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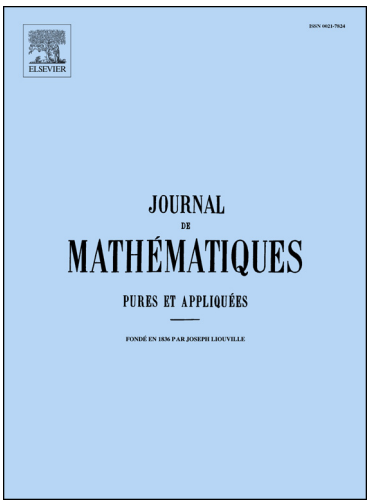

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PII: S0021-7824(17)30061-2
DOI: http://dx.doi.org/10.1016/j.matpur.2017.05.013
Reference: MATPUR 2895

To appear in: *Journal de Mathématiques Pures et Appliquées*

Please cite this article in press as: P.T. Nam, M. Napiórkowski, A note on the validity of Bogoliubov correction to mean-field dynamics, *J. Math. Pures Appl.* (2017), http://dx.doi.org/10.1016/j.matpur.2017.05.013

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A note on the validity of Bogoliubov correction to mean-field dynamics

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Abstract

We study the norm approximation to the Schrödinger dynamics of N bosons in $\mathbb{R}^3$ with an interaction potential of the form $N^{3\beta-1}w(N^\beta(x-y))$. Assuming that in the initial state the particles outside of the condensate form a quasi-free state with finite kinetic energy, we show that in the large N limit, the fluctuations around the condensate can be effectively described using Bogoliubov approximation for all $0 \leq \beta < 1/2$. The range of β is expected to be optimal for this large class of initial states.

Résumé: Nous étudions l'approximation en norme de la dynamique de Schrödinger de N bosons dans $\mathbb{R}^3$ interagissant via un potentiel de la forme $N^{3\beta-1}w(N^\beta(x-y))$. En supposant qu'au temps initial les particules en dehors du condensat forment un état quasi-libre d'énergie cinétique finie, nous montrons que, dans la limite où N devient grand, les fluctuations autour du condensat peuvent être effectivement décrites par l'approximation de Bogoliubov, et ce pour tout $0 \leq \beta < 1/2$. On conjecture que cette restriction sur β est optimale pour cette classe d'états initiaux.

Keywords: Quantum dynamics, Mean-field limits, Bogoliubov theory
MSC: 35J10,, 35Q40,, 35Q55,, 81Q05

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