Gravitational Lenses Astronomy And Astrophysics Library

Offers a collection of images captured by the Hubble Space Telescope, and describes their significance and what these discoveries reveal about the universe

The majority of books dealing with prospects for interstellar flight tackle the problem of the propulsion systems that will be needed to send a craft on an interstellar trajectory. The proposed book looks at two other, equally important aspects of such space missions, and each forms half of this two part book. Part 1 looks at the ways in which it is possible to exploit the focusing effect of the Sun as a gravitational lens for scientific missions to distances of 550 AU and beyond into interstellar space. The author explains the mechanism of the Sun as a gravitational lens, the scientific investigations which may be carried out along the way to a distance of 550 AU (and at the 550 AU sphere itself), the requirements for exiting the Solar System at the highest speed and a range of project ideas for missions entering interstellar space. Part 2 of the book deals with the problems of communicating between an interstellar spaceship and the Earth, especially at very high speeds. Here the author assesses a range of mathematical tools relating to the Karhunen–Loève Transform (KLT) for optimal telecommunications, technical topics that may one day enable humans flying around the Galaxy to keep in contact with the Earth. This part of the book opens with a summary of the author's 2003 Pešek Lecture presented at the IAC in Bremen, which introduces the concept of KLT for engineers and 'newcomers' to the subject. It is planned to include a DVD containing the full mathematical derivations of the KLT for those interested in this important mathematical tool whilst the text itself will contain the various results without outlines of the mathematical proofs. Astronautical engineers will thus be able to see the application of the results without getting bogged down in the mathematics.

One of the most attractive features of the young discipline of Space Science is that many of the original pioneers and key players involved are still available to describe their field. Hence, at this point in history we are in a unique position to gain first-hand insight into the field and its development. To this end, The Century of Space Science, a scholarly, authoritative, reference book presents a chapter-by-chapter retrospective of space science as studied in the 20th century. The level is academic and focuses on key discoveries, how these were arrived at, their scientific consequences and how these discoveries advanced the thoughts of the key players involved. With over 90 world-class contributors, such as James Van Allen, Cornelis de Jager, Eugene Parker, Reimar Lüst, and Ernst Stuhlinger, and with a Foreword by Lodewijk Woltjer (past ESO Director General), this book will be immensely useful to readers in the fields of space science, astronomy, and the history of science. Both academic institutions and researchers will find that this major reference work makes an invaluable addition to their collection.

This book provides a comprehensive and self-contained exposition of gravitational lensing phenomena. It presents the up-to-date status of gravitational lensing and microlensing, covering the cosmological applications of the observed lensing by galaxies, clusters and the large scale structures, as well as the microlensing searches in the Local Group and its applications to unveil the nature of the galactic dark matter, the search for planetary objects and the distribution of faint stars in our galaxy. Gravitational Lensing and Microlensing is pitched at the level of the graduate student interested in the issues of astrophysics and cosmology, and should be useful for specialist researchers as well. Contents:Historical IntroductionThe Deflection of LightGravitational Lensing TheoryMacrolensing ResultsMicrolensing I: BasicsMicrolensing II: Beyond the Simplest Light CurveCosmology Tools Readership: Graduate students, researchers and academics in astrophysics, astronomy and cosmology. Keywords:Gravitational Lensing;Microlensing;Deflection of Light;MacrolensingReviews:"… here one can find a complete overview of all the recent revolutionary developments of gravitational lensing, with a fully self-consistent treatment of microlensing. The quality and number of didactic illustrations is high … I think that this book should not be missing in scientific libraries that are to be updated on gravitational lensing. It also provides a useful support tool for basic gravitational lensing courses. Finally it can be recommended to researchers who want a rapid overview of the field, without getting swamped into too many details."General Relativity and Gravitation

Singularity Theory and Gravitational Lensing

General Relativity and Gravitation, 1989

Astronomy and Astrophysics in the New Millennium

Einstein's Telescope: The Hunt for Dark Matter and Dark Energy in the Universe

Encyclopedia of Astronomy & Astrophysics

Gravitational Lensing and Optical Geometry

A noted professor of physics and astronomy recalls the intellectual journey to understand the galaxy, and universe that contains it, in the twentieth century, looking at the unique features of the Milky Way, the technological advances that have allowed us to research it, and describing a black hole that exists at the very center of our galaxy. (Science & Mathematics)

