Localization, disorder and boson peak in an amorphous solid

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Abstract:

The inhomogeneous density n(x) of a solid, often treated as an order parameter in the density functional theories (DFT), is usually expressed as a sum of gaussian profiles respectively centered around the different points of a lattice $\{R_i\}$. The average width of the gaussian profiles represents a characteristic length l signifying the degree of mass localization in the system. Using analysis based on entropic considerations, we show here that as ℓ for anamorphous solid spreads beyond a critical value ℓ_c, the corresponding vibrational density of states $g(\omega)$ deviates from the Debye form $gD(\omega)$ to develop the boson peak. For a hard core system of diameter σ we obtain $\ell_c = .2\sigma$.