## Contents

	of contributors	
	faceX	
	t I Single Light Scattering	
	ight scattering by irregular particles in the Earth's atmosphere	
	hony J. Baran	3
1.1	Introduction	3
1.2 1.3	Basic definitions of scattering	6
1.4		<ul><li>10</li><li>15</li></ul>
1.4	1.4.1 The sizes and shapes of mineral dust and volcanic ash particles	19
	· · · · · · · · · · · · · · · · · · ·	15
		20
1.5	Idealized geometrical models of mineral dust aerosol and ice crystals	
	· ·	28
		28
	" 01 1	37
1.6		52
$Ref\epsilon$	erences	55
scat aero	hysical-geometric optics hybrid methods for computing the tering and absorption properties of ice crystals and dust osols	
		69
2.1		69
2.2	1	71
2.3	•	75
		75 78
		10 81
2.4	o contract of the contract of	88
		88
	0 1	92
		94
		17



VI	Contents

2.5	Extinc	tion and absorption
	2.5.1	PGOH cross-sections
	2.5.2	Tunneling/edge effect
2.6	Numei	rical examples for ice crystals and mineral dusts
2.7	Summ	ary 108
Refe	rences .	
3 Li	ight sca	attering by large particles: physical optics and the
		rming field
Ana		Borovoi
3.1		uction
3.2	Physic	eal-optics approximations in the problem of light scattering 116
	3.2.1	Light scattering by use of the Maxwell equations
	3.2.2	Geometric optics versus the Maxwell equations
	3.2.3	Light scattering by use of geometric optics
	3.2.4	What is physical optics? Diffraction and interference
	3.2.5	Physical-optics approximations
3.3	The sl	nadow-forming field
	3.3.1	Does the shadow-forming field exist in reality?
	3.3.2	Conservation of the partial energy fluxes
	3.3.3	Scattering and extinction cross-sections
	3.3.4	Cross-sections for large optically hard particles
	3.3.5	Cross-sections for large optically soft particles
	3.3.6	Can the extinction efficiency exceed number 4?
3.4	Conclu	usions
Refe	rences	
4 A	pseud	lo-spectral time domain method for light scattering
	putati	
R. I	Lee Pane	etta, Chao Liu, and Ping Yang
4.1		uction
4.2	Conce	ptual background
	4.2.1	Scattering properties of interest
	4.2.2	Near-field calculations
	4.2.3	Near-to-far-field transformation
4.3	Deriva	atives: finite difference versus spectral
4.4		libbs phenomenon
4.5		PSTD results
	4.5.1	Comparison with Lorenz–Mie calculations
	4.5.2	Comparison with T-matrix calculations
	4.5.3	Two less-symmetric examples
4.6	Comp	arison with DDA
4.7		nary
Refe		

VII

5.4.1 Extremely prolate spheroids			ion of non-orthogonal bases in the theory of light	
5.1 Introduction		_	• •	100
5.2 Light scattering problem for a spheroidal particle 5.2.1 Differential and integral formulations of the light scattering problem 192 5.2.2 Original solution to the problem for a dielectric spheroid 193 5.2.3 Perfectly conducting spheroids 204 5.2.4 Spherical particles 204 5.2.5 Characteristics of the radiation scattered by a spheroid 205 5.2.6 Diffraction of the dipole field by a spheroid 205 5.2.6 Diffraction of the dipole field by a spheroid 205 5.3.1 Estimates of integrals of products of the SAFs 211 5.3.2 Asymptotics of the SRFs for large indices n 215 5.3.3 Properties of quasi-regular systems 218 5.3.4 Analysis of the infinite systems for perfectly conducting spheroids 225 5.3.5 Analysis of ISLAEs arisen for dielectric spheroids 226 5.3.6 Light scattering problem for extremely prolate and oblate spheroids 227 5.4.1 Extremely prolate spheroids 228 5.4.2 Extremely prolate spheroids 229 5.4.3 Justification of the quasi-static approximation 230 5.4 Extremely prolate perfectly conducting spheroids 231 5.5 Scattering of a plane electromagnetic wave by extremely oblate perfectly conducting spheroids 234 5.5.1 Problem formulation 245 5.5.2 Derivation of the scattered field for the TE mode 247 5.5.3 Derivation of the scattered field for the TM mode 248 5.5.4 Characteristics of the scattered field for the TM mode 249 5.5.5 Conclusions 250 260 261 262 263 264  264  264  265 264  266  266  266				