The year 2019 saw the centenary of Eddington's eclipse expeditions and the corroboration of Einstein's general relativity by gravitational lensing. To mark the occasion, a Special Issue of Universe has been dedicated to the theoretical aspects of strong gravitational lensing. The articles assembled in this volume contain original research and reviews and apply a variety of mathematical techniques that have been developed to study this effect, both in 3-space and in spacetime. These include: · Mathematical properties of the standard thin lens approximation, in particular caustics; · Optical geometry, the Gauss–Bonnet method and related approaches; · Lensing in the spacetime of general relativity and modified theories; black hole shadows.

This volume contains the proceedings of the twelfth triannual International Conference on General Relativity and Gravitation, the premier conference for presentation and discussion of new ideas in relativity and cosmology. The volume will contain the invited talks as well as short reports on the parallel workshops that took place at the meeting. It will be essential reading for all research workers in relativity, cosmology and astrophysics.

Astronomy, astrophysics and space research have witnessed an explosive development over the last few decades. The new observational potential offered by space stations and the availability of powerful and highly specialized computers have revealed novel aspects of the fascinating realm of galaxies, quasars, stars and planets. The present completely revised 5th edition of The New Cosmos provides ample evidence of these dramatic developments. In a concise presentation, which assumes only a modest prior knowledge of mathematics and physics, the book gives a coherent introduction to the entire field of astronomy and astrophysics. At the same time it takes into account the art of observation and the fundamental ideas behind their interpretation. Like its predecessors, this edition of The New Cosmos will provide new insight and enjoyment not only to students and researchers in the fields of astronomy, physics and earth sciences, but also to a wide range of interested amateurs.

Review of Radio Science

New Worlds, New Horizons in Astronomy and Astrophysics

Exploiting the Sun as a Gravitational Lens

Proceedings of a Conference Held in Hamburg, Germany, 9-13 September 1991

Gravitational Lensing: Strong, Weak and Micro

Gravitational Lensing: An Astrophysical Tool

Light observed from distant objects is found to be deflected by the gravitational field of massive objects near the line of sight - an effect predicted by Einstein in his first paper setting forth the general theory of relativity, and confirmed by Eddington soon afterwards. If the source of the light is sufficiently distant and bright, and if the intervening object is massive enough and near enough to the line of sight, the gravitational field acts like a lens, focusing the light and producing one or more bright images of the source. This book, by renowned researchers in the field, begins by discussing the basic physics behind gravitational lenses: the optics of curved space-time. It then derives the appropriate equations for predicting the properties of these lenses. In addition, it presents up-to-date observational evidence for gravitational lenses and describes the particular properties of the observed cases. The authors also discuss applications of the results to problems in cosmology.

"Astrophysics Updates" is intended to serve the information needs of professional astronomers and postgraduate students about areas of astronomy, astrophysics and cosmology that are rich and active research spheres. Observational methods and the latest results of astronomical research are presented as well as their theoretical foundations and interrelations. The contributed commissioned articles are written by leading exponents in a format that will appeal to professional astronomers and astrophysicists who are interested in topics outside their own specific areas of research. This collection of timely reviews may also attract the interest of advanced amateur astronomers seeking scientifically rigorous coverage.

