Resonant x-ray magnetic scattering under hydrostatic pressure: pressurised magnetic order in Co doped $CeFe_2$

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Pressure in an important experimental parameter that can provide, via perturbation, information on the origin of the ground state. In strongly correlated electron systems such perturbations can result in changes that are manifested in the electronic behaviour and thus leads to very useful information. The technique of resonant x-ray magnetic scattering has been highly productive in the field of strongly correlated electron systems yet, to date, it has been impossible to probe the pressure, temperature phase space. A new pressure set-up on ID20, the resonant scattering beamline of the ESRF, is able to provide in-situ pressure and temperature variation to study the resonant x-ray magnetic scattering (RXMS) amplitudes in strongly correlated electron systems [1,2]. This is exemplified by a study on cobalt doped $CeFe_2$

The cubic Laves phase $CeFe_2$ is a rarity among the cubic laves phase $RareEarthFe_2$ family with the lowest Curie temperature T_c =230 K and the smallest saturation moment. Inelastic neutron scattering experiments reveal a coexistence of antiferromagnetic fluctuations in the ferrimagnetic ground state and these results show that the system is close to an antiferromagnetic instability [3]. Doping $CeFe_2$ with Co stabilises the antiferromagnetic state below T_N = 69 K for 7 %
with a rhombohedral crystallographic distortion. Via RXMS and neutron diffraction it was shown that the antiferromagnetic ground state of the doped sample has a non-collinear magnetic structure on the Fe sites. This is interpreted in terms of a competition between antiferromagnetic and ferrimagnetic excitations due to the frustration of the Fe non-collinear sublattice [4].

The application of hydrostatic pressure on cobalt doped $CeFe_2$ reveals a great sensitivity to this external parameter. For a 7 % doped system T_N is greatly enhanced reaching 130 K at 2 GPa. In contrast applying 1.6 GPa on a 10 % doped sample reduced T_N to 37 K from T_N = 75 K for 0.15 GPa. These results contradict recent work by Koyama *et al*. which found an increase in T_N with pressure at this doping level [5]. We shall remove the ambiguity between these two results and show that the application of pressure in $CeFe_2$ systems is analogous to doping. Thus these result open up the possibility to study an antiferromagnetic quantum critical point within a ferromagnetic state.

References

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