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Phase-space network structure of two-dimensional ±J spin glasses[1] XIN CAO, Hong Kong Univ of Sci & Tech, FENG WANG, Boston University, YILONG HAN, Hong Kong Univ of Sci & Tech — We illustrate a complex-network approach to study the phase spaces of spin glasses. By exactly mapping the whole ground-state phase spaces of two-dimensional Edwards-Anderson bimodal ($\pm J$) spin glasses into networks, we discovered various phase-space properties via network analysis. The Gaussian connectivity distribution of the phase-space networks demonstrates that both the number of free spins and the visiting frequency of microstates follow Gaussian distributions. The spectra of phase-space networks are Gaussian, which is proved to be exact when the system is infinitely large. The phase-space networks exhibit community structures, which enables us to construct the entropy landscape of the ground state as a network and discover its scale-free property. The phase-space networks exhibit fractal structures, as a result of the rugged entropy landscape. Moreover, we show that the connectivity distribution, the community structure and the fractal structure drastically change at the ferromagnetic-glass transition. These quantitative measurements of the ground states provide new insight into the studies of spin glasses. On the other hand, the phase-space networks establish a new class of complex networks with unique topology.

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