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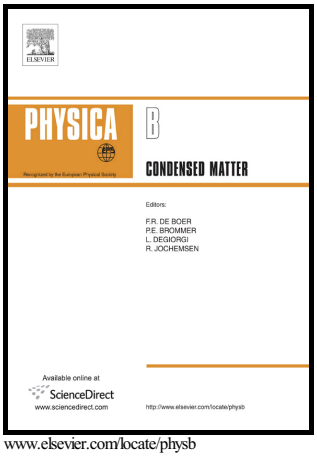
Daniele Colognesi



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Microscopic self dynamics in liquids: connections between the Gaussian approximation and the asymptotic impulsive regime

Daniele Colognesi*[1]

[1] *Consiglio Nazionale delle Ricerche, Istituto dei Sistemi Complessi, via Madonna del Piano 10, I-50019 Sesto Fiorentino, Italy.*

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Abstract

In this paper we have studied the Gaussian approximation and its violation when applied to quantum fluids. Deviations from the Gaussian approximation, the so-called non-Gaussian effects, have been presented in a very general framework and subsequently compared to the final state effects, i.e. the differences between the exact single-particle response function and the well-known impulsive approximation. We have shown that, similarly to final state effects, non-Gaussian effects too can be expressed as a power series of the inverse momentum transfer, where the first two terms can be approximately calculated making use of equilibrium properties of the system. Finally, we have accomplished a practical test on experimentally measured non-Gaussian effects in liquid parahydrogen (at $T = 15.7$ K and $n = 22.53$ nm^{-3}) by comparing them with the mentioned power series calculations. However, the agreement between the two data sets turned out to be rather poor, except for a general intensity level. The origin of this discrepancy is not evident at the moment and further tests on these physical quantities seem highly needed.

keywords: Quantum fluids; Microscopic liquid dynamics; Inelastic neutron scattering.

* Corresponding author. Tel.: +39-055-5226681; Fax: +39-055-5226683; E-mail: daniele.colognesi@isc.cnr.it