5.2.1 Differential and integral formulations of the light scattering problem				
problem 192 5.2.2 Original solution to the problem for a dielectric spheroid 193 5.2.3 Perfectly conducting spheroids 202 5.2.4 Spherical particles 204 5.2.5 Characteristics of the radiation scattered by a spheroid 205 5.2.6 Diffraction of the dipole field by a spheroid 208 5.3.1 Estimates of integrals of products of the SAFs 211 5.3.2 Asymptotics of the SRFs for large indices $n$ 215 5.3.3 Properties of quasi-regular systems 218 5.3.4 Analysis of the infinite systems for perfectly conducting spheroids 225 5.3.5 Analysis of ISLAEs arisen for dielectric spheroids 225 5.4.1 Extremely prolate spheroids 225 5.4.2 Extremely prolate spheroids 226 5.4.3 Justification of the quasi-static approximation 231 5.4.4 Extremely prolate perfectly conducting spheroids 225 5.4.3 Justification of the quasi-static approximation 231 5.4.4 Extremely prolate perfectly conducting spheroids 226 5.5.3 Derivation of the scattered field for the TE mode 247 5.5.3 Derivation of the scattered field for the TM mode 246 5.5.4 Characteristics of the scattered radiation 251 6.6 Conclusions 256 Appendix A: Integrals of the spheroidal angular functions and other relations 257 References 266 6.1 Introduction 269  Lintroduction 260  Lintroduction	5.2	_		192
5.2.2Original solution to the problem for a dielectric spheroid193 $5.2.3$ Perfectly conducting spheroids202 $5.2.4$ Spherical particles204 $5.2.5$ Characteristics of the radiation scattered by a spheroid205 $5.2.6$ Diffraction of the dipole field by a spheroid208 $5.3$ Analysis of ISLAEs arisen in the light scattering by spheroids211 $5.3.1$ Estimates of integrals of products of the SAFs211 $5.3.2$ Asymptotics of the SRFs for large indices $n$ 215 $5.3.3$ Properties of quasi-regular systems218 $5.3.4$ Analysis of the infinite systems for perfectly conducting spheroids225 $5.3.5$ Analysis of ISLAEs arisen for dielectric spheroids225 $5.4$ Light scattering problem for extremely prolate and oblate spheroids227 $5.4.1$ Extremely prolate spheroids228 $5.4.2$ Extremely oblate spheroids228 $5.4.3$ Justification of the quasi-static approximation231 $5.4.4$ Extremely prolate perfectly conducting spheroids234 $5.5$ Scattering of a plane electromagnetic wave by extremely oblate perfectly conducting spheroids234 $5.5.1$ Problem formulation245 $5.5.2$ Derivation of the scattered field for the TE mode247 $5.5.3$ Derivation of the scattered field for the TM mode248 $5.5.4$ Characteristics of the scattered radiation251 $6.6$ Conclusions256Appendix A: Integrals of the spher		5.2.1		100
5.2.3Perfectly conducting spheroids202 $5.2.4$ Spherical particles204 $5.2.5$ Characteristics of the radiation scattered by a spheroid205 $5.2.6$ Diffraction of the dipole field by a spheroid205 $5.3$ Analysis of ISLAEs arisen in the light scattering by spheroids211 $5.3.1$ Estimates of integrals of products of the SAFs211 $5.3.2$ Asymptotics of the SRFs for large indices $n$ 215 $5.3.3$ Properties of quasi-regular systems218 $5.3.4$ Analysis of the infinite systems for perfectly conducting spheroids222 $5.3.5$ Analysis of ISLAEs arisen for dielectric spheroids225 $5.4$ Light scattering problem for extremely prolate and oblate spheroids225 $5.4.1$ Extremely prolate spheroids228 $5.4.2$ Extremely oblate spheroids228 $5.4.3$ Justification of the quasi-static approximation231 $5.4.4$ Extremely prolate perfectly conducting spheroids234 $5.5$ Scattering of a plane electromagnetic wave by extremely oblate perfectly conducting spheroids234 $5.5.1$ Problem formulation245 $5.5.2$ Derivation of the scattered field for the TE mode247 $5.5.3$ Derivation of the scattered field for the TM mode246 $5.5.4$ Characteristics of the spheroidal angular functions and other relations256Appendix A: Integrals of the spheroidal angular functions and other relations257References264Part II Radiative		F 0 0	•	
5.2.4Spherical particles204 $5.2.5$ Characteristics of the radiation scattered by a spheroid205 $5.2.6$ Diffraction of the dipole field by a spheroid208 $5.3$ Analysis of ISLAEs arisen in the light scattering by spheroids211 $5.3.1$ Estimates of integrals of products of the SAFs211 $5.3.2$ Asymptotics of the SRFs for large indices $n$ 215 $5.3.3$ Properties of quasi-regular systems218 $5.3.4$ Analysis of the infinite systems for perfectly conducting spheroids225 $5.3.5$ Analysis of ISLAEs arisen for dielectric spheroids225 $5.4$ Light scattering problem for extremely prolate and oblate spheroids225 $5.4.1$ Extremely prolate spheroids228 $5.4.2$ Extremely oblate spheroids228 $5.4.3$ Justification of the quasi-static approximation231 $5.4.4$ Extremely prolate perfectly conducting spheroids234 $5.5$ Scattering of a plane electromagnetic wave by extremely oblate perfectly conducting spheroids234 $5.5.1$ Problem formulation244 $5.5.2$ Derivation of the scattered field for the TE mode247 $5.5.3$ Derivation of the scattered radiation251 $5.6$ Conclusions250Appendix A: Integrals of the spheroidal angular functions and other relations257References264Part II Radiative Transfer6 Radiative transfer and optical imaging in biological media by low-order transport approximations: the simplified spherica				
5.2.5Characteristics of the radiation scattered by a spheroid $208$ $5.2.6$ Diffraction of the dipole field by a spheroid $208$ $5.3$ Analysis of ISLAEs arisen in the light scattering by spheroids $211$ $5.3.1$ Estimates of integrals of products of the SAFs $211$ $5.3.2$ Asymptotics of the SRFs for large indices $n$ $215$ $5.3.3$ Properties of quasi-regular systems $218$ $5.3.4$ Analysis of the infinite systems for perfectly conducting spheroids $225$ $5.3.5$ Analysis of ISLAEs arisen for dielectric spheroids $225$ $5.4$ Light scattering problem for extremely prolate and oblate spheroids $225$ $5.4.1$ Extremely prolate spheroids $228$ $5.4.2$ Extremely oblate spheroids $228$ $5.4.3$ Justification of the quasi-static approximation $233$ $5.4.4$ Extremely prolate perfectly conducting spheroids $234$ $5.5$ Scattering of a plane electromagnetic wave by extremely oblate perfectly conducting spheroids $234$ $5.5$ Derivation of the scattered field for the TE mode $247$ $5.5$ Derivation of the scattered field for the TM mode $248$ $5.5$ Conclusions $256$ Appendix A: Integrals of the spheroidal angular functions and other relations $256$ Appendix A: Integrals of the spheroidal angular functions and other relations $256$ Appendix A: Integrals of the spheroidal imaging in biological media by low-order transport approximations: the simplified spherical harmonics (SP <sub>N</sub> ) approachJorge Bo				
