Counterflowing superlfuid mixtures

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Abstract

Since the discovery of superfluid 3He in 1972, the realization of a doubly-superfluid Bose-Fermi mixture has been one the major goals in the field of quantum liquids. However, due to strong repulsive interactions between helium atoms, the fraction of 3He inside 4He cannot exceed 6%. This high dilution of the fermionic species reduces dramatically its critical temperature from 2.5 mK for pure 4He to a predicted value of 40 K in the mixture. Despite decades of efforts, this range of temperature is still inaccessible to experimental investigation and has prevented the observation of a dual superfluid phase in liquid helium. In cold atoms however, Feshbach resonances make it possible to control the strength of interatomic interactions and realize stable Bose-Fermi mixtures. In my talk I will discuss the physical properties of weakly-coupled superfluid mixtures of 6Li and 7Li [1]. Superfluidity was revealed by the existence of a critical velocity below which the relative motion of the two species is undamped and the energy transfer between the two gases is coherent. We could interpret this critical velocity using a generalized Landau mechanism in which excitations are shed in both superfluids. [1] I. Ferrier-Barbut et al., Science 345, 1035 (2014)

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