Driven by discoveries, and enabled by leaps in technology and imagination, our understanding of the universe has changed dramatically during the course of the last few decades. The fields of astronomy and astrophysics are making new connections to physics, chemistry, biology, and computer science. Based on a broad and comprehensive survey of scientific opportunities, infrastructure, and organization in a national and international context, New Worlds, New Horizons in Astronomy and Astrophysics outlines a plan for ground- and space- based astronomy and astrophysics for the decade of the 2010's. Realizing these scientific opportunities is contingent upon maintaining and strengthening the foundations of the research enterprise including technological development, theory, computation and data handling, laboratory experiments, and human resources. New Worlds, New Horizons in Astronomy and Astrophysics proposes enhancing innovative but moderate-cost programs in space and on the ground that will enable the community to respond rapidly and flexibly to new scientific discoveries. The book recommends beginning construction on survey telescopes in space and on the ground to investigate the nature of dark energy, as well as the next generation of large ground-based giant optical telescopes and a new class of space-based gravitational observatory to observe the merging of distant black holes and precisely test theories of gravity. New Worlds, New Horizons in Astronomy and Astrophysics recommends a balanced and executable program that will support research surrounding the most profound questions about the cosmos. The discoveries ahead will facilitate the search for habitable planets, shed light on dark energy and dark matter, and aid our understanding of the history of the universe and how the earliest stars and galaxies formed. The book is a useful resource for agencies supporting the field of astronomy and astrophysics, the Congressional committees with jurisdiction over those agencies, the scientific community, and the public.

This monograph is the first to develop a mathematical theory of gravitational lensing. The theory applies to any finite number of deflector planes and highlights the distinctions between single and multiple plane lensing. Introductory material in Parts I and II present historical highlights and the astrophysical aspects of the subject. Part III employs the ideas and results of singularity theory to put gravitational lensing on a rigorous mathematical foundation.

Second Edition

The Sky at Einstein's Feet

Deep Space Flight and Communications

With Emphasis on Experiments and Observations

Unsolved Problems of the Milky Way

Principles of Gravitational Lensing

Gravitational lenses offer the best, and sometimes the only, means of tackling key problems in many fields of astrophysics and cosmology. According to Einstein's theory, the curvature of light-rays increases with mass; gravitational lenses can be used to map the distribution of mass in a Universe in which virtually all matter is dark matter of an unknown nature. Gravitational lensing has significantly improved our knowledge of many astrophysical phenomena, such as exoplanets, galaxies, active galactic nuclei, quasars, clusters, large-scale structure and the Universe itself. All these topics are covered fully in this book, together with two tutorials on lens and microlensing modelling. The future of lensing in relation to large surveys and the anticipated discoveries of thousands more gravitational lenses is also discussed, making this volume an ideal guide for postgraduate students and practising researchers in the use of gravitational lenses as a tool in their investigations.

The field of astrophysics is in the midst of a technologically driven renaissance, as fundamental discoveries are being made with astonishing frequency. In the last decade, new detectors in space, on earth, and deep underground have, when coupled with the computational power of modern computers, revolutionized our knowledge and understanding of the astronomical world. This is a great time for a student of any age to become acquainted with the remarkable universe in which we live. This volume is a collection of essays, originally presented orally to a diverse group of students and professionals, which reveal the most fertile areas for future study of astronomy and astrophysics. The emphasis of this work is on the clear description of the current state of our knowledge as a preparation for the future unraveling of the mysteries of the universe that appear today as most fundamental and most amenable to solution. A stellar group of astronomers and astrophysicists describes the directions and styles of work that they think are most likely to lead to progress. Bibliographical notes at the end of each presentation provide guidance for the reader who wishes to go more deeply into a given subject. Unsolved Problems in Astrophysics is a uniquely stimulating introduction to some of the most important topics in modern astrophysics.

