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IS THE UNIVERSE A SELF-ORGANIZED CRITICALITY SYSTEM ?

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Abstract

Sandpile Paradigm was proposed by Bak, Tang and Wiesenfeld (Bak et al. 1987) to explain simple model of Self-Organized Criticality (SOC). When the piles fall on the sandpile (input driver), we will see, that at some critical point (reaching adequate angle of response), sand will slide down to get the saturation phase.

The steady driver for Sandpile Paradigm is the gravity. Angle of response plays the role of criticality. Sand avalanches are the energy output. The SOC approach has been already used for interpretation of magnetospheric processes and recently for Auroral Kilometric Radiation (Marek & Schreiber 2017).

Not only astrophysical processes are included to explain by SOC model but also human activities (e.g. trafic jam or stock market's fluctuations). SOC systems exhibits itself as a straight line at a log - log graph.

In this paper I show that the Universe exhibits itself as a SOC system. Data gathered by the Planck i.e. maps of temperature Cosmic Microwave Background have been used for analysis of a number of counts of the CMB as a function of their temperature by *Fv* software (https://heasarc.gsfc.nasa.gov/ftools/fv/).

Keywords: Self-Organized Criticality, CMB

1. SELF-ORGANIZED CRITICALITY SYSTEMS

We can conclude that for earthquakes phenomenon energy input is tectonic stressing, criticality (instability threshold) is the dynamical friction and energy output is the rupture area. In astrophysics, for example, magnetospheric substorms exhibits itself as a SOC systems. Solar wind plays the energy input role, magnetic reconnection is the instability threshold (criticality) and auroral bursts are the intermittent avalanches (output). SOC systems exhibits itself as a straight line at a log-log graph (right hand of the histogram).

A general physics-based definition of SOC was given by (Aschwanden 2014):

SOC is a critical state of a nonlinear energy dissipation system that is slowly and continuously driven towards a critical value of a system-wide instability threshold, producing scale-free, fractal-diusive, and intermittent avalanches with powerlaw-like size distributions.

2. COSMIC MICROWAVE BACKROUND RADIATION - HISTOGRAMS

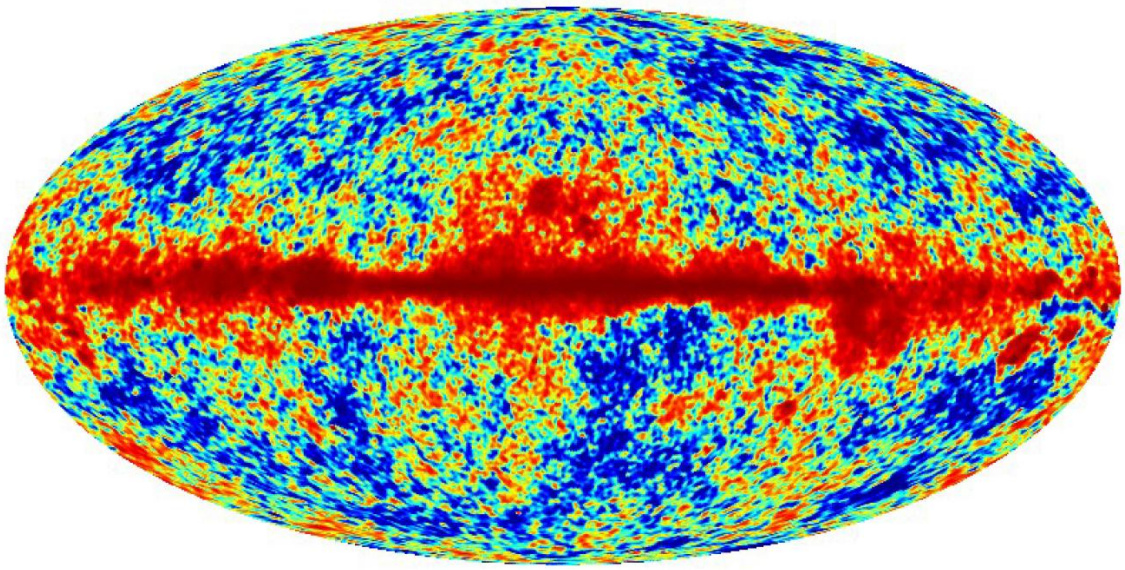

Figure 1. CMB's map from an example file (Planck Legacy Archive).

From Planck Legacy Archive website (http://pla.esac.esa.int/) I took the fits files with CMB maps and converted them by *Fv* software into histograms of CMB temperature's fluctuations.

I used LFI_SkyMap_044-BPassCorrected-field-IQU_0256_R2.01_full.fits file for instance.

The most important case is log - log, as shown in figure 2 right. Case-studied file as a map is shown in the first figure.

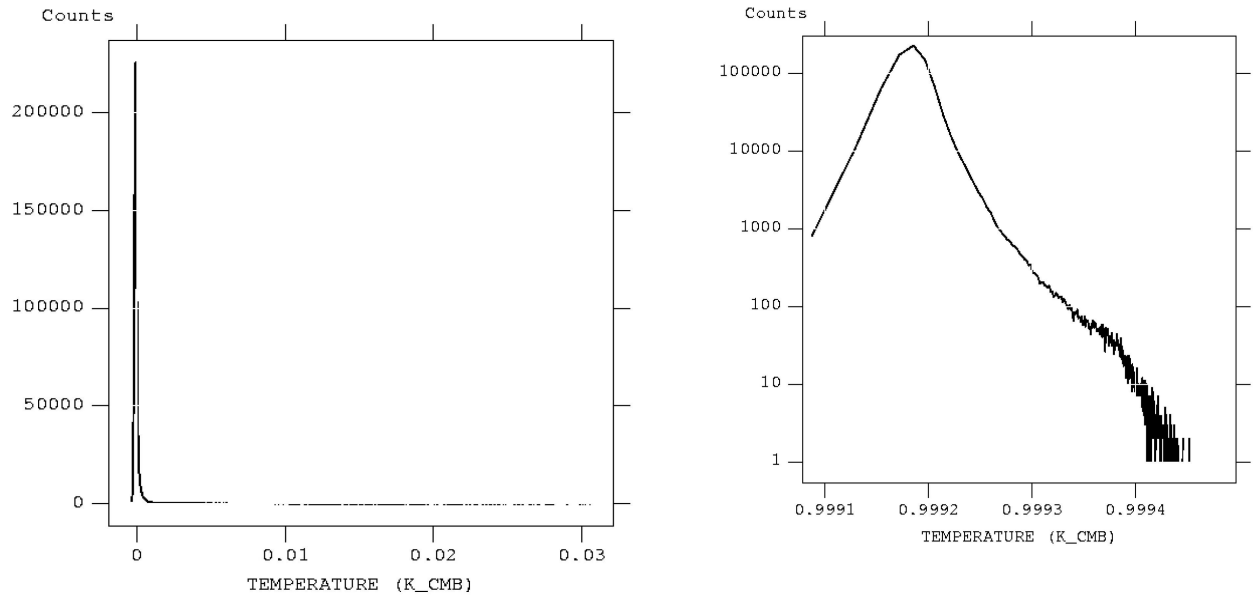

Figure 2. (Left) Lin - lin histogram from the CMB map. (Right) Log - log histogram from the CMB map.

3. CONCLUSIONS

We can fit straight line to the right part of histogram (log - log), just like in the SOC systems.

I have used only one case (example) because all the fits files with

temperature of CMB, from Planck Legacy Archive website, behave the same.

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