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Ultrafast dynamics and coherent excitations of 4f-orbitals derived electronic states in the Kondo semi metal CeSb

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The CeSb magnetic phase diagram contains at least 16 different magnetic phases in the H-T plane [1] comprising different sequences of ferromagnetic and paramagnetic (001) planes stacked along the c-axis. The complexity is thought to arise from the interplay of Kondo, spin-orbit and crystal-field effects. [1, 2] Lattice modulation in the magnetic phases was also observed [3].
The phase diagram [4, 5] and the magnetic excitations [1] were thoroughly studied by neutron scattering. Recently the sensitivity of the electronic structure to the magnetic phase has been demonstrated [6] and additional magnetic excitations were found in the ordered phases [7].
While the main features of the magnetic behavior are understood and successfully modeled using effective interaction approach [8] the microscopic origin of the interactions is still puzzling [2, 7]. Here we present and discuss our investigation of the ultrafast non-equilibrium dynamics in different magnetic phases in CeSb with focus on the magnetic excitations. We confirm the presence of the recently reported [7] additional modes in the ground-state antiferromagnetic phase and show that their frequencies are magnetic-field independent. In the high-magnetic field ferromagnetic phase we identify a previously unobserved $^2E_{2g}$, Ce^{3+} crystal-field excited state. The associated coherent oscillatory optical response can be linked to the real-time quantum evolution of the superposition state involving the ground state and the $^2E_{2g}$ crystal field excited state.

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