

# Electron-phonon coupling at the onset of charge ordering in magnetite $\text{Fe}_3\text{O}_4$

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At the Verwey transition temperature  $T_V = 122$  K the resistivity of  $\text{Fe}_3\text{O}_4$  jumps by two orders of magnitude from a metallic to an insulating state accompanied by a structural symmetry change. An analysis of the low temperature symmetries has revealed that a combination of  $X_3$  and  $\Delta_5$  can parameterize the transition [1]. Resonant x-ray scattering on the other hand has shown that the charge and orbital orderings set in at temperatures above  $T_V$  [2].

We have measured the phonon dispersion of low-lying branches connecting to  $X_3$  and  $X_4$  at temperatures above  $T_V$ . The  $\Delta_5$  branch has anomalous large widths at room temperature that broaden further on lowering the temperature to  $T_V$ . The  $X_3$  phonon shows the normal behaviour of sharpening up with lowering the temperature. We conclude that phonons of type  $\Delta_5$  couple to the electrons. This electron-phonon coupling drives the lattice distortion at the phase transition.

3D maps of diffuse scattering show a new arc-shaped feature outside of the X-point. A comparison with the calculated Fermi surface of cubic  $\text{Fe}_3\text{O}_4$  shows a good agreement between the spanning vectors of the principal Fermi surface sheets with the arc. Thus we assign this feature to a precursor of the lattice distortion due to Fermi surface nesting.

## References

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