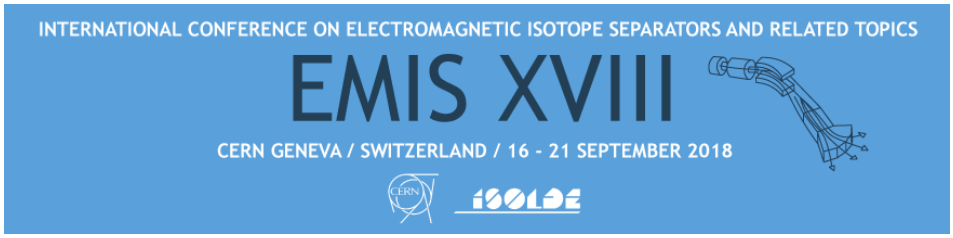

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Laser ion source development for the CERN-MEDICIS facility

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The new CERN-MEDICIS facility aims for production of medical radioisotopes. It is foreseen to use two production routes. The first one implies the use of the 1.4 GeV proton beam coming from the CERN Proton Booster for irradiation of a target material with subsequent radionuclide extraction at the dedicated off-line MEDICIS Mass Separator. However, during short and long shutdowns, this production route is not available. The second way is based on the extraction of radioisotopes from targets pre-irradiated and provided by external institutions: nuclear reactors, medical accelerators and cyclotrons, nuclear waste depositaries. This unique feature guarantees a continuous radionuclides supply to the end users, as well as the work of the Mass Separator independently from the CERN shutdowns.

The MEDICIS facility is designed on the ISOL technology. The off-line Mass Separator uses the conventional electromagnetic separation technology. It requires the ionic state of a work substance. A traditional surface ionization method does not possess enough efficiency in the ionization of MEDICIS targeted radionuclides, and is accompanied by undesired isobaric contamination. The presence of isobaric or other radionuclide impurities is not acceptable for the personalized nuclear medicine, because it can cause an unintended irradiation of living tissues as well as a contamination with long-lived radioisotopes.

Using the laser resonant ionization method, we are able to ionize only radioisotopes of a desired chemical element. Therefore, the resonance ionization laser ion source (RILIS technology) allows us to combine the benefit of element selectivity with mass selectivity of electromagnetic separation. As a result, we can produce a pure desired radionuclide. Moreover, the high ionization efficiency of the laser ion source ensures a high radioisotope production rate.

The MEDICIS Laser Ion Source Setup (MELISSA) will use a solid-state laser system. It is based on tuneable Ti:Sapphire lasers as the most reliable and flexible for continuous operation of a separation facility. The use of Ti:Sapphire lasers requires spectroscopic development of a suitable multi-step laser ionization scheme for every chemical element of interest. In the report, the current status of the laser ion source development for the CERN-MEDICIS facility is going to be presented. The newest results of laser resonant ionization spectroscopy will be demonstrated for several lanthanides, which medical radioisotopes are the most interesting for the theranostic approach. In particular, various laser ionization schemes will be considered to define the most optimal for the efficient production of innovative radiopharmaceuticals.

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