Hybrid dynamics of an optical field and a Bose-Einstein condensation

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Optical fields have played a critical role in manipulating ultracold atomic or molecular gases for precision measurement and quantum emulation. However, in most of these researches, the local field effect (or the feedback effect) of ultracold gases on the opticla field propagation has been ignored. However, our receny research [1–3] shows that including the feedback effect, the optical field progation and matter wave dyanamics cannot be separated, i.e., we enter a regime that hybrid dynamics of the optical field and the matter wave is dominant. Using our theory, we have succesfully explained asymmetric matter wave diffraction observed by Le et al. [4], and predicted polaritonic solitons in a soft optical lattice. Most recently, we further have proposed magnetic local field effect [3] which deals with the hybrid dynamcis of a spinor gas and a microwave field, and predicted the gneration of monopole-like subwavelength microwave soliton and matter wave soliton which could be useful for realizing atomic laser. Our thoery of hybrid optical wave and matter wave could be further extended to study precision measurement, to study polariton in far-off resonant regime and to study the subwavelength phenomena.

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