The ideal one-semester astrophysics introduction for science undergraduates—now expanded and fully updated Winner of the American Astronomical Society's Chambliss Award, Astrophysics in a Nutshell has become the text of choice in astrophysics courses for science majors at top universities in North America and beyond. In this expanded and fully updated second edition, the book gets even better, with a new chapter on extrasolar planets; a greatly expanded chapter on the interstellar medium; fully updated facts and figures on all subjects, from the observed properties of white dwarfs to the latest results from precision cosmology; and additional instructive problem sets. Throughout, the text features the same focused, concise style and emphasis on physics intuition that have made the book a favorite of students and teachers. Written by Dan Maoz, a leading active researcher, and designed for advanced undergraduate science majors, Astrophysics in a Nutshell is a brief but thorough introduction to the observational data and theoretical concepts underlying modern astronomy. Generously illustrated, it covers the essentials of modern astrophysics, emphasizing the common physical principles that govern astronomical phenomena, and the interplay between theory and observation, while also introducing subjects at the forefront of modern research, including black holes, dark matter, dark energy, and gravitational lensing. In addition to serving as a course textbook, Astrophysics in a Nutshell is an ideal review for a qualifying exam and a handy reference for teachers and researchers. The most concise and current astrophysics textbook for science majors—now expanded and fully updated with the latest research results Contains a broad and well-balanced selection of traditional and current topics Uses simple, short, and clear derivations of physical results Trains students in the essential skills of order-of-magnitude analysis Features a new chapter on extrasolar planets, including discovery techniques Includes new and expanded sections and problems on the physics of shocks, supernova remnants, cosmic-ray acceleration, white dwarf properties, baryon acoustic oscillations, and more Contains instructive problem sets at the end of each chapter Solutions manual (available only to professors)

This is an exhaustive review of our theoretical and observational knowledge of gravitational lensing 10 years after the discovery of the first lensed quasar, Q0957+561. Gravitational optics, optical, infrared, and radio observations of quasar-lens candidates, microlensing, arcs in clusters of galaxies, and radio rings are presented. In particular, the continuing survey of quasar-lens candidates, the new measurement of the time delay in 0957+561, the suspended microlensing effect through the galaxy 2237+030, as well as the discovery of new arcs and the measurement of new redshifts for two of them are presented. Numerous papers on the modelling of arcs and rings show how it should be possible to probe dark matter with these unexpected gravitational telescopes. Finally, tables summarize all the lens candidates we know today.

Astrophysics in a Nutshell

Fritz Zwicky

Recent Progress and Future Goals : Proceedings of a Conference Held at Boston University, Boston, Massachusetts, USA, 25-30 July 1999

Further Adventures with the Hubble Space Telescope

Gravity from the Ground Up

An Introduction

Astronomy and Astrophysics Abstracts aims to present a comprehensive documen tation of the literature concerning all aspects of astronomy, astrophysics, and their border fields. It is devoted to the recording, summarizing, and indexing of the relevant publications throughout the world. Astronomy and Astrophysics Abstracts is prepared by a special department of the Astronomisches Rechen-Institut under the auspices of the International Astronomical Union. Volume 34 records literature published in 1983 and received before February 17, 1984. Some older documents which we received late and which are not surveyed in earlier volumes are included too. We acknowledge with thanks contributions of our colleagues all over the world. We also express our gratitude to all organiza tions, observatories, and publishers which provide us with complimentary copies of their publications. Starting with Volume 33, all the recording, correction, and data processing work was done by means of computers. The recording was done by our technical staff members Ms. Helga Ballmann, Ms. Mona El-Choura and Ms. Monika Kohl. Mr. Martin Schlotelburg and Mr. Ulrich Oberall supported our task by careful proofreading. It is a pleasure to thank them all for their encouragement. Heidelberg, March 1984 The Editors Contents Introduction . . . . . Concordance Relation: ICSU-AB-AAA 3 Abbreviations 10 Periodicals, Proceedings, Books, Activities 001 Periodicals . . . . . 15 002 Bibliographical Publications, Documentation, Catalogues, Atlases 50 003 Books ..... 58 004 History of Astronomy 67 005 Biography . . 71 006 Personal Notes 73 007 Obituaries . . .

Annotation The power of gravity to bend and lens light has numerous applications in astrophysics. This volume contains over 100 papers on gravitational lensing from Brainerd (astronomy, Boston U.), Kochanek (Harvard- Smithsonian Center for Astrophysics) and other researchers from around the world. A sampling of topics includes gravitational lensing in galaxy redshift surveys, magnified views of BAL quasars, weak lensing by galaxy clusters, and galaxy-galaxy lensing. Annotation c. Book News, Inc., Portland, OR (booknews.com)

17 readable articles give a thorough and self-contained overview of recent developments in relativistic gravity research. The subjects covered are: gravitational lensing, the general relativistic n-body problem, observable effects in the solar system, gravitational waves and their interferometric detection, very-long-baseline interferometry, international atomic time, lunar laser- ranging measurements, measurement ofthe gravitomagnetic field of the Earth, fermion and boson stars and black holes with hair, rapidly rotating neutron stars, matter wave interferometry, and the laboratory test of Newton's law of gravity.Any scientist interested in experimentally or observatio- nally oriented relativistic gravity will read the book with profit. In addition, it is perfectly suited as a complementary text for courses on general relativity and relativistic astrophysics.

