1D Ultradilute Quantum Droplets in Driven Bi-periodic Optical Lattices

Contributed Talk

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Quantum droplets (QDs) represent a novel liquid phase with densities up to eight orders of magnitude lower than liquid helium droplets, exhibiting unique properties such as stable self-localization and liquid-like behavior at zero temperature. These droplets have been experimentally realized in single-component dipolar systems and Bose-Bose BEC mixtures [1]. Leveraging their inherent nonlinearity [2,3], this study explores the dynamics of 1D QDs in the presence of tilted and driven engineered bi-chromatic optical lattices (BOL), focusing on their out-of-equilibrium behavior under strong dc and ac fields [4]. Under a dc field, QDs exhibit stripe-like temporal patterns, whereas an ac field induces periodic and bi-periodic oscillations in density waves. Furthermore, time-dependent modulation of the BOL potential depth generates harmonics in the condensate's density oscillations. Fast Fourier Transform (FFT) analysis reveals that these harmonics comprise multiple and combined frequencies, suggesting applications for generating targeted frequency combs in QDs. Finally, we propose a novel approach to measure the temperature of QDs formed within the BOL.

References

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