Thursday 13 December, 2 pm

The search for the lost entropy of CeB_6

Mehdi Amara

Institut Néel, Grenoble

Among the many puzzles of CeB_6, there is the question of its magnetic entropy. In the paramagnetic range, the entropy curves derived from specific heat measurements [1,2] are inconsistent with the fourfold degenerate, well isolated, crystal field ground state [3]. This question is solved thanks to new specific heat measurements together with a better description, in the cage context, of the phonons and crystal field contributions.

Accurate analysis of the antiferromagnetic transition shows that it is actually first-order, resulting in an entropy step at T_N. Starting from the characteristic dispersion curves of a cage system, an improved modelling of the phonons contribution is proposed. This gives a physical ground to the derivation of CeB_6 phonons specific heat from the LaB_6 reference data.

The obtained temperature variation for CeB_6 magnetic entropy is consistent with the fourfold crystal field ground state. However, starting from an entropy value of only 8 ≈ *R ln(2.6) J/K.mol* at the ordering temperature T_Q, it takes as much as 30 K to reach the quadruplet entropy (*R ln(4) J/K.mol*). This temperature scale fits with the simultaneous shift in the energy separation of the crystal field levels [3]. These phenomena are readily explained if one considers that the rare-earth movement splits the crystal field ground state. Accounting for this cage distributed crystal field yields a quantitative description of the temperature dependence of the paramagnetic entropy.

The example of CeB_6 shows that a specific treatment of the crystal field is required in rare-earth cage compounds.

[1] T. Fujita, M. Suzuki, T. Komatsubara, S. Kunii, T. Kasuya, and T. Ohtsuka, Solid State Communications 35, 569 (1980).

[2] Y. Peysson, C. Ayache, J. Rossat Mignod, S. Kunii, and T. Kasuya, Journal de Physique 47, 113 (1986).

[3] E. Zirngiebl, B. Hillebrands, S. Blumenröder, G. Güntherodt, M. Loewenhaupt, J. M. Carpenter, K. Winzer, and Z. Fisk, Phys. Rev. B 30, 4052 (1984).