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Isotope Effect and Phonon Softening in Superconducting Borocarbides and Boronitrides

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Abstract: The isotope effect in the recently disvovered class o superconductors $LuNi_2B_2C$ and $La_3Ni_2B_2N_3$ is investigated in the context of electron-squezed phonon interaction renormalizing the Ni-d electron-electron correlations. Squeezed phonon mode originates from the anharmonic character of the tetragonal Ni-B structure and is polarized in the vortical direction to the Ni layers. The isotope effect arises as a result of the zero point motion of the Ni-Ni d-electron hopping amplitude dominantly due to this vertical phonon mode. Within this model the isotope exponent is calculated to be α_B \leq 0.20 as compared to the recently found experimental value α_B^{exp} = 0.27 \mp 0.10. Finally, the phonon frequency softening predicted by our model eletron-phonon interaction is discussed within the context of recent experiments on the relevant boron A_{1g} softening.

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