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Depinning transition in failure of disordered materials LAURENT PONSON, California Institute of Technology, Pasadena, US — Crack propagation is the fundamental process leading to material failure. However, its dynamics is far from being fully understood. In this work, we investigate both experimentally and theoretically the far-from-equilibrium propagation of a crack within a disordered brittle material. The variations of its growth velocity v with respect to the external driving force G are carefully measured on a brittle rock of average fracture energy $\langle\Gamma\rangle$. The crack dynamics is shown to display two regimes, well described by a sub-critical creep law $v \sim e^{-\frac{c}{(G-\langle\Gamma\rangle)^\mu}}$ with $\mu \simeq 1$ for $G < G_c$, at low velocities, and a critical behavior where $v \sim (G - G_c)^\theta$ with $\theta \simeq 0.8$ when $G > G_c$. We show that these variations, as well as the value of the exponents μ and θ, can be explained extending the continuum theory of Fracture Mechanics to inhomogeneous media. In particular, these two regimes are shown to be reminiscent of the dynamical critical transition underlying the failure of disordered brittle materials.

Laurent Ponson
California Institute of Technology, Pasadena, US

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