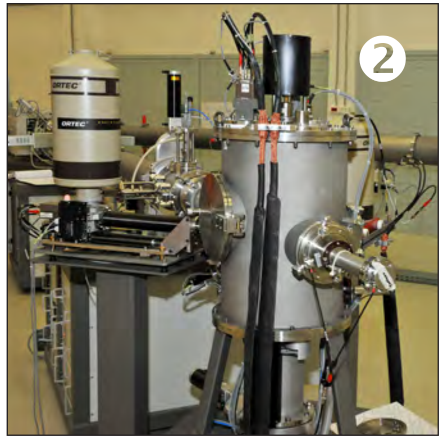
- Ion implantation
- Rutherford backscattering spectrometry (RBS);
- Elastic recoil detection analysis (ERDA);
- Particle induced X-ray emission (PIXE) – microbeam PIXE analysis;
- Particle induced gamma ray emission (PIGE).

Applications of IBA techniques for elemental analysis and material characterization:

- Study of ion-matter interaction;
- Biomedical and environment;
- Geology and archaeometry;
- State of the art material science: ion channeling.

The implantation system offers the possibility to study material modifications (induced by accelerated ions).





1 MV Cockroft-Walton Tandem Accelerator Dedicated to Accelerator Mass Spectrometry (AMS)

The new AMS facility recently installed in IFIN-HH

Experimental precision and background levels were determined to be (0,25%, 10^{-15}) for ^{14}C, (1,2%, 10^{-14}) for ^{10}Be, (0,8% 10^{-14}) for ^{26}Al and(1,7% 10^{-14}) for ^{129}I.

The AMS system is designed to measure the C, Be, Al and I elements. The accelerator uses a multiple cathode Cs sputter ion source with 50 samples/cathodes. A key component of the system is the 90° analyzing magnet equipped with a bouncer system. The bouncer system consists of an insulated chamber on which one can periodically apply high voltage. The bouncer system allows the alternative acceleration of two beams, with a very high and selectable frequency. This allows the user to permanently monitor isotope/element ratio, thus reducing very much the measurement error. The accelerator system is a T-shape tandem accelerator with a Cockroft-Walton charging system. Another 90° analyzing magnet is present after the accelerator. The microscopic beam is measured with the help of a final particle detector (Bragg type - gas filled ionization chamber), placed after the final selection element, the 120° electrostatic analyzer (ESA).

Accelerator Mass Spectroscopy is the most advanced method for elemental analysis.

Totally opposite but complementary to the classical techniques, the AMS method is not detecting the radioactive agents by their emitted radiation (α, β, γ), but it selects and counts them individually, one by one, each atom.

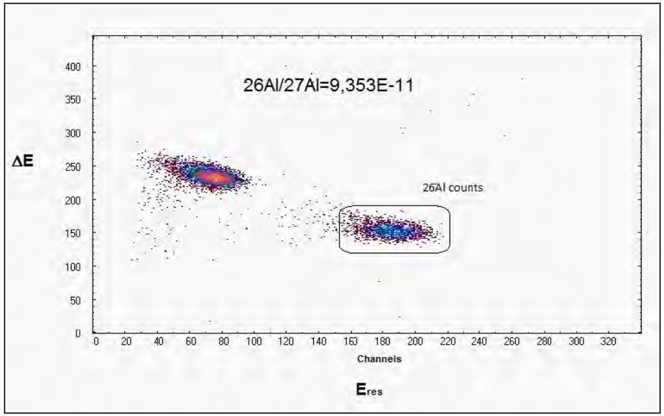
The AMS method has the highest analyzing sensitivity known today, which is 10^{-15} (ratio: isotope/element). This sensitivity is equivalent with the real possibility to select and register one single type of atom from a million of billions of other types of atoms.

The experimental facility is very complex, gathering many modern methods taken from atomic and nuclear physics, like particle accelerators and focusing elements, electromagnetic analyzers, automation and particle detection systems etc.

Applications

The possibility of performing analysis at a microscopic scale opens numerous applications in various domains. Some of the most important are:

- Biomedical and pharmacological applications;
- Detection of existing nuclear pollution;
- Forensic science and nuclear activity surveillance;
- Diagnose of fusion experiments;
- Carbon dating of artifacts;
- Material research;
- Geology, determination of erosion rates;
- Astrophysics and oceanography.



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