Fermi and Bose polarons in ultracold gases: universal concepts and key differences

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Impurities immersed in a quantum bath form quasiparticles called polarons. I will start revising the properties of dilute impurities in a Fermi sea, which are by now fairly well understood. Then I will switch to impurities in a dilute BEC, where the absence of Pauli blocking favours correlations between the impurity and multiple excitations in the medium, making their description particularly complex. I will present some general and exact thermodynamic relations, and I will discuss the Gross-Pitaevskii description of Bose polarons, which permits to characterize self-consistently heavy impurities surrounded by large dressing clouds.

[1] "Polarons in atomic gases and two-dimensional semiconductors", P. Massignan, R. Schmidt, G.E. Astrakharchik, A. İmamoglu, M. Zwierlein, J.J. Arlt, and G.M. Bruun, arXiv:2501.09618 (long review paper, to be published in Rev. Mod. Phys.)