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Lattice and magnetic dynamics of a laser induced phase transition in FeRh

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The interplay between the magnetic, electronic and structural degrees of freedom is often the key to understanding fundamental properties of solid state systems and forms the basis for their use in technological devices. In this context the magnetic alloy FeRh displays a phase transition consisting both of an isotropic lattice expansion and a magnetic transition from an anti-ferromagnetic to a ferromagnetic state, and thus serves as a model system to study the interaction between structural change and ferro-magnetic ordering. The ultra-fast laser-induced dynamics of this transition has previously been studied by optical methods [1,2] and x-ray magnetic dichroism [3]. Here we present the result of a time-resolved x-ray diffraction experiment which allows us to directly study the laser induced lattice dynamics in an FeRh thin-film. In addition measurements of the magneto optical Kerr effect on the same sample allow us to directly compare the structural and magnetic dynamics. The results show how the initial phase nucleation upon excitation with a fs laser starts in the surface region of the film, in agreement with static measurements of the transition, after which the created phase front moves into the now superheated film.

[1] J-U.Thiele et al., Appl.Phys.Lett. 85, 2857 (2004).
[2] G.Ju et al., Phys.Rev.Lett. 93, 197403 (2004).
[3] I.Radu et al. Phys.Rev.B 81, 104415 (2010).

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