This book invites the reader to understand our Universe, not just marvel at it. From the clock-like motions of the planets to the catastrophic collapse of a star into a black hole, gravity controls the Universe. Gravity is central to modern physics, helping to answer the deepest questions about the nature of time, the origin of the Universe and the unification of the forces of nature. Linking key experiments and observations through careful physical reasoning, the author builds the reader's insight step-by-step from simple but profound facts about gravity on Earth to the frontiers of research. Topics covered include the nature of stars and galaxies, the mysteries of dark matter and dark energy, black holes, gravitational waves, inflation and the Big Bang. Suitable for general readers and for undergraduate courses, the treatment uses only high-school level mathematics, supplemented by optional computer programs, to explain the laws of physics governing gravity.

Saas-Fee Advanced Course 33

Formation of Structure in the Universe

The Black Hole at the Center of Our Galaxy

Panel Reports

XXIV Canary Islands Winter School of Astrophysics

Hubble Vision

Gravitational lensing is by now sufficiently well understood that it can be used as a tool of investigation in other astrophysical areas. Applications include the determination of the Hubble constant, probing the dark matter context of galaxies and the mapping of the universe to the identification of otherwise invisible large-scale structures. Each chapter of the book covers in a self-contained manner a subfield of gravitational lensing, with the double aim of describing in a simple way the basics of the theory and of reviewing the most recent developments as well as applications foreseen in the near future. The book will thus be particularly useful as a high-level textbook for nonspecialist researchers and advanced students wishing to become familiar with the field all the way up to the forefront of research.

Specifically traces the impact of Einstein's ideas on astronomy, including the way we interpret observations of stars and galaxies. Includes comments from principals in important discoveries, illuminating the processes behind these results. Presents many applications of relativity that have not been shown in earlier popular-level books and illustrates how deeply physics permeates the way we interpret many astronomical phenomena. Highlights light-travel delays in cosmic jets, using gravitational lensing to trace cosmic mass distribution. Illustrations employ new and archival data from ground- and space-based observatories.

This English edition of the biography of the astronomer Fritz Zwicky highlights his fundamental research and discoveries including supernovae, dark matter, clusters of galaxies, neutron stars, gravitational lenses and also it recognises his significant contribution to research in astronomy and astrophysics. The volume presents a fascinating account of the life and work of this great twentieth century Swiss scientist and will appeal to a wide readership.

One of the most spectacular predictions of Einstein's theory of general relativity is the occurrence of gravitational lenses in our galactic system. Nowadays the mastering of the mathematics together with the technology available to astronomers allow Einstein's prediction to be confirmed. Several reviews here give the reader the chance to under- stand the basic theoretical concept of gravitational lensing and to obtain an overview of observational work. The present state of the field and latest results are given in a large number of specialized papers. Anextensive source and subject index make these proceedings valuable also as areference book for all researchers active in the field.

A Centennial Perspective

Astrophysical Applications of Gravitational Lensing

Investigation Relative to the Roentgen Satellite (Rosat)

An Extraordinary Astrophysicist

Literature 1983, Part 2

Unsolved Problems in Astrophysics

"Splendidly satisfying reading, designed for a nonspecialist audience."—Kirkus Reviews, starred review Evalyn Gates, a talented astrophysicist, transports readers to the edge of contemporary science to explore the revolutionary tool—"Einstein's telescope"—that is unlocking the secrets of the Universe. Einstein's telescope, or gravitational lensing, is so-called for the way gravity causes space to distort and allow massive objects to act like "lenses," amplifying and distorting the images of objects behind them. By allowing for the detection of mass where no light is found, scientists can map out the distribution of dark matter and come a step closer to teasing out the effects of dark energy on the Universe—which may forever upend long-held notions about where the Universe came from and where it is going.

