Contribution ID: **610** Type: **Poster (participant)**

Laser-Plasma Micro-accelerator for Health and Energy Applications in the framework of SAMOTHRACE project

Wednesday, 24 September 2025 19:00 (1h 30m)

High-intensity laser interactions with solid targets enable the generation of compact and energetic ion beams. When irradiated with laser intensities exceeding 10^{18} W/cm², target materials are rapidly ionized, leading to the formation of relativistic electron populations and strong transient electrostatic fields capable of driving efficient ion acceleration. Target Normal Sheath Acceleration (TNSA) is one of the most robust and widely adopted mechanisms for laser-driven ion acceleration. It can efficiently accelerate protons and ions to tens of MeV, enabling the development of compact, high-brightness ion sources.

In this context, the WP1-Spoke5 of the SAMOTHRACE ecosystem focuses on developing a compact laser-driven ion accelerator for medical and energy applications. This contribution presents the technological development and current implementation status of the miniaturized ion accelerator. It is composed by an ion target station that supports up to 900 targets at 3 Hz, with sub-micrometer positioning accuracy and full EMP compatibility. Ion diagnostics based on a Thomson Parabola Spectrometer (TPS), optimized for detecting protons up to 70 MeV will operate in low- and high-energy configurations, achieving energy resolutions of 2–5%. The micro-accelerator will be installed at the I-LUCE (INFN–Laser indUCEed radiation production) facility at INFN-LNS.

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Session Classification: Poster Session

Track Classification: PS1: Plasma-based accelerators and ancillary components