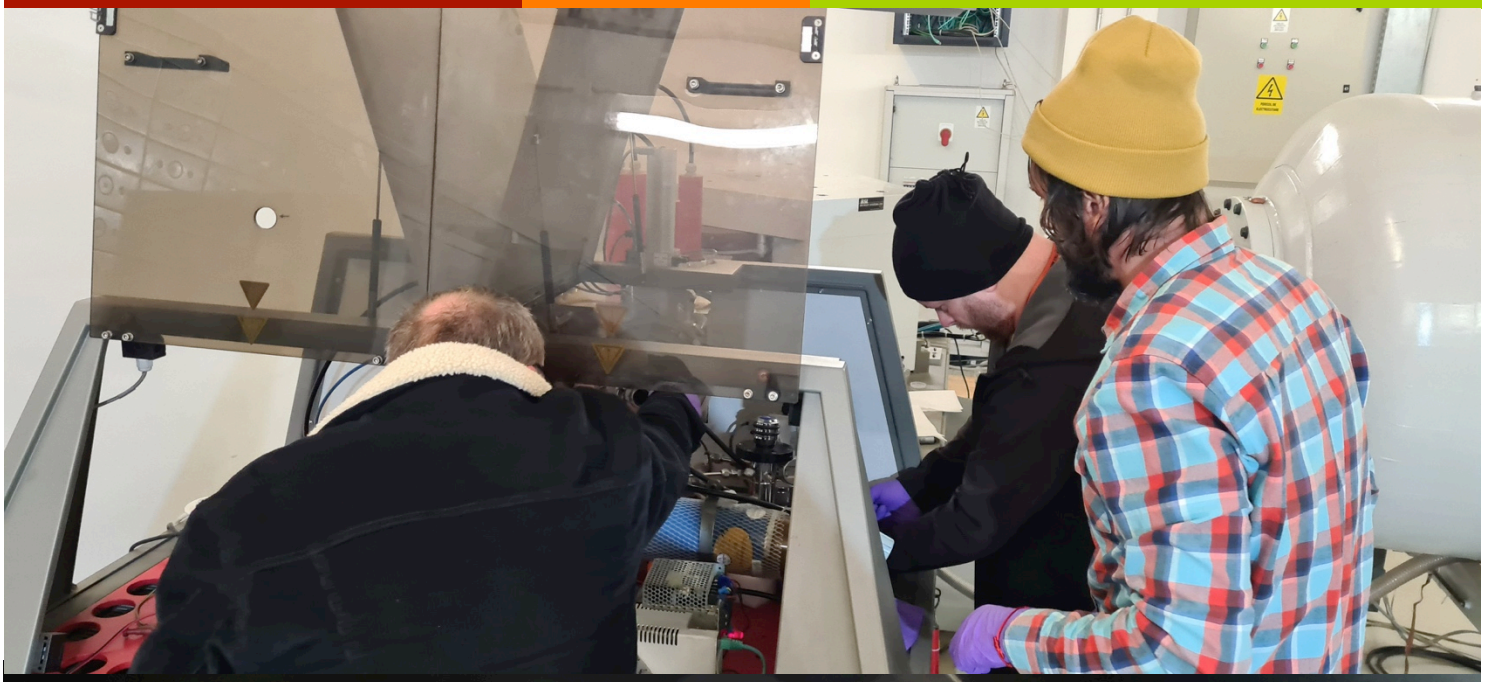
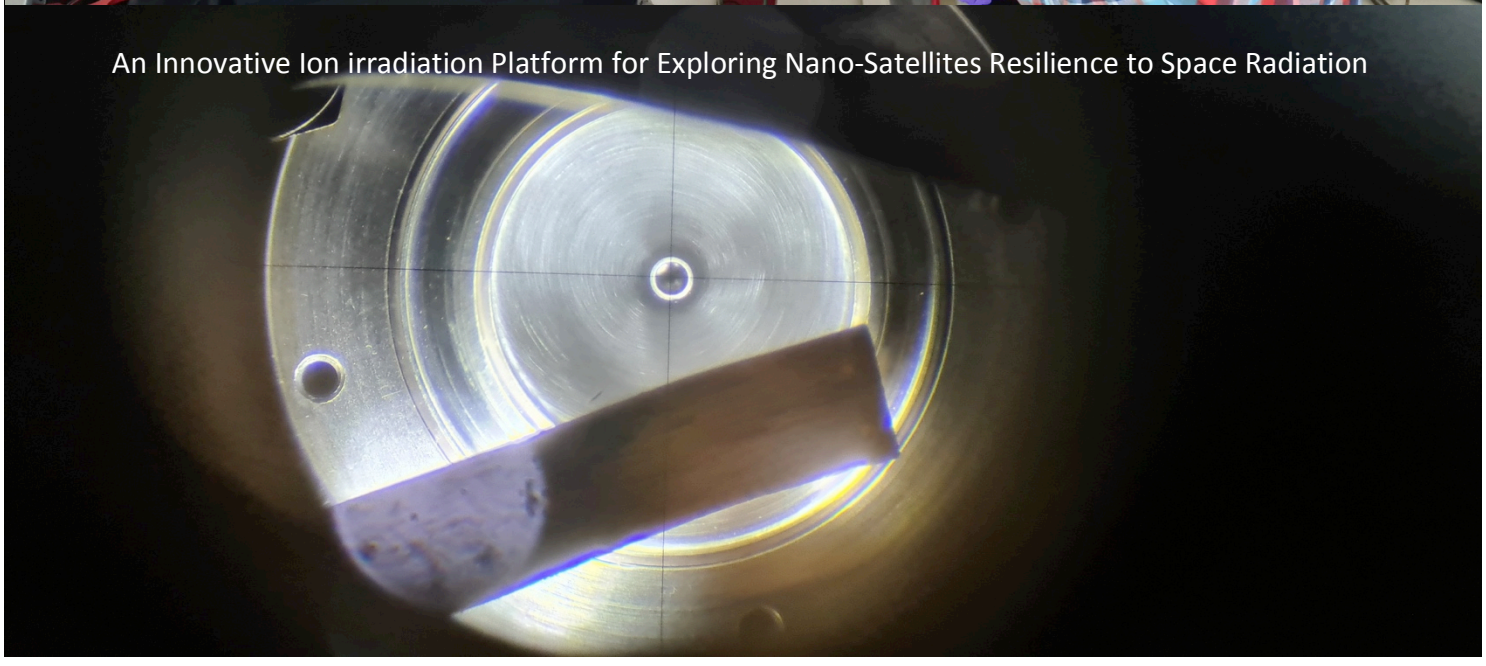
SPACERAD

