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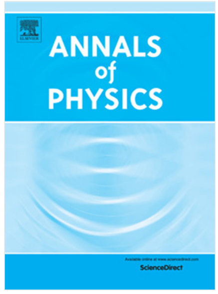

Quantum formalism for classical statistics

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Quantum formalism for classical statistics

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In static classical statistical systems the problem of information transport from a boundary to the bulk finds a simple description in terms of wave functions or density matrices. While the transfer matrix formalism is a type of Heisenberg picture for this problem, we develop here the associated Schrödinger picture that keeps track of the local probabilistic information. The transport of the probabilistic information between neighboring hypersurfaces obeys a linear evolution equation, and therefore the superposition principle for the possible solutions. Operators are associated to local observables, with rules for the computation of expectation values similar to quantum mechanics. We discuss how non-commutativity naturally arises in this setting. Also other features characteristic of quantum mechanics, such as complex structure, change of basis or symmetry transformations, can be found in classical statistics once formulated in terms of wave functions or density matrices. We construct for every quantum system an equivalent classical statistical system, such that time in quantum mechanics corresponds to the location of hypersurfaces in the classical probabilistic ensemble. For suitable choices of local observables in the classical statistical system one can, in principle, compute all expectation values and correlations of observables in the quantum system from the local probabilistic information of the associated classical statistical system. Realizing a static memory material as a quantum simulator for a given quantum system is not a matter of principle, but rather of practical simplicity.