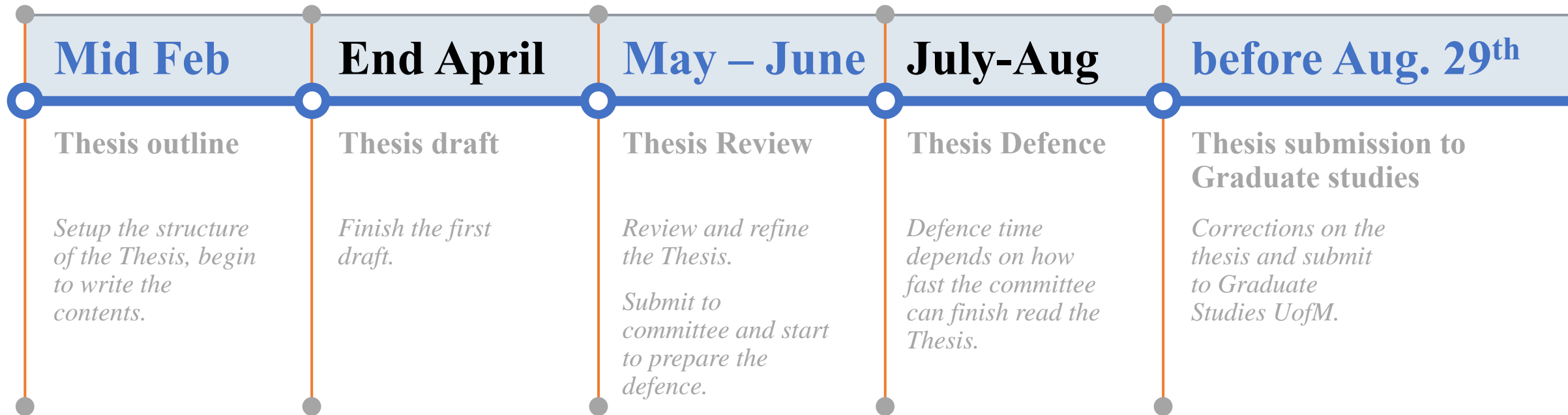


Master Thesis Timeline

Yutong Zhao



Abstract	ii
Table of Contents	iv
List of Figures	v
List of Tables	vi
1 Introduction	1
1.1 Hybridization in various coupled systems	1
1.2 Discovery of dissipatively coupled cavity magnonics	1
1.3 Thesis Outline	1

2	Theoretical Background	2
2.1	Lagrangian formalism of coupled systems	2
2.1.1	Coherent coupled systems	3
2.1.2	Dissipative coupled systems	3
2.2	Hamiltonian formalism of coupled systems	3
2.2.1	Coherent coupled systems	3
2.2.2	Dissipative coupled systems	3
2.3	N-port Network	3
2.3.1	Scattering parameters in a two-port network	3
2.3.2	Group velocity of electromagnetic wave	3
2.4	Numerical method	3
2.4.1	Simulation use finite element analysis method	3
2.4.2	Electric and magnetic field distribution	3
2.4.3	Time domain analysis use ODE solver	3

3	Experiments and Results	4
3.1	Background	4
3.1.1	Microwave resonators	4
	Typical types of microstrip resonators	5
	Excitations of split ring resonators	5
3.1.2	Scattering parameters	5
3.1.3	Ferromagnetic resonance	5
3.2	Dissipatively coupled magnon-photon system	6
3.2.1	Coupling mechanism in metamaterials	6
3.2.2	Design of dissipatively coupled matamaterials	6
3.2.3	Observation of zero damping conditions (ZDCs)	6
3.2.4	Voltage controlled dissipative coupling	6
3.2.5	Slowed light and effective negative damping	6
3.2.6	Damping influenced ZDCs	6
3.2.7	Modification of magnon damping	6
3.2.8	Enhancement of effective bandwidth	6
3.3	Summary	6
4	Conclusion	7