$5.2.6$ Diffraction of the dipole field by a spheroid. 208 $5.3$ Analysis of ISLAEs arisen in the light scattering by spheroids 211 $5.3.1$ Estimates of integrals of products of the SAFs 211 $5.3.2$ Asymptotics of the SRFs for large indices $n$ 215 $5.3.3$ Properties of quasi-regular systems 218 $5.3.4$ Analysis of the infinite systems for perfectly conducting spheroids 225 $5.4$ Analysis of ISLAEs arisen for dielectric spheroids 225 $5.4.1$ Extremely prolate spheroids 227 $5.4.1$ Extremely prolate spheroids 228 $5.4.2$ Extremely oblate spheroids 229 $5.4.3$ Justification of the quasi-static approximation 231 $5.4.4$ Extremely prolate perfectly conducting spheroids 234 $5.5.5$ Scattering of a plane electromagnetic wave by extremely oblate perfectly conducting spheroids 245 $5.5.1$ Problem formulation 245 $5.5.2$ Derivation of the scattered field for the TE mode 247 $5.5.3$ Derivation of the scattered field for the TM mode 246 $5.5.4$ Characteristics of the scattered radiation 251 $5.6$ Conclusions 256 Appendix A: Integrals of the spheroidal angular functions and other relations 257 References 266  Part II Radiative Transfer 267  6 Radiative transfer and optical imaging in biological media by low-order transport approximations: the simplified spherical harmonics $(SP_N)$ approach 269  Jorge Bouza Domínguez and Yves Bérubé-Lauzière 269 $6.1$ Introduction 269			•	
5.3 Analysis of ISLAEs arisen in the light scattering by spheroids 211 $5.3.1$ Estimates of integrals of products of the SAFs 211 $5.3.2$ Asymptotics of the SRFs for large indices $n$ 215 $5.3.3$ Properties of quasi-regular systems 218 $5.3.4$ Analysis of the infinite systems for perfectly conducting spheroids 225 $5.3.5$ Analysis of ISLAEs arisen for dielectric spheroids 225 $5.3.5$ Analysis of ISLAEs arisen for dielectric spheroids 227 $5.4.1$ Extremely prolate spheroids 228 $5.4.2$ Extremely prolate spheroids 229 $5.4.3$ Justification of the quasi-static approximation 231 $5.4.4$ Extremely prolate perfectly conducting spheroids 234 $5.5.5$ Scattering of a plane electromagnetic wave by extremely oblate perfectly conducting spheroids 245 $5.5.1$ Problem formulation 244 $5.5.2$ Derivation of the scattered field for the TE mode 247 $5.5.3$ Derivation of the scattered field for the TM mode 249 $5.5.4$ Characteristics of the scattered radiation 251 $6.5.4$ Characteristics of the spheroidal angular functions and other relations 250 $6.5.4$ Extremely prolate perfectly angular functions and other relations 250 $6.5.4$ Characteristics of the spheroidal angular functions and other relations 250 $6.5.4$ Extremely prolate perfectly angular functions and other relations 250 $6.5.4$ Extremely propagations: the simplified spherical harmonics $6.5.4$ Papproach 250 $6.5.4$ Extremely provided and 250 $6.5.4$ Extremely				
$5.3.1$ Estimates of integrals of products of the SAFs. 211 $5.3.2$ Asymptotics of the SRFs for large indices $n$ 215 $5.3.3$ Properties of quasi-regular systems. 218 $5.3.4$ Analysis of the infinite systems for perfectly conducting spheroids. 225 $5.3.5$ Analysis of ISLAEs arisen for dielectric spheroids. 227 $5.4.1$ Extremely prolate spheroids. 227 $5.4.1$ Extremely prolate spheroids. 228 $5.4.2$ Extremely oblate spheroids. 229 $5.4.3$ Justification of the quasi-static approximation. 231 $5.4.4$ Extremely prolate perfectly conducting spheroids. 234 $5.5.4$ Extremely prolate perfectly conducting spheroids. 234 $5.5.1$ Problem formulation. 245 $5.5.1$ Problem formulation. 245 $5.5.2$ Derivation of the scattered field for the TE mode. 247 $5.5.3$ Derivation of the scattered field for the TM mode. 246 $5.5.4$ Characteristics of the scattered radiation. 251 $5.6.4$ Conclusions. 256 Conclusions. 257 Appendix A: Integrals of the spheroidal angular functions and other relations. 257 References. 264  Part II Radiative Transfer  6 Radiative transfer and optical imaging in biological media by low-order transport approximations: the simplified spherical harmonics $(SP_N)$ approach $Jorge Bouza Domínguez and Yves Bérubé-Lauzière. 266 5.5.1 Introduction. 269$				
