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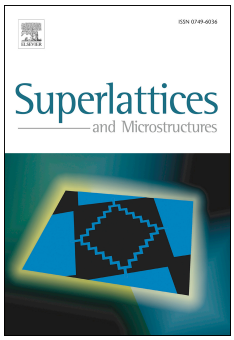

Dark and bright soliton solutions for a three-dimensional Gross-Pitaevskii equation with distributed time-dependent coefficients in the Bose-Einstein condensation

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PII: S0749-6036(16)31594-4

DOI: 10.1016/j.spmi.2017.01.005

Reference: YSPMI 4768

To appear in: *Superlattices and Microstructures*

Received Date: 25 November 2016

Revised Date: 3 January 2017

Accepted Date: 3 January 2017

Please cite this article as: L. Liu, B. Tian, H.-L. Zhen, X.-Y. Wu, W.-R. Shan, Dark and bright soliton solutions for a three-dimensional Gross-Pitaevskii equation with distributed time-dependent coefficients in the Bose-Einstein condensation, *Superlattices and Microstructures* (2017), doi: 10.1016/j.spmi.2017.01.005.

Dark and bright soliton solutions for a three-dimensional Gross-Pitaevskii equation with distributed time-dependent coefficients in the Bose-Einstein condensation

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Abstract

Under investigation in this paper is a three-dimensional Gross-Pitaevskii equation with the distributed time-dependent coefficients, which describes the phenomena associated with the three-dimensional Bose-Einstein condensation. Under the constraint $\alpha(t) = 2\beta(t)$, we obtain the bilinear forms, dark and bright N-soliton solutions via the Hirota method and symbolic computation, where t is the time, $\alpha(t)$ and $\beta(t)$ are the coefficients for the strength of the quadratic potential and diffraction, respectively. Specially, compared with the bright soliton solutions previously reported , we decrease one constraint and obtain more soliton parameters. We give the existence constraints of the dark N solitons and bright N solitons, respectively. Choosing the diffraction and gain/loss coefficients, we observe the growth, decay, periodic oscillation, periodic collapse and revival of the dark and bright solitons. Relationships between the BEC time-dependent coefficients and soliton properties are studied. With the help of the asymptotic and graphic analysis, elastic interactions of the dark and bright two solitons are exhibited.

Keywords: Three-dimensional Gross-Pitaevskii equation; Bose-Einstein condensation; Soliton solutions; Symbolic computation; Hirota method

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