

$N$  is the number of possible off-centre positions.  $Q_0$  may be called the off-centre displacement, but note that it does not necessarily describe a static displacement of the defect ion.

Inserting (5), (7), and (8) into (6) we obtain for the oscillator strength

$$f_{I_1^+ \rightarrow I_4^+ (I_5^+)} = A_{4(5)}^2 \{ \eta_x^2 \langle Q_{4y}^2 \rangle + \langle Q_{4z}^2 \rangle \} + \text{cyclic terms} \} + A_{4(5)}^2 \{ \eta_x^2 (Q_{4y0}^2 + Q_{4z0}^2) + \text{cyclic terms} \}, \quad (10)$$

$$f_{I_1^+ \rightarrow I_3^+} = A_3^2 \{ \eta_x^2 \langle Q_{4x}^2 \rangle + \text{cyclic terms} \} + A_3^2 \{ \eta_x^2 Q_{4x0}^2 + \text{cyclic terms} \}. \quad (11)$$

$A_3, A_4,$  and  $A_5$  are constants, depending on the excited state of the transition.  $\eta = (\eta_x, \eta_y, \eta_z)$  is the unit vector of polarization. The first expression describes transitions from a nondegenerated state  $I_1^+$  to the orbital triplet states  $I_4^+, I_5^+$ , the second one transitions to an orbital doublet state  $I_3^+$ . The second term represents the effect of the off-centre potential. Without stress the expressions (10) and (11) are isotropic in the polarization, because the mean square amplitudes of the lattice vibrations are equal in each direction:

$$\langle Q_{4i}^2 \rangle = \langle Q^2 \rangle = \frac{\hbar}{2\omega} \coth \frac{\hbar\omega}{2kT} \approx \begin{cases} \frac{kT}{\omega^2} & \text{for } kT \gg \hbar\omega, \\ \frac{\hbar}{2\omega} & \text{for } kT \ll \hbar\omega. \end{cases} \quad (12)$$

Inserting (12) into (10) and (11) we obtain the temperature dependence of the oscillator strength [2].

Uniaxial stress lifts the degeneracy of the resonance mode and we get different vibrational frequencies and different off-centre distortions parallel and perpendicular to the stress axis. As an example Fig. 4 shows the splitting of

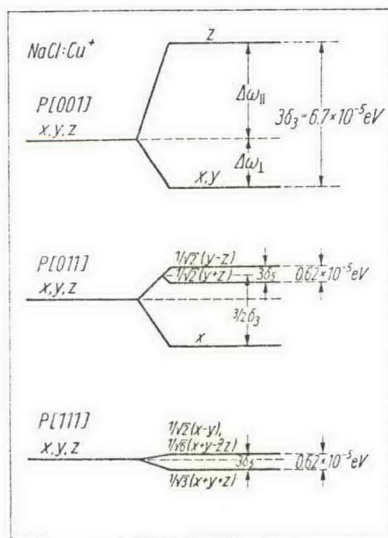


Fig. 4. Stress splitting of the local mode at  $23.5 \text{ cm}^{-1}$  in  $\text{NaCl}:\text{Cu}^+$  at  $4.3 \text{ }^\circ\text{K}$ . The applied stress is  $100 \text{ kp/cm}^2$

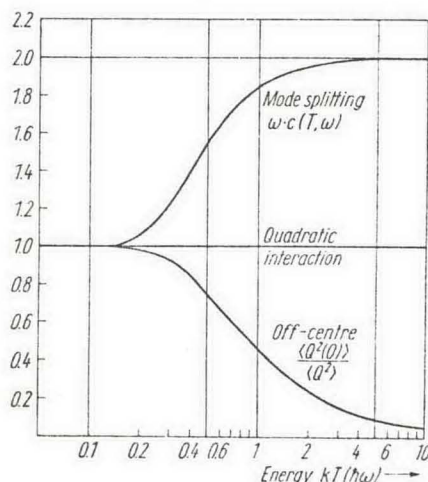


Fig. 5. Temperature dependence of the different effects contributing to  $(f_{||} - f_{\perp})/f$

uct  $q_{\alpha i}^- \times q_{\beta j}^+$ . In this approach as  $q_{\alpha i}$  contribute to our effects.  $\psi_{\mu i}$  is an eigenfunction of  $H_e$ .  $\psi_{\mu i}$  is a complex and is the  $i$ -th basis function of  $H_{e1}$  as a perturbation and obtain a mixing between even and

$$\langle \psi_{\mu i} | \psi_{\nu j} \rangle \quad (4)$$

energies  $E_{\mu j}(q_{\alpha i})$  are now functions  $\chi_k^{\mu j}(q_{\alpha i})$  are eigenvalues of nuclear quantum numbers. of  $\psi_{\mu j}$  and  $\chi_k^{\mu j}$  [10]:

$$(5)$$

transition between the ground

$$\sum_{j=1}^z r_j |\psi_{\mu i} \rangle|^2 \quad (6)$$

the mean energy of the transition thermal average over the ground

in (3a) of  $H_{e1}$  into account. We take into account products of the form  $q_{\alpha i} q_{\beta j}$  of the lattice cell, each ionic displacement and a dynamic part  $Q_{\alpha i}$ :

$$(7)$$

coordinates  $q_{\alpha i}$  of the complex we

$$\langle Q_{\beta j} + Q_{\alpha i} Q_{\beta j} \rangle = \dots \quad (8)$$

the coordinates of the potential using the linear electron-lattice interaction and Jahn-Teller distortions, we only consider parity which do not contribute to the transition. The octahedral complex has only distortions of odd parity resonance modes were observed in  $I_5^-$ -modes and assume that parity breaking effect.  $Q_{40}$  = distortion of the defect. We take the origin in the lattice cell:

$$Q_{4j0} = \dots \quad Q_{4j0}^2 \delta_{ij} = \frac{1}{3} Q_0^2 \delta_{ij}. \quad (9)$$