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Peculiarities of the energy spectrum and the magnetic properties of strongly correlated electron systems on bipartite lattices formed by weakly interacting linear segments

It is known that the intermediate plateau in field dependence of magnetization is informative characteristic for molecular ferrimagnets and some frustrated spin systems. We demonstrate the existence of intermediate magnetization plateau for a family of one-dimensional bipartite (non-frustrated) spin systems formed by weakly interacting segments and having singlet ground state. In the limit of weak interactions between segments these systems have a similar structure of the lowest part of the energy spectra and we presented simple description for above magnetization plateaus by means of perturbation theory. The increase of the interactions between segments leads to significant modification in the energy spectra and the magnetization curves for our systems. We studied this process numerically by the density matrix renormalization (DMRG) and Quantum Monte-Carlo (QMC) methods. We also performed numerical studies of the spin-Peierls instability for our systems and estimated the corresponding critical exponents for the ground state energy. We studied magnetic properties of the electron systems on finite 2-leg ladder rings formed by weakly interacting rungs and described by infinite-repulsion Hubbard model. For the numerical and analytical study of the lowest energy states of the above systems, we used cyclic spin permutation formalism. We found the possibility of jump-wise change of the ground state spin with the increase of the interaction between rungs. To explain this finite size effect, we derive new modification of magnetic polaron approximation, which agrees well with the results of the exact diagonalization study.

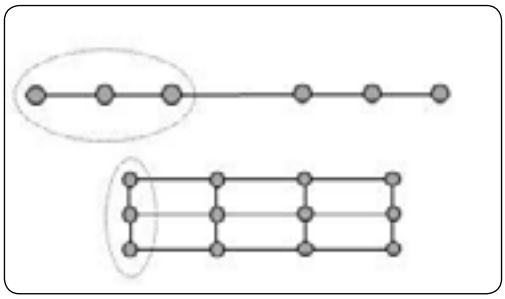

Figure 1: Two examples of spin systems studied: linear spin chain and 3-leg ladder fragments having three-site unit cells.

Recent Publications

1. V O Cheranovskii, D J Klein, E V Ezerskaya and V V Tokarev (2018) Finite size effects in anisotropic U=∞ Hubbard ladder rings. Journal of Superconductivity and Novel Magnetism 31:1369-1373.
2. V O Cheranovskii, D J Klein, E V Ezerskaya and V V Tokarev (2017) Validity of t-J approximation for extended Hubbard model with strong repulsion. Low Temperature Physics 43:1622-1625
3. V O Cheranovskii, D J Klein, E V Ezerskaya, V V Tokarev (2017) Lowest energy states of Hubbard ladder model with infinite electron repulsion. Computational and Theoretical Chemistry 1116:112-116.
4. V O Cheranovskii, E V Ezerskaya, D J Klein and V V Tokarev (2017) Ground state spin of Hubbard model with infinite electron repulsion. Acta Physica Polonica Series a 131(4):916-918.

5. V O Cheranovskii and E V Ezerskaya (2015) Magnetic properties of the infinite U Hubbard model on one-dimensional frustrated lattices. Journal of Superconductivity and Novel Magnetism 28:773-776.

Biography

Vladyslav O Cheranovskii completed his Doctor of Sciences in the year 1994 from Institute for Single Crystal. He is the Professor of V.N.Karazin Kharkiv National University, Department of Chemistry. He has published 49 papers recognized by Scopus and Web of Science databases. He is working in field of Solid State Physics and Quantum Chemistry. His main subject of interest includes strongly correlated electron system quantum theoretical simulation of electron structure and thermodynamics of nanomagnets.

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