Theory of enhanced thermopower by critical magnetic fluctuations

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Recent experiments by Sa Tu and Haiming Yu (Beihang University, Beijing) and collaborators, found[1] surprisingly large values of the Seebeck coefficient for magnetic films of IrMn close to their antiferromagnetic ordering temperatures. We discuss these results theoretically both in terms of weakly interaction electrons and also by adapting theories suitable for strongly interacting electrons developed primarily by Peter Wölfle and Elihu Abrahams
[2] in the context of heavy fermions close to a quantum critical point. This approach includes the effects of disorder, whose effects can be enhanced in the film geometry, and predicts a peaked form with a power law increase $(\frac{T-T_N)}{T_N})^{-\alpha}$ close to the Néel temperature T_N, with a small cut-off that determines the maximum value . In particular we comment on the possible rôle of dimensional crossover in determining the extremely large values of the Seebeck coefficient observed. The theoretical side of the work is developed with Peter Wölfle (Karlsruhe Institute of Technology) and Sadamichi Maekawa (Riken, Wako and KITS, Beijing), as well as our experimental collaborators.

[1] Sa Tu *et al.*, 'Record thermopower found in an IrMn-based spintronic devices', *submitted for publication*, Dec. 2019.

[2] E. Abrahams and P. Wölfle, 'Critical quasiparticle theory applied to heavy fermion metals near an antiferromagnetic quantum phase transition', PNAS **109**, 3238-3242 (2012)