5.3.2 Asymptotics of the SRFs for large indices n	5.3			
5.3.3 Properties of quasi-regular systems				
5.3.4 Analysis of the infinite systems for perfectly conducting spheroids				
$\begin{array}{c} \text{spheroids} & 222 \\ 5.3.5 & \text{Analysis of ISLAEs arisen for dielectric spheroids} & 225 \\ 5.4 & \text{Light scattering problem for extremely prolate and oblate spheroids} & 227 \\ 5.4.1 & \text{Extremely prolate spheroids} & 228 \\ 5.4.2 & \text{Extremely oblate spheroids} & 229 \\ 5.4.3 & \text{Justification of the quasi-static approximation} & 231 \\ 5.4 & \text{Extremely prolate perfectly conducting spheroids} & 234 \\ 5.5 & \text{Scattering of a plane electromagnetic wave by extremely oblate perfectly conducting spheroids} & 243 \\ 5.5.1 & \text{Problem formulation} & 243 \\ 5.5.2 & \text{Derivation of the scattered field for the TE mode} & 247 \\ 5.5.3 & \text{Derivation of the scattered field for the TM mode} & 245 \\ 5.5.4 & \text{Characteristics of the scattered radiation} & 256 \\ \text{Appendix A: Integrals of the spheroidal angular functions and} & 256 \\ \text{Other relations} & 256 \\ \text{References} & 264 \\ \hline \\ \textbf{Part II Radiative Transfer} & 264 \\ \hline \\ \textbf{Part II Radiative Transfer} & 264 \\ \hline \\ \textbf{Dorge Bouza Domínguez and Yves Bérubé-Lauzière} & 268 \\ \hline \\ \textbf{Littroduction} & 265 \\ \hline \\ $				218
5.3.5 Analysis of ISLAEs arisen for dielectric spheroids 225 5.4 Light scattering problem for extremely prolate and oblate spheroids 227 5.4.1 Extremely prolate spheroids 228 5.4.2 Extremely oblate spheroids 229 5.4.3 Justification of the quasi-static approximation 231 5.4.4 Extremely prolate perfectly conducting spheroids 234 5.5 Scattering of a plane electromagnetic wave by extremely oblate perfectly conducting spheroids 245 5.5.1 Problem formulation 243 5.5.2 Derivation of the scattered field for the TE mode 247 5.5.3 Derivation of the scattered field for the TM mode 249 5.5.4 Characteristics of the scattered radiation 251 5.6 Conclusions 256 Appendix A: Integrals of the spheroidal angular functions and other relations 257 References 264  Part II Radiative Transfer 6 Radiative transfer and optical imaging in biological media by low-order transport approximations: the simplified spherical harmonics (SP <sub>N</sub> ) approach  Jorge Bouza Domínguez and Yves Bérubé-Lauzière 266 6.1 Introduction 265		5.3.4		
5.4 Light scattering problem for extremely prolate and oblate spheroids			•	
5.4.1Extremely prolate spheroids $228$ $5.4.2$ Extremely oblate spheroids $229$ $5.4.3$ Justification of the quasi-static approximation $231$ $5.4.4$ Extremely prolate perfectly conducting spheroids $234$ $5.5$ Scattering of a plane electromagnetic wave by extremely oblate perfectly conducting spheroids $243$ $5.5$ Problem formulation $243$ $5.5.1$ Problem formulation $243$ $5.5.2$ Derivation of the scattered field for the TE mode $247$ $5.5.3$ Derivation of the scattered field for the TM mode $249$ $5.5.4$ Characteristics of the scattered radiation $251$ $5.6$ Conclusions $256$ Appendix A: Integrals of the spheroidal angular functions and other relations $256$ References $264$ Part II Radiative transfer and optical imaging in biological media by low-order transport approximations: the simplified spherical harmonics (SP <sub>N</sub> ) approachJorge Bouza Domínguez and Yves Bérubé-Lauzière $268$ $6.1$ Introduction $268$				
