

**K. B. Wolf**

# **Geometric Optics on Phase Space**

 **Springer**

# Geometric Optics On Phase Space

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## **Geometric Optics On Phase Space:**

Geometric Optics on Phase Space Kurt Bernardo Wolf, 2004-07-21 Symplectic geometry well known as the basic structure of Hamiltonian mechanics is also the foundation of optics. In fact, optical systems geometric or wave have an even richer symmetry structure than mechanical ones classical or quantum. The symmetries underlying the geometric model of light are based on the symplectic group. Geometric Optics on Phase Space develops both geometric optics and group theory from first principles in their Hamiltonian formulation on phase space. This treatise provides the mathematical background and also collects a host of useful methods of practical importance, particularly the fractional Fourier transform currently used for image processing. The reader will appreciate the beautiful similarities between Hamilton's mechanics and this approach to optics. The appendices link the geometry thus introduced to wave optics through Lie methods. The book addresses researchers and graduate students.

**Linear Ray and Wave Optics in Phase Space** Amalia Torre, 2005-11-11 Ray wave and quantum concepts are central to diverse and seemingly incompatible models of light. Each model particularizes a specific manifestation of light and then corresponds to adequate physical assumptions and formal approximations whose domains of applicability are well established. Accordingly, each model comprises its own set of geometric and dynamic postulates with the pertinent mathematical means. At a basic level, the book is a complete introduction to the Wigner optics which bridges between ray and wave optics, offering the optical phase space as the ambience and the Wigner function based technique as the mathematical machinery to accommodate between the two opposite extremes of light representation: the localized ray of geometrical optics and the unlocalized wave function of wave optics. At a parallel level, the analogies with other branches of both classical and quantum physics like classical and quantum mechanics, quantum optics, signal theory, as well as magnetic optics are evidenced by pertinent comments and/or rigorous mathematics. So the Lie algebra and group methods are introduced and explained through the elementary optical systems within both the ray and wave optics contexts, the former being related to the symplectic group and the latter to the metaplectic group. In a like manner, the Wigner function is introduced by following the original issue to individualize a phase space representation of quantum mechanics which is mirrored by the issue to individualize a local frequency spectrum within the signal theory context. The basic analogy with the optics of charged particles inherently underlying the ray optics picture in phase space is also evidenced within the wave optics picture in the Wigner phase space. Amalgamation of a great deal of contributions having witnessed the phase space picture of optics over the past 30 years introduces abstract concepts through concrete systems, hosts of figures and logical diagrams to favour intuition and to introduce mathematics, emphasis on the interrelations with quantum optics, signal theory and magnetic optics feeds a feeling for genuine issues in higher mathematics and theoretical physics.

Phase Space Analysis of Partial Differential Equations Antonio Bove, Ferruccio Colombini, Daniele Del Santo, 2007-12-28 Covers phase space analysis methods including microlocal analysis and their applications to physics. Treats the linear and nonlinear

aspects of the theory of PDEs Original articles are self contained with full proofs survey articles give a quick and direct introduction to selected topics evolving at a fast pace Excellent reference and resource for grad students and researchers in PDEs and related fields      **Geometrical Optics in Engineering Physics** I. U. Aleksandrovich Kravtsov, 2005 This monograph provides concise and clear coverage of modern ray theory without the need of complicated mathematics Comprehensive coverage is given to wave problems in engineering physics considering rays and caustics as physical objects

