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Uncertainty Principle Consequences on Thermal Equilibrium Thermodynamics JOHAN TRIANA GALVIS, LEONARDO PACHON CONTRERAS, Univ de Antioquia, DAVID ZUECO, Univ de Zaragoza, PAUL BRUMER, Univ of Toronto — In the framework of classical mechanics, it is shown that the thermal equilibrium distribution of a system interacting via central forces with a non self-interacting environment, irrespectively of the interaction strength, is exactly characterized by the canonical Boltzmann distribution. In the framework of quantum mechanics, we show that the fundamental constraints on the contraction of the phase-space volume, imposed by the uncertainty principle, not only inhibits the system thermal-equilibrium-state to be described by the canonical Boltzmann distribution but also it is the responsible of the failure of the Onsager's regression hypothesis and a violation of the KMS condition. Furthermore, as a consequence of this analysis, we discuss the emergence of an *effective coupling* to the environment that depends on all the energy scales involved in the system and reservoir interaction. This effective coupling defines a new quantum limit and has immediately consequences: (i) For the case of strong effective coupling, the system thermal equilibrium state does not match into the canonical distribution and (ii) For the case of weak effective coupling, quantum fluctuations are able to maintain, e.g., stationary entanglement at higher temperatures.

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