Nuclear spin phase transition in the presence of interacting two-dimensional electrons

ROBERT ŽAK, University of Basel, DMITRII MASLOV, University of Florida, DANIEL LOSS, University of Basel — The recent study of the RKKY interaction between localized moments, e.g., nuclear spins of Ga and As atoms in a GaAs heterostructure, mediated by interacting two-dimensional electrons, has shown a possibility of polarizing nuclear spins at currently accessible temperatures [1]. This ferromagnetic phase transition is governed by: (i) anisotropy of the electron spin susceptibility, \( \chi \), in the presence of Rashba spin-orbit interaction (RSOI) and (ii) nonanalyticity in momentum dependence of \( \chi \). In this talk I will argue that on top of the anisotropy in \( \chi \) caused by the RSOI at zero momentum [2], the momentum dependence of \( \chi \) is anisotropic itself: while the linear scaling of \( \chi_{zz} \) with momentum saturates at the energy scale set by the RSOI, that of the \( \chi_{xx} = \chi_{yy} \) continues through this energy scale (in this way it resembles the temperature and magnetic field dependence of \( \chi \) in the presence of the RSOI [2]). The effect of the renormalization of the backscattering amplitude in the Cooper channel will be taken into account as well. In the end I will elaborate on possible implications of our results for the stability and nature of the nuclear spin ordered phase. References: [1] P. Simon and D. Loss, PRL 98, 156401 (2007), P. Simon, B. Braunecker, and D. Loss, PRB 77, 045108 (2008); [2] R. A. Žak, D. Maslov, and D. Loss, PRB 82, 115415 (2010).