The influence of a further-neighbour spin-spin interaction on a rotating magnetoelectric effect in a spin-electron model with a doubly decorated square lattice

H. Čenčariková and J. Strečka

1 Institute of Experimental Physics, Slovak Academy of Sciences, Watsonova 47, 040 01 Košice, Slovakia
2 Department of Theoretical Physics and Astrophysics, Faculty of Science, P. J. Šafárik University, Park Angelínum 9, 040 01 Košice, Slovakia

Exact analytical calculations have been used to study the influence of a further-neighbour spin-spin interaction on a rotating magnetoelectric effect in a hybrid spin-electron model on a doubly-decorated square lattice. The special attention has been focused on a ground-state analysis and a thermal behaviour at a quarter- and a half-filled case. It was found that the competition between the non-zero spin-spin interaction, electron hopping and applied electric field gives rise to novel spatially (an)isotropic magnetic states, whose frontiers are influenced by a spatial orientation of an applied electric field. It is shown that the thermal stability of spontaneous long-range order can be enhanced by a rotating magnetoelectric effect, which may result in an enhancement of the critical temperature. The further-neighbour spin-spin interaction may cause a striking magnetic reentrance with either two or three consecutive critical points for both studied electron fillings.