Condensed Matter > Statistical Mechanics

On Modeling of Statistical Properties of Classical 3D Spin Glasses

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We study statistical properties of 3D classical spin glass layer of certain width and infinite length. The 3D spin glass is represented as an ensemble of disordered 1D spatial spin-chains (SSC) where interactions are random between spin-chains (nonideal ensemble of 1D SSCs). It is proved that at the limit of Birkhoff's ergodic hypothesis performance 3D spin glasses can be generated by Hamiltonian of disordered 1D SSC with random environment. Disordered 1D SSC is defined on a regular lattice where one randomly oriented spin is put on each node of lattice. Also it is supposed that each spin randomly interacts with six nearest-neighboring spins (two spins on lattice and four in the environment). The recurrent transcendental equations are obtained on the nodes of spin-chain lattice. These equations combined with the Silvester conditions allow step by step construct spin-chain in the ground state of energy where all spins are in minimal energy of classical Hamiltonian. On the basis of these equations an original high-performance parallel algorithm is developed for 3D spin glasses simulation. Distributions of different parameters of unperturbed spin glass are calculated. In particular, it is analytically proved and by numerical calculations shown that the distribution of spin-spin interaction constant in Heisenberg nearest-neighboring Hamiltonian model as opposed to widely used Gauss-Edwards- Anderson distribution satisfies L\'evy alpha-stable distribution law which does not have variance. A new formula is proposed for construction of partition function in kind of one-dimensional integral on energy distribution of 1D SSCs

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