

Contents

1	Introduction	9
2	Fundamentals	13
2.1	Magnetism in Iron	13
2.1.1	Spontaneous Magnetization in Bulk Fe	13
2.1.2	Magnetic Anisotropy	16
2.1.3	Ferromagnetic Domains and Domain Walls	19
2.2	The Magnetic Vortex State	21
2.3	Equation of Motion for the Magnetization	23
2.4	Gyrotropic Vortex Motion	24
2.5	Giant Magnetoresistance	28
2.6	Spin-Transfer Torque	35
3	Experimental Techniques	41
3.1	Sample Preparation	41
3.1.1	Layer Growth and Epitaxy	41
3.1.2	Nano Structure Patterning	43
3.2	Experimental Setup	49
4	Single vortex configurations	53
4.1	GMR-measurements	53
4.2	Microwave excitations	57
4.3	Vortex gyration under influence of a homogeneously polarized current	62
5	Double vortex configurations	69
5.1	GMR measurements: low versus high sample currents	71
5.2	Double vortex configurations of type P^+	76
5.3	Double vortex configurations of type AP^+	85
5.4	Double vortex configurations of type AP^-	94
5.5	Double vortex states in a type II contact	102
5.6	Phase locking of a double vortex state	107
6	Summary	111