

CONTENTS

Spectral Composition of the Radiation of Solid Lasers

A. A. Sychev

Introduction	1
Chapter I	
Spectral Composition of Radiation and Kinetics of Spectra of Ruby and Neodymium Glass Lasers	3
§ 1. Spectral Composition of Radiation of Solid Lasers	3
§ 2. Kinetics of Spectrum of Free Generation of a Ruby Laser with Elimination of Mode Discrimination	5
§ 3. Kinetics of Free Generation of Ruby and Neodymium Glass Lasers in the Mode of "Traveling" Waves	12
Chapter II	
Structure of Spectra of Solid Lasers	18
§ 1. Experimental Study of Structure of Free-Generation Radiation Spectra of Solid Lasers	18
§ 2. Analysis of Spectral Composition of Radiation on the Basis of Existing Concepts of the Fluctuation Nature of Radiation. Role of the Spectral Instrument	23
Chapter III	
Study of Spectral and Time Characteristics of a Laser with a Passive Gate	28
§ 1. Methods of Modulation of Laser Quality and the Phenomenon of Self-synchronization of Modes (Self-mode Locking)	28
§ 2. Spectral-Temporal Method of Studying Partial Self-synchronization of Modes	32
§ 3. Study of Self-synchronization of Modes in Ruby and Neodymium Glass Lasers	38
Chapter IV	
Statistics of Laser Radiation. Effect of Relaxation Time of Passive Gate on Characteristics of Generation Radiation	42
§ 1. Characteristics of Radiation of a Neodymium Glass Laser with a Passive Gate Possessing a Finite Relaxation Time	42
§ 2. Statistics of Radiation of a Neodymium Glass Laser	46
§ 3. Method of Decreasing Relaxation Time of Passive Gate of a Neodymium Glass Laser	54
Literature Cited	57

Time Characteristics of Laser Pulses and Methods for Their Measurement
T. I. Kuznetsova

Introduction	61
Chapter I	
Theory of Generation of Supershort Pulses in Lasers	62
Introduction to Chapter I	62
§ 1. Prethreshold Establishment of Quasi-periodic Fluctuation Pattern (Process of Formation of Modes)	65
§ 2. Narrowing of Radiation Spectrum in Stage before Clearing of Filter	67
§ 3. Interaction of Radiation with Filter in the Process of Clearing	72
§ 4. Properties of Time Dependence of Radiation Which Develop during Clearing	75
§ 5. Estimate of Distortions of Time Dependence of Radiation Arising upon Saturation of Amplification	76
§ 6. Temporal and Spectral Description of Self-synchronization of Modes	79
§ 7. Statistics of Formation of Single Supershort Pulses upon Clearing of Filter	80
Conclusion to Chapter I. Comparison with Experiment	86
Chapter II	
Special Cases of Self-synchronization of Laser Modes	87
Introduction to Chapter II	87
§ 1. Self-synchronization of Modes in a Standing-Wave Laser	88
§ 2. Transformation of Field in a Laser for an Arbitrary Law of Nonlinearity	91
§ 3. Interaction of Opposing Waves in a Two-Direction Traveling-Wave Laser	93
§ 4. Detuning of Centers of Filter Absorption Band and Laser Amplification Line	96
§ 5. Laser with a Large Coefficient of Absorption in the Filter	101
§ 6. Influence of Relaxation Time of Filter on Self-synchronization of Modes	104
§ 7. Overlapping of Stage of Clearing of Filter with Stage of Saturation of Amplification	107
Conclusion to Chapter II. Comparison with Experiment	109
Chapter III	
Indirect Methods of Measuring the Duration of Supershort Light Pulses	111
Introduction to Chapter III	111
§ 1. The Two-Photon Method. Basic Equations	113
§ 2. Comparison of Two-Photon Luminescence Tracks for Different Cases of Time Dependence of Radiation	114
§ 3. Correlation Functions of Radiation of a Laser with Incomplete Self-synchronization of Modes	118
§ 4. Effective Duration of the Radiation	121
§ 5. Connection of Effective Duration with Characteristics of Two-Photon Luminescence Track	123
§ 6. Demands on Accuracy of Measurement of Track	125
§ 7. Additional Factors Reducing the Contrast of a Two-Photon Luminescence Track	126
§ 8. Measurements Based on Luminescence with Multiphoton Absorption	129
§ 9. Determination of Effective Duration from Efficiency of Nonlinear Conversion of Radiation Being Studied	133

§ 10. Some Other Indirect Methods of Measuring Time Characteristics of Lasers with Self-synchronization of Modes	134
§ 11. Positive Aspects of Correlation Methods	135
Conclusion to Chapter III. Comparison with Experiment	136
Chapter IV	
Holographic Principle of Recording Time Characteristics of Radiation	137
Introduction to Chapter IV	137
§ 1. A System for Recording a Transient Optical Signal on a Plane Hologram	137
§ 2. Reconstruction of the Signal	139
§ 3. Space-Time Pattern of the Reconstructed Field	141
§ 4. Detailed Derivation of Equation for the Time Resolution of the Method	144
§ 5. Formation of the Reference Wave	145
§ 6. Diffraction Distortions of Reference Wave and Conveyance of Reference Wave over a Distance	149
§ 7. Principle of Recording and Reconstruction of Signals Which Vary in Space and in Time	150
§ 8. Recording and Reconstruction of Transient Fields Using a Volumetric Hologram. General Case	153
§ 9. Comparison with a Discrete Recording System	155
§ 10. Time and Spatial Resolution of a Three-Dimensional Hologram. Volume of Information	157
§ 11. Some Applications of the Method	158
Conclusion to Chapter IV	161
Conclusion and Brief Results	161
Literature Cited	163
Study of the Dynamics of Complex Crystal Lattices by the Method of Laser Spectroscopy of the Raman Scattering of Light	
V. S. Gorelik	
Introduction	167
Chapter I	
Survey of the Literature	168
§ 1. Harmonic Vibrations of a Crystal Lattice	168
§ 2. Damping of Long-Wave Optical Phonons. Shifts of Vibrational Levels	169
§ 3. Theory of Raman Scattering in Crystals	170
§ 4. A General Review of Experimental Research	172
Chapter II	
Methods of Group-Theory Analysis of Raman Scattering Spectra in Crystals	174
§ 1. Classification of Principal Crystal Vibrations Based on Irreducible Representations of Space Groups	174
§ 2. Classification of Vibrations in Crystals Containing Complex Atomic Groups	176
§ 3. Selection Rules in Raman Scattering Spectra	178
Chapter III	
Method of Investigation of Raman Scattering Spectra in Crystals	178
§ 1. General Description of the Experiment	178
§ 2. Properties of an Argon Laser	179

Chapter IV

Raman Scattering of Light in NaClO_3 and NaNO_2 Crystals	181
§ 1. Properties of the Vibrational Spectra of Ferroelectric Crystals	181
§ 2. Raman Scattering in NaClO_3 Crystals	183
§ 3. Raman Scattering of Light in NaNO_2	187

Chapter V

Raman Scattering of Light in the α -Sulfur Molecular Crystal	189
§ 1. Group-Theory Analysis	189
§ 2. Experimental Study of the First-Order Raman Scattering Spectrum	192
§ 3. Study of the Second-Order Raman Scattering Spectrum	194
Literature Cited	196

