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Superconducting state of correlated metals

Richard Hlubina*[1], Juraj Mráz[2]

[1] *Comenius University, Bratislava, Slovakia*
[2] *IBL Software Engineering, Bratislava, Slovakia*

In strongly correlated electron systems, one of the main difficulties is caused by the fact that usually several symmetry breaking states appear as natural candidates for the ground state. This is so because, due to the large interaction strength, typically several mean field criteria for an instability are simultaneously satisfied. Unfortunately, mean field theory can not tell reliably which of the possible competing instabilities wins. This forces us to search for finer methods, taking into account also the correlations which are neglected at the mean field level. In the first part of this talk we will describe a recently developed method for calculating perturbative corrections to the mean field theory both in the particle-hole and particle-particle channels, which enables an unbiased comparison of various symmetry breaking states within the same approximation scheme.
In the second part of this talk we will discuss applications of our method to the superconducting state of correlated metals. We will present a microscopic theory of the T_c enhancement of the bilayer. We will discuss the quantum phase transitions between pairing states of different symmetry (both of the singlet-singlet and singlet-triplet type), which generically appear in the weak coupling limit. Finally, we describe our search of signatures of retardation effects in unconventional superconductors.

*also at International School for Advanced Studies (SISSA), Via Beirut 2-4, I-34014 Trieste, Italy

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