First observation of the β-decay of neutron-rich ^{215}Pb and ^{218}Bi by the pulsed-release technique and resonant laser ionisation

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The neutron-rich Tl, Pb and Bi isotopes are of exceptional interest to trace the evolution of single-particle levels away from the doubly magic ^{208}Pb towards the neutron-rich side of the nuclear chart. While ^{208}Pb is well understood in terms of the shell model, experimental data on the heavier isotopes is very scarce and it is far from clear to what extent the shell model is upheld [1]. Furthermore, large branchings ratios for β-delayed neutron emission are expected in this mass region, adding astrophysical interest to the subject [2].

Beta-decay studies at on-line mass separators, however, often suffer from mass contaminations. The pulsed-release technique, pioneered at ISOLDE [3], allows to considerably reduce the contamination whenever the isotopes of interest are longer lived than the unwanted species. In the mass region $215 < A < 219$, this indeed holds for the β-decaying Pb isotopes versus the Fr alpha emitters [2]. In an earlier experiment, new spectroscopic information was thus obtained in the $A = 215, 216, 217$ isobaric chains [4, 5].

Recently we have complemented the pulsed-release suppression of contaminants with the element selectivity of the ISOLDE laser ion source. Comparison of the spectra recorded by a $\beta X\gamma\gamma$ coincidence set-up with and without laser irradiation of the ion source has allowed to unambiguously identify the γ deexcitation pattern following the β decay of ^{215}Pb and $^{215-218}$Bi. The deduced production rate for ^{215}Pb, determined at 1 at/μC, is several orders of magnitude lower than expected from the extrapolation of abrasion-ablation calculations [6].

Preliminary analysis of the data has already disclosed the existence of an isomer in ^{215m}Bi and the β-decay of ^{215}Pb, where a 183.5 keV γ transition was observed. The excitation energy of a presumably 8^+- 6^+- 4^+- 2^+- 0^+ cascade in ^{218}Po was established as well: 263 keV(8^+- 6^+), 385 keV(6^+- 4^+), 425 keV(4^+- 2^+), 510 keV(2^+- 0^+).

A side-line production test on neutron-deficient Pb has furthermore revealed a new isomeric state in ^{185}Pb.

References

1. E.K. Warburton, B.A. Brown, Phys. Rev. C **43**, 602 (1991).
2. P. Moeller, J.R. Nix, K.-L. Kratz, At. Dat. Nucl. Dat. Tabl. **66**, 131 (1997).
3. P. Van Duppen *et al.*, Nucl. Instrum. Methods B **134**, 267 (1998).
4. K. Rykaczewski *et al.*, *Proc. Int. Conf. on Exotic Nuclei and Atomic Masses*, Bellaire, 1998 (AIP, 1998), p. 581.
5. J. Kurpeta *et al.*, Eur. Phys. J. A **7**, 49 (2000).
6. K.H. Schmidt, Nucl. Phys. A **542**, 699 (1992) and private communication.

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