18èmes Journées de la Matière Condensée
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"Scale-invariant dynamics in dissipative systems"

1. Organisateurs :

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2. Parrainage ou lien avec des sociétés savantes, des GDR ou autres structures :

GDR Interactions, Désordre, Élasticité.

3. Résumé de la thématique du minicolloque :

In many different phenomena including earthquakes, granular faults, imbibition, subcritical rupture, and even stock-markets, energy is slowly stored in the system and erratically released by sudden events of all sizes. These energy bursts are usually called *scale-invariant avalanches* (SIA). The existence of spatio-temporal clustering and memory effects [1] are often observed in these dynamics, which, besides the ubiquity of the SIA systems, remains poorly understood. Key open questions in this field include the origin, robustness and parameter dependences of SIA, the interpretation of exponent values, and the explanation of memory effects and time clustering. Other points of discussion and recent development correspond to the possibilities of predicting or controlling catastrophic and rare events, as well as the challenges of using artificial intelligence (AI) methods to analyze SIA.

From an experimental point of view, several systems based on subcritical fracture [2,3], adhesion [4] and granular shear [5,6] to name a few, have focused on establishing analogies with earthquake dynamics. These multiple points of view are an opportunity from bridging together different approaches in order to tackle common issues concerning SIA. From a theoretical perspective, simple cellular automata models of earthquakes have varied dissipation to tune the exponent values of the distribution of avalanche size [7]. This contrasts with renormalization approaches [8] where we expect robust exponent values in agreement with a certain class of universality. In this latter case, the studied phenomenon is the behavior of an elastic interface in a disordered landscape, where recent results include a seismic-like organization of the dynamics [9]. Mesoscopic models, locally alternating elastic and plastic behaviors [10], also bring a relevant insight into the questions cited earlier.

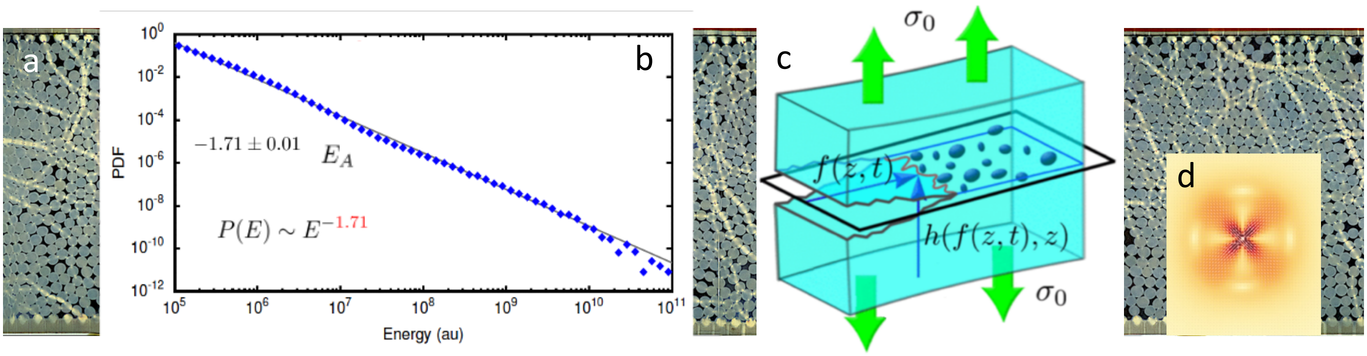

Fig.1 a) Granular fault containing about 4000 grains. b) Scale-invariant distribution of events' energy obtained in (a). Notice that catastrophic events carry one million times more energy and they are more than a billion times less probable to occur than the smallest ones [5]. c) Propagation of an elastic line in a disordered landscape [9]. d) Average displacement field induced by a shear transformation in an underdamped elastic medium [10].

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