TABLE OF CONTENTS

ABST	RACT		.i
TABI	E OF	CONTENTS	v
LIST	OF 1	TABLES	.x
LIST	OF I	FIGURES	x
1.	INTRO	DDUCTION	1
	1.1	General Introduction	1
	1.2	Partially Transparent Echoes from Midlatitude Sporadic-E	
		Layers	7
	1.3	Objectives of this Study	8
2.	THEOF	RY OF FORMATION OF SPORADIC-E LAYERS	.1
	2.1	Introduction	.1
	2.2	Wind-Shear Theory	3
		2.2.1 E-region winds 1	. 3
		2.2.2 The equation of motion of a charged particle 1	. 8
		2.2.3 The polarization electric field	21
		2.2.4 The formation of ionized layers	22
	2.3	Metallic Ions	24
		2.3.1 Introduction. \ldots 2	24
		2.3.2 General characteristics of metallic ions	25
		2.3.3 Production rates of metallic atoms and ions 2	26
		2.3.4 Lifetimes of metallic ions	28
		2.3.5 Diurnal variation \ldots \ldots \ldots \ldots \ldots \ldots 2	29
		2.3.6 Effect of heavy ions	36
3.	REFL	ECTION OF RADIO WAVES BY SPORADIC-E LAYERS	39
	3.1	Introduction	39
	3.2	Ionosonde Observations of Sporadic E	39

	3.3	Reflect	tion Coefficients
		3.3.1	Introduction
		3.3.2	Propagation of radio waves in the ionosphere 42
		3.3.3	Approximate solutions
		3.3.4	Full-wave solution
		3.3.5	Solution using a digital computer
		3.3.6	Description of sporadic-E layer by a mathematical
			function
		3.3.7	Performing the integration 61
	3.4	Result	s of Reflection Coefficient Calculations 64
		3.4.1	Comparison with independent solutions 64
		3.4.2	The effect of ionosonde sensitivity 65
		3.4.3	Results of reflection coefficient analysis 71
4.	OBSE	RVATION	OF SPORADIC-E LAYERS BY INCOHERENT-SCATTER RADAR 84
	4.1	Introd	uction
	4.2	Incohe	rent Scatter
		4.2.1	Introduction
		4.2.2	Scattering of radio waves
		4.2.3	Autocorrelation analysis
		4.2.4	Pulse compression
	4.3	The Ar	ecibo Observatory
	4.4	Experi	mental Techniques
		4.4.1	Electron density
		4.4.2	Ion drift velocity
		4.4.3	Data collection and presentation
	4.5	0b ser v	ations
		4.5.1	Introduction

