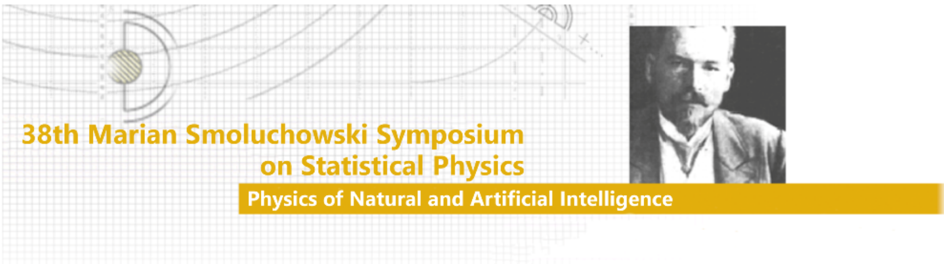

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Long-term memory induces correlations and clustering of extreme events

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Extreme events, although rare, hold significant importance due to their huge impact in various areas of science (earthquakes, chemical reactions, population extinction, etc.). Typically, the kinetics of these events is described by Arrhenius laws, with exponentially distributed waiting times. However, this description may break down in the presence of long-term memory, i.e., for stochastic processes with correlation functions decaying as a power-law rather than exponentially, since Arrhenius times cannot be larger than (infinite) correlation times. This leads to several intriguing questions such as: (a) Do rare-events show correlations in their successive occurrences? (b) Given an extreme event, can we predict the time before next occurrence? (c) And finally, can we characterize analytically the phenomenon of rare-event clustering? Here, we analyze the kinetics to reach a rarely reached threshold for a Gaussian stationary random walker with long-term memory, as an example of the paradigmatic Kramer's escape problem. We calculate analytically the joint distribution of the last and first passage to a rarely reached threshold (relative to a specified reference point) to explore correlations and the predictability of return intervals between consecutive rare-events. Additionally, we examine the second passage distribution to an extreme event to study their clustering. We find analytically that long-term memory induces (i) non-exponential corrections in the joint distribution of last and first passage of rare-events, (ii) non-zero correlations between their occurrences, and (iii) clustering of successive rare events.

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