Universal slip statistics: from nanopillars to earthquakes

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The deformation of many solid materials is not continuous, but discrete and jerky, with sudden, intermittent slips, similar to earthquakes. We discuss a simple model thatpredicts that the statistical distributions of the slips should be universal, i.e. they should be the same for many different materials, spanning a wide range of scales, from nanometer-sized crystalline pillars to earthquake faults that are a hundred kilometers long. We show a comparison of the model predictions to recent experiments on many different materials,
ranging from nanocrystals, to bulk metallic glasses, to granular materials, to earthquakes and find good agreement with the model predictions. Tools from the theory of phase transition, such as the renormalization group can be used to explain the wide applicability of the simple model. The study provides intuition and a unified framework to understand the fundamental properties of
shear-induced deformation in systems ranging from nanocrystals to earthquakes. It also provides many new predictions for future experiments, observations, and simulations. The results can be used for materials testing, evaluation, and hazard prevention.

Reference:
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