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New aspects of the low-energy structure of 211At

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Lifetimes of low-energy states in ^{211}At have been measured using the recoil-distance Doppler shift, Doppler-shift attenuation, and fast-timing methods at the University of Cologne. The obtained reduced transition probabilities have been compared to two shell-model calculations, a large-scale shell-model calculation using the Kuo-Herling residual interaction and a calculation using a single-j approximation for protons in the $0h_{9/2}$ orbital. The newly obtained reduced transition probabilities are described very well by a single-j calculation. This, together with the fact that the energy spectrum of ^{211}At is also well described, indicates that seniority can be regarded as a good quantum number in ^{211}At. While the single-j calculation can only describe states with a dominant $0h^3_{9/2}$ configuration, the presence of other low-lying proton orbitals, like $1f_{7/2}$ and $0i_{13/2}$, requires a multi-j calculation. The multi-j calculation using the Kuo-Herling interaction gives a satisfactory description of the nuclei in the region but significantly overestimates some of the ground-state transition probabilities, for example, the $B(E2; 13/2^-_1 \rightarrow 9/2^-_1)$ value in ^{211}At. This discrepancy has been attributed to the presence of higher-order particle-hole excitations in the wave function of the ground state, which are not accounted for by the Kuo-Herling interaction. The effects of those excitations on the transition rates, however, are weaker in ^{211}At than they are in ^{210}Po. On the other hand, a strong underestimation of the $E2$ strengths involving the $7/2^-_1$ state is also observed, where one proton occupies the $0f_{7/2}$ orbital. Therefore, a phenomenological modification to the $< 0h_{9/2}, 0h_{9/2}|\hat{V}|0h_{9/2}, 1f_{7/2} >_{J=2}$ two-body matrix element has been introduced which leads to a considerably better description of the structure of ^{210}Po and ^{211}At. However, the origin of this effect needs to be further investigated.

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