



Is there a unified theory for the ways in which elements of a system organize themselves to produce a behaviour that is typical of large classes systems?

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Earthquakes (EQs) Epileptic Seizures (ESs) and Magnetic Storms (MSs) are phenomena involving huge and rapid releases of energy characterized by complex temporal occurrence. A basic reason for our interest in complexity is the striking similarity in behavior close to irreversible phase transitions among systems that are otherwise quite different in nature. The universal character of the approach of various extreme phenomena is a challenge for our understanding of these phenomena. Motivated by this hypothesis, we evaluate the capability of linear and non-linear techniques to extract common features from pre-seismic EM emissions, brain electrical activities, and available experimental Dst catalogs on predictive of EQs, ESs intense MSs respectively. Interestingly, theoretical studies suggest that the EQ dynamics at the final stage and neural seizure dynamics should have many similar features and can be analyzed within similar mathematical frameworks [1]. We show that distinctive changes in scaling parameters occur as an EQ, ES or intense MS approaches, revealing a gradual reduction of complexity. The emergence of persistent behaviour in the tail of the precursory activities, the significant acceleration of the energy release, i.e., the increase of the susceptibility of the system, the appearance of fluctuations at all scales with simultaneous predominance of large precursory events, the emergence of strong anisotropy, namely the appearance of preferential direction, may indicate that the generation of a catastrophic event becomes unavoidable. The observed similarities support the consideration that the detected preseismic EM anomalies are originated during the micro-fracturing in the focal area of the impending EQ. The results suggest that a

unified theory may exist for the ways in which firing neurons, opening cracks or magnetic storms organize themselves to produce a large crisis, while the preparation of an epileptic shock, a large EQ or an intense magnetic storm can be studied in terms of “Intermittent Criticality”.

[1] Unified approach to catastrophic events: from the normal state to geological or biological shock in terms of spectral fractal and nonlinear analysis, K. A. Eftaxias, P. G. Kapis, G. T. Balasis, A. Peratzakis, K. Karamanos, J. Kopanas, G. Antonopoulos, and K. D. Nomicos

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