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Avalanches on vortex piles

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The Bean state of pinned vortex matter very much resembles the slope of a pile of sand, as noted a long time ago by de Gennes. Recently, we discovered that this similarity goes much further: (i) avalanches occur on the slopes of both systems (ii) a close relation exists between the statistical properties of the (vortex) pile surface and those of the avalanches. We find that the punctuated behavior of the avalanches falls in the class of Self-Organized Criticality (SOC). The intriguing relation between the amount of disorder and the onset of SOC behavior was investigated in Niobium thin films, where disorder was introduced by adding interstitial hydrogen atoms, absorbed from the controlled surrounding gas. In Niobium deposited on R-plane sapphire we find that a minimum amount of disorder (created by absorbing hydrogen) is necessary for SOC to occur. In Niobium on A-plane sapphire, huge compact avalanches are observed. The behavior of these avalanches is compared to a recent model by Aranson et al., who e.g. predict a minimum amount of penetration before avalanches can occur, which is corroborated by experiment.