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Nonextensive entropy of quantum liquid in fractal dimension space

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Abstract

There are several approaches to describe the behavior of superfluid helium-4. For example, two-fluid model, the microscopic description based on the Gross-Pitaevskii equation and one-fluid theory in the framework of extended thermodynamics. Recently the observable peculiarities of quantum liquids behavior in the confined geometries (nanopores, aerogels, etc.) have caused the interest to the correct description of quantum liquids at nanoscale. The fractal geometry and the effects of huge inner surface area should be taken into account to describe dynamics and thermodynamics of liquid helium-4 inside nanoporous media. In the present paper we propose a two-fluid hydrodynamic model in fractal dimension space on the basis of a nonextensive entropy and energy approach. In the framework of this model the coupling between temperature and pressure oscillations ("sound modes conversion") due to fractal geometry is found. © 2009 Springer Science+Business Media, LLC.

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Keywords

Fractal, Helium-4, Non-extensive thermodynamics, Restricted geometry, Sound modes, Superfluidity