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A simple analytic theory for the statistics of avalanches in sheared granular materials KARIN DAHMEN, University of Illinois at Urbana Champaign, YEHUDA BEN-ZION, University of Southern California, Los Angeles, JONATHAN UHL, private — Slowly sheared granular materials at high packing fractions deform via slip avalanches with a broad range of sizes. Conventional continuum descriptions are not expected to apply to such highly inhomogeneous, intermittent deformations. Here, we show that it is possible to analytically compute the dynamics using a simple model that is inherently discrete. This model predicts quantities such as the avalanche size distribution, power spectra and temporal avalanche profiles as functions of the grain number fraction and the frictional weakening. A dynamical phase diagram emerges with quasi-static avalanches at high number fractions, and more regular, fluid-like flow at lower number fractions. The predictions agree with experiments and simulations for different granular materials, motivate future experiments and provide a fresh approach to data analysis. The simplicity of the model reveals quantitative connections to plasticity and earthquake statistics. (Reference: K.A. Dahmen, Y. Ben-Zion, J.T. Uhl, Nature Physics 7, 554-557 (2011).)

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