5.4.2 Extremely oblate spheroids	5.4		· · · · · · · · · · · · · · · · · · ·	
5.4.3 Justification of the quasi-static approximation				
5.4.4 Extremely prolate perfectly conducting spheroids 234 5.5 Scattering of a plane electromagnetic wave by extremely oblate perfectly conducting spheroids 243 5.5.1 Problem formulation 243 5.5.2 Derivation of the scattered field for the TE mode 247 5.5.3 Derivation of the scattered field for the TM mode 249 5.5.4 Characteristics of the scattered radiation 251 6.6 Conclusions 256 Appendix A: Integrals of the spheroidal angular functions and other relations 257 References 264  Part II Radiative Transfer 264  6 Radiative transfer and optical imaging in biological media by low-order transport approximations: the simplified spherical harmonics (SP <sub>N</sub> ) approach  Jorge Bouza Domínguez and Yves Bérubé-Lauzière 269 6.1 Introduction 269				
5.5 Scattering of a plane electromagnetic wave by extremely oblate perfectly conducting spheroids				
perfectly conducting spheroids				234
5.5.1 Problem formulation	5.5		· · · · · · · · · · · · · · · · · · ·	
5.5.2 Derivation of the scattered field for the TE mode 247 5.5.3 Derivation of the scattered field for the TM mode 249 5.5.4 Characteristics of the scattered radiation 251 5.6 Conclusions 256 Appendix A: Integrals of the spheroidal angular functions and other relations 257 References 264  Part II Radiative Transfer 6 Radiative transfer and optical imaging in biological media by low-order transport approximations: the simplified spherical harmonics (SP <sub>N</sub> ) approach  Jorge Bouza Domínguez and Yves Bérubé-Lauzière 269 6.1 Introduction 266		-	•	
5.5.3 Derivation of the scattered field for the TM mode		5.5.1		
5.5.4 Characteristics of the scattered radiation		5.5.2		
5.6 Conclusions		5.5.3		
Appendix A: Integrals of the spheroidal angular functions and other relations		5.5.4	Characteristics of the scattered radiation	251
other relations	5.6	Conclu	asions	256
References	App			
Part II Radiative Transfer  6 Radiative transfer and optical imaging in biological media by low-order transport approximations: the simplified spherical harmonics ( $SP_N$ ) approach  Jorge Bouza Domínguez and Yves Bérubé-Lauzière		other	relations	257
6 Radiative transfer and optical imaging in biological media by low-order transport approximations: the simplified spherical harmonics ( $SP_N$ ) approach  Jorge Bouza Domínguez and Yves Bérubé-Lauzière	Refe	rences		264
6 Radiative transfer and optical imaging in biological media by low-order transport approximations: the simplified spherical harmonics ( $SP_N$ ) approach  Jorge Bouza Domínguez and Yves Bérubé-Lauzière				
by low-order transport approximations: the simplified spherical harmonics $(SP_N)$ approach  Jorge Bouza Domínguez and Yves Bérubé-Lauzière	Par	t II Ra	ndiative Transfer	
harmonics $(SP_N)$ approach       269         Jorge Bouza Domínguez and Yves Bérubé-Lauzière       269         6.1 Introduction       269				
Jorge Bouza Domínguez and Yves Bérubé-Lauzière       269         6.1 Introduction       269	-			
6.1 Introduction				260
0.4				
6.2.1 The radiative transfer equation	0.2	0	•	
6.2.2 Spherical harmonics expansion and the $P_N$ approximation				
6.2.3 $P_1$ and the diffusion approximation			*	

