Quantum transport models based on Tsallis statistics

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In early 2000's, Degond and Ringhofer developed a comprehensive approach for the derivation of quantum hydrodynamic models from first principles [2, 3]. Starting from the collisional quantum Liouville equation they derive a whole hierarchy of moment models, where the moment model is closed by the constrained entropy minimization principle. The entropy is von Neumann (quantum Boltzmann) entropy and constraints are moments given in terms of local quantities (density, energy, etc.). As a consequence of the quantum nature, the resulting models are nonlocal. Our work extends this approach to the constrained minimization of quantum Tsallis entropies in the context of Tsallis statistics [1], where the moments are calculated by nonlinear means. In particular we derive the corresponding drift-diffusion and energy transport models. Furthermore, thanks to expansions in terms of the scaled Planck constant, analogously to [3], we also derive localized models given in terms of fourth-order evolution equations.

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References

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