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THE INTENSITY OF f - f ELECTRONIC TRANSITIONS IN A CRYSTAL $PrFe_3(BO_3)_4$ DURING ELECTRON-PHONON INTERACTION

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Earlier, in the works [1-3], the method of terahertz spectroscopy revealed and investigated new effects due to electron-phonon interaction in an antiferromagnetic crystal. In the spectra of a crystal $PrFe_3(BO_3)_4$, splitting of a nondegenerate low-frequency phonon of A_2 symmetry was observed due to its interaction with is close in energy the 4*f*-electron excitation of the Pr^{3+} ion [1]. As a result, a bound electron-phonon mode is formed, in which, as the temperature decreases, repulsion and energy transfer between its quasi-phonon and quasi-electron components are observed. It should be noted that isolated 4*f*-electronic excitations are not visible in the reflection spectra due to the small oscillator strength. Modeling based on the theory of electron-phonon interaction allowed us to find the interaction constant. When a $PrFe_3(BO_3)_4$ single crystal is placed in an external magnetic field along the easy axis of magnetization, a gap appears in the spectrum of quasi-electron excitations in an arbitrarily weak field [2]. It was shown [2] that the frequencies of coupled electron-phonon excitations in a magnetic field up to 30 T are successfully simulated on the basis of equations obtained in the framework of the theory of electron-phonon interaction, with the interaction constant independent of the field, previously found in [1].

The temperature and field behavior of the intensities of the components of the coupled electron-phonon mode has not yet been quantitatively considered. Even qualitatively, the field behavior of the intensities of the split quasi-electron components when the crystal was placed in an external magnetic field remained incomprehensible. In the present work, the problem of a bound electron-phonon mode is considered by the method of Green functions. The frequencies of the coupled excitations are found as poles of the spectral representation of the Green function.

$$G_{QQ}(\omega) = \frac{1}{2\pi}\int G_{QQ}(t)e^{i\omega t}dt \qquad (1)$$

The intensity of the electric dipole absorption at frequency ω is proportional to the imaginary part of function (1). The simulation made it possible to quantitatively describe the observed experimental data on the behavior of the coupled electron-phonon mode in a $PrFe_3(BO_3)_4$ crystal in fields up to 30 T.

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