# Deeply bound polaronic states

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The physics of strongly interacting quantum systems remains a central challenge in many-body physics. We explore this regime by creating impurities with strong attractive or repulsive interactions in a quantum-degenerate gas of 39K atoms. This system supports two well-known quasiparticles: attractive and repulsive polarons. I first review previous spectroscopic and interferometric measurements of these states. Ramsey interferometry reveals distinct dynamical regimes associated with polaron formation and demonstrates how many-body states can be probed in the time domain.

More recently, we employed an ejection spectroscopy sequence that reveals a pronounced spectral feature at energies well below the polaron energy. We measure both the energy and spectral weight of this signal and compare our results to two theoretical scenarios: a low-energy polaron dressed by many bosons, and a bipolaron formed by two polarons bound via BEC-mediated interactions. Our observations provide evidence for deeply bound states below the conventional polaron branch, opening new perspectives on strong coupling physics in Bose gases.