6.3	The sin	applified spherical harmonics approximation	. 274
	6.3.1	The steady-state $SP_N$ equations	. 275
	6.3.2	$SP_N$ boundary conditions and measurement modeling	
	6.3.3	Analytical solutions	. 281
	6.3.4	Frequency-domain simplified spherical harmonics equations	. 289
	6.3.5	Time-domain simplified spherical harmonics equations	
6.4	Numeri	cal solutions	
	6.4.1	Finite-difference method	. 292
	6.4.2	Finite volume method	. 294
	6.4.3	Finite element method	. 296
6.5	Diffuse	optical tomography based on $SP_N$ models	. 298
	6.5.1	DOT based on the FD- $SP_N$ model	
	6.5.2	DOT based on the TD-p $SP_N$ model	
6.6	Molecu	lar imaging of luminescence sources based on $SP_N$ models	
	6.6.1	Bioluminescence imaging	
	6.6.2	Fluorescence imaging	
	6.6.3	Cerenkov luminescence imaging	
6.7	Summa	ry	
Refe		······································	
		mination of highly scattering media by polarized light	
		Corodnichev, Sergei V. Ivliev, Alexander I. Kuzovlev,	~ <b>-</b>
		B. Rogozkin	
7.1		action	
7.2		l relations	
7.3		node approximation	
7.4		propagation	
7.5		of depolarization	
7.6		ation-difference imaging through highly scattering media	
	7.6.1	General relations. Edge spread function	
	7.6.2	Time-resolved polarization imaging	
	7.6.3	Polarization-difference imaging under CW illumination	
7.7		simulation	
7.8		sions	
Refe	rences .		. 358
8 O	n the a	pplication of the invariant embedding method and the	
		cansfer equation codes for surface state analysis	
		Fanas'ev, Dmitry S. Efremenko and Alexander V. Lubenchenko .	. 363
8.1		iction	
8.2		ructure of the elastic peak	
-	8.2.1	The energy shift of elastic peaks	
	8.2.2	The broadening of elastic peaks	
	8.2.3	Qualitative analysis of the experimental spectra of elastically	
	J.2.0	scattered electrons	. 369
8.3	Models	of elastic electron transport in solids	
0.0	8.3.1	Review of electron transport models in solids	
	8.3.2	The model of elastic electron scattering by a single plane layer	
	0.0.2	The state of the s	5.5

		Contents	IA
	8.3.3	The optical similarity	. 374
	8.3.4	Equations for elastically reflected and elastically transmitted	
		electrons derived by the invariant-embedding method	. 375
8.4	The q	uasi-single scattering approximation and the quasi-multiple	
	scatter	ring approximation	. 377
	8.4.1	The single scattering model	. 378
	8.4.2	Linearization of the system of equations in a model with one	
		strong collision	. 378
	8.4.3	The classical quasi-single scattering approximation	
	8.4.4	The small-angle quasi-single scattering approximation	. 380
	8.4.5	The quasi-multiple small-angle approximation. The nonlinear	
		term in the radiative transfer equation	
	8.4.6	Scattering by two-layer systems	
	8.4.7	Scattering by a multi-component sample	
8.5		cattering from a semi-infinite sample	
	8.5.1	The expansion by the number of elastic collisions	
	8.5.2	Expansion by the number of 'strong' elastic scatterings	
	8.5.3	The discrete ordinate method	
	8.5.4	Solution of the discrete Ambartsumian equation	
	8.5.5	The computation accuracy and time	
0.0	8.5.6	Angular distributions of the elastically scattered electrons	. 394
8.6		bation of the theoretical models based on the discrete ordinate	20.0
		d (DISORT, MDOM, NMSS)	. 396
	8.6.1	The comparison of DISORT, MDOM, NMSS calculations with	200
	0.00	Bronstein and Pronin experiments	. 396
	8.6.2	Influence of multiple scattering on the form of angular	200
	069	distributions of the elastically scattered electrons	. 399
	8.6.3	The asymptotic formula for angular distributions of the	409
	8.6.4	elastically scattered electrons	. 402