53 PED/2025 PROJECT

3 MV Tandetron Laboratory @IFIN-HH



An Innovative Ion irradiation Platform for Exploring Nano-Satellites Resilience to Space Radiation



Unique facility in Romania

Accelerated ion beams are available to be used in various applications starting from materials science, astrophysics, archaeometry up to space applications. Proton beams up to 6 MeV, He up to 9 MeV and many other ion beams ready for scientific discoveries: e.g. Au, Nb, Si, C, O.

The 3 MV Tandetron™ accelerator system has been installed and commissioned at the ''Horia Hulubei'' National Institute for Physics and Nuclear Engineering – IFIN-HH, Magurele, Romania, in 2012. The main purpose of this machine is to strengthen applied nuclear physics research ongoing in our institute for more than four decades. The accelerator system was developed by High Voltage Engineering Europa B.V. (HVE) and comprises four high energy beam lines. The first beam line is dedicated to ion beam analysis (IBA) techniques: Rutherford Backscattering Spectrometry – RBS, Nuclear Reaction Analysis – NRA, Particle Induced X-ray and Particle X-ray Emission – PIXE and PIGE and micro-beam experiments. The second beam line is dedicated to high energy ion implantation experiments and the third beam line was designed mainly for nuclear cross-sections measurements used in nuclear astrophysics. SPACERAD is based on the fourth beam line, used for radiobiogy experiments.

