



LEZIONE LAGRANGIANA

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Weakly interacting fermions: mean-field and semiclassical regimes

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ABSTRACT: The derivation of effective macroscopic theories approximating microscopic systems of interacting particles is a major question in non-equilibrium statistical mechanics. For non-interacting particles this is a relatively easy task. However when particles interact among them, the many-body theory becomes very complicated and non-approachable from a computational viewpoint. In this lecture we will be concerned with the dynamics of systems made of many interacting fermions. We will focus on the mean-field regime, i.e. weakly interacting particles whose collective effect can be approximated by an averaged potential in convolution form, and review recent mean-field techniques based on second quantization approaches. As a first step we will obtain a reduced description given by the time-dependent Hartree-Fock equation. As a second step we will look at longer time scales where a semiclassical description starts to be relevant and approximate the many-body dynamics with the Vlasov equation, which describes the evolution of the effective probability density of particles on the one particle phase space and is largely used in plasma physics.

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