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A fluctuation-based probe to criticality in structural transitions
U. CHANDNI, ARINDAM GHOSH, Department of Physics, Indian Institute of Science, Bangalore 560 012, H.S. VIJAYA, S. MOHAN, Department of Instrumentation, Indian Institute of Science, Bangalore 560 012 — Many natural phenomena, extending from biology to material science, involve slowly driven dissipative systems that are far from thermal equilibrium, triggered only by a slowly varying external field and to which the systems respond through scale-free avalanches in physical observables. In spite of decades of research, experiments are inconclusive whether these systems self organize to the critical state over a broad range of external field, or if there exists a unique critical point that is smudged by a wide critical zone. Here, through the higher order statistics of time dependent avalanches, or noise, in electrical resistivity during temperature-driven martensite transformation in thin nickel-titanium films, we demonstrate for the first time, the existence of a singular 'global instability' or divergence of the correlation length as a function of temperature. These results not only establish a mapping of non-equilibrium first order phase transition and equilibrium critical phenomena, but perhaps also call for a re-evaluation of many existing experimental claims of self-organized criticality. References: 1. U. Chandni et.al, Appl. Phys. Lett. 92, 112110 (2008). 2. U. Chandni et. al, arxiv:0811.0102 (2008).

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