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A. Labeyrie, S. G. Lipson, and P. Nisenson
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AN INTRODUCTION TO OPTICAL STELLAR INTERFEROMETRY

During the last two decades, optical stellar interferometry has become an important tool in astronomical investigations requiring spatial resolution well beyond that of traditional telescopes. This is the first book to be written on the subject. The authors provide an extended introduction discussing basic physical and atmospheric optics, which establishes the framework necessary to present the ideas and practice of interferometry as applied to the astronomical scene. They follow with an overview of historical, operational and planned interferometric observatories, and a selection of important astrophysical discoveries made with them. Finally, they present some as-yet untested ideas for instruments both on the ground and in space which may allow us to image details of planetary systems beyond our own.

This book will be used by advanced students in physics, optics, and astronomy who are interested in the ideas and implementations of astronomical interferometry.

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Preface

Although the optical telescope is the most venerated instrument in astronomy, it developed relatively little between the time of Galileo and Newton and the beginning of the twentieth century. In contrast to the microscope, which enjoyed considerable conceptual development during the same period from the application of physical optics, telescopes suffered from atmospheric disturbances, and therefore physical optics was considered irrelevant to their design. The realization that wave interference could be employed to overcome the atmospheric resolution limit was first recorded by Fizeau and put into practice by Michelson around 1900, but his experience then lay dormant until the 1950s. Since then, first in radio astronomy and later in optical and infrared astronomy, interferometric methods have improved in leaps and bounds. Today, many optical interferometric observatories around the world are adding daily to our knowledge about the cosmos.

The aim of this book is to build on a basic knowledge of physical optics to describe the ideas behind the various interferometric techniques, the way in which they are being put into practice in the visible and the infrared regions of the spectrum, and how they can be projected into the future. Some techniques consist of optical additions to existing large telescopes; others require complete observatories which have been built specially for interferometry. Today all these are being used to make accurate measurements of stellar angular positions, to discern features on stellar surfaces and to study the structure of clusters and galaxies. Tomorrow, maybe they will be able to image planetary systems other than our own. To this end, many new ideas are being generated and tested with the eventual aim of looking at an extrasolar Earth-like planet, either from the ground or from a space platform.

The book contains some introductory chapters on basic optics, which establish an unsophisticated physical and mathematical framework which is used to discuss the various ideas and instruments presented in the later chapters. It is hoped that, despite the inevitable use of mathematics, the physical principles of the astronomical interferometric techniques in the following chapters will be clear. In the final

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chapters, some astrophysical results achieved by interferometry are discussed, and some untested future ideas are presented. The level of detail is hopefully sufficient for senior undergraduate and graduate students who are interested in understanding the ideas and implementations of astronomical interferometry. We have attempted to give fair credit to all those whose work has substantially advanced the field, without overloading the book with references to every detail.

Peter Nisenson first conceived of this book in 2002, and asked us to join him in writing it. Sadly, he never lived to see its publication, but he was active in determining its layout and he wrote fairly complete drafts of two chapters. As a result of this, we decided to continue the work as a memorial to his life-long dedication to astronomy, although his further contributions are sorely missing.

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