SFB/TRR 21 - Seminar

5. Juni 2015, Stuttgart

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Decoherence of impurities in ultracold quantum gases

In this talk I will present our ongoing work on the decoherence of an impurity subject to the interaction with a bath of ultracold atoms and the corresponding spectral signatures. We study the question under which conditions a heavy impurity immersed in a Fermi liquid is subject to the orthogonality catastrophe with its resulting edge singularities and complete loss of coherence. For infinite mass, the quasi-particle weight of the impurity vanishes in all dimensions. While in one spatial dimension this result also holds for an impurity of finite mass, theoretical predictions in d=2 are not conclusive. We study the finite-mass corrections to the non-equilibrium dynamics of an impurity in a gas of lattice fermions after an interaction quench and calculate the time-dependent Ramsey interference signal using a novel hybrid approach which combines path integral and functional determinant methods. We find that a finite quasi-particle peak persists in d $\geq$ 2 in agreement with previous work and explore the influence of finite temperature. Using a similar microscopic approach we also study the time evolution of a Bose-Einstein-Condensate after the excitation of a Rydberg atom. The systems undergoes a non-equilibrium time evolution resulting in the formation of a sequence of giant molecular bound states. We determine the Ramsey signal, predict the absorption spectra of the system and comment on related experimental observations.

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