Work fluctuations in slow processes: quantum signatures and optimal control

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An important result in stochastic thermodynamics is that the work probability distribution of a classical system during a slow process is Gaussian. This conclusion, together with the Jarzynski equality, implies that the fluctuations during the protocol are proportional to the dissipation. In the present article we show how processes which are essentially quantum, i.e., in the presence of coherence, violate both these conditions. We prove that the fluctuations will be in general bigger than the dissipation, and we show that the extra contribution is related to a generalisation of the Wigner-Yanase skew information. Moreover, we demonstrate that this simple result is sufficient to deduce that the process will show a non-Gaussian work distribution. These two features are a purely quantum signature of the protocol. Finally, we show that, in contrast with the classical case, minimising dissipation does not minimise fluctuations. This will imply that the space of thermodynamic states is naturally endowed with two metrics, which will give minimally dissipating or minimally fluctuating protocols.