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Negative ion beams at ISOLDE

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Most commonly, ISOLDE uses positively charged ion beams produced by a variety of ion sources such as the positive surface ion source, the Resonance Ionization Laser Ion Source (RILIS) or the Forced Electron Beam Induced Arc Discharge (FEBIAD) ion source. In recent years, the availability of negative ion beams at ISOLDE was re-established and the development program of negative ion sources was revitalized to increase the production efficiency of low electron affinity elements. Currently, negative ions are created by means of surface ionization with a lanthanum hexaboride (LaB6) surface ionizer in pellet or tubular form.

In order to promote the negative ion source development, a dedicated ion source test stand was conceived and constructed, the two main features being an ion extraction system that allows measuring the total ion beam current, and a residual gas analyzer that allows us to monitor source degradation and outgassing. This test stand was used to perform measurements of the electron emission of candidates of new ion source materials and compare with the performance of LaB6. Additionally, a campaign of simulations has been initiated to gain more insight in the negative surface source.

We will give an introduction to the negative ion sources at ISOLDE and present first results from the low work-function materials study. We will conclude highlighting the results of the negative ion campaign 2018 where the electron affinity of astatine could be measured for the first time. The negative astatine ions were produced by a MK4 surface ion source giving an ion current of about 300fA. The beam of negative ions was overlapped with a laser beam and the wavelength of the laser light was scanned and the onset for the photodetachment process was observed.

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