

Partially coherent matter wave soliton solutions_ Multimode theory

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In a realistic system, the ultra cold Bose gases can be considered as partially coherent matter wave (PCMW). To analyze the dynamics of PCMW, many theoretic models have been presented. Most of them rely on the assumption that the zero momentum state is macroscopically populated and atoms in all other states are small perturbations. These models work well when the temperature is well below the critical temperature T_c , but if the temperature increases to around or slightly above T_c , it is not such appropriate to use the above assumption since the influences from other states can not be regarded as small perturbations.

Inspired by the similarity between the physics of the interacting Bose gas and that of light in nonlinear medium, we present a multimode theory to deal with the nonlinear evolution of PCMW. We find that in some condition analytic soliton solutions of PCMW exist. We also analyze the coherence properties of them.