This second edition has been updated and substantially expanded. Starting with the description of our home galaxy, the Milky Way, this cogently written textbook introduces the reader to the astronomy of galaxies, their structure, active galactic nuclei, evolution and large scale distribution in the Universe. After an extensive and thorough introduction to modern observational and theoretical cosmology, the focus turns to the formation of structures and astronomical objects in the early Universe. The basics of classical astronomy and stellar astrophysics needed for extragalactic astronomy are provided in the appendix. While this book has grown out of introductory university courses on astronomy and astrophysics and includes a set of problems and solutions, it will not only benefit undergraduate students and lecturers; thanks to the comprehensive coverage of the field, even graduate students and researchers specializing in related fields will appreciate it as a valuable reference work.

In a unique collaboration, Nature Publishing Group and Institute of Physics Publishing have published the most extensive and comprehensive reference work in astronomy and astrophysics. This unique resource covers the entire field of astronomy and astrophysics and this online version includes the full text of over 2,750 articles, plus sophisticated search and retrieval functionality and links to the primary literature. The Encyclopaedia's authority is assured by editorial and advisory boards drawn from the world's foremost astronomers and astrophysicists. This first class resource is an essential source of information for undergraduates, graduate students, researchers and seasoned professionals, as well as for committed amateurs, librarians and lay people wishing to consult the definitive astronomy and astrophysics reference work.

EDWIN TURNER AND RACHEL WEBSTER Co-Chairs, Scientific Organizing Committee lAU Symposium 173, Astrophysical Applications of Gravitational Lenses, was held in Melbourne, Australia from July 9–14, 1995. The Symposium was sponsored by lAU Commissions 47 and 40. With the discovery by Walsh and collaborators of the first instance of a gravitational lens, the multiply imaged quasar 0957+561, the area of grav itational lensing moved from speculative theory to a major astrophysical tool. Since that time, there have been regular, approximately biennial in ternational meetings both in Europe and in North America, which have specifically focussed on gravitational lensing. On this occasion, with the blessing of the lA U, the meeting was held at the University of Melbourne in Australia. It was the first international astronomical meeting to be held at the University of Melbourne, and hope fully has given the astronomical community some enthusiasm for trekking half-way round the globe to Australia to discuss their latest work.

Astrophysics Update 2

Proceedings of a Workshop Held in Toulouse, France, September 13–15, 1989

Proceedings of the 173rd Symposium of the International Astronomical Union, Held in Melbourne, Australia, 9–14 July, 1995

The New Cosmos

Gravitational Lensing and Microlensing

Relativistic Gravity Research

This book introduces the phenomenology of gravitational lensing in an accessible manner and provides a thorough discussion of the related astrophysical applications. It is intended for advanced undergraduates and graduate students who want to start working in this rapidly evolving field. This includes also senior researchers who are interested in ongoing or future surveys and missions such as DES, Euclid, WFIRST, LSST. The reader is guided through many fascinating topics related to gravitational lensing like the structure of our galaxy, the searching for exoplanets, the investigation of dark matter in galaxies and galaxy clusters, and several aspects of cosmology, including dark energy and the cosmic microwave background. The author, who has gained valuable experience as academic teacher, guides the readers towards the comprehension of the theory of gravitational lensing and related observational techniques by using simple codes written in python. This approach, beyond facilitating the understanding of gravitational lensing, is preparatory for learning the python programming language which is gaining large popularity both in academia and in the private sector.

Annotation The power of gravity to bend and lens light has numerous applications in astrophysics. This volume contains over 100 papers on gravitational lensing from Brainerd (astronomy, Boston U.), Kochanek (Harvard- Smithsonian Center for Astrophysics) and other researchers from around the world. A sampling of topics includes gravitational lensing in galaxy redshift surveys, magnified views of BAL quasars, weak lensing by galaxy clusters, and galaxy-galaxy lensing. Annotation copyrighted by Book News, Inc., Portland, OR.

