

# Contents

<i>Acknowledgements</i>	<i>page</i> ix
<i>Introduction</i>	1
<b>1 Basic equations</b>	<b>5</b>
1.1 Approximations	5
1.2 Development of an initial perturbation	6
1.3 The dispersion equation	13
1.4 The plasma dielectric tensor (general expression)	15
1.5 The plasma dielectric tensor (weakly relativistic approximation)	20
1.6 The plasma dielectric tensor (non-relativistic approximation)	23
1.7 The plasma dielectric tensor (special cases)	27
1.8 The plasma dielectric tensor (effect of electron beams)	29
1.9 The plasma dielectric tensor (cold plasma approximation)	32
1.10 Wave polarization	33
<b>2 Propagation in a cold plasma</b>	<b>36</b>
2.1 The Appleton–Hartree equation	36
2.2 Whistler-mode group velocity	42
2.3 Whistler-mode polarization	51
2.4 A physical model of wave propagation	57
<b>3 Parallel propagation (weakly relativistic approximation)</b>	<b>61</b>
3.1 Simplification of the general dispersion equation	61
3.2 Low-temperature limit	65
3.3 Physical interpretation	69
<b>4 Parallel propagation (non-relativistic approximation)</b>	<b>76</b>
4.1 Analytical solutions	76
4.2 A graphical solution	85
4.3 Group velocity	87

<b>5</b>	<b>Quasi-longitudinal approximation</b>	<b>94</b>
5.1	Almost parallel propagation (low-temperature limit)	94
5.2	Propagation at a finite $\theta$ (low-temperature limit)	101
5.3	Special cases of quasi-longitudinal propagation	110
5.4	Wave polarization	114
5.5	Propagation in the presence of electron beams	115
<b>6</b>	<b>Quasi-electrostatic approximation</b>	<b>121</b>
6.1	The dispersion equation in a low-temperature limit	121
6.2	The quasi-electrostatic solution for $a_1^t \neq 0$	125
6.3	The quasi-electrostatic solution for $a_1^t = 0$	131
6.4	An improved quasi-electrostatic approximation	133
6.5	The quasi-electrostatic solution for $\xi_1 = -0.924$	136
6.6	Wave polarization	137
6.7	Propagation in the presence of electron beams	140
<b>7</b>	<b>Growth and damping of the waves</b>	<b>144</b>
7.1	Parallel propagation (weakly relativistic approximation)	144
7.2	Parallel propagation (non-relativistic approximation)	154
7.3	Quasi-longitudinal propagation	161
7.4	Quasi-electrostatic propagation	170
7.5	A physical model	174
<b>8</b>	<b>Non-linear effects</b>	<b>185</b>
8.1	Quasi-linear theory	185
8.2	Monochromatic waves	201
<b>9</b>	<b>Applications to the Earth's magnetosphere</b>	<b>210</b>
9.1	Whistler diagnostics of magnetospheric parameters	210
9.2	Whistler-mode emissions in the vicinity of the magnetopause	224
9.3	Mid-latitude hiss-type emissions	231
	<i>References</i>	236
	<i>Solutions to the problems</i>	250
	<i>Index</i>	258