Abstract Submitted
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Cost and consequences of breaking the fluctuation dissipation relation in biochemical networks[1] YUHAI TU, IBM — Living systems need to be highly responsive, and also to keep fluctuations low. These goals are incompatible in equilibrium systems due to the Fluctuation Dissipation Theorem (FDT). Here, we show that biological sensory systems, driven far from equilibrium by free energy consumption, can reduce their intrinsic fluctuations while maintaining high responsiveness. By developing a continuum theory of the *E. coli* chemotaxis pathway, we demonstrate that adaptation can be understood as a non-equilibrium phase transition controlled by free energy dissipation, and it is characterized by a breaking of the FDT [1]. We show that the maximum response at short time is enhanced by free energy dissipation. At the same time, the low frequency fluctuations and the adaptation error decrease with the free energy dissipation algebraically and exponentially, respectively. [1] "Free Energy Cost of Reducing Noise while Maintaining a High Sensitivity", Pablo Sartori and Yuhai Tu, Phys. Rev. Lett. 2015. 115: 118102.

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