Consistent theory of magnetism and superconductivity of iron pnictides

V. P.Antropov (Ames Laboratory, Ames, USA), M. I. Katsnelson (University of Nijmegen, Netherlands), M. van Schilfgaarde (Kings College, London, UK)

We show that iron pnictide systems possess unusual quantum spin fluctuations which strongly affect their magnetic properties and may be relevant for the mechanism of superconductivity. The fluctuations represent highly non-linear anharmonic excitations and have both transversal and longitudinal components which may contribute differently to the observed properties. From the point of view of magnetism these fluctuations are responsible for the stability of the observed magnetic ground states and thus determine the spin-wave spectra. The anharmonic character of the excitations under consideration provides a strong coupling with electron degrees of freedom which may be relevant for the appearance of high-temperature superconductivity. We discuss a spin fluctuation related mechanism of superconductivity which uses the same pool of fluctuations to explain the Cooper pairing. Theory predicts some correlations between superconductivity temperature and magnetic characteristics which seem to be in agreement with the available experimental data for the pnictides and selenides. We discuss also other materials where one can expect a similar behavior.