Abstract Submitted
for the DAMOP20 Meeting of
The American Physical Society

Theory of radio-frequency spectroscopy of impurities in quantum gases[1] WEIZHE LIU, ZHE-YU SHI, MEERA PARISH, JESPER LEVINSEN, School of Physics and Astronomy in Monash University — We present a theory of radio-frequency spectroscopy of impurities interacting with a quantum gas at finite temperature. We show that the impurity spectral response is directly connected to the finite-temperature equation of state (free energy) of the impurity. We consider two different response protocols: injection, where the impurity is introduced into the medium from an initially non-interacting state; and ejection, where the impurity is ejected from an initially interacting state with the medium. We show that there is a simple mapping between injection and ejection spectra, which is connected to the detailed balance condition in thermal equilibrium. We specialize in the case of the Fermi polaron, corresponding to an impurity atom that is immersed in a non-interacting Fermi gas. For a mobile impurity with a mass equal to the fermion mass, we find a striking non-monotonic dependence on temperature in the impurity's free energy, the contact, and the radio-frequency spectra. For the case of an infinitely heavy Fermi polaron, we derive exact results for the finite-temperature free energy, thus generalizing Fumis theorem to arbitrary temperature.

[1]J. L., Z. Y. S., and M. M. P. acknowledge support from the Australian Research Council via Discovery Project No. DP160102739. W. E. L., J. L. and M. M. P. acknowledge support from the Australian Research Council Centre of Excellence in Future Low-Energy Electronics Technologies (Grant No.CE170100039). J. L. is supported through the Australian Research Council Future Fellowship No. FT160100244.

Weizhe Liu
School of Physics and Astronomy in Monash University

Date submitted: 29 Jan 2020 Electronic form version 1.4