DETERMINATION OF THE PHONON AMPLITUDES EMPLOYED IN BOSON EXPANSION THEORIES

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Low-lying states linked up by strong enough $E2-$transitions can be interpreted as superposition of many collective phonon configurations $(D^+)^{nd}$. In Boson Expansion Theories these phonons are mapped onto quadrupole boson operators, e.g. in [1] $D^+ \to d^+\sqrt{1-\hat{n}_d/\Omega} \sim d^+ s$, $\hat{n}_d$ is the number operator of $d-$boson, Ω is their maximum number, s is a scalar auxiliary boson of the Interacting Boson Model. Wave functions in such approach are found as solutions of the boson Hamiltonian (H_{B}). Theoretical calculations of H_{B} parameters begin with a choice of the $D-$phonon operator for which we use the form of the Quasiparticle Random Phase Approximation (QRPA): $D^+_\mu \sim \sum(\psi_{12}a^+_1 a^+_2 + \varphi_{12}a_{\bar{2}}a_{\bar{1}})$ where amplitudes ψ, φ determine its two-quasiparticle composition. However, in contrast to QRPA where ψ, φ are defined for a one-phonon state, we search them taking into account many phonon (boson) structure of the collective states. With this object we minimize over ψ and φ a functional Φ comprising the expectation value of H_{B} (parameters of which are functions of ψ, φ and effective quasiparticle interactions) and some additional conditions, details can be found in [2]. Thus, equations for ψ, φ involve the boson expectation values (BEV) such as $< n_d >$, $< d^+ \cdot d^+ ss + \text{H.c.} >$ and others, i.e. the equations allow for the many boson structure of states. One of the addition conditions in Φ fixes the value of $\xi = \sum\varphi^2 / \sum\psi^2$ to be $\ll 1$, that gives the possibility, first, to employ the usual QRPA calculations and, secondly, to obtain the selfconsistent description of ψ, φ and BEV, i.e. the H_{B} parameters calculated with final values of ψ, φ give such BEV which being substituted into equations for ψ, φ lead to the same values of parameters. Such selfconsistency is impossible in the Tamm-Dankoff method, i.e., when $\varphi \equiv 0$. Calculations for Xe isotopes have shown that ξ cannot be larger than 0.065 and a reasonable agreement between calculations and all experimental data can be attained with $0.012 < \xi \le 0.050$. A part of these calculations for ^{122}Xe is given in the table (E in MeV, МэВ, $B(E2)$ in e^2fm^4).

	$E(2^+_1)$	$E(2^+_2)$	$E(4^+_1)$	$B(E2: 2^+_1 \to 0^+_1)$	$B(E2: 4^+_1 \to 2^+_1)$
Exp.	0.331	0.843	0.828	2890^{+125}_{-165}	4150^{+190}_{-180}
$\xi = 0.0145$	0.330	0.838	0.882	2920	4360
$\xi = 0.02$	0.339	0.843	0.894	2860	4270
$\xi = 0.03$	0.329	0.858	0.866	2800	4210

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