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**The Verwey transition in $Fe_3O_4$: lattice distortions on a fs time-scale** R. KUKREJA, S. DE JONG, M. HOSSAIN, C. BACK, A. SCHERZ, D. ZHU, W. SCHLOTTER, J. TURNER, W. LEE, Y. CHUANG, R. MOORE, O. KRUPIN, M. TRIGO, H. DÜRR, SLAC/ RSXS collaboration, L. PATTHEY, SLAC/ RSXS collaboration and PSI, N. PONTIUS, T. KACHEL, A. FÖHLISCH, M. BEYE, Helmholtz Zentrum Berlin, F. SORGENFREI, Uni. Hamburg and CFEL, W. WURTH, Uni. Hamburg and CFEL, C. CHANG, M. DÖHLER, C. TRABANT, Uni. Cologne, C. SCHÜSSLER-LANGEHEINE, Uni. Cologne and HZB
— Magnetite, $Fe_3O_4$, displays a strong decrease in resistivity upon heating above $T_C = 123$ K: the Verwey transition. This transition is accompanied by a structural change from monoclinic to cubic symmetry. Despite decades of research and indications that charge and orbital ordering play an important role, the mechanism behind the Verwey transition is yet unclear. Using pump-probe soft X-ray scattering at the new LCLS SXR beamline, we have studied the role of the structural transition for the Verwey transition on ultra-fast time-scales. Focusing off-resonance on the high T forbidden (001) lattice reflection, we find a lattice response on time-scales $t < 250$ fs. The response displays a pump fluence threshold indicative of a phase transition. This strongly suggests that the lattice, via coupling to certain low energy phonon modes, plays a crucial role for the Verwey transition in $Fe_3O_4$.

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