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Between Bose-Einstein condensate and fermionic superfluid.

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In the last couple of years we have witnessed a tremendous progress in the field of cold fermionic atoms. Ultra cold atomic gases provide a remarkable opportunity to investigate strongly correlated Fermisystems. They are dilute and their interactions can be precisely controlled over an enormous range. In particular, they form unique laboratories where the crossover between the Bose-Einstein condensate and the BCS superfluid can be explored. In this limit, which is relevant for the dilute neutron matter, the scattering length greatly exceeds the average inter-particle separations. Consequently, the system is believed to be strongly paired and the size of Cooper pairs is comparable to the Fermi wavelength.

On the theoretical side, our overall understanding of these remarkable many body systems has improved tremendously, even though many questions remain yet unanswered. During the talk I shall discuss the properties of dilute and strongly interacting Fermi system, emphasizing the link with the nuclear matter properties and the neutron star structure. I will discuss the equation of state for fermions in the so-called unitary regime, where the scattering length tends to infinity. The comparison with recent experiments concerning trapped atomic gases will be presented.

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