**Description of the infrastructure**

Name of the infrastructure (and its installations, if applicable): The Tandem accelerator complex consisting of a 9-MV Tandem, a 3-MV Tandetron and a 1-MV Tandetron accelerators. A high-power laser system (HPLS) and a high intensity monochromatic gamma source are also available.

Location (town, country) of the infrastructure: Magurele, ROMANIA.

Web site address: <http://www.nipne.ro>

Annual operating costs (excl. investment costs) of the infrastructure (€):

Description of the infrastructure:

The 9-MV Tandem accelerator of IFIN-HH is one of the most reliable small-scale facilities in Europe that provides a wide range of accelerated ions, with high intensity and stable operating conditions. These abilities have attracted considerable interest in the last years from users all over the world, and therefore, the international user community is steadily growing. The high competition for beam time has also increased the quality of the proposals, addressing most of the time hot topics in nuclear structure.

The 3 MV TandetronTM accelerator is mainly dedicated to applied nuclear physics: materials characterization and modifications, radiobiology, archaeometry, radiation hardness, etc., but also used for fundamental research, for example nuclear astrophysics studies.

The 1 MV TandetronTM is a state-of-the-art equipment that plays the key-role in the Accelerator Mass Spectrometry (AMS) studies. 14C dating is by far the most common application with more than 80% of the beam time allocated. Besides radiocarbon, other isotopes: 10Be, 26Al, 129I and more recently actinides were successfully measured within geological and environmental studies.

The HPLS is a unique experimental complex for laser-driven nuclear physics studies, delivering 2 x 10 PW laser shots at 1/60 Hz, 2 x 1 PW shots at 1 Hz and 2 x 0.1 PW at 10 Hz. The HPLS has been successfully commissioned and at present commissioning experiments are been carried out at the 100-TW and 1-PW beamlines. 10-PW laser pulses will be delivered for commissioning experiments in 2022.

Equipment available for users include:

* The ROSPHERE spectrometer which is a state-of-the-art high-efficiency gamma array capable of housing up to 25 detectors, HPGe or LaBr3(Ce) scintillators. This combination allows for fast-timing measurements which is one of the most successful specialized segments our lab has to offer. In addition, charged particle and neutron detection capabilities complete the spectroscopic possibilities at IFIN-HH.
* A setup dedicated to nuclear reaction and nuclear astrophysics studies consisting of multi-strip silicon detectors for particle detection with the possibility of radial and longitudinal movement around the target;
* The Neutron Array consisting of 81 BC400 plastic scintillators
* Low-background measurements setup for nuclear reaction cross-section measurements through the activation method
* Ion Beam Analysis (IBA) setup at the 3 MV TandetronTM comprising: RBS-channeling, RBS, NRA, PIGE, PIXE and foil-ERDA techniques
* External beam setup with He-flow for in-air PIXE with applications in archaeometry and radiobiology studies
* Accelerator Mass Spectrometry (AMS) for a wide range of isotopes for various studies related to environment, medicine, nuclear forensics and of course the working horse for the AMS method, which is represented by the radiocarbon dating for archaeometry

Services available for the users are:

* The entire research infrastructure described above is open for external users around the world. The research activities are coordinated in collaboration with our local staff. The R&D personnel participate in the experiments, starting from the setting up of the experiments to data analysis and publication of the results. The average beam time per year for each accelerator is around 5000 hours of beam on target.
* A fully equipped electronics laboratory, a state-of-the-art target laboratory and a HPGe detector maintenance laboratory are supporting the experimental activity at Tandem accelerator complex. The electronics lab offers expertise on several topics, including the development of front-end electronics for SIPM readout or digital data acquisition systems. The target lab has already produced a significant number of targets for a wide range of experiments at different facilities in Europe and around the world, and it will deliver high-quality products for the research units involved in this project.

Services currently offered by the infrastructure:

The Tandem accelerator complex, being a stable beam facility, manages to attract users and obtain relevant scientific results through a combination of factors that include local expertise that is able to open niche research opportunities and beam availability that makes possible weeks long low cross-section experiments.

Results:

* This RI was among the first to introduce the use of large arrays of LaBr3(Ce) scintillators in lifetime measurements by the in-beam fast-timing method. Since then, lifetime measurements became a niche subject in which the lab excelled, complementing the fast-timing method by the development of a plunger device and implementing the ROSPHERE array.
* Another successful niche development was the use of transfer reaction induced by heavy ions (i.e. 13C, 18O), originally used in the 80’s to study neutron rich nuclei, to measure lifetimes using the ROSPHERE array.
* These tools were used in an exploratory study (supported within ENSAR2) to put into light the shape isomerism in 66Ni. A month-long experiment allowed the measurement of the half-lives of three excited 0+ populated in a 2n transfer reaction induced by 18O and showed a hindered transition from the third excited 0+ state identified by shell model calculations as an oblate state.
* Constraining the 12C+12C astrophysical S-factors with the 12C+13C measurements at very low energies. The 13C beam was delivered continuously (except for the target changes) by the 3-MV Tandetron in a three-weeks long experiment.
* RBS analysis for amorphous Si–Ge–Te thin films. The RBS measurements showed that an uninvestigated until now domain in the compositional space, was obtained: Si [7.7 ÷ 45.6] at%, Ge [11.2 ÷ 62.5] at%, Te [15 ÷ 69.8] at%.
* Optical waveguides in KTaO3 crystals were fabricated by using accelerated ion beams delivered by 3 MV Tandetron™ from IFIN-HH.

**Description of work**

Modality of access under this proposal:

The TANDEM accelerator complex is a user facility open to all user groups. Access is being offered in hours of beam time on the basis of written proposals submitted to the Program Advisory Committee that meets once per year. To comply with the experimental conditions and safety rules, the spokesperson for each experimental proposal has to establish preliminary contacts with the scientific and technical staff in IFIN-HH.

Support offered under this proposal:

Any research group running experiments at IFIN-HH has access to the local infrastructure (detectors lab, target lab, electronics lab) and is being actively supported by the local staff in setting up and performing the experiments. A local contact person is assigned to each accepted proposal in order to coordinate with the spokesperson the technical and logistical local support required.

Outreach to new users:

The call for proposals is widely announced to the user community using web pages and large e-mail lists a few months before the PAC meeting.

Review procedure under this proposal:

The TANDEM PAC has currently 8 members, 6 of them being external and coming from international facilities.