New upgrades and capabilities at the new ion accelerator at Jožef Stefan Institute

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The Microanalytical Centre (MIC) at the Jožef Stefan Institute operates the only research ion accelerator facility in Slovenia. Its primary focus is Ion Beam Analysis (IBA) techniques, with increasing emphasis on ion implantation and irradiation in recent years. MIC began operation in 1997 with the installation of a 2 MV tandem accelerator (Tandetron) manufactured by High Voltage Engineering Europa (HVEE), initially equipped with two ion beam lines. Over the years, significant expertise has been developed in the operation and construction of ion beam systems. Since 2020, several major upgrades have been implemented; three of these will be presented in this contribution.
One of the key beamlines, operational since the early stages of MIC, is the microbeam system, which enables focusing of MeV ion beams down to micrometer dimensions. Increasing demand for sub-micrometer resolution led to the development of a new nanobeam beamline. This system is based on four thin quadrupole lenses configured into a user-friendly focusing setup, capable of focusing ion beams with magnetic rigidities up to 45 MeV/amu. The achieved beam size strongly depends on the brightness of the injected ion beam. Using a high-brightness H^- multicusp ion source [1], proton beams of 3 MeV were focused to sizes of 300 × 300 nm² at 5 pA and 80 × 120 nm² at a flux of 10,000 ions/s. With heavy ion sources, a 3.85 MeV $^{15}N^{2+}$ beam was focused to 600 × 600 nm² at 5 pA, and a 3 MeV $^{28}Si^{2+}$ beam to 700 × 700 nm².
A second major development is the construction of the UHV beamline coupled with the DeHydrAC (Defects and Hydrogen Analysis Chamber) experimental station. This system builds on experience gained in the INSIBA experiment [2,3], which investigates hydrogen isotope interactions in materials, primarily used for fusion-related applications. The new beamline is designed to provide a low-divergence ion beam, enabling IBA measurements in channeling mode and thus offering deeper insight into processes at the crystal lattice level and ion irradiation on large surface area.
After 28 years of operating the 2 MV accelerator, a new 3 MV Tandetron, also manufactured by HVEE, was installed in early 2026. Its higher terminal voltage and excellent stability (40 V at 3 MV) will enable the production of high-quality ion beams with energies up to 20.5 MeV. Together, these upgrades are expected to position the facility at the forefront of ion beam research in the coming decades.

[1] P. Pelicon et al, NIM B 332, 229 (2014)

[2] S. Markelj et al., Phys. Scr. 97 (2022) 024006

[3] E. Punzón-Quijorna et al., NIM B 574 (2026) 166080.