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Ion source development for TATTOOS: the new large-scale radionuclide production infrastructure at the Paul Scherrer Institute

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TATTOOS (Targeted Alpha Tumor Therapy and Other Oncological Solutions) offers the potential to produce radionuclidically pure radioisotopes towards radiopharmaceutical applications, revolutionizing cancer diagnosis and treatment. The facility plans to utilize a portion (100 μA) of the high-intensity (~2.4 mA), high-energy (590 MeV) proton beam from the ring cyclotron at Paul Scherrer Institute's High Intensity Proton Accelerator (HIPA) facility, combined with dedicated high-power spallation targets, to produce radionuclides. The proton beam impinging on the joule-heated target results in a spallation reaction. Nonselective surface ionization or selective laser resonance ionization occurs inside an ionizer tube directly attached to the target. These ions are extracted by high voltage fields and guided towards the online mass separation using a dedicated dipole magnet.
The ion optical extraction geometry has a significant impact on beam parameters and, consequently, on ion beam transport efficiency as well as on the achievable resolving power of the mass separation. The analysis of ion trajectories defines the beam quality that can be translated into the emittance and the energy spread of the beam. Studies on TATTOOS's proposed ion beam extraction were performed, simulating the effect of ionization via either surface or laser or a combination of both being investigated. Optimum ionizer and ion extraction designs, based on these simulations, will be presented. Furthermore, the envisaged laser infrastructure as well as the beam transport with respect to the layout of the future TATTOOS building and the proposed arrangement of target and ion beamline will be presented.

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Classification

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