

# Sandpile Dynamics and Renormalization-group Approach

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A successful renormalization-group (RG) approach may provide significant insights of a system exhibiting power-law dependencies. In 1994, a RG scheme [1] was proposed for sandpile models which exhibit power-law behavior and function as the models of self-organized criticality [2]. One momentous result of such a RG approach is that Bak-Tang-Wiesenfeld (BTW) [2] sandpile possessing a deterministic toppling rule and Manna sandpile [3] possessing a stochastic toppling rule share the same universality class. Such a conjecture is opposite to the numerical results. To clear up the discrepancy, Lin *et al.* [4] developed a sampling procedure to sample the RG events. Based on such a sampling procedure, we propose a Monte Carlo RG approach to  $q$ -state Manna model and such a study will be a prescription to perform our RG results for the high  $q$  case. In this paper, we calculate the related physical quantities for  $q = 2, 3, 4, 6, 8, 12, 14, 16,$  and  $20$ . The results of our RG approach can be used to investigate the universality issue of  $q$ -state Manna model and the key factor effecting the exponents.

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