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Thermodynamics and Phase Transitions of Ising Model on Inhomogeneous Stochastic Recursive Lattice[1] RAN HUANG, Shanghai Jiao Tong Univ — As one of the few exactly solvable thermodynamic models, the Ising model on recursive lattice is featured by its impressive advantages and successful applications in various thermodynamic and statistical researches. However this model was considered that, since the recursive calculation demands homogeneous structure, it can only describe the bulk and even systems with narrow utilization. In this work we figured out a practical methodology to extend the conventional homogeneous structure of single-unit Husimi lattice to be random inhomogeneous lattices with variable units and structures, while keeping the feature of exact calculation. Three designs of inhomogeneous recursive lattices: the random-angled rhombus lattice, the Husimi lattice of variable units, and the randomly multi-branched Husimi square lattice; and the corresponding exact recursive calculations based on the partial partition function algorithm, which is derived from the Bethe Cavity method, have been investigated and developed. With the "total-symmetry assumption" and the "iterative-replica trick" we were able to exactly solve the classical ferromagnetic spin-1 Ising models on these lattices, to describe the complex systems that can only be solved by approximations or simulations on regular lattices. Our work may enhance the application of the exact calculation on recursive lattices in various fields of materials science and applied physics, especially it may serve as a powerful tool to explore the cross-dimensional thermodynamics and phase transitions.

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Ran Huang
Shanghai Jiao Tong Univ

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