

# Contents

|                                                                                                                                 |       |
|---------------------------------------------------------------------------------------------------------------------------------|-------|
| Preface .....                                                                                                                   | v     |
| List of Contributors .....                                                                                                      | xxiii |
| <b>Part I Self-focusing in the Past</b>                                                                                         |       |
| 1. Self-Focusing and Filaments of Light: Past and Present .....                                                                 | 3     |
| <i>Y. Ron Shen</i>                                                                                                              |       |
| 2. Notes on Early Self-Focusing Papers .....                                                                                    | 21    |
| <i>John H. Marburger</i>                                                                                                        |       |
| Reprint of Review Paper .....                                                                                                   |       |
| J.H. Marburger, Self-focusing: Theory, Progr. in Quant. Electron.,<br>4, 35–110 (1975)                                          |       |
| 3. Optical Self-Focusing: Stationary Beams<br>and Femtosecond Pulses .....                                                      | 103   |
| <i>G.M. Fraiman, A.G. Litvak, V.I. Talanov, and S.N. Vlasov</i>                                                                 |       |
| 4. Self-Focusing of Optical Beams .....                                                                                         | 129   |
| <i>R.Y. Chiao, T.K. Gustafson, and P.L. Kelley</i>                                                                              |       |
| 5. Multi-Focus Structure and Moving Nonlinear Foci: Adequate<br>Models of Self-Focusing of Laser Beams in Nonlinear Media ..... | 145   |
| <i>V.N. Lugovoi and A.A. Manenkov</i>                                                                                           |       |
| 6. Small-Scale Self-focusing .....                                                                                              | 157   |
| <i>Anthony J. Campillo</i>                                                                                                      |       |
| 7. Wave Collapse in Nonlinear Optics .....                                                                                      | 175   |
| <i>E. A. Kuznetsov</i>                                                                                                          |       |
| 8. Beam Shaping and Suppression of Self-focusing in<br>High-Peak-Power Nd:Glass Laser Systems .....                             | 191   |
| <i>Svetlana G. Lukishova, Yury V. Senatsky, Nikolai E. Bykovsky,<br/>and Alexander S. Scheulin</i>                              |       |

|                                                                                                 |     |
|-------------------------------------------------------------------------------------------------|-----|
| 9. Self-focusing, Conical Emission, and Other Self-action Effects<br>in Atomic Vapors . . . . . | 231 |
| <i>Petros Zerom and Robert W. Boyd</i>                                                          |     |
| 10. Periodic Filamentation and Supercontinuum Interference . . . . .                            | 253 |
| <i>Xiaohui Ni and R.R. Alfano</i>                                                               |     |
| 11. Reprints of Papers from the past . . . . .                                                  | 265 |

(1) G.A. Askar'yan: Effects of the Gradient of a Strong Electromagnetic Beam on Electrons and Atoms, Sov. Phys. JETP 15, 1088–1090 (1962) – *First paper on self-focusing and self-trapping.*

(2) V.I. Talanov: On Self-focusing of Electromagnetic Waves in Nonlinear media, Izv. Vuzov, Radiophysica, 7, 564–565 (1964) – *First time translation from Russian.*

(3) M. Hercher: Laser-induced Damage in Transparent Media. *Presents the first laboratory observation of self-focusing. This paper is published here for the first time in its entirety. Previously, only the abstract had been published in J. Opt. Soc. Am., 54, 563 (1964).*

## Part II Self-focusing in the Present

|                                                                                                                                 |     |
|---------------------------------------------------------------------------------------------------------------------------------|-----|
| 12. Self-focusing and Filamentation of Femtosecond Pulses in Air<br>and Condensed Matter: Simulations and Experiments . . . . . | 297 |
| <i>A. Couairon and A. Mysyrowicz</i>                                                                                            |     |
| 13. Self-organized Propagation of Femtosecond Laser<br>Filamentation in Air . . . . .                                           | 323 |
| <i>Jie Zhang, Zuoqiang Hao, Tingting Xi, Xin Lu, Zhe Zhang,<br/>Hui Yang, Zhan Jin, Zhaohua Wang, and Zhiyi Wei</i>             |     |
| 14. The Physics of Intense Femtosecond Laser Filamentation . . . . .                                                            | 349 |
| <i>See Leang Chin, Weiwei Liu, Olga G. Kosareva, and<br/>Valerii P. Kandidov</i>                                                |     |
| 15. Self-focusing and Filamentation of Powerful Femtosecond<br>Laser Pulses . . . . .                                           | 371 |
| <i>V.P. Kandidov, A.E. Dormidonov O.G. Kosareva, S.L. Chin, and<br/>W. Liu</i>                                                  |     |
| 16. Spatial and Temporal Dynamics of Collapsing Ultrashort<br>Laser Pulses . . . . .                                            | 399 |
| <i>Alexander L. Gaeta</i>                                                                                                       |     |
| 17. Some Modern Aspects of Self-focusing Theory . . . . .                                                                       | 413 |
| <i>Gadi Fibich</i>                                                                                                              |     |
| 18. X-Waves in Self-Focusing of Ultra-Short Pulses . . . . .                                                                    | 439 |
| <i>Claudio Conti, Paolo Di Trapani, Stefano Trillo</i>                                                                          |     |

|                                                                                                                                               |     |
|-----------------------------------------------------------------------------------------------------------------------------------------------|-----|
| 19. On the Role of Conical Waves in Self-focusing and Filamentation of Femtosecond Pulses with Nonlinear Losses . . . . .                     | 457 |
| <i>Eugenijus Gaižauskas, Audrius Dubietis, Viačeslav Kudriašov, Valdas Sirutkaitis, Arnaud Couairon, Daniele Faccio, and Paolo Di Trapani</i> |     |
| 20. Self-focusing and Self-defocusing of Femtosecond Pulses with Cascaded Quadratic Nonlinearities . . . . .                                  | 481 |
| <i>Frank W. Wise and Jeffrey Moses</i>                                                                                                        |     |
| 21. Effective Parameters of High-Power Laser Femtosecond Radiation at Self-focusing in Gas and Aerosol Media . . . . .                        | 507 |
| <i>G.G. Matvienko, S.N. Bagaev, A.A. Zemlyanov, Yu.E. Geints, A.M. Kabanov and A.N. Stepanov</i>                                              |     |
| 22. Diffraction-Induced High-Order Modes of the $(2 + 1)$ D Nonparaxial Nonlinear Schrödinger Equation . . . . .                              | 517 |
| <i>Sabino Chávez-Cerda, Marcelo David Itube-Castillo, and Jandir Miguel Hickmann</i>                                                          |     |
| 23. Self-focusing and Solitons in Photorefractive Media . . . . .                                                                             | 547 |
| <i>E. DelRe and M. Segev</i>                                                                                                                  |     |
| 24. Measuring Nonlinear Refraction and Its Dispersion . . . . .                                                                               | 573 |
| <i>Eric W. Van Stryland and David J. Hagan</i>                                                                                                |     |
| Index . . . . .                                                                                                                               | 593 |

