Unconventional Magnetism
Seminars

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Spin dynamics of the magnetocaloric compound $Mn_{5-x}Fe_xSi_3$

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Interest for the magnetocaloric effect (MCE) has been increasing in the last decades in view of applications for solid state room temperature refrigeration. Neutron scattering studies can bring important microscopic information on the spin and lattice dynamics of these systems and reveal key ingredients at play in their magneto-thermodynamics properties. In this context, experiments were performed on a model system $Mn_{5-x}Fe_xSi_3$ for x=0 and x=4, where large single crystal samples are available.

In the ferromagnetic compound $MnFe_4Si_3$ (T_c=305 K), which exhibits direct MCE, i.e. cooling by adiabatic demagnetization, the importance of short-range magnetic correlations as well as their suppression by a modest magnetic field is highlighted [1]. In the antiferromagnet compound Mn_5Si_3 showing inverse MCE, i.e. the cooling by adiabatic magnetization, it is shown that, among the two stable antiferromagnetic phases of this compound, the high temperature one (T_{N2}= 100 K) has an unusual magnetic excitation spectrum where propagative spin waves and diffuse spin fluctuations coexist. Moreover, it is evidenced that the inverse MCE of Mn_5Si_3 is associated with field induced spin fluctuations in relation with the transition between the two antiferromagnetic phases [2].

An important issue in MCE materials is the magnon-phonon coupling. While no clear hint for such effects has clearly been evidenced sofar in $Mn_{5-x}Fe_xSi_3$, another unusual feature is evidenced and the « ghost phonon » story of $MnFe_4Si_3$ will be told [3].

[1] N. Biniskos et al., Phys. Rev. B 96 (2017) 104407

[2] N. Biniskos et al., Phys. Rev. Lett. 120 (2018) 257205

[3] S. Raymond et al., arXiv:1812.02564