Fermion condensation in strongly interacting Fermi liquids

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ABSTRACT

The common approaches to describe the non-Fermi-liquid (NFL) behaviour in the strongly correlated fermion systems can be summarized by the phrase, that Landau quasiparticles become heavy and die. We propose other approach [1], in which the Landau quasiparticles also acquire very high (actually infinite) effective mass, but then survive changing their properties drastically. The essence of the approach is that Pomeranchuk conditions of LFL stability do not encompass all possible types of instability. This channel corresponds to the situation (related to the properties of Landau interaction amplitudes) when quasiparticle effective mass diverges. In this case, to avoid the unphysical situation with negative effective mass, the Fermi surface alters its topology so that the substance undergoes so - called fermion condensation quantum phase transition (FCQPT), leading to possibility of "fermion condensation" (FC), i.e. to the situation, where the fermions can occupy the same quantum state very similar to Bose-Einstein condensation.

In contrast to the standard Landau Fermi liquid (LFL) result that the quasiparticle effective mass is independent of external parameters like temperature, external magnetic field, pressure etc, the quasiparticle in FC state have their mass dependent on the above parameters. This dependence permits to explain theoretically many NFL peculiarities, inaccessible to other approaches, which do not utilise our extended quasiparticle picture.

References

[1] Amusia M. Ya., Popov K.G., Shaginyan V.R., and Stephanovich V.A. *Theory of Heavy-Fermion Compounds - Theory of Strongly Correlated Fermi-Systems*, Springer Series in Solid-State Sciences 182, (2014).