

High-precision electron affinity of oxygen

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Negative ions are important in many areas of science and technology, e.g., in interstellar chemistry, for accelerator-based radionuclide dating, and in antimatter research. They are unique quantum systems where electron-correlation effects govern their properties. Atomic anions are loosely bound systems, which with very few exceptions lack optically allowed transitions. This limits prospects for high-resolution spectroscopy, and related negative-ion detection methods. Here, we present a method to measure negative ion binding energies with an order of magnitude higher precision than what has been possible before. By laser-manipulation of quantum-state populations, we are able to strongly reduce the background from photodetachment of excited

states using a cryogenic electrostatic ion-beam storage ring where keV ion beams can circulate for up to hours. The method is applicable to negative ions in general and here we report an electron affinity of 1.461 112 972(87) eV for ^{16}O . This unprecedented high precision opens up for studies of isotope shifts at levels of detail that will challenge atomic and nuclear theory. The isotope shift in the electron affinity of $^{18-16}\text{O}$ will also be presented.

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