Imitating Chemical Motors with Information Motors

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A characteristic of Brownian motors is the one-directionality of the particle transport. The one-directional transport is possible if the detailed balance is broken and the motor is out of equilibrium. Its common mechanism is to bias the dynamics with a thermodynamic fuel such as chemical energy. A Brownian ratchet driven by a chemical fuel is a typical example of such chemical motors [1-3]. The mechanics of chemical motors has clearly been understood in terms of conventional irreversible thermodynamics.

An intriguing, alternative strategy for the one-directionality is for Maxwell's demon [4] to effect the bias via feedback control by using information about the motor particle. Recently, thermodynamics of Maxwell's demon has been intensively studied [5-10], and the role of information in nonequilibrium systems has become clearer in general situations.

In this talk, we explicitly demonstrate that these two different mechanisms, the chemical and information motors, lead to distinct thermodynamics by contrasting a chemical motor and information motor with identical dynamics [10]. To clarify this difference, we study both models within a single unified framework, highlighting the role of the interaction between the demon and the motor. This analysis elucidates the manner in which information is incorporated into a physical system.

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