When Impurities Meet Efimov Physics: Fermion-Mediated Pairing in a Quantum Gas

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ABSTRACT

Interactions mediated by a surrounding medium appear across physics, from magnetic impurities in metals to few-body bound states in nuclear systems. Two well-known examples are the Ruderman–Kittel–Kasuya–Yosida (RKKY) interaction, where fermions induce correlations between impurities, and Efimov physics, which describes universal three-body bound states near resonant interactions. These phenomena are usually studied in very different physical regimes.

In this talk, I will show how ultracold Bose–Fermi mixtures connect these two limits. Using a mixture of bosonic cesium and fermionic lithium atoms with tunable interactions, we explore the crossover from weakly interacting, RKKY-like behavior to strongly interacting Efimov physics. Measurements of collective excitations and relaxation dynamics reveal fermion-mediated scattering resonances in the many-body system, which continuously evolve into Efimov resonances in the dilute thermal regime, highlighting the interplay of two-, three-, and many-body physics in a single quantum platform.