Finite-Size Effects on Critical Behaviors in Random *K*-SAT

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We explore random *K*-satisfiability problems (*K*-SAT) in terms of the simplest among focused stochastic-local-search heuristics, namely average SAT (ASAT), and provide a comprehensive view of various scaling behaviors in random *k*-SAT. The density of unsatisfied clauses clearly indicates the transition from the solvable (SOL, absorbing) phase to the unsolvable (UNSOL, active) phase by ASAT as varying the noise (temperature-like) parameter and the density of constraints by the finite-size scaling (FSS) analysis, which is analogous to the order parameter of nonequilibrium absorbing phase transitions. In particular, we focus on the FSS exponent, which is mathematically important and practically useful in analyzing finite systems as well as the transition nature and the accuracy for the exact location of such a transition in the thermodynamic limit. Based on scaling properties near and at the SOL/UNSOL transition with the solution clustering (percolation-type) argument, we propose the schematic phase diagram of the ASAT and conjecture two possible values for the FSS exponent in random *K*-SAT. Finally, we confirm them using extensive numerical simulations for $2 \leq K \leq 3$, including the discussion of (2+*X*)-SAT.

References

[1] S.H. Lee, M. Ha, C. Jeon, and H. Jeong, arXiv:1005.0251v2.

[2] S.H. Lee, M. Ha, and H. Jeong (in preparation).