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Moments of inertia of pairing rotation within the BCS model for Sn and Ni isotopes

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The pair condensation in a nucleus can be regarded as the "deformation"of the nucleus in the gauge space due to the pairing correlation, thus creating a rotational degree of freedom. The deformation makes it possible to specify orientation angles. This is analogous to the fact that spatial deformation produces rotational modes in real space.
The energy of rotation in real space is written as $E(I) \approx I(I+1)/2J$, where I is an angular momentum, and J is a moment of inertia. From the analogy with the spatial rotation, we may expect that the energy of rotation in gauge space is described by the ground-state energies of different neutron (proton) numbers as $E(N) \approx (N-N_0)/2J$, and thus the ground states form the rotational spectra. It is called "pairing rotation." Experimental data also support the interpretation of this pairing rotational band.
In this study, we focus on the moment of inertia J of the pair rotation.

In this study, we adopt a pairing model and calculate the pairing rotational bands and their moments of inertia in the BCS approximation. We analyze the properties of neutron pairing correlation for Sn and Ni isotopes. From our calculation, the energy of pairing rotation is well reproduced by the BCS model. The isotopic trend of moments of inertia calculated with number projection change at 114Sn, 68Ni, and this is because the orbitals that contribute to the pairing correlation change at these isotopes. Furthermore, we will discuss the relation between this change in the moment of inertia and the second-order quantum phase transition with a control parameter N.
We investigate the dependence of moments of inertia on the size of pair condensation.
We will also discuss the properties of the pairing rotational moment of inertia such as the dependence on the size of the pair condensation and the similarity and difference with the inertia for the spatial rotation.

Presentation type

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