Isomer and ground state properties of yttrium and scandium isotopes measured by laser spectroscopy

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High resolution laser spectroscopy is a well-established method for measuring nuclear moments and charge radii of radioactive nuclei. The sensitivity of the standard collinear beams technique has been significantly improved by using an ion beam bunching technique in gas-filled RFQ trap. This has allowed studies of some odd-Z isotope chains (yttrium and scandium) for which there have been no previous laser measurements. These measurements were carried out by a Birmingham/Manchester/Jyvaskyla collaboration at the IGISOL isotope separator facility in Jyvaskyla.

The neutron-rich yttrium isotopes, produced by proton-induced fission of uranium, were measured on the 363 nm transition in the yttrium ion (0 - 27,517 cm^{-1}). The hyperfine structures and isotope shifts for both ground states and isomers were measured out to A=102. The pronounced shape transition seen in the neighbouring Sr and Zr chains at neutron number N=60 is clearly evident in the yttrium ground state systematics. The transition occurs at N=59 in the isomer systematics. The isotope shifts and extensive quadrupole moment data provides complementary information on the evolution of the nuclear shapes.

The scandium isotopes and isomers were measured in the mass range A = 42-46 on the 363 nm (68 - 27,602 cm^{-1}) transition in Sc^{+}.
They were produced by (d,p) and (p,pxn) reactions on a natural scandium target. Isomer shifts, which are directly proportional to the change in nuclear mean square charge radius, were of opposite sign for the A=44 and 45 isotopes. Systematics will be compared with the neighbouring Ca and Ti isotope chains.

A similar ion buncher is being built at Europe's premier on-line isotope separator facility, ISOLDE, at CERN. The plans for the first on-line collinear laser experiments in 2006 will be discussed.