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Avalanche dynamics in complex networks BYUNGNAM KAHNG, KWANG-IL GOH, DEOK-SUN LEE, EUN-J LEE, DOOCHUL KIM, Seoul National University — Avalanche dynamics, triggered by small initial perturbation, but spreading to other constitutes successively, is one of intriguing problems in complex systems. Here, we study such dynamics on scale-free networks. We first consider the case where the failed vertex can be recovered through the Bak-Tang-Wisenfeld sandpile model. Using the branching process approach, we obtain the exponents associated with the power-law behaviors of the avalanche size and duration time distributions, which depend on the degree exponent. Second, for the case where the failed vertex cannot be recovered permanently, we study the model for the data packet transport proposed by Motter and Lai. We find that depending on the control parameter, which is the relative ratio between the traffic amount and the failure threshold, a phase transition can occur from a free flow to congested state. At the transition point, the avalanche size distribution turns out to be robust against the degree exponent as long as the degree exponent is between 2 and 3.

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