

# **Carnot efficiency in an irreversible process**

Jae Sung Lee and Hyunggyu Park

*School of Physics and Quantum Universe Center, Korea Institute for Advanced Study, Seoul  
02455, Korea*

In thermodynamics, there exists a conventional belief that “the Carnot efficiency is reachable only when a process is reversible.” However, there is no theorem proving that the Carnot efficiency is unattainable in an irreversible process. Here, we show that the Carnot efficiency is reachable in an irreversible process through investigation of the Feynman-Smoluchowski ratchet (FSR). Our result opens a new possibility of designing an efficient heat engine even in a highly irreversible process and also answers the long-standing question of whether the FSR can operate with the Carnot efficiency.

[1] Jae Sung Lee and Hyunggyu Park, arXiv:1611.07665