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A statistical model of plastic deformation in disordered media
MEHDI TALAMALI, DAMIEN VANDEMBROUCQ, STÉPHANE ROUX, Unité Mixte CNRS/Saint-Gobain — Plastic deformation at the macroscopic scale is assumed to stem from series of successive localized plastic events. A random elastic limit is associated to each site of a discrete mesh. Using a quasi-static driving, one site at a time undergoes plastic shear. The local plastic threshold is then renewed. The localized slip induces long range elastic interactions of quadrupolar symmetry. These additional internal stresses are then used to determine the next weakest site. The model gives rise to a macroscopic plastic flow, corresponding to a genuine depinning transition. We obtain an asymptotic macroscopic yield stress. The transient regime can be associated to a hardening phenomenon of pure statistical origin. Beyond the average plastic behavior we observe stress fluctuations following a universal distribution (only dependent on the system size L). Shear deformation presents at all scales spatial and temporal fluctuations of universal character. We observe shear band-like structures which persist only during a finite time $\tau \propto L^z$ and which present a clear anisotropic character with a system size dependent width $w \propto L^\zeta$.

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