

Plenary Talk

PV VI Wed 9:50 PV-Rooms

A Bose-Fermi Double Superfluid Mixture — ●CHRISTOPHE SALOMON — LKB, Physics Department of ENS, 24 rue Lhomond, 75005 Paris

In recent years, ultra-cold atoms have established a very fruitful connection with condensed matter physics, nuclear physics, and astrophysics. Thanks to the tunability of atomic systems, Bose and Fermi gases can be brought to the strongly correlated regime and simulate outstanding problems in quantum many-body physics. One of them deals with the possibility to produce a mixture of Bose and Fermi superfluids, a long-standing challenge in Helium 4 -Helium 3 mixtures. Using lithium 7 and lithium 6 isotopes, we have produced a quantum gas mixture where both the Bose species and the Fermi species are

superfluid [1]. We probe the collective dynamics of this system by exciting center-of-mass oscillations that exhibit extremely low damping below a certain critical velocity. Using high precision spectroscopy of these low-lying modes we observe coherent energy exchange and measure the coupling between the two superfluids. We have also measured the critical velocity for superfluid counterflow. In the phonon-dominated regime and for weak Bose-Fermi coupling, the critical velocity is predicted to be given by the sum of the sound velocities in the Bose gas and in the Fermi gas [2]. In some parameter range of the BEC-BCS crossover, our observations are consistent with this prediction.

[1] I. Ferrier-Barbut, M. Delehay, S. Laurent, A.T. Grier, M. Pierce, B.S. Rem, F. Chevy, C. Salomon, *Science* 345, 1035 (2014)

[2] Y. Castin, I. Ferrier-Barbut, and C. Salomon, ArXiv 1408.1326