IDENTIFICATION OF NEW Tl-ISOTOPES AT PROTON DRIP-LINE

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The identification of the new Tl-nuclides at the proton drip-line have been performed at the IRIS-facility.

The interest to such rare objects, located near the boundary of nucleon instability at mass numbers close to $A = 180$ was discussed in [1]. Moreover there is some specific interest for investigation of Tl-isotopes:

1) the shape coexistence for ground and isomeric states is expected,

2) the mentioned Tl-nuclides belong to the new region of beta-delayed nuclear fission where ^{180}Tl as the first very light precursor of this phenomenon has been observed in Dubna [2].

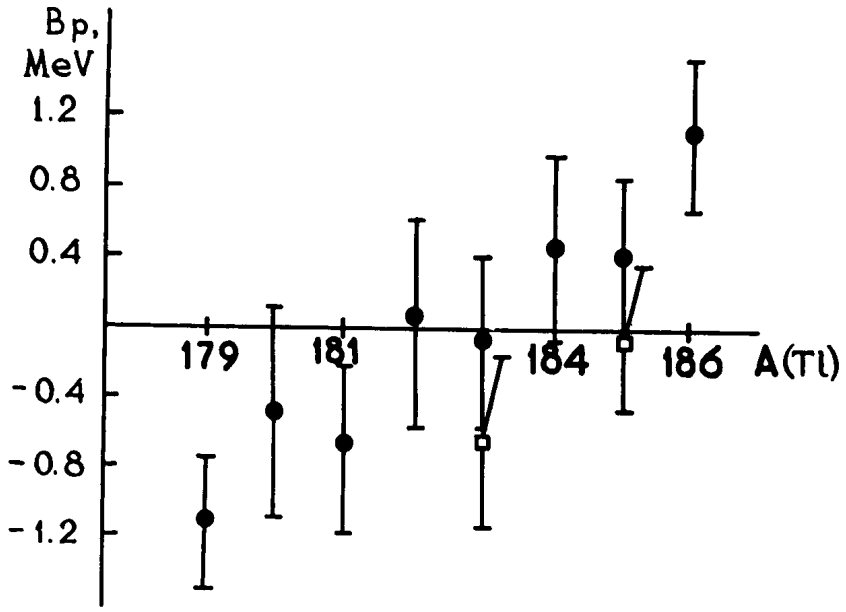

Fig.

The experiments have been carried out using conventional scheme for identification of the new nuclides, described in our previous work [3].

The $(U+Th)C_x$ target material was prepared by the method of the diphtalocyanines distruction. This material has some distinct advantages [4]:

1) the release time for Tl-nuclides is rather small which gives a possibility to identify short lived isotopes with $T_{1/2}$ value about 1 s,

2) the material is not sintered during a long (more than 100 hours) experimental run in spite of the high temperature ($T \approx 2300 - 2400^{\circ} C$);

therefore a massive target (with material weight 50 g of U) can be used.

In addition the selectivity of target-ion source unit for Tl-nuclides is sufficiently high in comparison with the neighbouring nuclides of other elements at the same mass region (A≈180).

Different solid state detectors have been used; α, β, γ, X — radiation and fission fragments were under investigation.

The results on identified nuclides are shortly summarized in the table. All the data are obtained for the first time [5] (except data for ^{180}Tl, see [2]). The figure shows behaviour of the proton binding energies at various mass numbers for Tl-isotopes deduced from literature atomic mass data. As it can be seen from the figure the Tl-nuclides with mass number $A \leq 181$ are proton unstable which means that they are situated beyond the proton drip-line. The nuclides ^{182,183}Tl as well as isomeric state of ^{185}Tl (indicated on figure by square) are possibly also proton unstable.

The performed identification opens the way to the detailed investigation of properties of Tl-nuclides at the proton drip-line, including the phenomen of shape coexistence using laser spectroscopy as well as evolution of the deformation parameters far off the beta stability line.

Table

Isotope	Spectrum	$T_{1/2}$
	$K_{\alpha 1}$(Hg)	19.5(5) s
^{185}Tl	E_α(Hg) 5.65 *MeV*	18(2) s
	E_α(Tl*) 5.97 *MeV*	2 s
^{183}Tl	$K_{\alpha 1}$(Hg)	6.9(7) s
(^{183m}Hg)	W_α(Hg) 5.9 *MeV*	6.9(1.4) S
		Br_{df}(Tl) < 0.04%
	E_α(Hg) 5.86 *MeV*	*Br*(*Tl*) < 4%
^{182}Tl	Beta-spectrum	2.0(3) s
	E_α(Tl) 6.05 *MeV*	2.8(6) s
^{181}Tl	E_α(Tl) 6.18 *MeV*	3.4(6) s
	E (Hg) 6.00 *MeV*	Daught
^{180}Tl	Beta-spectrum	~2 s

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