Field Theory of Nonimaging Optics Angel Garcia-Botella, Roland Winston, Lun Jiang, 2023-07-10 This book aims to overcome the traditional ray paradigm and provide an analytical paradigm for Nonimaging Optics based on Field Theory As a second objective the authors address the connections between this Field Theory of Nonimaging Optics and other radiative transfer theories The book introduces the Field Theory of Nonimaging Optics as a new analytical paradigm not statistical to analyze problems in the frame of nonimaging geometrical optics with a formulation based on field theory of irradiance vector  $D$  This new paradigm provides new principles and tools in the optical system design methods complementary to flowline method overcoming the classical ray paradigm This new Field paradigm can be considered as a generalization of the ray paradigm and new accurate and faster computation algorithms will be developed In a parallel way the advance in the knowledge of the principles of Field Theory of Nonimaging Optics has produced clear advances in the connection between nonimaging optics and other apparently disconnected theories of radiation transfer The irradiance vector  $D$  can be considered as the macroscopic average of Poynting vector with a clear connection with radiation pressure Lorentz geometry techniques can also be applied to study irradiance vector  $D$  There are clear thermodynamic connections between the nonimaging concentrator and Stefan Boltzmann law of radiation From this thermodynamic connection nonimaging optics and irradiance vector  $D$  can also be studied from a phase space point of view This book is intended for researchers graduate students academics and professionals looking to analyze design and optimize optical systems      Phase-Space Optics: Fundamentals and Applications Markus Testorf, Bryan Hennelly, Jorge Ojeda-Castaneda, 2009-09-07 A comprehensive cross section of phase space optics This definitive volume highlights an elegant unified approach to optical rays waves and system design using cutting edge phase space techniques Phase Space Optics Fundamentals and Applications details theoretical concepts of phase space as well as novel engineering applications in specific disciplines This authoritative guide includes full coverage of sampling superresolution imaging and the phase space interpretation of ultrafast optics Work with Wigner optics analyze phase space equations develop wave propagation models and gain a new understanding of optical sources and systems Discover how to Describe optical phenomena using Wigner and ambiguity functions Perform phase space rotations using ray transformation matrices Influence the trade off between pupil size and depth of field Analyze and design optical signals using the Radon Wigner transform Accomplish superresolution by squeezing phase space Interpret the intimate relationship between radiometry and coherence Use basic algebra to discover self imaging Fresnel diffraction and the Talbot

effect Develop discrete models sampling criteria and interpolation formulae Work with ultrafast processes and complex space time structures

**Encyclopedia of Modern Optics** Bob D. Guenther, Duncan Steel, 2018-02-14 The Encyclopedia of Modern Optics Second Edition Five Volume Set provides a wide ranging overview of the field comprising authoritative reference articles for undergraduate and postgraduate students and those researching outside their area of expertise Topics covered include classical and quantum optics lasers optical fibers and optical fiber systems optical materials and light emitting diodes LEDs Articles cover all subfields of optical physics and engineering such as electro optical design of modulators and detectors This update contains contributions from international experts who discuss topics such as nano photonics and plasmonics optical interconnects photonic crystals and 2D materials such as graphene or holey fibers Other topics of note include solar energy high efficiency LED s and their use in illumination orbital angular momentum quantum optics and information metamaterials and transformation optics high power fiber and UV fiber lasers random lasers and bio imaging Addresses recent developments in the field and integrates concepts from fundamental physics with applications for manufacturing and engineering design Provides a broad and interdisciplinary coverage of specialist areas Ensures that the material is appropriate for new researchers and those working in a new sub field as well as those in industry Thematically arranged and alphabetically indexed with cross references added to facilitate ease of use

Physics of Particle Accelerators Margaret Dienes, 1989

**Sixteenth Marcel Grossmann Meeting, The: On Recent Developments In Theoretical And Experimental General Relativity, Astrophysics, And Relativistic Field Theories - Proceedings Of The Mg16**

**Meeting On General Relativity (In 4 Volumes)** Remo Ruffini, Gregory Vereshchagin, 2022-12-15 The proceedings of MG16 give a broad view of all aspects of gravitational physics and astrophysics from mathematical issues to recent observations and experiments The scientific program of the meeting included 46 plenary presentations 3 public lectures 5 round tables and 81 parallel sessions arranged during the intense six day online meeting All talks were recorded and are available on the ICRANet YouTube channel at the following link [www.icranet.org/video\\_mg16](http://www.icranet.org/video_mg16) These proceedings are a representative sample of the very many contributions made at the meeting They contain 383 papers among which 14 come from the plenary sessions The material represented in these proceedings cover the following topics accretion active galactic nuclei alternative theories of gravity black holes theory observations and experiments binaries boson stars cosmic microwave background cosmic strings dark energy and large scale structure dark matter education exact solutions early universe fundamental interactions and stellar evolution fast transients gravitational waves high energy physics history of relativity neutron stars precision tests quantum gravity strong fields and white dwarf all of them represented by a large number of contributions The online e proceedings are published in an open access format

Group Theoretical Methods In Physics - Proceedings Of The Yamada Conference XI And Xx International Colloquium Tohru Eguchi, A Arima, Noboru Nakanishi, 1995-05-11 The topics discussed in this volume are Symmetry and Foundations in Classical and Quantum Mechanics Geometry Topology and