SPACERAD project aims to design, develop and calibrate an experimental platform for Radiation Hardness of Microelectronic Devices and Integrated Circuits. The platform will be integrated at the 3 MV Tandetron™ multipurpose facility of Horia Hulubei National Institute for Research & Development in Physics and Nuclear Engineering (IFIN-HH). After installation, the system will be commissioned by monitoring the response of CARD-SAT® nano-satellite components to different extreme conditions (i.e., high dose and flux). This system is based on our previous setup for basic radiobiology studies using a 3 MV Tandetron™ electrostatic accelerator. In this design the horizontal proton beam delivered by the 3 MV Tandetron™ is generated from the 860 negative ion source with Cs sputtering and focused using an electrostatic quadrupole triplet just before reaching the switching magnet that sends the ions to the radiobiology line. Particle accelerators, whether designed for ions or leptons, may be considered multi-tools for science, education and technology. CARD-SAT® is designed and built by our project partner MAZAROM IMPEX SRL. https://mazarom.ro/ro/

High-Impact Research Needs Your Skills

The 3 MV Tandetron™ accelerator located at IFIN-HH is a part of the Tandem Accelerators Complex which is part of the National Interest Installations and Special Objectives (IOSIN) and represents the research infrastructure that hosts the SPACERAD project by integrating the universal platform proposed as a modular element on either of the accelerator lines.

The 3 MV Tandetron accelerator allows the development and installation of modular and prototype experimental platforms with applications in experimental physics, materials physics and applied physics.

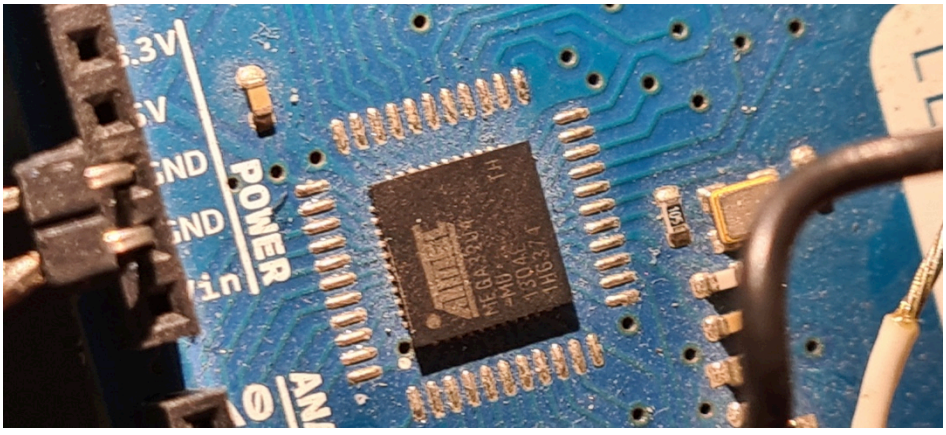
The project is targeting **STUDENTS** from science or technology faculties through the possibility of carrying out **bachelor's, master's** or **doctoral theses**, associated with accelerated **ion beam analysis techniques**, **ion irradiation**, and **radiation resistance tests** that can be performed using the universal platform for testing the radiation resistance of **microelectronic circuits**, micro-chips, and integrated circuits used in space applications.

The existing infrastructure as well as that developed within the project represents powerful technological and scientific tools, and last but not least a relevant educational tool through the possibilities it offers.

Curious about ion sources or accelerator technology? Let's talk science!

