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COMMENT ON "SPATIOTEMPORAL INTERMITTENCY ON THE SANDPILE"

by

Constantino TSALLIS and Francisco TAMARIT

Centro Brasileiro de Pesquisas Físicas - CBPF/CNPq
Rua Dr. Xavier Sigaud, 150
22290 - Rio de Janeiro, RJ - Brasil

ABSTRACT

A simple model is presented which exhibits, for the Hamming distance, the same unusual behaviour as the sandpile model recently studied by Erzan and Sinha.

Key-words: Hamming distance; Sandpile model; Intermittency.

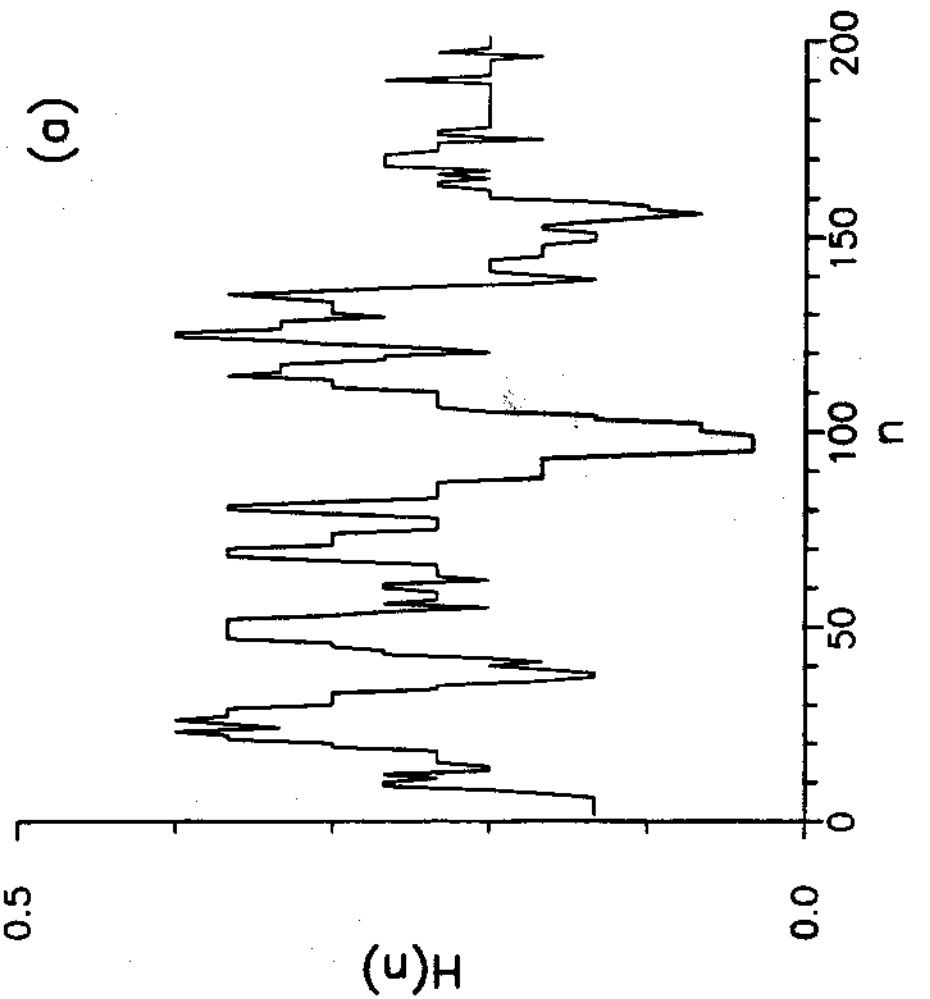
In their recent paper [1] Erzan and Sinha obtained, for a two-dimensional sandpile model, an interesting and unusual time evolution of the Hamming distance $H(n)$ (see their Fig. 1). It is not clear what are the basic mathematical ingredients which are present in the model and are responsible for this peculiar behavior (in which abrupt jumps are observed between "plateaux"). We present here an extremely simple model which exhibits the same phenomenon, and which consequently belongs, as much as $H(n)$ is concerned, to the same "universality class".

