Creating Skyrmion phase diagrams in Heisenberg Model Lattice Configurations With Dzyaloshinskii-Moriya Interactions

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Skyrmions or skyrmion phases are magnetic quasiparticle-like configurations characterized by swirling vertices with non-trivial topological charge (Mohylna M. and Zukovic M., 2019). Magnetic skyrmions are promising in device applications such as memory storage, due to their atomic-scale and manipulability in changing charge and swirl direction. We study the phase diagrams of topological magnetic skyrmions on a triangle or honeycomb lattice Heisenberg model with Dzyaloshinskii-Moriya (DMI) interaction. Using the atomistic simulation software Vampire (Evans R., 2018), we describe these two-dimensional skyrmion lattices by a simple Hamiltonian with classical spin. The spin Hamiltonians were used to recover the lattice arrangement's spin interactions; required for building the input unit cell file required for Vampire simulations. For computation, we used the University of Florida's HiPerGator supercomputer used to process interactions for lattices of ~1000 atoms. The simulation output was visualized via Gnuplot. We were able to create skyrmion phase diagrams for the triangle and honeycomb lattices using Landau-Lifshitz-Gilbert (LLG) integration with an applied magnetic field.

References

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