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Investigations of many-particle excitations of the type $(j)^n$ are of theoretical interest, especially with regard to the determination of the residual interaction parameters. Recently the $(h_{9/2})^3$ multiplet has been investigated in $^{211}_{85}At_{126}$, in which nucleus 3 protons are outside the double magic $^{208}_{82}Pb_{126}$ core. This multiplet is fed by the $21/2^-$ isomeric state, which is the highest spin state of the same configuration /1/.

Such high spin states are preferably excited in heavy-ion compound nuclear reactions. At the U-300 heavy-ion cyclotron of the Laboratory for Nuclear Reactions, JINR Dubna we started, therefore, pulsed beam experiments for the investigation of similar isomeric states. By use of the reaction $^{197}Au(^{12}C,4n)$ $^{205}_{85}At_{120}$ an isomeric state with the half-life $T_{1/2} = 110 \pm 25$ ns was found, which also can be ascribed (cf. below) to the $21/2^-$ state of the $(h_{9/2})^3$ configuration. Basing on two-dimensional time and energy spectra, the intensities of the prompt and delayed gamma transitions and the measured excitation functions we concluded the level scheme shown in fig. 1. A detailed description of the experiment will be published in a forthcoming paper /2/.

In fig. 2 our level scheme is compared with those of the neighbouring even isotones $N = 120$, namely ^{202}Pb /3/ and

^{204}Po /4/. A similar but clearer comparison is possible /1/ for the neighbouring closed neutron shell isotones ^{210}Po and ^{211}At with $N = 126$, which is also drawn in fig. 2. The level schemes of ^{210}Po and ^{211}At can be described by the pure $p(h_{9/2})^2$ and $p(h_{9/2})^3$ configurations.

In case of the $N = 120$ isotones ^{204}Po and ^{205}At the situation is somewhat different. Going away from the closed neutron shell we find an increasing collective character of the first low-spin levels $I^{\pi} = 2^+$ and 4^+ in ^{204}Po, for the two-neutron quasiparticle states are increasingly admixed. For example the 2^+ and 4^+ states of the $(f_{5/2})^2$ neutron configuration in ^{202}Pb are placed at 960 keV and 1384 keV, respectively /3/. On the other hand, the $I^{\pi} = 6^+$ and 8^+ levels in ^{204}Po remain fairly pure proton states of the $p(h_{9/2})^2$ configuration, for the corresponding neutron configurations in ^{202}Pb which give such high spin values, have considerably higher energies and should, therefore, be of little influence.

It seems to us, that the $I^{\pi} = 21/2^-$ - level in ^{205}At corresponds to the $I^{\pi} = 6^+$ level in ^{204}Po and may be regarded as the highest spin state with $I = I_{max}$ of the $(h_{9/2})^3$ proton configuration, similar to the situation in ^{211}At. The excitation energies of the $I^{\pi} = 21/2^-$ levels in ^{205}At and ^{211}At are nearly the same (1492 keV and 1416 keV, respectively) and somewhat lower than the $I^{\pi} = 6^+$ levels in ^{204}Po and ^{210}Po (1624 keV and 1472 keV, respectively). Deviating from the ^{211}At deexcitation we observed two gamma transitions of 125 keV and 191 keV of nearly equal intensity, outgoing from the isomeric $21/2^-$ level. The intensity balance of the whole decay scheme may only be fulfilled if we assume an E2 multipole order for both the 125 keV and 191 keV transitions. The $B(E2)$ value of the 125 keV transition (table) does not deviate much from the theoretical value $B(E2) = 61\ e^2 fm^4$ of the $(h_{9/2})^3_{21/2^-} \rightarrow (h_{9/2})^3_{17/2^-}$ transition [5], whereas the 191 keV transition gives a very low B(E2) value. We, therefore, assume the existence of a second $17/2^-$ level not belonging to the $(h_{9/2})^3$ configuration. Corresponding to the coupling rules [6] such a $17/2^-$ state may be formed by coupling the $(h_{9/2})^3_{9/2}$ proton state to the second 4^+ state in ^{202}Pb [3] with the structure $n_1(f_{5/2})n_2(p_{3/2})$. The 191 keV transition from the $21/2^-$ level to this $17/2^-$ level at 1301 probably goes via an $(h_{9/2})^3$ admixture of the $17/2^-$ state. From the above mentioned cause we expect, that the states with spins $17/2^-$, $15/2^-$, $13/2^-$ and $11/2^-$ are of complicated structure. They correspond to the 4^+ and 2^+ levels in ^{202}Pb and ^{204}Po. The assumption, that these states are not pure proton states is supported by the facts, that no E2 transition from the $17/2^-$ level at 1367 keV to the $13/2^-$ level at 663 keV could be found, and that the 332 keV gamma transition to the $15/2^-$ level is of mainly M1 character, which assumption results in a better intensity balance than a pure E2 transition.

