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Tsallis entropy and complexity theory in the understanding of physics of precursory accelerating seismicity.

Filippos Vallianatos (1) and George Chatzopoulos (1,2)

(1) Technological Educational Institute of Crete, Geophysics and Seismology, CHANIA, Greece (fvallian@chania.teicrete.gr),
(2) Brunel University, School of Engineering and Design, Uxbridge, London, UK

Strong observational indications support the hypothesis that many large earthquakes are preceded by accelerating seismic release rates which described by a power law time to failure relation. In the present work, a unified theoretical framework is discussed based on the ideas of non-extensive statistical physics along with fundamental principles of physics such as the energy conservation in a faulted crustal volume undergoing stress loading. We derive the time-to-failure power-law of: a) cumulative number of earthquakes, b) cumulative Benioff strain and c) cumulative energy released in a fault system that obeys a hierarchical distribution law extracted from Tsallis entropy. Considering the analytic conditions near the time of failure, we derive from first principles the time-to-failure power-law and show that a common critical exponent m(q) exists, which is a function of the non-extensive entropic parameter q. We conclude that the cumulative precursory parameters are function of the energy supplied to the system and the size of the precursory volume. In addition the q-exponential distribution which describes the fault system is a crucial factor on the appearance of power-law acceleration in the seismicity.
Our results based on Tsallis entropy and the energy conservation gives a new view on the empirical laws derived by other researchers. Examples and applications of this technique to observations of accelerating seismicity will also be presented and discussed.

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