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High-precision work distributions for extreme non-equilibrium processes in large systems ALEXANDER HARTMANN, Institute of Physics, University of Oldenburg, 26111 Oldenburg, Germany — The distributions of work for strongly non-equilibrium processes are studied using a very general form of a large-deviation approach, which allows one to study distributions down to extremely small probabilities of almost arbitrary quantities of interest for equilibrium, non-equilibrium stationary and even non-stationary processes. The method is applied to varying quickly the external field in a wide range $B = 3 \leftrightarrow 0$ for critical ($T = 2.269$) two-dimensional Ising system of size $L \times L = 128 \times 128$. To obtain free energy differences from the work distributions, they must be studied in ranges where the probabilities are as small as 10^{-240}, which is not possible using direct simulation approaches. By comparison with the exact free energies, one sees that the present approach allows one to obtain the free energy with a very high relative precision of 10^{-4}. This works well also for non-zero field, i.e., for a case where standard umbrella-sampling methods seem to be not so efficient to calculate free energies. Furthermore, for the present case it is verified that the resulting distributions of work fulfill Crooks theorem with high precision. Finally, the free energy for the Ising magnet as a function of the field strength is obtained.

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