Abstract

Frustrated spin systems show exotic ground state known as spin liquid. Spin liquid is a disordered state where the system does not undergo any magnetic ordering even at very low temperature due to uctuations. Understanding of spin liquid is challenging as it is hard to find their existence experimentally. Spin liquid can show both gapless and gapped excitations. However, spin liquid cannot be studied with conventional Landau-Ginzburg order parameter as it does not show any spontaneous symmetry breaking. Rather, the gapless phases are protected by some gauge fields. Recently, Kitaev[1] has proposed a two dimensional exactly solvable spin 1=2 model on honey-comb lattice which hosts quantum spin liquid as its ground state. This model has bond directional interactions which make it a frustrated system and it is different than geometrical frustration. This has generated significant interests to look for materials which can show Kitaev like spin interaction. Kitaev like interaction is observed in the presence of Heisenberg spin coupling term which is called Kitaev-Heisenberg model. Recently, people have found bond directional interaction in iridates[7] and observed the Kitaev spin liquid behaviour in α - RuCl3[10]. In first part of my thesis work, I understood the analytical techniques required to solve the Kitaev model[1]. Using the fermionisation of spin 1=2 method, Kitaev spin 1=2 interacting Hamiltonian can be simplified to a non-interacting Majorana fermions hopping Hamiltonian in pres- ence of constant background gauge fields. In the second part of my thesis, classical Kitaev-Heisenberg Hamiltonian[9] was explored. In order to understand classical KH model, certain thermodynamical quantities like energy, specific heat, magnetisation, have been calculated using classical Monte-Carlo simulations on honeycomb lattice and triangular lattice. We have shown that if we go away from the Kitaev limit, the system shows phase transition on honeycomb lattice. But for α = 1(Kitaev limit) the specific heat and energy curves show no transitions on honeycomb lattice. However, using CMC we observe that for triangular lattice, the system always shows phase transitions occurring at low temperature for all ranges of α. Corresponding structure factors plots guide us to the ferromagnetic(α = 1) and anti-ferromagnetic(α = 0) ground states on triangular lattice.