Title:	Unconventional Magnetic Ordering in Heisenberg and Hubbard Models
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Abstract:	Magnetism is one of the most prominent phenomena displayed by correlated electron systems. The most commonly known, and well understood, examples of long-range magnetic ordering are ferromagnets and antiferromagnets, which can be well characterized via magnetization and magnetic susceptibility measurements [1]. Such magnetic orderings can be classified as collinear magnetism. Very often, presence of a specific magnetic order leads to an understanding of seemingly unrelated phenomena. For example, the observation of Hall effect without external magnetic field can be explained by the existence of a ferromagnetic order in the material [2, 3]. Similarly, an antiferromagnetic order can lead to insulating behavior in charge transport [4]. In addition to collinear magnets non-collinear and non-coplanar magnetic orderings have been reported in a variety of materials in recent years [5, 6, 7]. Interestingly, these unusual orderings also imply the existence of a set of new observable phenomena. For example, non-collinear magnetic order in oxides can lead to a new way of inducing ferroelectricity, also known as improper ferroelectricity [8, 9], non-coplanar states can provide an explanation for the anomalous Hall effect [10, 11]. While the Heisenberg model and the Hubbard model provide a standard framework for understanding the nature of magnetic order present in a system, the details of the underlying lattice are typically important. Motivated by the importance of these unconventional magnetically ordered phases in real systems, in this thesis we explore the possibility of unconventional magnetic ordering in the three well-known models of correlated electrons and magnetism, namely, the Heisenberg model, the Kondolattice model and the Hubbard model. The choice of problems undertaken is motivated by the implications of non-collinear and non-coplanar magnetism for various application oriented phenomena, such as multiferroicity, magnetocaloric e ect, and anomalous Hall effect. We employ a combination of variational calculations, classical Monte Carlo simulations and mean-field Hartree-Fock analysis to explore the magnetic behavior of the aforementioned Hamiltonians. Additionally, we investigate the possibility of spin-charge ordered phases in the extended Hubbard model. The problems undertaken in this thesis provide a broader perspective on the possible existence of unconventional magnetic order in elementary models of magnetism.
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