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# Violation of the second law of thermodynamics in the quantum microworld

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**Abstract**

One of the previously reported linear models of open quantum systems (interacting with a single thermal bath but otherwise not aided from outside) endowed with the faculty of spontaneous self-organization challenging standard thermodynamics is reconstructed here. It is then able to produce, in a cyclic manner, a useful (this time mechanical) work at the cost of just thermal energy in the bath whose quanta get properly in-phased. This means perpetuum mobile of the second kind explicitly violating the second law in its Thomson formulation. No approximations can be made responsible for the effect as a special scaling procedure is used that makes the chosen kinetic theory exact. The effect is purely quantum and disappears in the classical limit.


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## 1. Introduction

The quantum theory of open system [1–3] is perhaps the most important part of the nonequilibrium statistical physics, mainly owing to its impact on as complicated complex systems as living organisms. Mechanisms of energy, particle, etc. transfer or transformation revealed by biologists are often connected with a particular feature of macromolecular systems – topological instability upon detecting the presence of a particle, molecular group, excitation, etc. on a specialized place called usually receptor [4]. In other words, complicated molecular systems adjust very fast to the presence of the species to be processed [4]. For, e.g. the particle transfer and in terms of the

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