# From *ab initio* nuclear matter theory to the nuclear energy functional

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Density functional theory (DFT) is a powerful and versatile method in nuclear structure theory, with a wealth of application to ground state and collective excitations over the whole nuclear chart, as well as infinite nuclear matter [1]. The key object on which DFT is based on is the nuclear energy density functional (EDF). Current phenomenological EDFs, which are constrained by experimental measurements of nuclei close to magicity, are rather successful in reproducing stable nuclei. However, there are well-known shortcomings when they are applied e.g. to nuclei far from the stability valley of current interest for experimental nuclear physics and for their impact on modeling astrophysical scenarios. New strategies should thus be explored.

Our work aims at exploiting parallel developments in *ab initio* nuclear theory to devise a new methodology to build new EDFs. The motivation lies in the fact that *ab initio*, that describe nuclear systems starting from the interactions between their constituent nucleons, allows to determine the properties of nuclei and nuclear matter in a potentially unbiased way [2]. However, *ab initio* can be applied to heavy systems only in few selected cases and at a very high computational cost. Therefore, a combination of the flexibility of the DFT approach and the accuracy of *ab initio* has to be searched for.

Our strategy is based on constraining the EDF on infinite nuclear matter calculations . We target not only the equation of state (EOS), but also the response of nuclear matter to an external static potential. In our contribution, we will present our results obtained with Quantum Monte Carlo and how the DFT and *ab initio* static responses can be matched in order to fix the gradient contributions of the EDF. Then, developments of the *ab initio* Self-consistent Green's function (SCGF) approach in nuclear matter [6] shall be discussed.

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