



THE CHINESE UNIVERSITY OF HONG KONG
Department of Physics
SEMINAR

Generation of $^{23}\text{Na}^{40}\text{K}$ Polar Molecules in the Quantum Degenerate Regime

by

Dr. Xin-Yu LUO (羅鑫宇博士)

Max Planck Institute of Quantum Optics, Germany

Date: *July 5, 2021 (Monday)*

June 28, 2021 (Monday)

Time: 4:00 - 5:00 p.m.

Join ZOOM Meeting: <https://cuhk.zoom.us/j/92046435238>



ALL INTERESTED ARE WELCOME

Abstract

Bose-Fermi mixtures of ultracold atoms exhibit a rich phase diagram ranging from polarons, p-wave superfluid to molecules formation. Due to severe collisional losses, the phase diagram in the strongly-interacting regime was rarely explored in experiments except in the impurity limit. Here, we observe a predicted transition from a polaronic phase to a molecular phase in a density-matched mixture of a sodium Bose-Einstein condensate (BEC) and a Fermi gas of potassium. We eliminate the detrimental losses by selectively decompressing the BEC in a species-dependent dipole trap. As a result, the majority of the sodium BEC can be converted into $^{23}\text{Na}^{40}\text{K}$ Feshbach molecules below 0.3 of the Fermi temperature. We characterize the transition by directly measuring the depletion of the condensate. Intriguingly, the remained BEC fraction reproduces the quasi-particle weight of Fermi polarons. Reversing the transition partially restores the sodium BEC from the Fermi degenerate gas of Feshbach molecules. Finally, we produce 30000 $^{23}\text{Na}^{40}\text{K}$ ground-state molecules in the quantum degenerate regime by coherently transferring from the Feshbach molecules via stimulated Raman adiabatic passage. Our work does not only provide a good starting point to explore novel spin models with strong dipolar interactions, but also open up the possibilities of exploring the long-sought rich phase-diagram of Bose-Fermi mixtures.