An up-to-date and comprehensive graduate-level textbook on the fast-moving subject of structure formation in cosmology, written by eleven world-leading authorities.

Reports include: High Resolution Observations of the Central Region of M31; The X-ray Emission of Low-X-ray-Luminosity Early-Type Galaxies: Gas Versus Compact Sources; Interaction Between Cluster Gas and Radio Features of Cygnus A; Hot Gas and Dark Halos in Early-Type Galaxies; A Gravitational Lens in X-rays - 0957+461; How Massive are Early-Type Galaxies?; Three Crab-Like SNR in the Large Magellanic Cloud; and Soft X-ray Emission from Boundary Layers in Cataclysmic Variables. Papers submitted to the Astrophysical Journal are attached. Elvis, Martin S. and Primini, Francis A. and Fabbiano, Guiseppina and Harris, Daniel E. and Jones-Foreman, Christine and Trinchieri, Ginevra and Golub, Leon and Bookbinder, Jay and Seward, Frederick D. and Zombeck, Martin V. Unspecified Center RADIO ASTRONOMY; ROSAT MISSION; SPACEBORNE ASTRONOMY; SUPERNOVA REMNANTS; X RAY ASTRONOMY; X RAY SOURCES; ANDROMEDA GALAXY; ASTROPHYSICS; CATACLYSMIC VARIABLES; CYGNUS CONSTELLATION; GRAVITATIONAL LENSES; MAGELLANIC CLOUDS; QUASARS...

Extragalactic Astronomy and Cosmology

Detecting Gravitational Lensing of the Cosmic Microwave Background by Galaxy Clusters

Gravitational Lensing

The Century of Space Science

An Introductory Guide to Gravity and General Relativity

Recent Progress and Future Goals : Proceedings of Conference Held at Boston University, Boston, Massachusetts, USA, 25-30 July 1999

A triennial summation of the state of the art in radio science This book is the fourth in the modern series of triennial reviews prepared by the International Union of Radio Science to further communication and understanding of the status and future of radio science, both for those working in the field, and for those who want to know what is of current importance in this area. The International Union of Radio Science, URSI (Union Radio-Scientifique Internationale), has divided the subject of "Radio Science" according to the ten topics of the Scientific Commissions that make up URSI. This volume consists of thirty-eight original, peer-reviewed papers. Each paper provides a critical, in-depth review of—and, in many cases, tutorial on—advances and research that have been of significant importance within the area of interest of the Commissions during the past three to four years. Among the topics covered are: Electromagnetic metrology Fields and waves Signals and systems Electronics and photonics Electromagnetic noise and interference Wave propagation and remote sensing Ionospheric radio and propagation Waves in plasmas Radio astronomy Electromagnetics in biology and medicine With an included CD-ROM of the full book text, allowing the user to do full-text searching of all the papers, the Review of Radio Science: 1999–2002 is a resource of vital importance to anyone working in, or with an interest in, radio science.

In preparing the report, Astronomy and Astrophysics in the New Millenium , the AASC made use of a series of panel reports that address various aspects of ground- and space-based astronomy and astrophysics. These reports provide in-depth technical detail. Astronomy and Astrophysics in the New Millenium: An Overview summarizes the science goals and recommended initiatives in a short, richly illustrated, non-technical booklet.

The observation, in 1919 by A.S. Eddington and collaborators, of the gra- tational de?ection of light by the Sun proved one of the many predictions of Einstein's Theory of General Relativity: The Sun was the ?rst example of a gravitational lens. In 1936, Albert Einstein published an article in which he suggested - ing stars as gravitational lenses. A year later, Fritz Zwicky pointed out that galaxies would act as lenses much more likely than stars, and also gave a list of possible applications, as a means to determine the dark matter content of galaxies and clusters of galaxies. It was only in 1979 that the ?rst example of an extragalactic gravitational lens was provided by the observation of the distant quasar QSO 0957+0561, by D. Walsh, R.F. Carswell, and R.J. Weymann. A few years later, the ?rst lens showing images in the form of arcs was detected. The theory, observations, and applications of gravitational lensing cons- tute one of the most rapidly growing branches of astrophysics. The gravi- tional de?ection of light generated by mass concentrations along a light path producesmagni?cation,multiplicity,anddistortionofimages,anddelaysp- ton propagation from one line of sight relative to another. The huge amount of scienti?c work produced over the last decade on gravitational lensing has clearly revealed its already substantial and wide impact, and its potential for future astrophysical applications.

