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Multipartite Entanglement of a Tetrahedron Lattice

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Abstract: Three-dimensional Heisenberg model in the form of a tetrahedron lattice is investigated. The concurrence and multipartite entanglement are calculated through 2-concurrence C and 4-concurrence C_4. The concurrence C and multipartite entanglement C_4 depend on different coupling strengths J_i and are decreased when the temperature T is increased. For a symmetric tetrahedron lattice, the concurrence C is symmetric about J_1 when J_2 is negative while the multipartite entanglement C_4 is symmetric about J_1 when $J_2<2$. For a regular tetrahedron lattice, the concurrence C of ground state is 1/3 for ferromagnetic case while C=0 for antiferromagnetic case. However, there is no multipartite entanglement since $C_4=0$ in a regular tetrahedron lattice. The external magnetic field B can increase the maximum value of the concurrence C_B and induce two or three peaks in C_B. There is a peak in the multipartite entanglement C_{4B} when C_{4B} is varied as a function of the temperature T. This peak is mainly induced by the magnetic field B.

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