

Contents

Acknowledgment	i
Abstract	iii
1 Introduction	1
1.1 Heavy-Fermion Systems	1
1.1.1 Models for Heavy-Fermion Systems	1
1.1.2 Competing Interactions in Heavy-Fermion Systems	3
1.1.3 Doniach Phase Diagram and Quantum Critical Behavior	6
1.2 Geometrical Frustration	7
1.3 Frustration induced Phenomena in Quantum Critical Region	8
1.4 Purpose of This Thesis	8
1.5 Organization of This Thesis	10
2 Previous Experiments and Theories on Partial Disorder	11
2.1 Partially Disordered States	11
2.1.1 In Localized Spin Systems	11
2.1.2 In Laves Phases	14
2.1.3 In Heavy Fermion Systems	16
2.2 Experiments	17
2.2.1 Distorted Kagome Lattice Compound CePdAl	17
2.2.2 Triangular Lattice Compound UNi ₄ B	27
2.3 Theories	33
2.3.1 Mean-Field Study of Effective Pseudomoment Models	33
2.3.2 Variational Monte Carlo study	35
3 Model and Method	41
3.1 Model	41
3.2 Method	42
4 Result at Half-Filling	47
4.1 Partially Disordered State	47
4.1.1 Phase Diagram	47
4.1.2 Electronic Structure	52
4.1.3 Comparison to the Kondo Lattice Model	57
4.2 Effect of Ising coupling	58

4.2.1	Phase Diagram	58
4.2.2	Comparison to the Kondo Lattice Model	65
4.3	Effect of Magnetic Field	66
4.3.1	Phase Diagram	66
4.3.2	Electronic Structure	70
5	Result for Carrier Doping to Half-Filling	75
5.1	Instability toward Phase Separation	75
5.2	Effect of Ising Coupling	78
5.3	Nature of Partially Disordered Metal	80
6	Result at Other Commensurate Fillings	87
6.1	Partial Disorder at 2/3 Filling	87
6.1.1	Phase Diagram	88
6.1.2	Electronic Structure	95
6.1.3	Effect of Ising Coupling	97
6.1.4	Effect of Magnetic Field	101
6.2	Partial Disorder at 8/3 filling	105
6.2.1	Phase Diagram	106
6.2.2	Electronic Structure	112
6.2.3	Effect of Ising coupling	115
6.2.4	Effect of Magnetic Field	119
6.3	Other Commensurate Fillings	121
6.3.1	4/3 Filling	121
6.3.2	10/3 Filling	124
7	Result for Carrier Doping to Other Commensurate Fillings	127
7.1	Near 2/3 Filling	127
7.1.1	Partially Disordered Metal by Hole Doping	127
7.1.2	Nature of Partially Disordered Metal	129
7.1.3	Effect of Ising Coupling	133
7.2	Near 8/3 Filling	135
7.2.1	Phase Diagram	135
7.2.2	Effect of Ising Coupling	137
8	Summary	139