Pairing vibrations in superfluid nuclei: a semiclassical Hartree-Fock-Bogoliubov approach

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Collective pairing excitations in heavy superfluid nuclei are studied on the basis of the semiclassical time-dependent Hartree-Fock-Bogoliubov theory [1]. The pairing-field fluctuations are derived from the self-consistent relation (the gap equation of the BCS type), while the static pairing field is approximated with a constant phenomenological parameter Δ. In a self-consistent theory, the changes in the pairing field are related to the changes in the anomalous density. The anomalous density response function is analyzed in a simple model, in which nuclei are represented as homogeneous spheres of symmetric nuclear matter characterized by parameters (size, density, pairing gap) typical of heavy superfluid nuclei. The strength function obtained from the anomalous density response function has a resonance structure with a sharp peak around 2Δ that displays the monopole collective pairing mode. The width of this mode is due to the Landau damping. Found semiclassical collective pairing mode reproduces the average behavior of discrete quantum 0^+-states that are observed in the (p,t)-reactions in the even heavy nuclei.

The kinetic coefficients (the restoring force and the mass parameter) associated with monopole pairing vibrations in heavy nuclei have studied in the low-frequency limit. It is found that the pairing correlations give a coherent contribution to slow collective nuclear motion.

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1. Abrosimov V. I., Brink D. M., Dellafiore A., Matera F. Self-consistency and search for collective effects in semiclassical pairing theory. Nuclear Physics A, 2011, 864, 38-62.