Phase transition and size distributions in finite-size branching processes

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By means of a mapping with random walks, we study the size of branching processes with geometrical offspring distribution in a finite system, extending the results of Font-Clos and Moloney [PHYSICAL REVIEW E 94, 030102(R) (2016)] to the case of non-percolating avalanches. We obtain the exact finite-size size distribution in Laplace space in the subcritical, critical, and supercritical cases. Finite-size scaling is also discussed.