Magnetic phase transition and soft mode behaviour in the systems with singlet ground state

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Abstract

The crystal field defined nonmagnetic (singlet) ground state is formed for the most of the rare earth intermetallic compounds with even number of f-electrons. Therefore a paramagnetic phase is stable up to the lowest temperatures for these systems. Nevertheless, some number of singlet ground state compounds demonstrates the ferro- or antiferromagnetic phase transition, that is in fact some kind of an ordering for a system of induced magnetic moments. According to the existing models for double singlet level system such transition should be induced by the temperature dependent soft magnetic mode. Nevertheless up to now such softening effect have not been observed experimentally.

In the present work the ferromagnetic phase transition has been studied on PrNi single crystal. This substance has low crystal symmetry resulting in complete lifting of the ground state multiplet degeneracy by crystal field and becoming ordered below 21K. This is a good example of the induced moment system. Neutron scattering experiments in the temperature range 22 K – 100 K show soft mode behaviour for one of excitation branches for some directions in Brillouin zone. Experimental data are analyzed quantitatively basing on MF-RPA model for two level system with exchange and crystal field.

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