International Nuclear Physics Conference INPC2013: 2-7 June 2013, Firenze, Italy

Laser-assisted decay spectroscopy of neutron-deficient Tl isotopes at CERN ISOLDE.

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One of the regions of the nuclear chart that has drawn considerable interest is that of the neutron-deficient Pb isotopes with Z ~ 82 and N ~ 104. This region exhibits a dramatic manifestation of shape coexistence.

The onset of competing proton intruder states in the odd-Tl isotopes opens the ground for complex structures at low energy leading to isomerism. A band of high-spin states was observed, built on the $9/2^-$ isomer and suggested that this was due to the odd proton occupying the $1h_{9/2}$ intruder orbital [1].
The well-established occurrence of intruder states and shape coexistence in odd-Tl isotopes, raises the question of where such states appear in the even-Tl isotopes and especially in the lightest isotopes where, based on our current knowledge, the isomeric staggering in the isotope shift is expected to disappear when going beyond N=104 to lighter nuclei.
However, the spectroscopic elucidation of such structures has proven to be highly demanding. The decay schemes are extremely complex and low-energy, highly converted transitions must be reliably identified and located in the odd-mass decay schemes. This knowledge is crucial for the measurement of charge-state distributions ($\delta\langle r^2\rangle$) through the resonant laser ionization technique.

Combining the high-sensitivity of the in-source laser spectroscopy technique and characteristic decay spectroscopy, exotic Tl isotopes (Z = 81) down to N = 98 have been studied in July 2011 with the On-Line Isotope Mass Separator ISOLDE at CERN, Geneva, Switzerland, using the Windmill detection system. Complementary decay data on isomerically purified sources were additionally collected.

The goal of these studies is to deduce ground-state and isomeric-state properties of the most neutron-deficient Tl isotopes. In this contribution, we shall report on the present status of the laser-assisted decay spectroscopy analysis of these isotopes.

[1] J.O. Newton, S.D. Cirilov, F.S. Stephens and R.M. Diamond, Noel. Phys. A148 (1970) 593