Aftershocks in Slow Crack Growth ?

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A large number of very different physical systems ranging from the microscopic plastic deformation of materials to earthquakes can display an intermittent avalanche dynamics –also called “crackling Noise” – sequence of burst events, power-law distributed in size and duration. Moreover, these events are usually temporally correlated evidenced by power-law distributed waiting times separating two consecutive bursts.
In this talk, I will specifically discuss the statistics of those waiting times between subsequent burst events with in particular the possible detection of aftershocks that may occur during the slow growth of cracks in disordered materials for two different model fracture experiments.

On one hand, the subcritical propagation of a single crack in paper sheets is analyzed by combining simultaneous direct imaging and acoustic emission measurements. Both methods show that the fracture proceeds through a succession of discrete intermittent bursts events. However, in those experiments, we could show that a high frequency acoustic monitoring reveals aftershocks responsible for a timescale dependent exponent of the power-law energy distributions. On the contrary, direct imaging, which is unable to resolve these aftershocks, delivers a misleading exponent value of such power-law distributions of energies [1].
On the other hand, I will also present experimental results where the propagation of a crack front along a heterogeneous weak plane of a transparent Plexiglas block is directly observed by a high resolution and high-speed camera. This interfacial crack growth displays an intermittent avalanche dynamics. However, in that case, interestingly, we could show –helped as well by numerical simulations– how inter-event correlations could arise simply from the thresholding procedure used to define the avalanches [2].

1. M. Stojanova, S. Santucci, L. Vanel, and O. Ramos,
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2. S. Janicevic, L. Laurson, K. J. Måløy, S. Santucci, and M. J. Alava,
Inter-event Correlations from Avalanches Hiding Below the Detection Threshold
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