Seminar on Condensed Matter Theory

Group of Theoretical Physics at the Department of Condensend Matter Physics
of Charles University has a pleasure to invite you to attend the seminar

on 28 February 2019 at 13:00

at Faculty of Mathematics and Physics of Charles University, Ke Karlovu 5, 121 16 Praha 2

Seminar room F052

Prof. RNDr. Václav Janiš, DrSc.

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Mean-field theories for many-body systems: From Hartree to two-particle self-consistency

Mean-field approximation is the basic tool for getting overall insight into physical properties of many-body systems. The archetypal Landau mean-field theory of the critical behavior uses an expansion in the static, local order parameter around the critical point. A comprehensive mean-field approximation, however, aims at a global picture of equilibrium states in the whole range of the input parameters. This is usually achieved by an exact solution in a specific limit, such as long-range interaction or infinite lattice dimension. I will review in this talk various approaches to the construction of mean-field approximations.

For pedagogical reasons I will start with constructions of the mean-field approximation for the Ising model from which we derive its fundamental general characteristics and flaws: a self-consistent analytic, static, and local solution neglecting spatial fluctuations.

In the second part I will use the Hubbard model to explain the differences in the construction of mean-field approximations quantum dynamics brings in. I will derive the dynamical mean-field theory as the limit to infinite dimensions within the Baym and Kadanoff scheme of renormalizations the perturbation expansion. In the last part I will discuss options how to remove spurious critical behavior of static mean-field approximations by introducing renormalizations of the perturbation expansion for two-particle Green and response functions. The key element missed in the standard mean-field theories is a two-particle self-consistency. This will be introduced via the parquet approach within which, after suitable simplifications, one ends up with a static, local, semi-analytic theory free of unphysical behavior even in low dimensions.

For more information follow: theory.kfkl.cz/seminars.php
If you wish to receive regular updates on fothcoming seminars, contact T. Novotný (tno@karlov.mff.cuni.cz).