IMPACT OF PAIRING CORRELATIONS ON THE CHEMICAL COMPOSITION OF THE INNER CRUST OF A NEUTRON STAR

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Neutron Stars are very fascinating objects since in their interior we can find nuclear matter under different conditions. Going from the outside toward the inside (from low to high density) we encounter the crust (outer/inner) and the core. The two extreme conditions are the crust and the core where we have isolate nuclei arranged in a crystal structure (low density) and a uniform Fermi liquid where protons and neutron move freely (high density). The crust is the interface region between these two regimes. Within the crust we find still nuclei, but surrounded by a gas of free neutrons. The effect of the interaction gas-nucleus give rise to very exotic systems that can not exist on Earth. The only valuable theoretical model used to describe such a complex system is the nuclear energy density functional (NDFT) theory. In principle, by using standard Hartree-Fock-Bogoliubov equation it would be possible trough a minimisation procedure (under β equilibrium) to determine the chemical composition of the crust for a given functional. Due to several technical aspect (that I will illustrate during the talk), it has not been possible to perform a complete and reliable calculation, most of them being based on semi-classical approximation of the basic HFB equations.

I will illustrate that using new numerical techniques it is possible to strongly reduce the numerical noise found during the minimisation procedure and thus performing a first fully microscopic HFB calculation of the star. By changing the parameter of the adopted pairing functio- nal, I will also show a systematic effect of pairing correlations on the distribution of the nuclear clusters within the star.