Thermal entanglement and quantum non-locality along the magnetization curve of the spin-1/2 Ising-Heisenberg trimerized chain

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ABSTRACT

The spin-1/2 Ising-Heisenberg trimerized chain in a presence of external magnetic field is exactly solved using the decoration-iteration transformation and transfer-matrix method [1]. The magnetization curve exhibits two intermediate magnetization plateaus at zero and one-third of the saturation magnetization, which correspond to two unusual quantum ground states with antiferromagnetic and ferrimagnetic character [1]. To bring an insight into quantum features of the investigated spin-chain model, we have exactly calculated the concurrence and Bell function that quantify a degree of the quantum entanglement and quantum nonlocality at zero as well as nonzero temperatures. It is demonstrated that the zero-temperature magnetization jumps between the intermediate magnetization plateaus are also reflected in the respective field-induced changes of the concurrence and Bell function. More strikingly, the concurrence and Bell function are both increasing when the magnetic field drives the investigated spin chain towards the intermediate one-third magnetization plateau what is in contrast with general expectations. Although the sudden changes of the concurrence and Bell function are mostly smoothened upon increasing temperature, the rising temperature may alternatively lead to an increase of the thermal entanglement and quantum non-locality close to the magnetization jump towards the intermediate one-third magnetization plateau. The threshold temperature for a disappearance of the thermal entanglement and quantum non-locality is examined in detail as a function of the magnetic field and the relative ratio between two different coupling constants.

References

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