		4.5.2	14	Janua	ary	197	74 ,	14:	11-1	5:02	3 A.	ST.	•	•	•	•	•	•	•	•	•	•	•	111
		4.5.3	17	Janua	ary	197	,4°	20:	06-22	2:15	5 A	ST.	•	•	•	•	•	•	•	•	•	•	•	112
		4.5.4	18	Janua	ary	197	74 ,	12:	38- 14	4:02	2 A	ST.	•	•	•	•	•	•	•	•	•	•	•	117
		4.5.5	19	Janua	a r y	197	74 ,	12:	5 3- 14	4:56	3 A	ST.	•	•	•	•	•	•	•	•	•	•	•	117
		4.5.6	24	Janua	ary	197	'4 ,	18:	03-19	9:01	l A	ST.	•	•	•	•	•	•	•	•	•	•	•	120
		4.5.7	2 8	Janua	ary	197	,4°	12:	52-14	1:5 8	3 A.	ST.	•	•	•	•	•	•	•	•	•	•	•	123
		4.5.8	10	July	197	75 ,	11:	31-	13:3	3 A.S	ST		•	•	•	•	•	•	•	•	•	•	•	132
		4.5.9	16	July	197	75 ,	12:	14-	18 : 58	3 A.S	ST		•	•	•	•	•	•	•		•	•	•	134
		4.5.10	17	July	197	75 ,	03:	33-	08:20) AS	ST		•	•	•	•	•	•	•	•	•	•	•	139
		4.5.11	19	July	197	75 ,	11:	05-	14:22	2 A.S	ST		•	•	•	•	•	•	•	•	•	•	•	141
		4.5.12	20	July	197	75 ,	10:	55-	15:23	3 A.S	ST		•	•	•	•	•	•	•	•	•	•	•	145
		4.5.13	21	July	197	75 ,	19:	-52-	24:00) AS	ST		•	•	•	•	•	•	•	•	•	•	•	147
		4.5.14	23	July	197	75 ,	03:	11-	08:08	5 AS	ST		•	•	•	•	•	•	•	•	•	•	•	153
		4.5.15	26	July	197	75 ,	09:	07	16 : 42	7 AS	T		•	•	•	•	•	•	•	•	•	•	•	153
		4.5.16	26	July	197	75 ,	19:	44-	21:3	7 AS	ST		•	•	•	•	•	•	•	•	•	•	•	158
		4.5.17	27	July	197	75,	11:	25-	15:02	2 AS	ST		•	•	•	•	•	•	•	•	•	•	•	158
	4.6	Compart	isor	n of I	Ionc	0801	ide	and	Inco	oher	ren	t - S	cai	tte	r-	Ra	da:	r						
		Observa	atic	ons.	• •	• •		•	•••		•		•	•	•	•	•	•	•	•	•	•	•	163
		4.6.1	Ef	fect a	of i	olı	me	ave	ragir	ıg.	•		•	•	•	•	•	•	•	•	•	•	•	163
		4.6.2	Ef	fect d	of l	limi	tec	l sa	mplir	ıg.	•		•	•	•	•	•	•	•	•	•	•	•	164
	4.7	Summarı	1.				• •	•	••		•	• •	•	•	•	•	•	•	•	•	•	•	•	168
5.	DISC	USSION.	•			• •		•	••		•	• •	•	•	•	•	•	•	•	•	•	•		170
	5.1	Introdi	uct	ion.	•			•	•••	•••	•		•	•	•	•	•	•	•	•	•	•	•	170
	5.2	Ion Dra	ift	Velo	rity	1 an	ıd t	the .	Forma	atic	on	of	Spa	ora	ıdi	c-	Ε.	La	ye	rs	•	•	•	170
	5.3	Altitu	les	of S_1	oord	idic	•E	Lay	ers		•		•	•			•	•	•	•	•	•	•	174
		5.3.1	Cor	nbine	d ej	ffec	ets	of	gravi	ity	ωα	ves	a	ıd	ti	đe	ទ	•	•	•	•	•	•	174
		5.3.2	Cor	mponer	nts	of	tic	lal i	modes	3.	•	• •	•	•	•	•	•	•	•	•	•	•	•	178
						-																		

5.

		5.3.3	Standing waves
		5.3.4	Quasi-stagnation levels
	5.4	Boundar	ries of Sporadic-E Layers
	5.5	Wave-la	ike Structure in Sporadic-E Layers
	5.6	Irregu	lar Structure Associated with Critical Levels 18
		5.6.1	Introduction. \ldots 189
		5.6.2	Critical levels
		5.6.3	Effect on sporadic-E layer formation
	5.7	Irregu	lar Structure Caused by Fluid Instabilities 194
	5.8	Irregu	lar Structure Caused by Plasma Instabilities 193
	5.9	Irregu	lar Structure Attributed to Meteor Trails
		5.9.1	Irregular source function
		5.9.2	Individual meteor trails
		5.9.3	Convergence of a meteor trail
		5.9.4	Correlations with meteor activity 201
	5.10	Summary	/••••••••••••••••••••••••••••••••••••••
6.	SUMM	ARY AND	CONCLUSIONS
	6.1	Summary	/
	6.2	Conclus	sions
	6.3	Suggest	tions for Future Work
APPI	ENDIX	I THE	EFFECT OF THE POLARIZATION ELECTRIC FIELD ON THE
		FOF	AMATION OF SPORADIC-E LAYERS
APPI	ENDIX	II APP	PROXIMATE DERIVATIONS OF REFLECTION COEFFICIENTS 216
		II.	.1 Approximation of a Layer by Multiple Thin Films 216
		II.	2 W.K.B. Solution
		II.	3 Solution Using Hypergeometric Functions 222
RE FI	ERENCE	ES	