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Condition for the existence of complex modes in a trapped Bose-Einstein condensate with a highly quantized vortex MAKOTO MINE, ERIKO FUKUYAMA, Department of Physics, Waseda University, MASAHIKO OKUMURA, Japan Atomic Energy Agency, and CREST (JST), TOMOKA SUNAGA, Department of Physics, Waseda University, YOSHIYA YAMANAKA, Department of Electronic and Photonic Systems, Waseda University — We consider a trapped Bose-Einstein condensate (BEC) with a highly quantized vortex. For the BEC with a doubly, triply, or quadruply quantized vortex, the numerical calculations have shown that the Bogoliubov-de Gennes equations, which describe the fluctuation of the condensate, have complex eigenvalues. In this talk, we show the analytic expression of the condition for the existence of complex modes, using the method developed by Rossignoli and Kowalski[1] for the small coupling constant. To derive it, we make the two-mode approximation. With the derived analytic formula, we can identify the quantum numbers of the complex modes for each winding number of the vortex[2]. Our result is consistent with those obtained by the numerical calculation in the case that the winding number is two, three, or four. We prove that the complex modes always exist when the condensate has a highly quantized vortex[2].

[1] R. Rossignoli and A. M. Kowalski, Phys. Rev. A **72**, 032101 (2005).
[2] E. Fukuyama, M. Mine, M. Okumura, T. Sunaga and Y. Yamanaka, Phys. Rev. A **76**, 043608 (2007).

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