Nonmagnetic insulators in hexagonal lattice models

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A key recent advancement in condensed-matter physics is to study the interplay between nontrivial topology and electronic correlations. The variational cluster approach (VCA) is a very powerful method in the presence of competing phenomena like frustrated magnetism and symmetry protected topological order. Originally developed for strong-coupling electron systems, optimizations of the VCA extends the area of application into weak to intermediate interacting problems. I have investigated different hexagonal models like Hubbard model the anisotropic triangular lattice [1] for organic charge transfer salts or the full Kane-Mele-Hubbard model with Rashba spin-orbit coupling [2]. We further study a monolayer of the 5d-compound Na_2IrO_3, described by a Hubbard-model on a honeycomb lattice where the spin symmetry is not conserved. The limiting case of the latter with strong spin-orbit coupling leads to the Kitaev-Hubbard model on the triangular lattice which shows evidence of quantum disordered states of matter in the presence of charge fluctuations.

[1] Manuel Laubach, Ronny Thomale, Werner Hanke, and Gang Li. Competing magnetism, spin liquid candidate regime, and adiabatic cooling in the anisotropic triangular Hubbard model. arXiv:1401.8198.
[2] Manuel Laubach, Johannes Reuther, Ronny Thomale, and Stephan Rachel. Rashba spin orbit coupling in the Kane-Mele-Hubbard model. arXiv:1312.2934.