Contents

1.	Introduction—A Historical Overview. By S.L. Shapiro (With 4 Figures)	
	1.1 Historical Concepts for Measuring Brief Time Intervals	1
	1.1.1 Physiological Techniques	
	1.1.2 Mechanical Techniques and Streak Concepts	3
	1.1.3 Studies in Motion with Spark Photography	4
	1.1.4 Probe Technique Experiments in the Last Century	
	1.1.5 Popularization of Spark Photography—	
	Chemical Applications	
	1.1.6 Electrical Technique	6
	1.1.7 Historical Summary	8
	1.2 Picosecond Techniques	8
	1.2.1 Their Origins	8
	1.2.2 Advantages and Differences of the New Techniques	10
	1.3 Present Trends and Future Studies	12
	1.4 Organization of the Book	13
	References	15
2.	Methods of Generation. By D. J. Bradley (With 46 Figures)	
	2.1 Optical Pulse Properties and Methods of Measurement	18
	2.1.1 General Description of Modelocked Laser Pulses	
	2.1.2 Measurement of Pulse Intensity Profile <i>I</i> (<i>t</i>)	23
	Two-Photon Fluorescence (TPF) Measurements	
	Electron-Optical Picosecond Chronoscopy	
	Photoelectron Time Dispersion	26
	Streak-Camera Systems	28
	xuv and x-Ray Streak Cameras	33
	2.2 Types of Modelocked Lasers	36
	2.2.1 Giant-Pulse Lasers	36
	2.2.2 Dye Lasers	41
	Flashlamp Pumped Systems	
	Temporal Buildup of Modelocking in Dye Lasers	44
	Saturable Absorber Recovery Time and Photoisomer	
	Generation	48
	Comparison of Modelocked Ruby and Cresyl-Violet	
	Lasers	51

		Modelocked cw Dye Lasers	54
		Synchronously Pumped Dye Lasers	57
	2.3	The Fluctuation Model of Modelocked Lasers	
		2.3.1 Passive Modelocking of Giant-Pulse Lasers	
		2.3.2 Passively Modelocked Dye Lasers	62
		Rate-Equation Analysis	63
		Steady-State Pulse Solutions	64
	2.4	Picosecond Pulse Amplification	65
		2.4.1 Neodymium: Glass Amplifiers	67
		2.4.2 Amplification of Dye Laser Pulses	
	2.5	Frequency Changing	
	Ref	erences	76
3.	Tec	chniques for Measurement. By E. P. Ippen and C. V. Shank	
		ith 28 Figures)	
	3.1	Pulsewidth Measurements	83
		3.1.1 Correlation Functions	85
		3.1.2 The Two-Photon Fluorescence Method	89
		3.1.3 Second-Harmonic Generation Methods	90
		3.1.4 The Optical Kerr Shutter	92
		3.1.5 Pulse Compression and Dynamic Spectroscopy	96
		3.1.6 Higher Order Nonlinear Methods	
		3.1.7 Summary	
	32	Techniques for Measuring Picosecond Events	
	5.2	3.2.1 Pump and Probe Techniques	
		3.2.2 Time-Resolved Measurements with Continuously Operated	102
		Systems	108
		3.2.3 Light-Gating Techniques for Time-Resolved Emission	100
		Studies	113
		3.2.4 Streak Camera Techniques for Time-Resolved Emission	113
		Studies	112
		3.2.5 Conclusion	
	Daf	Serences	
	KCI	crences	117
4.		osecond Nonlinear Optics. By D. H. Auston (With 24 Figures)	
		Nonlinear Optical Effects	
	4.2	Optical Harmonic Generation and Mixing	
		4.2.1 Second Harmonic Generation	
		4.2.2 Third and Higher Order Harmonic Generation and Mixing	
	4.3	Parametric Emission	134
		4.3.1 Three Photon Parametric Fluorescence and Amplification .	134
		4.3.2 Four Photon Parametric Interactions	136
	4.4	Stimulated Scattering	
		4.4.1 Transient Stimulated Raman Scattering	140
		4.4.2 Stimulated Raman Scattering of Picosecond Pulses:	
		Experiments	142

