The Inside-Triplet E2 Transition due to the Leading HRPA Process for a Normal plus Superfluid System

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We take into account second- and induced third-order diagrams for the E2 transition between two-phonon states, by combining the basic particle (quasiparticle)-vibration process in all possible ways. One vertex is always of the HRPA type. This approach is exemplified for the $4_1 \rightarrow 2_2$ E2 transition in ^{60}Ni. For protons, the system is normal, with proton particle-hole excitations appearing in the intrinsic phonon structure and for neutrons, it is a superfluid system with two quasineutron excitations appearing in the intrinsic phonon structure. The superfluid factors U_j, V_j and the quasiparticle energies for neutrons are the BCS solutions calculated using neutron single-particle energies of Reehel and Sorensen and the pairing strengths determined by fitting the odd-even mass difference. The $B(E2)(4_1 \rightarrow 2_2)$ is calculated as arising from the interference of the proton and quasineutron third-order HRPA process. By applying the harmonic relation for $B(E2)(4_1 \rightarrow 2_1)$, we calculated the intensity ratios

$$\frac{W(4_1 \rightarrow 2_2)}{W(4_1 \rightarrow 2_1)} = \frac{B(E2)(4_1 \rightarrow 2_2)}{B(E2)(4_1 \rightarrow 2_1)} \left(\frac{0.347}{1.173}\right)^5$$

to be 2.5×10^{-5}, 5.8×10^{-5} and 11.9×10^{-5} for the radial matrix elements in the physical region, with $\langle r \frac{dV}{dr} \rangle$ dqual to 40, 45 and 50 MeV, respectively. This is of the same order of magnitude as the experimental value $(6.9 \pm 1) \times 10^{-5}$ (ref.1).

1) B.A. Logan, W.R. Dixon, R.S. Storey and A. Ljubičić, Can. J. Phys. 55 (1977) 142.