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ON THE UNCERTAINTY RELATIONS IN STOCHASTIC MECHANICS

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Abstract.

It is shown that the Bohm equations for the phase S and squared modulus ρ of the quantum mechanical wave function can be derived from the classical ensemble equations admiting an aditional momentum p_s of the form proportional to the osmotic velocity in the Nelson stochastic mechanics and using the variational principle with appropriate change of variables. The possibility to treat grad$S$ and p_s as two parts of the momentum of quantum ensemble particles is considered from the view point of uncertainty relations of Robertson - Schrödinger type on the examples of the stochastic image of quantum mechanical canonical coherent and squeezed states.

1. Introduction

The uncertainty (indeterminacy) principle in quantum physics, which quantitatively is expressed in the form of uncertainty relations (URs) [13, 14, 24, 25] is commonly regarded as the most radical departure from the classical physics.

However in the recent decades publications have appeared [5, 11, 12, 21, 23] in which inequalities are introduced in Nelson stochastic mechanics (SM) [19] and discussed as Heisenberg-type URs. The equations of motion in this mechanics coincide with the David Bohm equations [1] (the continuity equation and the modified Hamilton-Jacobi equation, the latter known also as Hamilton-Jacobi-Madelung (HJM) equation) for the phase S and squared modulus $|\psi|^2 \equiv \rho$ of the Schrödinger wave function ψ. Bohm equations for S and ρ have been later derived from 'the stochastic variational principles of control theory' by Guerra and Marra [9], and by Reginatto [23], using the 'principle of minimum Fisher information' [6].