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**Nonlinear Excitations of Bose-Einstein Condensates  
with Higher-order Interaction**

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Abstract:

We use a Gross-Pitaevskii equation comprising cubic, residual, and quintic nonlinearities to examine the modulational instability (MI) of Bose-Einstein condensates at higher densities in the presence of higher-order interaction. We obtain an explicit time-dependent criterion for the MI and the instability domains of the condensates. Localized nonlinear excitations are generated by suitably exciting the MI. We find that higher-order interaction can completely change the instability of condensates by reversing the nature of the effective two-body interactions. The interplay between three-body interactions and higher-order interaction is shown. Numerical simulations are performed to support our analytical predictions.