Although the Milky Way is the most studied and best understood galactic system, there are many fundamental questions about our Galaxy that remain unanswered. This book concentrates on those questions which have the widest applicability in all of astrophysics, and for which answers are most likely to be forthcoming in the next few years. Is the Milky Way a barred spiral, and if so, what are its properties? Is the disk of the Milky Way axisymmetric and what does the answer tell us about its dynamical history? Is there a black hole at the center of the Galaxy? How far does the Galaxy extend? How much dark matter is there in the Milky Way system? And more.

1999-2002 URSI

Gravitational Lenses

Proceedings of a Conference Held at the Massachusetts Institute of Technology, Cambridge, Massachusetts, in Honour of Bernard F. Burke's 60th Birthday, June 20, 1988

With Python Examples

Light Deflection as a Probe of Astrophysics and Cosmology

Introduction to Gravitational Lensing

Clusters of galaxies gravitationally lens the Cosmic Microwave Background (CMB) leading to a distinct signal in the CMB on arcminute scales. Measurement of the cluster lensing effect offers the exciting possibility of constraining the masses of galaxy clusters using CMB data alone. Improved constraints on cluster masses are in turn essential to the use of clusters as cosmological probes: uncertainties in cluster masses are currently the dominant systematic affecting cluster abundance constraints on cosmology. To date, however, the CMB cluster lensing signal remains undetected because of its small magnitude and angular size. In this thesis, we develop a maximum likelihood approach to extracting the signal from CMB temperature data. We validate the technique by applying it to mock data designed to replicate as closely as possible real data from the South Pole Telescope's (SPT) Sunyaev-Zel'dovich (SZ) survey: the effects of the SPT beam, transfer function, instrumental noise and cluster selection are incorporated. We consider the effects of foreground emission on the analysis and show that uncertainty in amount of foreground lensing results in a small systematic error on the lensing constraints. Additionally, we show that if unaccounted for, the SZ effect leads to unacceptably large biases on the lensing constraints and develop an approach for removing SZ contamination. The results of the mock analysis presented here suggest that a 4 sigma first detection of the cluster lensing effect can be achieved with current SPT-SZ data.

This textbook provides an introduction to gravitational lensing, which has become an invaluable tool in modern astrophysics, with applications that range from finding planets orbiting distant stars to understanding how dark matter and dark energy conspired to form the cosmic structures we see today. Principles of Gravitational Lensing begins with Einstein ' s prediction that gravity bends light, and shows how that fundamental idea has spawned a rich field of study over the past century. The gravitational deflection of light was first detected by Eddington during a solar eclipse in May 1919, launching Einstein and his theory of relativity into public view. Yet the possibility of using the phenomenon to unlock mysteries of the Universe seemed remote, given the technology of the day. Theoretical work was carried out sporadically over the next six decades, but only with the discovery of the system Q0957+561 in 1979 was gravitational lensing transformed from a curiosity of general relativity into a practical observational tool. This book describes how the three subfields known as strong lensing, weak lensing, and microlensing have grown independently but become increasingly intertwined. Drawing on their research experience, Congdon and Keeton begin with the basic physics of light bending, then present the mathematical foundations of gravitational lensing, building up to current research topics in a clear and systematic way. Relevant background material from physics and mathematics is included, making the book self-contained. The derivations and explanations are supplemented by exercises designed to help students master the theoretical concepts as well as the methods that drive current research. An extensive bibliography guides those wishing to delve more deeply into particular areas of interest. Principles of Gravitational Lensing is ideal for advanced students and seasoned researchers looking to penetrate this thriving subject and even contribute research of their own.

An Introduction to Astronomy and Astrophysics

Proceedings of the 12th International Conference on General Relativity and Gravitation

Astronomy and Astrophysics Abstracts