TABLE OF CONTENTS

Chapter 1. Introduction…….....1-5

Chapter 2. Fundamental concepts……....6-27

2.1. Introduction……..7

2.2. Magnetic materials……..7

2.2.1. Ferromagnets…..……..8

2.2.2. Antiferromagnets……..8

2.3. Exchange Energy……..9

2.4. Spin wave and properties……..12

2.5. Holstein-Primakoff description of ferromagnetic spin waves.....13

2.6. Holstein-Primakoff description of antiferromagnetic spin waves.....14

2.7. Interaction of magnons.....16

2.8. Superconductivity…….....18

2.9. BCS theory of superconductivity……20

2.10. Density Functional theory……..23

2.10.1. The local density approximation (LDA)……..26

2.10.2. The generalized gradient approximation (GGA)……..27

Chapter 3. Spin wave instability under perpendicular pumping……....28-40

3.1. Introduction……....29

3.2. Ferromagnetic material under static field ……...29

3.3. Ferromagnetic resonance……31

3.4. High power resonance and perpendicular pumping……...34

3.5. Conclusions…….....40

Chapter 4. Spin wave instability under parallel pumping……...41-49

4.1. Introduction……...…42

4.1. Parallel pumping and excitation of magnons magnetic material……..43

4.2. Calculation of relaxation time and increase in temperature……46

4.3. Conclusions……...49

Chapter 5. Bose-Einstein Condensation of magnon in thin film…….50-63

5.1. Introduction……....51

5.2. Magnon Dispersion in thin film……..52

5.3. Rise –time for BEC of magnons Parallel pumping……..54

5.4. Rise –time for BEC of magnons perpendicular pumping……..60

5.5. Conclusions……..63

Chapter 6. Ferromagnetic superconductivity…….....64-79

6.1. Introduction……..65

6.2. Magnon mediated Cooper pair formation……67

6.3. Application in $UGe_2$and URhGe.....72

6.3.1. Computational details……....72

6.3.2. Computational results……....76

6.4. Conclusions……81

Chapter 7. Antiferromagnetic superconductivity iron pnictides…….…...82-99

7.1. Introduction……....83

7.2. Pairing via magnons in Antiferromagnetic 122 iron pnictides crystals……..86

7.3. Application in $CaFe_2As_2$ and $BaFe_2As_2$……93

7.3.1. Computational details……....90

7.3.2. Computational results……94

7.4. Conclusions……97

Chapter 8. Discussion and Future work…….....…...100-102

List of publications……...103

Bibliography……..104-117

Acknowledgements ……..118

Index……...119-121