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About Possible Ambiguities From Alpha Spectroscopy and Direct Mass Measurements of Neutron-deficient Actinium and Radium Isotopes

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Due to the two-body nature of the alpha decay, nuclear alpha spectroscopy has become one of the most relied upon techniques for accurate linking of nuclear masses. Based on a single nucleus of well-known mass serving as anchor point, masses of all mother and daughter nuclei that possess an alpha-decay channel can be determined precisely by the energy of the emitted alpha particles and, if present, subsequent gamma rays. However, the evaluation of masses from spectroscopic data can be influenced by presently unknown (especially low-lying) states in the alpha-daughters and also from complicated spectra that include a large number of isotopes at the same time. In such cases as, e.g., 150Ho in the 1990's [1], direct mass measurements with high precision are desired for clarification. At the gas-filled recoil ion separator GARIS-II behind the RILAC accelerator at the RIKEN, the nuclides 210-214Ac have been produced by 169Tm(48Ca,xn)217-xAc and 210-214Ra by 169Tm(48Ca,pxn)217-xRa reactions. Direct mass measurements of these isotopes have so far been carried out only for 211,214Ra [2,3] by Penning-trap mass spectrometry at ISOLDE/CERN. The other isotopes have been investigated by alpha spectroscopy from the 1960's on (see e.g. [4]) and more recently by alpha-gamma coincidence measurements performed at GSI (see e.g. [5,6]). Direct mass measurements of the eight simultaneously produced isotopes have been performed using a multi-reflection time-of-flight mass spectrograph (MRTOF-MS) coupled to GARIS-II [7]. In this contribution the experimental results, which include six new direct mass measurements, will be presented. Among the new measurements, the existing data in a somewhat wider region of neutron-deficient heavy isotopes and possible future impact of direct mass measurements will be discussed in the context of the significant energy scales of collective effects in heavy nuclei.

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