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Table

E (keV)	I_γ (relativ)	α_{tot}	branching ratio β	B(E2) $e^2\ fm^4$
125	55 ± 5	2.78	0.37 ± 0.07	31 ± 9
191	49 ± 4	0.58	2.71 ± 0.49	3.4±1.4

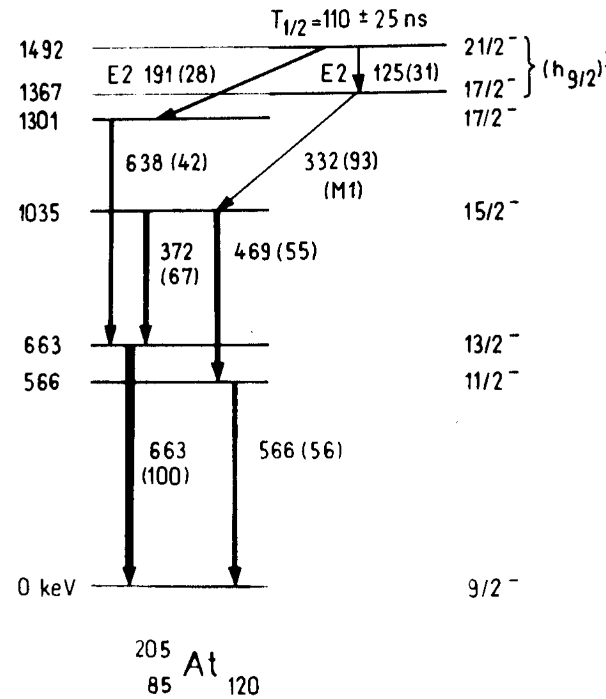

Fig. 1. Level scheme of ^{205m}At.

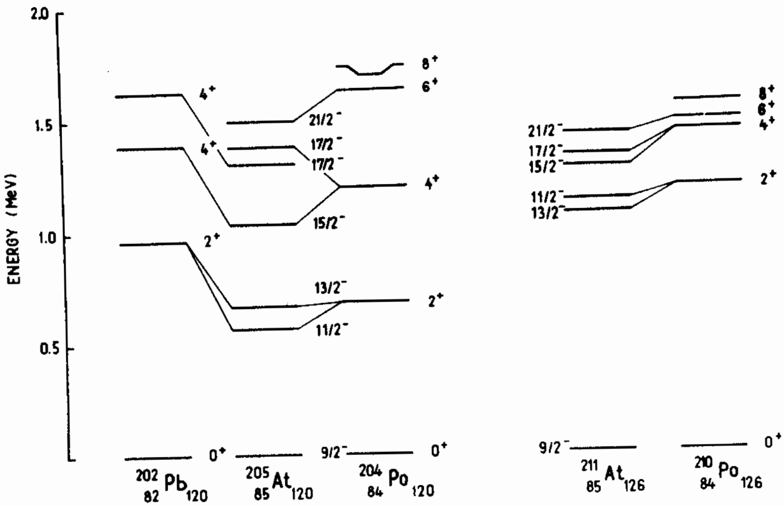

Fig. 2. Comparison of many-particle levels in the N = 120 and N = 126 isotones.