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SEMINAIRE IPCMS

From Ultracold Fermi Gases to Neutron Stars

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In the recent years ultracold atomic gases have been used to probe some fundamental questions in Many-body Physics. Thanks to the high degree of control of cold atoms using laser fields and magnetic fields, new insights on key problems from condensed matter systems has been gained. In this talk, we will provide one such example through the measurement of the equation of state of strongly interacting Fermi gases [1,2]. The tunability of the interaction between atoms enables one to connect the regime of superfluidity of weakly bound Cooper pairs described by BCS theory to the regime of strongly bound molecular pairs forming a Bose-Einstein condensate. The phase diagram of the dilute Fermi gas has been established experimentally and comparison with advanced many-body theories has revealed several surprises. Our equation of state can be directly used to describe the outer shell of neutron stars despite of 24 orders of magnitude difference in matter density and 14 orders of magnitude in temperature.

[1] S. Nascimbène, N. Navon, K. J. Jiang, F. Chevy, and C. Salomon, Exploring the thermodynamics of a universal Fermi gas, arXiv:0911.0747, Nature, **463,** 1057 (2010)

[2] N. Navon, S. Nascimbène, F. Chevy, and C. Salomon, The Equation of State of a Low Temperature Fermi Gas with Tunable Interaction, Science **328**, 729 (2010)

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