



# CONTENTS

CHAPTER I. Methods for the Calculation of Wave Functions	1
§ 1. Introduction	1
§ 2. The Variational Principle	2
§ 3. The One-Configuration Approximation	3
§ 4. Methods of Calculating Radial Functions	6
§ 5. More Accurate Methods for the Calculation of the Wave Functions	9
§ 6. Calculation of the Oscillator Strengths	10
CHAPTER II. Calculation of Radial Wave Functions with the Help of an Electronic Digital Computer	13
§ 7. The Semiempirical Method	13
§ 8. The Effective Potential. Introduction of Atomic-Core Deformation	14
§ 9. Derivation of the Basic Equations	15
§ 10. Determination of the Parameter $\omega$	17
§ 11. Boundary Conditions	18
§ 12. General Scheme of the Solution	19
§ 13. Comments on Individual Subroutines	22
§ 14. Results of the Calculations	23
CHAPTER III. Analytical Radial Functions	26
§ 15. Introduction	26
§ 16. Radial Functions of Slater and Bates and Damgaard . . . . .	26
§ 17. Radial Functions for the Lower States of the Optical Electron	29
CHAPTER IV. Calculation of the Oscillator Strengths . . . . .	32
§ 18. Results of the Calculations and Experimental Data	32
§ 19. Discussion of the Results .	32
§ 20. Summary and Conclusion	36
APPENDIX. Detailed Arrangement of the Numerical Integration of the Differential Equation . . . . .	38
LITERATURE CITED	40
Bibliographical List of Papers by Workers in the Spectroscopy Laboratory of the P. N. Lebedev Physics Institute of the Academy of Sciences of the USSR, 1932-1960 . . . . .	43



# CONTENTS

INTRODUCTION.	1
CHAPTER I. The Theory of Spectral Line Broadening	3
§ 1. Introduction	4
§ 2. Collision Theory	5
§ 3. Broadening by Charged Particles	7
§ 4. Nonstationary Theory	9
§ 5. Broadening by Neutral Particles	11
§ 6. Line Wings	12
CHAPTER II. Investigation of the Width and Shift of Lines in the Plasma of a Spark Discharge	16
§ 1. Introduction . . . . .	16
§ 2. Description of Apparatus . . . . .	17
§ 3. Treatment of Spectrograms . . . . .	19
§ 4. Characteristics of the Lines Investigated	21
§ 5. Results of Measurements . . . . .	23
§ 6. Measurements of a Small Time Interval	27
CHAPTER III. Investigation of the Width and Shift of Lines in the Plasma of an Arc Discharge	28
§ 1. Introduction	28
§ 2. Description of Apparatus	31
§ 3. Treatment of Spectrograms	33
§ 4. Description of the Lines Investigated	34
§ 5. Results of Measurements	35
CHAPTER IV. Discussion of Results	37
A. Investigation of Spark Discharge	37
§ 1. Evaluation of the Applicability of Collision Theory	37
§ 2. Comparison with Stationary Theory	38
§ 3. Comparison with Nonstationary Theory	38
Appendix to § 3	42
§ 4. The Case of Two Perturbing Levels	43
§ 5. Determination of the Concentration of Charged Particles	45
§ 6. Asymmetric Lines	47
B. Investigation of Arc Discharge	49
§ 1. Evaluation of the Applicability of Collision Theory	49
§ 2. Roles of Charged and Neutral Particles in Line Broadening	51
§ 3. Determination of Electron Concentrations and the van der Waals Constant	51
CONCLUSION	54
LITERATURE CITED	56
Bibliographical List of Papers by Workers in the Spectroscopy Laboratory of the P. N. Lebedev Physics Institute of the Academy of Sciences of the USSR, 1932 - 1960	59



# CONTENTS

INTRODUCTION	1
CHAPTER I. Elementary Processes of Excitation and Ionization of Atoms in a Spark Discharge	3
§ 1. Introduction - Survey of Data in the Literature	3
§ 2. Elementary Processes in the Channel of a Spark Discharge	5
§ 3. Discussion of Results	12
CHAPTER II. Methods of Measurement and Experimental Apparatus for Determining the Temperature in a Spark Discharge	14
§ 1. Introduction	14
§ 2. Description of Apparatus	16
§ 3. Methods of Measurement	17
CHAPTER III. Discussion of the Results of Temperature Measurements	21
§ 1. Results of Measurements	21
§ 2. Additional Measurements	21
§ 3. Discussion of Results	25
CHAPTER IV. On Electrode Processes in a Spark Discharge	29
§ 1. Introduction	29
§ 2. Investigation of Jet Structure	33
§ 3. Investigation of Electrode Processes in a Spark Discharge	37
§ 4. Discussion of Results	40
CONCLUSION	42
LITERATURE CITED	43
Bibliographical List of Papers by Workers in the Spectroscopy Laboratory of the P. N. Lebedev Physics Institute of the Academy of Sciences of the USSR, 1932-1960	45



# CONTENTS

INTRODUCTION	1
CHAPTER I. Review of Work on Radioluminescence	3
§ 1. Emission Spectra	3
§ 2. Radioluminescence Yield	3
§ 3. The Duration of Scintillations	4
§ 4. Variation of the Luminescent Yield with the Energy and Nature of the Particle	5
§ 5. The Scintillation Process	6
§ 6. The Author's Dissertation	10
CHAPTER II. The Photoluminescence Yield of Organic Crystals	11
§ 1. Measurement of the Luminescence Quantum Yield in Finely Crystalline Powders	11
§ 2. Measurement of the Fluorescence Yield of Monocrystalline Anthracene Plates by the Method of Comparison with the Fluorescence of a Solution	11
CHAPTER III. The Luminescence Energy Yield for $\gamma$ -Scintillations in Stilbene Crystals	14
§ 1. $\gamma$ -Ray Absorption	14
§ 2. Experimental Apparatus	15
§ 3. Calibration of the Photomultiplier, Amplifier, and Discriminator	16
§ 4. Calculation of Yield	18
CHAPTER IV. Comparison of Yields for $\gamma$ - and Photoexcitation	20
CHAPTER V. Luminescence and the Vavilov-Cerenkov Radiation in Solutions under the Influence of $\gamma$ -Rays	24
§ 1. The Solutions Investigated	24
§ 2. Measurement of the Luminosity from Solutions under the Influence of $\gamma$ -Rays	25
§ 3. Measurement of Concentration Quenching	26
§ 4. Determination of the Wavelength Limits for Absorption by Solutions and Solvents	26
§ 5. Calculation of Excitation Efficiency	27
CHAPTER VI. Quenching of the Luminescence of Organic Substances Excited by $\alpha$ -Particles	30
§ 1. Ratio of Luminescence Yields in Excitation by $\alpha$ -Particles and Electrons	30
§ 2. Dependence of the $\alpha/\beta$ Ratio on Temperature	32
§ 3. Quenching of the $\alpha$ - and $\gamma$ -Luminescence of Solutions of Terphenyl in Xylene by Carbon Tetrachloride	32
§ 4. Concentration Variation of the $\alpha$ - and $\beta$ -Luminescence Yields for Solutions of Terphenyl in Xylene	35
CONCLUSION	36
SUMMARY	39
LITERATURE CITED	40
Bibliographical List of Papers by Workers in the Spectroscopy Laboratory of the P. N. Lebedev Physics Institute of the Academy of Sciences of the USSR, 1932-1960	43