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DYNAMICS OF YRAST BANDS UP TO MAXIMUM KNOWN SPINS I N EVEN THORIUM NUCLEI

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There are only a few works using the boson approach to describe the intersection of the collective band and the band built on a two-quasiparticle mode. The first of these was the work of Gelberg and Zemel [1] based on IBM1. In it, the Hamiltonian term responsible for the interaction of the collective and non-collective bands was replaced by a constant and did not depend on either the spin J of a pair of quasiparticles or the total spin I. The limit val-ue $J^\pi = 10^+$ is accepted for the case of Xe, Ba, Ce, etc. due to configuration $(h^2_{11/2}$. In [2], collective states were considered in the IBM2 approximation, and the interaction of collective and quasiparticle excitation modes was considered sequentially through a long chain of matrix elements. Thus, to couple a collective mode with a mode con-taining a pair of quasiparticles $J^\pi = 10^+$, fourth order in perturbation theory is required. As a result, in such a model a very weak interaction of intersecting bands of states is realized. These works did not receive further development. In [3], using IBM1, the space was also ex-panded to include bosons up to $J^\pi = 10^+$, but the parameters of the interaction terms of collective states and states including quasiparticle pairs were calculated microscopically. How-ever, even in this case, automatic strong mixing of bands with different modes as the leading level could not be fully achieved.
This problem was solved in a series of works, the idea of which was outlined in more detail in [4]. It turned out that it is necessary to take into account the connection between high-spin quasiparticle modes and states that also contain quasiparticles, but which are used when renormalizing the microscopically calculated parameters of the traditional Hamiltonian IBM1. This allowed us to significantly expand the channels of interaction. As a result, strong mixing of states was obtained for several states at once in the band intersection region, which led to large values of $B(E2)$ at the band intersection point, regardless of the position of the energy of the quasiparticle pair. Moving on to heavy and superheavy nuclei, the need arose to expand the two-quasiparticle basis of phonons and, accordingly, bosons to pairs with due to the pair of quasiparticles $(j_{15/2})^2$.
This was done in [5], on the basis of which all even isotopes of Th for which excitation energies were known were analyzed. These are nuclei in the $^{220-236}$Th range. The first of them has an almost ideal vibration spectrum and a first excitation energy of 373 keV. The latter, respectively, has an energy of 48 keV. A preliminary analysis of excitation energies us-ing IBM1 phenomenology showed that it is possible to reproduce energies well up to the max-imum known spins, and this is, for example, up to 30^+ in ^{232}Th. In this regard, the question arises about the role of high-spin quasiparticle modes and their influence on the spec-trum of observed states. It turned out that in nuclei with A = 220, 222 the crossing of the bands occurs, but very smoothly, so it doesn't significantly affect the smooth dependence of the moment of inertia on the square of the frequency, at least for ^{222}Th. For heavier thorium isotopes, where the band energies are already significantly reduced, the main compo-nent remains collective. The reasons for this are being discussed.

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Section

Nuclear structure: theory and experiment

Primary author: EFIMOV, Aleksandr (Admiral Makarov State University of Maritime and Inland Shipping, St.-Petersburg, Russia; Ioffe Institute, St.-Petersburg, Russia)

Co-author: IZOSIMOV, Igor (Joint Institute for Nuclear Research)

Presenter: EFIMOV, Aleksandr (Admiral Makarov State University of Maritime and Inland Shipping, St.-Petersburg, Russia; Ioffe Institute, St.-Petersburg, Russia)

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