MAR11-2010-006226

Abstract for an Invited Paper
for the MAR11 Meeting of
the American Physical Society

Thermal spin fluctuations in itinerant ferromagnets: Aspects of magnetic thermodynamics and transport properties

KIRILL BELASHCHENKO, University of Nebraska-Lincoln

The character of thermal spin fluctuations in itinerant ferromagnets is a long-standing problem. Our recent theoretical results offer new insights in this issue. First, I will discuss a classical effective spin model with both rotational and longitudinal spin fluctuations, which allows for a variable degree of itinerancy. Magnetic thermodynamics in this model was analyzed for fcc and bcc lattices using Monte Carlo simulations compared (favorably) with mean-field and generalized Onsager approximations. It was found that magnetic short-range order is relatively weak and almost independent on the degree of itinerancy. The ambiguity of the phase space measure will be emphasized. Next, I will discuss our first-principles calculations of spin-disorder resistivity (SDR) of Fe, Ni, and heavy rare-earth metals (Gd-Tm series), in which the Landauer conductance is explicitly averaged over spin disorder configurations. For Fe the SDR agrees very well with experiment. For Ni, comparison with experiment suggests that the average local moment in the paramagnetic state is reduced to $\sim$0.35 μ_B. The effect of magnetic short-range order on SDR is found to be weak in both Fe and Ni. Overall, the results suggest that thermal spin fluctuations in Fe and Ni have an effectively classical character. While the crystallographically averaged paramagnetic SDR for rare earth metals agrees quite well with experiments, its anisotropy systematically and significantly exceeds the available measurements. This discrepancy is critically evaluated, suggesting the need for additional experiments.

[1] A. L. Wysocki, J. K. Glasbrenner, and K. D. Belashchenko, Phys. Rev. B **78**, 184419 (2008).
[2] A. L. Wysocki, R. F. Sabirianov, M. van Schilfgaarde, and K. D. Belashchenko, Phys. Rev. B **80**, 224423 (2009).