Quantum Field Theory Quantum Groups and Infinite Dimensional Lie Algebras Algebraic Approach to Nuclear Structure Integrable Statistical Systems and Theory of Critical Phenomena Supersymmetry Atomic and Molecular Physics Condensed Matter Physics Other Applications of Group Theory to Physics     *An Introduction to Riemann Surfaces, Algebraic Curves and Moduli Spaces* Martin Schlichenmaier, 2010-02-11 This book gives an introduction to modern geometry Starting from an elementary level the author develops deep geometrical concepts that play an important role in contemporary theoretical physics presenting various techniques and viewpoints along the way This second edition contains two additional more advanced geometric techniques the modern language and modern view of Algebraic Geometry and Mirror Symmetry

**Modern Classical Physics** Kip S. Thorne, Roger D. Blandford, 2017-09-05 A groundbreaking text and reference book on twenty first century classical physics and its applications This first year graduate level text and reference book covers the fundamental concepts and twenty first century applications of six major areas of classical physics that every masters or PhD level physicist should be exposed to but often isn't statistical physics optics waves of all sorts elastodynamics fluid mechanics plasma physics and special and general relativity and cosmology Growing out of a full year course that the eminent researchers Kip Thorne and Roger Blandford taught at Caltech for almost three decades this book is designed to broaden the training of physicists Its six main topical sections are also designed so they can be used in separate courses and the book provides an invaluable reference for researchers Presents all the major fields of classical physics except three prerequisites classical mechanics electromagnetism and elementary thermodynamics Elucidates the interconnections between diverse fields and explains their shared concepts and tools Focuses on fundamental concepts and modern real world applications Takes applications from fundamental experimental and applied physics astrophysics and cosmology geophysics oceanography and meteorology biophysics and chemical physics engineering and optical science and technology and information science and technology Emphasizes the quantum roots of classical physics and how to use quantum techniques to elucidate classical concepts or simplify classical calculations Features hundreds of color figures some five hundred exercises extensive cross references and a detailed index An online illustration package is available     [The Iv Wigner Symposium](#) Thomas H Seligman, Natig M Atakishiyev, K B Wolf, 1996-08-22 The Wigner symposia gather forefront researchers in the many branches of mathematical physics initiated or influenced by the work of Eugene P Wigner who died this year It is a group theoretic view of Nature encompassing particle nuclear and molecular physics quantum optics random matrices and the study of groups themselves     [Group Theoretical Methods in Physics](#) G.S Pogosyan, L.E Vincent, K.B Wolf, 2005-05-01 Symmetry is permeating our understanding of nature Group theoretical methods of intrinsic interest to mathematics have expanded their applications from physics to chemistry and biology The ICGTMP Colloquia maintain the communication among the many branches into which this endeavor has bloomed Lie group and representation theory special functions foundations of quantum mechanics and elementary particle nuclear atomic and molecular physics are among the traditional subjects More

recent areas include supersymmetry superstrings and quantum gravity integrability nonlinear systems and quantum chaos semigroups time asymmetry and resonances condensed matter and statistical physics Topics such as linear and nonlinear optics quantum computing discrete systems and signal analysis have only in the last few years become part of the group theorists turf In Group Theoretical Methods in Physics readers will find both review contributions that distill the state of the art in a broad field and articles pointed to specific problems in many cases preceding their formal publication in the journal literature

*Non-Equilibrium Phase Transitions* Malte Henkel, Haye Hinrichsen, Sven Lübeck, 2008-11-27 This book describes two main classes of non equilibrium phase transitions static and dynamics of transitions into an absorbing state and dynamical scaling in far from equilibrium relaxation behavior and ageing

*Level Set Methods and Dynamic Implicit Surfaces* Stanley Osher, Ronald Fedkiw, 2006-04-06 Scope Aims and Audiences This book Level Set Methods and Dynamic Implicit Surfaces is designed to serve two purposes Parts I and II introduce the reader to implicit surfaces and level set methods We have used these chapters to teach introductory courses on the material to students with little more than a fundamental math background No prior knowledge of partial differential equations or numerical analysis is required These first eight chapters include enough detailed information to allow students to create working level set codes from scratch Parts III and IV of this book are based on a series of papers published by us and our colleagues For the sake of brevity a few details have been occasionally omitted These chapters do include thorough explanations and enough of the significant details along with the appropriate references to allow the reader to get a firm grasp on the material This book is an introduction to the subject We have given examples of the utility of the method to a diverse but by no means complete collection of application areas We have also tried to give complete numerical recipes and a self contained course in the appropriate numerical analysis We believe that this book will enable users to apply the techniques presented here to real problems

