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Entropy Production and Fluctuation Relation in Turbulent Convection SERGIO CHIBBARO, Institut d'Alembert Paris 6, FRANCESCO ZONTA, Univ. Udine — We report on a numerical experiment performed to analyze fluctuations of the entropy production in turbulent thermal convection. Using Direct Numerical Simulations (DNS), we estimate the entropy production from instantaneous measurements of the local temperature and velocity fields sampled along the trajectory of a large number of point-wise Lagrangian tracers. Entropy production is related to the work made by buoyancy force. The entropy production is characterized by large fluctuations and becomes often negative. This represents a sort of "finite-time" violation of the second principle of thermodynamics, since the direction of the energy flux is opposite to that prescribed by the external gradient. We provide a physical-sound definition of energy-scale characterizing the sytem, based upon Kolmogorov theory. Then, we link our results with recent theory of statistical mechanics of nonequilibrium systems, notably the results obtained by Evans, Cohen, Morris and Gallavotti for generic reversible dynamical systems. We show that the fluctuations of entropy production observed in the present system verify neatly the Fluctuation Relation (FR), cornerstone of that theory, even though the system is time-irreversible.

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