
Seminar

Fluid-Insulator transitions in a system of interacting Bose gas in 1D disordered lattices

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Several open questions about the nature of quantum phase transitions in condensed matter systems can now be addressed from an entirely new perspective in experiments with quantum gases owing to the unprecedented controllability over inter-particle interaction and geometry of external confinement. One such example is the understanding of the complex interplay between interaction and disorder leading to various quantum phases, such as superfluid, Mott insulator, Anderson insulator and Bose-glass.

In this seminar, I shall discuss about our recent experimental results where we investigate the momentum-dependent transport of an array of ^{39}K quasi-condensates in a disordered optical lattice potential. We observe a sharp cross-over from a weakly dissipative to a strongly unstable regime at a disorder strength dependent critical momentum. We identify a set of critical disorder and interaction strengths for which such critical momentum vanishes separating a fluid regime from an insulating one. These set of critical points in disorder-interaction phase diagram agrees well with the predicted zero-temperature superfluid-Bose glass transition.

A natural extension of these experiments is to employ long-range interactions between dipolar molecules in disordered optical lattices. Long-range and anisotropic interaction in dipolar quantum gases is in contrast with contact interactions in atomic Bose-Einstein Condensates and can be used as an additional control parameter to reveal a large phase-space in quantum many body theories. I shall outline our activity in upgrading the experiment to prepare ground-state ^{39}K - ^{87}Rb molecules. In particular, I shall present the design and implementation of the optical frequency comb based STIRAP laser system we have prepared for the ground state transfer. Preparing quantum degenerate ground state molecules with permanent electric dipole moment requires good understanding of molecular potentials. In this context, I shall also discuss about our previous results from ^6Li - ^{40}K cold molecular spectroscopy experiment.

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11:30 AM (Tea/Coffee at 11:15 AM)

Seminar Hall, TCIS