

Contents

Publication List	i
Acknowledgments	ii
Abstract	iii
1 Introduction	1
1.1 Ferromagnetic Kondo Lattice Model	1
1.2 Geometrical Frustration	2
1.3 Spin Scalar Chirality and Unconventional Anomalous Hall Effect	3
1.4 Purpose of This Thesis	5
1.5 Organization of this thesis	6
2 Model and Method	7
2.1 Model Hamiltonian	7
2.2 Variational Calculation of Ground-State Energy	8
2.3 Perturbation theory in J_H/t	13
3 Results and Discussions	17
3.1 Triangular Lattice	17
3.1.1 Numerical comparison of grand-canonical potential	17
3.1.2 Perturbation calculation of grand-canonical potential	19
3.1.3 Ground state phase diagram: noncoplanar four-sublattice order at 1/4 filling	21
3.1.4 Hall Conductivity	24
3.1.5 Lightly-doped region: noncoplanar three-sublattice order	26
3.2 Stability of noncoplanar order at 1/4 and 3/4 filling: Triangular-Kagome Lattice	31
3.3 Stabilization mechanism of scalar chiral order	32
3.3.1 Effective spin Hamiltonian in the fourth-order perturbation in J_H/t 32	
3.3.2 Origin of positive biquadratic interaction	35
3.3.3 Non-perturbative effect with level repulsion	36
3.4 Other frustrated lattices	41
3.4.1 Face-centered-cubic lattice	41
3.4.2 Checkerboard lattice	45

3.4.3	Pyrochlore lattice	47
3.5	Relation to Other Theoretical Studies	49
4	Summary	50
A	Formulation of Hall Conductivity	52
B	Ground-state phase diagram for a triangular-kagome lattice model	54
C	Perturbation Calculation	57