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Could Complexity theory and Statistical physics be used to support earthquake precursors recognition ?

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In the present work some ideas based on complexity theory and statistical physics are presented in view of their applicability to understand earthquake precursory patterns. We focused on the non-extensive statistical physics view of Earthquake Physics from laboratory to geodynamic scale. Boltzmann-Gibbs (BG) statistical physics is one of the cornerstones of contemporary physics. It establishes a remarkably useful bridge between the mechanical microscopic laws and macroscopic description using classical thermodynamics. Although BG entropy seems the correct one to be used in a large and important class of physical systems with strongly chaotic dynamics (positive maximal Lyapunov exponent), an important class of weakly chaotic systems (where the maximal Lyapunov exponent vanishes) violates this hypothesis. On the other hand, if long-range interactions, non-markovian microscopic memory, multifractal boundary conditions and multifractal structures are present then another type of statistical mechanics seems appropriate to describe nature (Tsallis, 2001).

In the present work we review a collection of Earthquake physics problems such as a) Non-extensive pathways in earthquake size distribution b) The fragment-asperity model, c) Global earthquake size distribution. The effect of mega-earthquakes, d) Increments of earthquake energies e) Spatiotemporal description of Seismicity, f) Fault networks and g) laboratory seismology and fracture. The aforementioned cases cover the most of the problems in Earthquake Physics indicated that non extensive statistical physics could be the underline interpretation tool to understand earth's evolution and dynamics.

The results of the analysis indicate that the ideas of complexity theory and non-extensive statistical physics can be used to express the non-linear dynamics that control the evolution of Earthquake dynamics at different scales and could be used as the key scientific methodology to understand its pattern in a unified way, using Tsallis entropy principles.

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