Three-quasiparticle-plus-rotor Coriolis coupling calculations

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In this paper, we present three-quasiparticle-plus-rotor Coriolis coupling calculations for explanation of signature effects exhibited by the three-quasiparticle (3qp) rotational bands. We also discuss various special issues involved in these Coriolis mixing calculations.

The Coriolis mixing is generally responsible for a host of phenomena in rotational bands [1, 2]. Therefore, in order to reproduce the experimentally observed staggering behavior in the 3qp rotational bands, we have undertaken a Coriolis mixing of the 3qp bands with higher order mixing taken into account. Some of the major issues involved in these calculations are:

1. For a given 3qp configuration, we have four band-heads and hence four different rotational bands, which leads to the complexity of Coriolis mixing calculations. In order to overcome this problem and to test the validity of our calculations, we have considered only those 3qp configurations which involve relatively low-Ω orbitals, so that we get a small basis and hence a relatively small number of interacting bands.
2. Since the experimental data for 3qp bands is still scarce, most of the important bands taking part in the Coriolis mixing are not known. In order to handle this problem we calculate the band-head energies for all the interacting bands.
3. The exact estimation of the band-head energies, which is one of the main input parameters in these calculations, is still a problem due to non-availability of the experimental data/accurate estimates for the Gallagher-Moszkowski (GM) splitting as well as the Newby shift energies of all the two-quasiparticle (2qp) doublets comprising the 3qp configurations. In order to handle these situations, we obtain the energies for all the three-quasiparticles in a given 3qp configuration by using the known properties of the involved one-quasiparticle (1qp) configuration from the neighboring odd-A nuclei [3] and estimated values GM splitting energies [3].

With the existing experimental data and the above choice of parameters, we are able to reproduce the phase of staggering in the 3qp rotational bands observed in ^{155}Dy**,** ^{165}W [4] and ^{167}W. On the basis of these Coriolis mixing calculations, we suggest that the rotor-particle (Coriolis) terms play a major role for the observed signature effects in the 3qp rotational bands. The phase as well as the magnitude of the staggering do not remain same for all the members of a given 3qp quadruplet. Since a complete and confirmed quadruplet is yet to be observed in any nucleus, it remains an open challenge for experimentalists to reliably identify a given 3qp quadruplet and rotational bands for each member of a quadruplet, and hence to see the variation in the phase of the staggering in all the members of a given 3qp quadruplet.

References:

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