Geophysical Research Abstracts,
Vol. 11, EGU2009-2047, 2009
EGU General Assembly 2009

Evidence of dispersion relations for the nonlinear response of the Lorenz 63 system

V. Lucarini (1,2,3)

(1) University of Bologna, Department of Physics, Viale Berti Pichat 6/2, 40127 Bologna, Italy (lucarini@adgb.df.unibo.it), (2) Istituto Nazionale di Fisica Nucleare, Sezione di Bologna, Via Irnerio 46, 40127 Bologna, Italy, (3) CINFAI, Via Viviano Venanzi 15, 62032 Camerino, Italy

Along the lines of the nonlinear response theory developed by Ruelle, in a previous paper we have proved under rather general conditions that Kramers-Kronig dispersion relations and sum rules apply for a class of susceptibilities describing at any order of perturbation the response of Axiom A non equilibrium steady state systems to weak monochromatic forcings. We present here the first evidence of the validity of these integral relations for the linear and the second harmonic response for the perturbed Lorenz 63 system, by showing that numerical simulations agree up to high degree of accuracy with the theoretical predictions. Some new theoretical results, showing how to derive asymptotic behaviors and how to obtain recursively harmonic generation susceptibilities for general observables, are also presented. Our findings confirm the conceptual validity of the nonlinear response theory, suggest that the theory can be extended for more general non equilibrium steady state systems, and shed new light on the applicability of very general tools, based only upon the principle of causality, for diagnosing the behavior of perturbed chaotic systems and reconstructing their output signals, in situations where the fluctuation-dissipation relation is not of great help.