Our team represents a **benchmark of excellence** in the field of ion beam modification of materials, bringing together researchers who have been recognized with **national and international awards**

Curious how electronics behave in extreme environments like space or accelerators? In our lab you can **design, simulate, and test real systems under a proton beam.** We welcome students skilled in **FPGA programming, Arduino, Raspberry Pi, embedded systems, CAD, physics and related fields** who want to contribute and help shape new capabilities within the lab. Talented students from any technical or scientific background are also encouraged to contact us.



I. Burducea, M. Straticiuc, D. G. Ghiță, D. V. Moșu, C. I. Calinescu, N. C. Podaru, D. J. W. Mous, I. Ursu, N. V. Zamfir, **Nucl. Instrum. Methods Phys. Res., Sect. B 2015**, 359, 12.
G. Velisa, R. F. Andrei, I. Burducea, A. Enciu, D. Iancu, D. A. Mirea, A. Spiridon, M. Straticiuc, **Eur. Phys. J. Plus 2021**, 136, 1171.

2026 Open day visit for Students

In 2026 we will organize a **1day Open Visit** for students. During this visit you will get to know our facility, our team members and scientific collaboration opportunities. All the information regarding this event will be disseminated through the website project, and our department Facebook page. A maximum number of 10 students will be selected to participate in this event.

Our **Applied Nuclear Physics Department** is actively involved in **Outreach activities**, where we like to disseminate the science discoveries to the whole community.

Applied Nuclear Physics Department - DFNA se simte recunoscător cu **Mircea Lechintan** şi **Burducea Ion** la **IFIN-HH**.
5 martie · Magurele, Ilfov ·

We are very happy that today we had the kickoff meeting for the #SPACERAD project, led by Ion Burducea.

SPACERAD represents a partnership between IFIN-HH and Mazarom Impex SRL that aims to design, develop and calibrate an universal experimental platform for Radiation Hardness Assurance Testing of Microelectronic Devices and Integrated Circuits.

This platform will be integrated in the first phase at the 3 MV Tandetron™ multipurpose facility of IFIN-HH and commissioned by monitoring in real time the response of CARD-SAT Nano-satellite, previously developed by Mazarom, to extreme conditions (i.e., high dose and flux).

We remind you that ion beams, also available in our department, are extremely versatile tools which can improve a microprocessor or even intervene in the preparatory phase of sending a satellite into orbit or in the design of a new type of nuclear reactor.
Same ions come into play and have a deciding word by probing an advanced material for which the radiation hardness is tested. Currently accelerated ion beams are used worldwide in a variety of applications in areas of study such as
corrosion resistance, radiation resistance, wear and friction reduction or improved adhesion, but also for tackling medical applications and fundamental astrophysics studies.

#radiationhardness #spaceapplications #ionbeamsforsociety

SPACERAD IFIN-HH team: Ion Burducea, Mihai Straticiuc, Dan-Gabriel Ghiță, Gihan Velișa, Marta Petruneac, Marin Focșăneanu, Mircea Lechințan, Radu-Florin Andrei, Decebal-Alexandru Iancu
SPACERAD MAZAROM team: Adrian Totu, Cosmin Gogu, Maria-Isadora Lazăr, Marius-Constantin Simion, Cristian Pahontu, Anghel Sorin, Constantin Mocanu,
IFIN-HH team for surface imaging/elemental analysis, special design applications: Paul Mereuță, Dragos Mirea, Cristina Burducea, Daniela Stan, Andrei-Theodor Hotnog

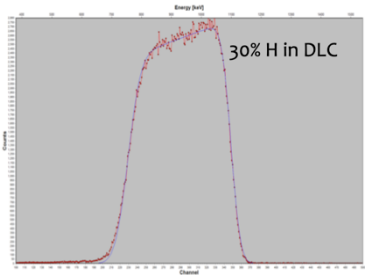
Kick-off Meeting of the SPACERAD project @IFIN-HH
5th of March, 2025

Ion Beam Services for Companies and Industry

For more information please contact us at: **bion@nipne.ro**

Ion Beam Irradiation/Implantation

- Various ions available: H, He, C, O, Nb, Ag, Au, etc
- Typical ion beam currents: from a few nA up to tens of µA
- Implantation doses: from 10^{10} up to 101^{6} atoms/cm^2
- Implanted area(wafer size) from 1 cm^2 up to 200 cm^2
- Useful for: Si wafers, other semiconductors, electronics, decapped micro-chips, etc.



