Non-conserved magnetization, negative g-factors and 'fire-and-ice' spin configurations.

V. Ohanyan[a] J. Strečka[b] O. Rojas[c], J. Torrico[c], S. Bellucci[d]
[a] *Laboratory of Theoretical Physics, Yerevan State University, Alex Manoogian 1, 0025 Yerevan, Armenia,*
[b] *Department of Theoretical Physics and Astrophysics, Faculty of Science, P. J. Šafárik University, Park Angelinum 9, 040 01, Košice, Slovak Republic*
[c] *Departamento de Ciencias Exatas, Universidade Federal de Lavras, 37200-000, Lavras - MG, Brazil*
[d] *INFN-Laboratori Nazionali di Frascati, Via E. Fermi 40, 00044 Frascati, Italy*

We examine general features of the non-commutativity of the magnetization operator and Hamiltonian for small quantum spin clusters. The source of this non-commutativity can be a difference in the Landé g-factors for different spins in the cluster, XY-anisotropy in the exchange interaction and the presence of the Dzyaloshinskii-Moriya term in the direction different from the direction of the magnetic field. As a result, zero-temperature magnetization curves for small spin clusters mimic those for the macroscopic systems with the band(s) of magnetic excitations, i.e. for the given eigenstate of the spin cluster the corresponding magnetic moment can be an explicit function of the external magnetic field yielding the non-constant (non-plateau) form of the magnetization curve within the given eigenstate. In addition, the XY-anisotropy makes the saturated magnetization (the eigenstate when all spins in cluster are aligned along the magnetic field) inaccessible for finite magnetic field magnitude (asymptotical saturation). We demonstrate all these features through three examples: spin-1/2 dimer, mixed spin-(1/2,1) dimer, spin-1/2 ring trimer. For the case when al least one of the unit cell spin in the lattice has negative g-factor the system can exhibit unusual frustration for ferromagnetic couplings leading to the ground states with ordered and disordered sublattice at the same time ('fire-and-ice'). We illustrate these features through the example of Ising-Heisenberg diamond chain with four different g-factors.