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Avalanches and universality in condensed matter[1]

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An overview is given on recent progress in the study of avalanches in a number of experimental systems and in models having disorder. In particular, we show how recent studies on magnetizing avalanches ("Barkhausen noise") in magnets (driven by a slowly increasing magnetic field) shed light on modeling damage avalanches in stressed materials, the plastic depinning of charge density waves, the statistics of earthquakes in irregularly shaped fault zones, and other systems characterized by "crackling noise". In particular, we focus on the universal, i.e., detail independent, effects of disorder in these cases. Unexpected connections between nonequilibrium and equilibrium "avalanches" reveal a surprisingly large universality class of systems that all show the same scaling behavior on long length scales. This universality class includes driven far-from-equilibrium behavior (for various histories), and the equilibrium behavior of some of these systems. The studies draw on methods from the theory of phase transitions, the renormalization group, and numerical simulations.

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