

A Diffusive Sandpile as a Model for the Dynamics of Avalanche Based Turbulent Transport in Plasmas and other Natural Systems

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ABSTRACT

In nature there are many systems which appear to exhibit some form of self-organization. Among these are forest fires, earthquakes, sandpiles, turbulent transport in plasmas and even many aspects of society itself. Investigations into the similarity of the dynamics of such systems have been undertaken by using simple cellular automata models. A running sandpile Self-Organized Criticality (SOC) model for turbulent transport in magnetically confined plasmas has been used explain some of the observed features of the transport dynamics in these plasmas. These models have produced a remarkable amount of insight into the dynamics of such systems. However, most real systems have some diffusive like process in addition to the transport events in our simple models. Therefore we add such a mechanism and have discovered a rich new world of dynamics. Some of the basic features of the basic SOC system and its connection to non-diffusive turbulent transport will first be reviewed. Then, an extension of a sandpile model to include diffusion will be introduced, and the details of an observed dynamical transition will be explored. Finally, time permitting, some speculation on the implications for understanding the dynamics of real systems (plasma transport and earthquakes) the context of a diffusive SOC system will be discussed.