ID de Contribution: **43** Type: **Non spécifié**

Dynamics and energetics of fermionic impurities in a Bose Einstein condensate from moderate to near resonant interactions as they approach quantum criticality (ONLINE presentation)

jeudi 16 septembre 2021 13:00 (1 heure)

Mixtures of quantum fluids lie at the forefront of research into strongly-correlated quantum matter. In this talk I will explore the rich many-body phase diagram of the Bose-Fermi mixture in the impurity limit by immersing fermionic impurities in a Bose-Einstein condensate (BEC) with near-resonant interactions.

I will describe an experiment, where we create Bose polarons near quantum criticality and probe their energy, spectral width, and short-range correlations as a function of temperature. We observe their inverse lifetime, determined via spectral width, to increase linearly with temperature at the Planckian scale, a hallmark of quantum critical behavior.

I will further present a study of dynamics of spin-polarized fermionic impurities immersed in a superfluid BEC through their collective excitations. We observe a dissipationless flow of the fermionic impurities, even as the mixture enters the strong-coupling regime where the impurities inherit the hydrodynamic modes of the BEC. We further probe the systems response as a function of temperature observing the fermions' transition from the collisionless to the hydrodynamic regime right at the superfluid transition temperature. Our experiments demonstrate the ability to pristinely control the fluid dynamics of a Bose-Fermi mixture in a dual-species ultracold atomic gas experiment.

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