Resonance Ionization Mass Spectroscopy on Americium

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Americium (Am, Z=95) is a transuranic member of the actinide series and was discovered in 1944 by the group led by Glenn T. Seaborg. The two most long-lived americium isotopes are ^{241}Am with a half-life of $t_{1/2}$=432.2 a and ^{243}Am with a half-life of $t_{1/2}$=7370 a. As any primordial americium has decayed by now, these isotopes are produced artificially by neutron irradiation, also in nuclear power reactors. One ton of spent nuclear fuel contains about 100 g of americium. Applications for americium have been proposed, e.g., as fuel for spaceships with nuclear propulsion [1], and ^{241}Am is routinely used today in ionization-type smoke detectors [2] and - when mixed with beryllium - as a neutron source [3]. The accumulated knowledge on atomic and nuclear properties in literature is rather scarce and only very limited fundamental atomic and nuclear data obtained in optical spectroscopic studies have been reported to date.

Resonance ionization spectroscopy (RIS) was used as a very sensitive technique to precisely study atomic excitation schemes and level positions in the spectrum of americium, both for fundamental studies as well as in preparation of laser mass spectrometric ultra-trace analysis.

We report on two-step high resolution RIS in Am at the RISIKO off-line radioactive ion beam facility [4]. About 10^{13} atoms of both isotopes ^{241}Am and ^{243}Am each were prepared on zirconium foil and loaded into a resistively heated tantalum oven. A wide-range tuneable, frequency doubled, continuous wave Ti:sapphire laser [5] was used for spectroscopy by injection locking of a high power pulsed Ti:sapphire ring laser setup. Hyperfine structures of the two isotopes ^{241,243}Am were investigated in two different ground state transitions at 23437.0 cm^{-1} and 25409.5 cm^{-1}, which served as first excitation steps for resonant ionisation via suitable autoionizing states. In addition, the isotope shift was measured for both isotopes. Results regarding the atomic structure of Am as well as extracted hyperfine parameters will be discussed.

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