**Linear Ray and Wave Optics in Phase Space** Amalia Torre, 2029-01-15 Linear Ray and Wave Optics in Phase Space Second Edition is a comprehensive introduction to Wigner optics The book connects ray and wave optics offering the optical phase space as the ambience and the Wigner function based technique as the mathematical machinery to accommodate between the two opposite extremes of light representation the localized ray of geometrical optics and the unlocalized wave function of wave optics Analogies with other branches of classical and quantum physics such as classical and quantum mechanics quantum optics signal theory and magnetic optics are evidenced by pertinent comments and or rigorous mathematics Lie algebra and group methods are introduced and explained through the elementary optical systems within the ray and wave optics contexts the former being related to the symplectic group and the latter to the metaplectic group In a similar manner the Wigner function is introduced by following the original issue to individualize a phase space representation of quantum mechanics which is mirrored by the issue to individualize a local frequency spectrum within the signal theory context The basic analogy with the optics of charged particles inherently underlying the ray optics picture in phase space is also evidenced within the

wave optics picture in the Wigner phase space This second edition contains 150 pages of new material on Wigner distribution functions ambiguity functions for partially coherent beams and phase space picture and fast optics All chapters are fully revised and updated All topics have been developed to a deeper level than in the previous edition and are now supported with Mathematica and Mathcad codes Provides powerful tools to solve problems in quantum mechanics quantum optics and signal theory Includes numerous examples supporting a gradual and comprehensive introduction to Wigner optics Treats both ray and wave optics resorting to Lie algebra based methods Connects the subject with other fields such as quantum optics quantum mechanics signal theory and optics of charged particles Introduces abstract concepts through concrete examples Includes logical diagrams to introduce mathematics in an intuitive way Contains 150 pages of new material on Wigner distribution functions ambiguity functions for partially coherent beams and phase space picture and fast optics Supported with Mathematica and Mathcad codes

**Quantum-like Models And Coherent Effects - Proceedings Of The 27th Workshop Of The Infn Eloisation Project** Padma Kant Shukla, Renato Fedele, 1995-10-17 On July 17 2012 the centenary of Henri Poincaré's death was commemorated his name being associated with so many fields of knowledge that he was considered as the Last Universalist In Pure and Applied Mathematics Physics Astronomy Engineering and Philosophy his works have had a great impact all over the world Poincaré acquired in his lifetime such a reputation that both nationally and internationally his life and career were made the object of various articles in the daily papers not only in France but also in the USA Some of his philosophical concepts have even caused sharp controversies in the Press as we will discover in this book This work presents an original portrait of Henri Poincaré based on various press cuttings from The New York Times The San Francisco Sunday Call The Times The Sun The Washington Post that chronicled unknown anecdotes of his life for example his first name was actually not Henri but Henry he obtained his high school diploma in sciences with a zero in mathematics etc Such an approach enables the discovering of many forgotten or unknown aspects of his scientific and philosophical works as well as his important role in the public sphere

Design and Performance of Large Solar Thermal Collector Arrays, 1985

**Unifying Physics of Accelerators, Lasers and Plasma** Andrei Seryi, Elena Seraia, 2023-04-13 Unifying Physics of Accelerators Lasers and Plasma introduces the physics of accelerators lasers and plasma in tandem with the industrial methodology of inventiveness a technique that teaches that similar problems and solutions appear again and again in seemingly dissimilar disciplines



## **Geometric Optics On Phase Space** Book Review: Unveiling the Power of Words

In some sort of driven by information and connectivity, the energy of words has be more evident than ever. They have the ability to inspire, provoke, and ignite change. Such could be the essence of the book **Geometric Optics On Phase Space**, a literary masterpiece that delves deep into the significance of words and their effect on our lives. Written by a renowned author, this captivating work takes readers on a transformative journey, unraveling the secrets and potential behind every word. In this review, we will explore the book is key themes, examine its writing style, and analyze its overall affect readers.

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