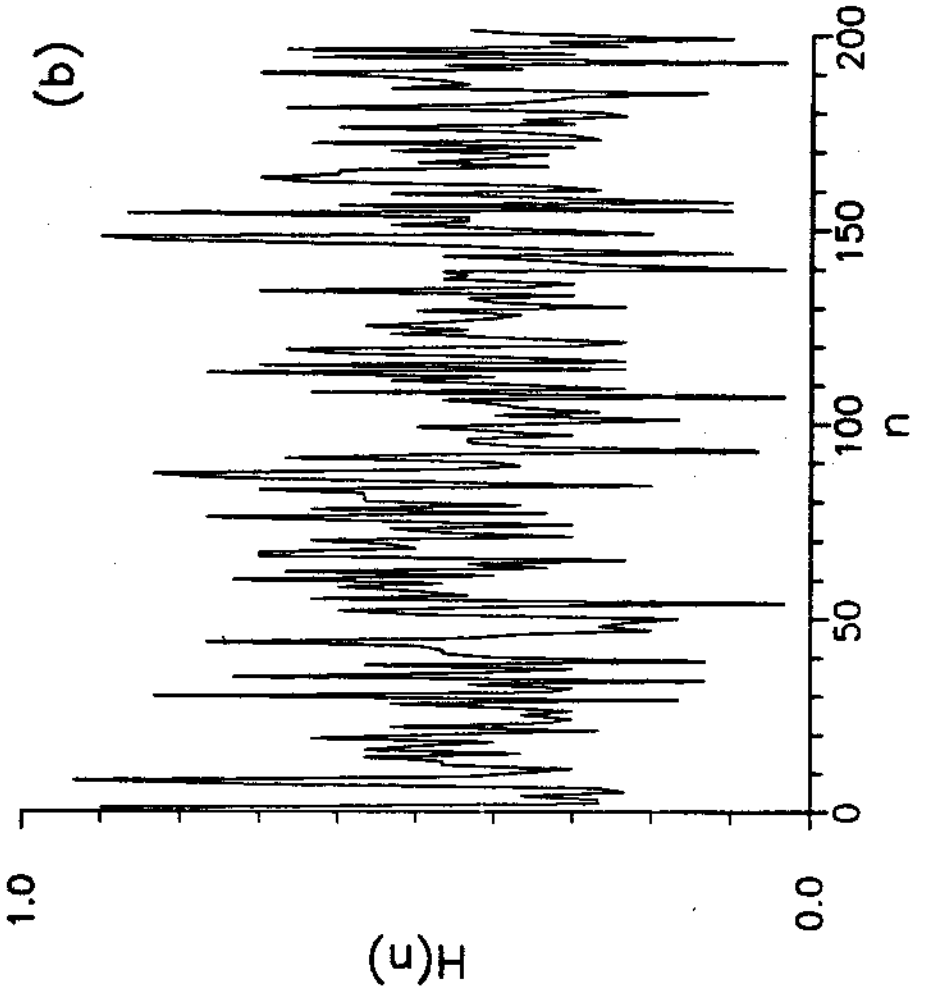
Consider two semi-infinite strips of binary bits ($S_i^\alpha = 0,1$) with $\alpha = 1,2$ and $i = 0,1,2\ldots$. Each strip is generated as follows. We conventionally assume $S_0^\alpha = 1$, and then S_{i+1}^α equal to S_i^α with probability p (hence different with probability $(1 - p)$) Although p is shared by both strips, the random sequences used to generate the strips are different. We now focus on a window of length L and define the following Hamming distance:

$$H = \frac{1}{L} \sum_{i=i_0}^{i_0+L} |S_i^1 - S_i^2| \qquad (1)$$

where $i_0 = Jn$, J being a fixed positive integer number and the "time" $n = 0,1,2,\ldots$. $H(n)$ will clearly fluctuate, and the fluctuations are expected to decrease for increasing L. In the figure we present two typical cases corresponding to

$L = 30$ (chosen to coincide with the linear size of the sample used in Ref. [1]) and $p = 0.9$. Cases (a) and (b) respectively correspond to small J ($J = 2$) and large J ($J = 30$). We verify that the case (a) of our figure is qualitatively similar to Fig. 1 of Ref. [1], whereas the case (b) just exhibits trivial fluctuations. This simple model appears as mathematically tractable and could be useful for understanding the deep mathematical reasons for the H vs. n behavior observed in the sandpile model.


(a)
H(n)
0.5
0.0
0
50
100
150
200
n



Time evolution of the Hamming distance for $p = 0.9$ and $L = 30$: (a) $J = 2$; (b) $J = 30$.

Reference

[1] A. Erzan and S. Sinha, Phys. Rev. Lett. 66,2750 (1991)