		4.4.3 Stimulated Raman Scattering of Picosecond Pulses: Theory	147
		4.4.4 Other Light Scattering	153
	4.5	Self-Focusing, Self-Phase Modulation and Self-Steepening	154
		4.5.1 Nonlinear Index of Refraction	155
		4.5.2 Self-Focusing of Picosecond Pulses: Experiments	161
		4.5.3 Self-Focusing of Picosecond Pulses: Theory	168
		4.5.4 Limiting Filament Diameters	
		4.5.5 Self-Phase Modulation	171
		4.5.6 Self-Steepening of Picosecond Pulses	175
	4.6	Optical Damage	177
	4.7	Coherent Pulse Propagation	180
		4.7.1 Coherent Birefringence Echoes in Kerr Gases	181
		4.7.2 Self-Induced Transparency	
	4.8	Device Applications	184
		4.8.1 Optical Rectification	19/
		4.8.2 Picosecond Electronics	104
		4.8.3 Holography	100
		4.8.4 Ontical Communications	100
		4.8.4 Optical Communications	102
	Dof	erences	193
	KCI	erences	194
5.	Pic	osecond Interactions in Liquids and Solids. By D. von der Linde	
		ith 31 Figures)	
		Vibrational Relaxation in the Electronic Ground State	204
		5.1.1 Excitation and Detection of Vibrational Waves by Means of	207
		the Raman Effect	
		5.1.2 Dephasing Processes and Relaxation of the Vibrational	207
		Energy	206
		5.1.3 Coherent and Incoherent Raman Scattering	200
		5.1.4 Measurement of Dephasing Times in Liquids	200
		5.1.5 Dephasing in Inhomogeneously Broadened Systems	217
		5.1.6 Measurement of Optical Phonon Lifetimes in Crystals	21/
		5.1.0 Measurement of Optical Filonon Electrices in Crystals	221
	5.2	5.1.7 Energy Relaxation and Energy Transfer	223
	5.2	Picosecond Electronic Interactions	233
		5.2.1 Multiphoton Interactions	233
		5.2.2 Saturation of the Optical Absorption	238
		5.2.3 High Density Electron-Hole Plasmas	243
	- 2	5.2.4 Nonradiative Relaxation of Electronic Excitation	247
	5.3	Picosecond Spectroscopy of Excitons	252
		5.3.1 Overview of the Properties of Excitons	
		5.3.2 A ₁ -Exciton Bottleneck	
		5.3.3 Exciton Luminescence Spectra at High Density	
		5.3.4 Dynamics of Excitons at High Density	261
		5.3.5 Bose Condensation of Excitonic Molecules	
		5.3.6 Discussion of the High Density Exciton Experiments	
		Summary	
	Ref	erences	271

6.	Picosecond Relaxation Processes in Chemistry. By K. B. Eisenthal	
	(With 16 Figures)	
	6.1 Intermolecular Energy Transfer	275
	6.1.1 Singlet-Singlet Transfer	
	6.1.2 Triplet-Triplet Transfer	
	6.2 Orientational Relaxation of Molecules in Liquids	
	6.2.1 Optical Kerr Effect	282
	6.2.2 Induced Dichroism Method	
	6.2.3 Transient Grating Method	288
	6.3 Photodissociation and the Cage Effect	289
	6.4 Electron Transfer Processes	292
	6.4.1 Electron Photoejection and Solvation	292
	6.4.2 Excited-State Charge Transfer Complexes	294
	6.5 Picosecond Measurements of Internal Conversion and Intersystem	207
	Crossing	291
	6.5.1 Absorption Measurements of Internal Conversion and	208
	Intersystem Crossing	290
	Intersystem Crossing	305
	References	311
	References	211
7	Picosecond Relaxation Measurements in Biology	
/٠	-	
	By A. J. Campillo and S. L. Shapiro (With 24 Figures)	217
	7.1 Photosynthesis	317
	7.1.1 Primary Events in Photosynthesis	
	7.1.2 The Pigments	220
	7.1.3 Exciton Migration	330
	7.1.4 Reaction Center Oxidation	3 4 3
	7.2 Measurements with Hemoglobin	354
	7.2.1 Properties of Hemoglobin	355
	7.2.3 Photodissociation Properties of HbCO and HbO ₂	356
	7.2.4 Picosecond and Subpicosecond Measurements in	
	Hemoglobin Compounds	357
	7.3 The Visual Molecules	359
	7.4 Deoxyribonucleic Acid (DNA)	364
	7.4.1 Possible Applications in DNA	. 364
	7.4.2 Transfer to Intercalated Dye Molecules	. 368
	7.4.3 Picosecond Studies	. 369
	7.4.4 Picosecond Pulses and Selective Biochemical Reactions	
	in DNA	. 371
	References	
	The line of the Tale.	377
	Additional References with Titles	
S	Subject Index	. 381