Contribution ID: **173** Type: **Poster**

The target-ion source system for the SPES facility commissioning: design, development and online testing

Tuesday, 9 September 2025 16:30 (1h 30m)

SPES, acronym for Selective Production of Exotic Species, is an Isotope-Separation On-Line (ISOL) facility at INFN-LNL that was commissioned in November 2024 with the production of the first Radioactive Ion Beam (RIB). In such kind of facilities the RIB production is achieved with the following steps: firstly a production target is typically impinged by a high energy and high intensity primary beam, generating radioactive isotopes. The target is coupled to an ion source, towards where the produced species migrate by diffusive and effusive phenomena and are then ionized, allowing their electrostatic extraction and acceleration as a RIB, useful for several multidisciplinary experimental activities. With the aim of an efficient RIB production, both target and ion source work in the 1600-2200℃ temperature range at high vacuum.
The Target-Ion Source (TIS) system represents the core of the RIB production process, and its reliable and efficient operation is of fundamental importance. For such reason, for the first RIB at SPES, the chosen TIS was constituted by a silicon carbide target, that was carefully designed and studied with an extensive use of thermomechanical simulations, and a Forced Electron Beam Induced Arc Discharge (FEBIAD) ion source, that included the most recent technological advancements. In particular, the tantalum ion source cathode, its most critical component, was produced by AM technologies, given the outstanding stability and reliability achieved in the context of HISOL (High performance ISOL systems for the production of RIBs) a structured INFN program of research activities on targets, ion sources and molecular beams.
The activities related to the design, development, test and online operation of the firs SPES TIS system will be presented in detail.

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Session Classification: Poster Session

Track Classification: Production of high intensity ion beams