

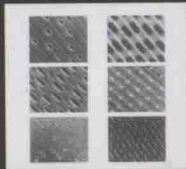
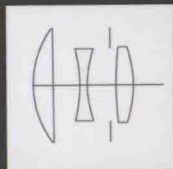
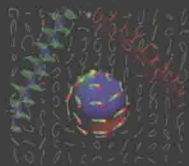
Third Edition

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HANDBOOK OF OPTICS

Volume I

*Geometrical and Physical Optics, Polarized Light,
Components and Instruments*



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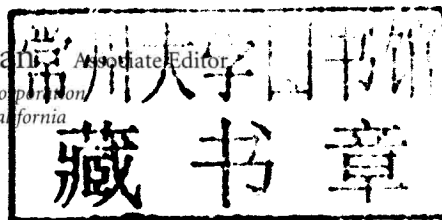
Volume I
Geometrical and Physical Optics,
Polarized Light,
Components and Instruments

THIRD EDITION

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Handbook of Optics, Third Edition, Volume I: Geometrical and Physical Optics, Polarized Light, Components and Instruments

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HANDBOOK OF OPTICS

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COVER ILLUSTRATIONS

Left: Poincaré sphere describing light's polarization states is shown floating in front of a depolarized field of polarization ellipses, with linearly and circularly polarized fields propagating on its left and right, respectively. See Chaps. 12 and 15.

Middle: Triplet lens developed for photographic applications that can zero out the primary aberrations by splitting the positive lens of a doublet into two and placing one on each side of the negative lens. See Chap. 17.

Right: Micrographs of different optical storage media showing the straight and narrow tracks with 1.6- μm spacing between adjacent tracks. The recorded information bits appear as short marks along each track. See Chap. 35.

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EDITORS' PREFACE

The third edition of the *Handbook of Optics* is designed to pull together the dramatic developments in both the basic and applied aspects of the field while retaining the archival, reference book value of a handbook. This means that it is much more extensive than either the first edition, published in 1978, or the second edition, with Volumes I and II appearing in 1995 and Volumes III and IV in 2001. To cover the greatly expanded field of optics, the *Handbook* now appears in five volumes. Over 100 authors or author teams have contributed to this work.

Volume I is devoted to the fundamentals, components, and instruments that make optics possible. Volume II contains chapters on design, fabrication, testing, sources of light, detection, and a new section devoted to radiometry and photometry. Volume III concerns vision optics only and is printed entirely in color. In Volume IV there are chapters on the optical properties of materials, non-linear, quantum and molecular optics. Volume V has extensive sections on fiber optics and x ray and neutron optics, along with shorter sections on measurements, modulators, and atmospheric optical properties and turbulence. Several pages of color inserts are provided where appropriate to aid the reader. A purchaser of the print version of any volume of the *Handbook* will be able to download a digital version containing all of the material in that volume in PDF format to one computer (see download instructions on bound-in card). The combined index for all five volumes can be downloaded from www.HandbookofOpticsOnline.com.

It is possible by careful selection of what and how to present that the third edition of the *Handbook* could serve as a text for a comprehensive course in optics. In addition, students who take such a course would have the *Handbook* as a career-long reference.

Topics were selected by the editors so that the *Handbook* could be a desktop (bookshelf) general reference for the parts of optics that had matured enough to warrant archival presentation. New chapters were included on topics that had reached this stage since the second edition, and existing chapters from the second edition were updated where necessary to provide this compendium. In selecting subjects to include, we also had to select which subjects to leave out. The criteria we applied were: (1) was it a specific application of optics rather than a core science or technology and (2) was it a subject in which the role of optics was peripheral to the central issue addressed. Thus, such topics as medical optics, laser surgery, and laser materials processing were not included. While applications of optics are mentioned in the chapters there is no space in the *Handbook* to include separate chapters devoted to all of the myriad uses of optics in today's world. If we had, the third edition would be much longer than it is and much of it would soon be outdated. We designed the third edition of the *Handbook of Optics* so that it concentrates on the principles of optics that make applications possible.

Authors were asked to try to achieve the dual purpose of preparing a chapter that was a worthwhile reference for someone working in the field and that could be used as a starting point to become acquainted with that aspect of optics. They did that and we thank them for the outstanding results seen throughout the *Handbook*. We also thank Mr. Taisuke Soda of McGraw-Hill for his help in putting this complex project together and Mr. Alan Tourtlotte and Ms. Susannah Lehman of the Optical Society of America for logistical help that made this effort possible.

We dedicate the third edition of the *Handbook of Optics* to all of the OSA volunteers who, since OSA's founding in 1916, give their time and energy to promoting the generation, application, archiving, and worldwide dissemination of knowledge in optics and photonics.

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PREFACE TO VOLUME I

The third edition of the *Handbook of Optics* has been completely reorganized, expanded, and updated. The four volumes of the second edition grew to five in the current edition. Each volume is divided into parts, where each part, sometimes referred to as a section, consists of several chapters related to a certain topic. Volumes I and II are devoted primarily to the basic concepts of optics and optical phenomena, sometimes called classical optics. Volume I starts with geometrical optics and continues with physical optics. This includes interference, diffraction, coherence theory, and scattering. A new chapter on tools and applications of coherence theory has been added. A several-chapter section follows devoted to issues of polarized light. The chapter on polarimetry has been updated and its content on the Mueller matrices now appears in a separate chapter by that title. Next there are chapters on components such as lenses, afocal systems, nondispersive and dispersive prisms, and special optics that include integrated, miniature and micro-, binary, and gradient index optics. Finally, there are several chapters on instruments. They include cameras and camera lenses, microscopes, reflective and catadioptric objectives, scanners, spectrometers, interferometers, xerographic systems, and optical disc data storage.

There are many other chapters in this edition of the *Handbook* that could have been included in Volumes I and II. However, page limitations prevented that. For example, in Volume V there is a section on Atmospheric Optics. It consists of three chapters, one on transmission through the atmosphere, another on imaging through atmospheric turbulence, and a third on adaptive optics to overcome some of the deleterious effects of turbulence.

The chapters are generally aimed at the graduate students, though practicing scientists and engineers will find them equally suitable as references on the topics discussed. Each chapter has sufficient references for additional and/or further study.

The whole *Handbook* has been retyped and the figures redrawn. The reader will find that the figures in the new edition are crisp. Ms. Arushi Chawla and her team from Glyph International have done an outstanding job in accomplishing this monumental task. Many of the authors updated and proofread their chapters. However, some authors have passed away since the second edition and others couldn't be located. Every effort has been made to ensure that such chapters have been correctly reproduced.

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