Polaron physics with quantum gases

A talk by Jacques Tempere

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DATE / TIME: Monday, May 30th 2016, 4:00 p.m.

LOCATION: Erwin-Schrödinger Lecture Hall, 5th floor, Boltzmanngasse 5, 1090 Vienna

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The polaron concept was introduced in the context of electrons in a polar medium. The electron distorts the surrounding polar medium through the electron-phonon coupling, and the resulting quasiparticle acquires a larger effective mass. In solids, this polaron manifests itself through a typical spectral profile in optical absorption measurements. The theoretical descriptions for the polaron absorption agree at low electron-phonon coupling, but there are still unresolved issues regarding strong coupling, as well as regarding the crossover between weak and strong coupling. Recently, the advent of ultracold quantum gases has allowed to create idealized realizations of many condensed matter models. The tunability of these quantum gases turns these systems into versatile quantum simulators for many models, including the Fröhlich polaron. This has intensified the search for the strong-coupling regime, elusive in solids. In this contribution, I review the theory for the Bose-polaron (an impurity placed in a Bose-Einstein condensate), highlighting our own contributions, and I discuss the first recent experimental results.