Scaling relations of excess work when quenching a system across phase transitions

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According to the maximum work principle, the average work spent during a driving process is always larger than the free energy difference associated with the initial and the final work parameters. Previously, it has been known that the excess work spent during a nonequilibrium driving process is proportional to the driving speed v in the isothermal processes, and proportional to the square of the driving speed v^{2} in the adiabatic processes, respectively. However, if quenching a system across a phase transition point, the excess work will exhibit various scaling behaviors with the quenching speed. When the system is quenched across a first-order phase transition, where hysteresis and metastable states makes the problem very involved, it is found that the excess work (enclosed area between the dynamical and static hysteresis) exhibits universal scaling behavior v^{2/3}. I will discuss the scaling relations of excess work in these situations and the crossovers between them when downsizing the system.

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