	0.0.4	coefficient	. 406
	8.6.5	The influence of surface plasmons on the angular distribution	. 400
	0.0.0	of elastically scattered electrons	. 406
8.7	The n	ractical applications of small-angle models	
0.1	8.7.1	The comparison with the Monte Carlo simulations for Au+Si	. 100
	0.7.1	sample	. 408
	8.7.2	The stratified analysis of the samples by means of EPES	
	8.7.3	Determination of the thickness of the deposited layer in the	. 110
	0.1.0	case of a low-energy resolution	. 415
8.8	Concli	usions	
	n som Isfer	e trends in the progress of astrophysical radiative	
		Vikoghosian	. 425
9.1		luction	
9.2		rinciple of invariance	
	Р	1	

X	<ul> <li>Contents</li> </ul>	
^	CONTRIBUTE	١

	9.2.1	Anisotropic scattering	490
	9.2.1	Partial redistribution over frequencies and directions	
9.3		tic and bilinear relations of radiative transfer theory	
5.5	9.3.1	The problem of diffuse reflection	
	9.3.2	Uniformly distributed energy sources	
	9.3.3	Exponentially distributed energy sources	
	9.3.4	The Milne problem	
9.4		odified principle of invariance	
9.5		riational formalism	
0.0	9.5.1	The polynomial distribution of sources	
9.6	0.0	oup of RSF (reducible to the source-free) problems	
9.7	_	rily varying sources	
9.8		medium	
9.9		cal description of the radiation diffusion process	
9.10		vers adding method	
	9.10.1	The nature of some nonlinear relations of the radiation	
		transfer theory	. 449
	9.10.2	The Chandrasekhar relations	. 450
9.11	Inhomo	geneous atmosphere	. 452
	9.11.1	The radiative transfer equations	. 456
	9.11.2	Determination of some other quantities	. 457
9.12	The gro	oup theoretical description of the radiation transfer	. 458
	9.12.1	Radiation field inside a medium	. 460
	9.12.2	Semi-infinite medium	. 462
	9.12.3	Multicomponent atmosphere	
9.13		ane-parallel atmosphere	
		rmation in mesoturbulent atmosphere	
Refer	rences .		. 469
10 /	rovio	w of fast radiative transfer techniques	
			475
10.1		uction	
10.1		bution and correlated- $k$ methods	
10.2		ential sum fitting of transmittances	
10.4		al mapping	
10.5		al spectral sampling	
10.6		-k, linear- $k$ and low streams interpolation approaches	
10.7		pal component analysis	
		networks	
		eterizations for semi-infinite and optically thick media	
		ders of scattering approximations	
		sions	
		: Functions relevant to second order of scattering for	
1.1		eneous atmospheres	. 499
Appe		: Functions relevant to second order of scattering for	
		ogeneous atmospheres	. 500
Refe			

	_	ence of direct aerosol radiative forcing on the optical of atmospheric aerosol and underlying surface	
		asi, Christian Lanconelli, Angelo Lupi, and Mauro Mazzola	505
11.1		ection	
11.2		models	
	11.2.1	The three 6S original aerosol models	
	11.2.2	The 6S supplementary aerosol models	
	11.2.3	The 6S modified (M-type) aerosol models	
	11.2.4	The OPAC aerosol models	
	11.2.5	The Shettle and Fenn (1979) aerosol models	
	11.2.6	The seven additional aerosol models	
	11.2.7	Comparison among the radiative properties of the 40 aerosol	
		models	551
11.3	Underl	ying surface reflectance characteristics	
	11.3.1	The non-lambertian surface reflectance models	
	11.3.2	The isotropic (lambertian) surface reflectance models	
11.4		aneous direct aerosol-induced radiative forcing (DARF)	
	11.4.1	Definitions	
	11.4.2	Theory	
	11.4.3	Dependence of instantaneous DARF on aerosol properties	
	11.4.4	Dependence of instantaneous DARF on underlying surface	
		reflectance	591
	11.4.5	Dependence of instantaneous DARF on solar zenith angle	600
11.5	Conclu	ding remarks	
			•
Inde	x		629