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Séminaire de Physique Nucléaire Théorique

Screening and antiscreening of the pairing interaction in neutron matter

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There are still large uncertainties about the density dependence of the critical temperature T_c for the onset of superfluidity in neutron matter. In this talk, I will revisit the effect of particle-hole (screening) corrections on the S-wave pairing at densities prevailing in the inner crust of neutron stars. At low densities, the repulsive effect of spin fluctuations leads to a strong reduction of T_c ompared to the BCS result, also seen in quantum Monte-Carlo calculations. However, I will show that at densities above 0.01-0.02 fm^{-3}, the attractive density fluctuations win against the repulsive spin fluctuations if realistic values for the Landau parameters are employed, leading to antiscreening rather than screening, i.e., to an enhancement of T_c. Then I will discuss the limit of low densities. In this limit, the celebrated Gorkov-Melik-Barkhudarov result, based on a weak-coupling formula, predicts a reduction of T_c by a factor of 0.45. However, if one wants to reproduce this result by solving the gap equation with the screened pairing interaction, it turns out to be necessary to use renormalization-group evolved interactions with cutoffs that scale with the Fermi momentum k_F. Finally, I will briefly discuss the reduction of T_c that one obtains by including, in addition to screening, the effect of pairing fluctuations in the framework of the Nozières-Schmitt-Rink theory.

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