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Velocity fluctuations of a crack front during slow propagation and seismic moment distribution

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The propagation of a fracture front through a weak plane of a transparent Plexiglas block has been studied experimentally using a high speed camera. The dynamics of the fracture front exhibit irregular bursts with large velocity fluctuations. We proposed a new approach to estimate the local velocity based on the waiting time. The velocity distribution $P(v/\langle v\rangle)$ of the front line is nicely fitted by a power law behavior for velocities v larger than the average velocity $\langle v\rangle$ with an exponent -2.7 for various average crack speeds (ranging from $0.35\mu m/s$ to $40\mu m/s$). The spatial correlations of the velocity fluctuations also follow a power law behavior which indicates that velocity fluctuations are propagating over large length scales along the fracture front. Events are defined as clusters of large crack velocities. A seismic moment for each event is then estimated from an accurate optical measurement of the crack area. The distribution of the seismic moments for a large set of events is shown to be consistent with statistics of natural faults.