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Advances in surface ion suppression from ISOLDE-RILIS using µs beam-gating and pulsed heating

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The RILIS - Resonance Ionization Laser Ion Source - is the most commonly used ion source type at CERN-ISOLDE. While it is both efficient and highly element-selective its application to certain experiments is limited by the presence of isobaric contaminants due to the surface ionization of neighbouring elements. Different approaches have been demonstrated varying degrees of efficacy in tackling this problem: suppressing the production of surface ions by selecting low work function cavity materials, the use of a surface ion repeller, and the use of a pulsed electrostatic ion deflector to deviate the DC beam of surface ions away from the pulsed beam of laser-ions, referred to as beam-gating.

In this paper we will present recent results from the ongoing developments in ion beam purification using the microsecond beam-gating technique and its planned adaptation towards ISOLDE on-line conditions. By increasing the voltage across the hot cavity through the use of a high resistivity graphite tube, the bunch-length of laser ions extracted from the cavity can be reduced to below 5 µs, as observed during off-line tests. Combined with microsecond beam-gating, this enables a 20-fold selectivity improvement with minimal loss of the ions of interest. A further increase in the voltage across the ionizer can be realized by applying a pulse-width modulated (PWM) heating current whilst maintaining the same time-averaged electrical power level. The results of these tests will be presented, along with details of the cavity materials used and possible solutions to the technical challenges that they impose. Some additional promising applications of this new laser-ion source cavity configuration, with a view to a further increase in ion beam purity, will also be introduced.

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