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Statistical Mechanical Proof of the Second Law of Thermodynamics based on Volume Entropy MICHELE CAMPISI, University of North Texas — As pointed out in [M. Campisi. Stud. Hist. Phil. M. P. 36 (2005) 275-290] the volume entropy (that is the logarithm of the volume of phase space enclosed by the constant energy hyper-surface) provides a good mechanical analogue of thermodynamic entropy because it satisfies the heat theorem and it is an adiabatic invariant. This property explains the "equal" sign in Clausius principle ($S_f \geq S_i$) in a purely mechanical way and suggests that the volume entropy might explain the "larger than" sign (i.e. the Law of Entropy Increase) if non adiabatic transformations were considered. Based on the principles of quantum mechanics here we prove that, provided the initial equilibrium satisfy the natural condition of decreasing ordering of probabilities, the expectation value of the volume entropy cannot decrease for arbitrary transformations performed by some external sources of work on a insulated system. This can be regarded as a rigorous quantum mechanical proof of the Second Law.

Michele Campisi
University of North Texas

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