Direct versus measurement assisted bipartite entanglement in multi-qubit systems and their dynamical generation in spin systems

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We consider multi-qubit systems and relate quantitatively the problems of generating cluster states with high value of concurrence of assistance, and that of generating states with maximal bipartite entanglement. We prove an upper bound for the concurrence of assistance. We consider dynamics of spin-1/2 systems that model qubits, with different couplings and possible presence of magnetic field to investigate the appearance of the discussed entanglement properties. We find that states with maximal bipartite entanglement can be generated by an XY Hamiltonian, and their generation can be controlled by the initial state of one of the spins. The same Hamiltonian is capable of creating states with high concurrence of assistance with suitably chosen initial state. We show that the production of graph states using the Ising Hamiltonian is controllable via a single-qubit rotation of one spin-1/2 subsystem in the initial multi-qubit state. We shown that the property of Ising dynamics to convert a product state basis into a special maximally entangled basis is temporally enhanced by the application of a suitable magnetic field. Similar basis transformations are found to be feasible in the case of isotropic XY couplings with magnetic field.