Rutherford Backscattering Spectrometry/RBS In Channeling Geometry

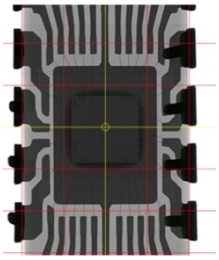
- Thin films stoichiometry
- Thickness measurements for thin films: from a few nm up to 1 µm
- Light elements depth profiling in thin films: C, N, O
- Crystalline quality, lattice damage, defect profiles in Single-crystal materials.

Foil-Elastic Recoil Detection Analysis

- H measurements in thin film and D concentration quantification in thin films or metallic samples.

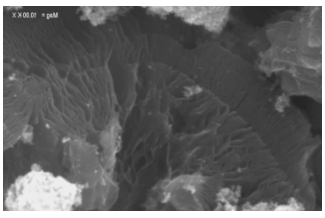
Particle Induced X-ray Emission

- Elemental composition for various samples (environment, archaeometry, coins, paintings, etc)



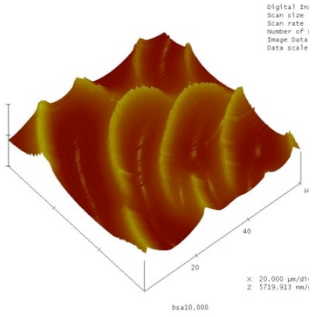
Micro X-ray Computer Tomography

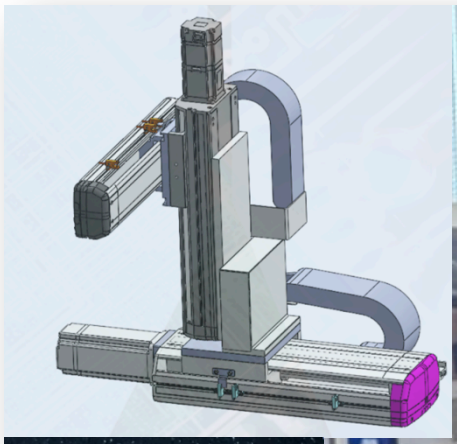
- Various samples analysis: materials science, biological, electronics, fossils, soils, etc.
- Non-destructive 3D imaging
- Internal 3D structure, porosity, cracks, density variations.

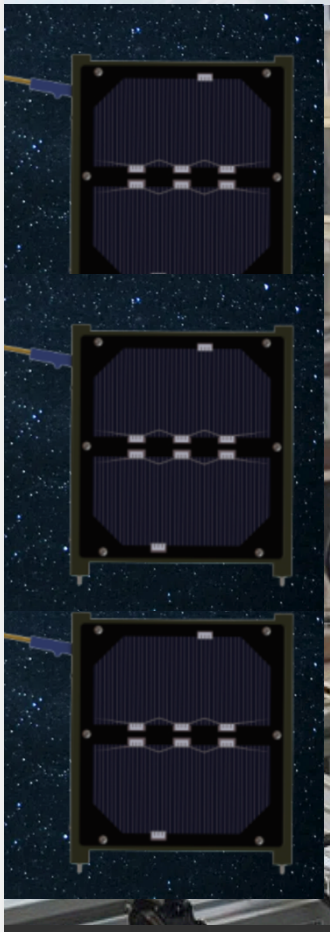


Scanning Electron Microscopy, Atomic Force Microscopy, X-ray Fluorescence

- Surface morphology,
- Nano-scale topography
- Elemental analysis







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SCAN ME

https://www.nipne.ro/proiecte/pn4/6-projects.html

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