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] $D^{+}\rightarrow d^{+}\sqrt{1-\hat{n}_{d}/\Omega}\sim d^{+}s$, $\hat{n}_{d}$ 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 $0.012<\xi\leq 0.050$. A part of these calculations for ^{122}Xe is given in the table (E in MeV, МэВ, $B(E2)$ in e^{2}fm^{4}).

	$E(2_1^+)$	$E(2_2^+)$	$E(4_1^+)$	$B(E2:2_1^+\rightarrow 0_1^+)$	$B(E2:4_1^+\rightarrow 2_1^+)$
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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2. A.D.Efimov, V.M.Mikhajlov // Bull. RAS. Ser. Phys. 2011. V.75. P.890.