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First photodetachment studies on radioactive negative ions - Towards the electron affinity measurement of astatine

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Negatively charged ions are mainly stabilized through the electron correlation effect. A measure of their stability is their binding energy which is termed the electron affinity (EA). This fundamental quantity is, due to the almost general lack of bound excited states, the only atomic property that can be determined with high accuracy for negative ions. Together with the ionization potential (IP) of the element it determines the properties of the inter-atomic bonds in chemical compounds. For radioactive elements such as astatine, a measurement of the EA is essential to benchmark and improve computational chemistry methods assisting conventional chemistry research on artificially produced samples. The standard method to measure the EA is Laser Photodetachment Threshold (LPT) spectroscopy where negative ions interact with light from a frequency tunable laser and the onset of the photodetachment is detected.

We will present the results of the first LPT studies of radioactive ion beams at ISOLDE. The photodetachment threshold for the radiogenic iodine isotope ^{128}I was measured successfully, demonstrating the performance of the upgraded GANDALPH experimental beam line. The first detection of photo-detached astatine atoms marks a milestone towards the determination of the EA of the element. An outlook to our future campaigns to study the EA of polonium and isotope shifts in the EA will be given.

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