

Arthur D. Yaghjian

# Relativistic Dynamics of a Charged Sphere

Updating the Lorentz-Abraham Model

*Third Edition*



Springer

# Relativistic Dynamics Of A Charged Sphere Updating The Lorentz Abraham Model

**Arthur D. Yaghjian**



## **Relativistic Dynamics Of A Charged Sphere Updating The Lorentz Abraham Model:**

**Relativistic Dynamics of a Charged Sphere** Arthur Yaghjian, 2010-10-19 This is a remarkable book Arthur Yaghjian is by training and profession an electrical engineer but he has a deep interest in fundamental questions usually reserved for physicists Working largely in isolation he has studied the relevant papers of an enormous literature accumulated over a century The result is a fresh and novel approach to old problems and to their solution Physicists since Lorentz have looked at the problem of the equations of motion of a charged object primarily as a problem for the description of a fundamental particle typically an electron Yaghjian considers a macroscopic object a spherical insulator with a surface charge was therefore not tempted to take the point limit and he thus avoided the pitfalls that have misguided research in this field since Dirac's famous paper of 1938 Perhaps the author's greatest achievement was the discovery that one does not need to invoke quantum mechanics and the correspondence principle in order to exclude the unphysical solutions runaway and pre acceleration solutions Rather as he discovered the derivation of the classical equations of motion from the Maxwell Lorentz equations is invalid when the time rate of change of the dynamical variables too large even in the relativistic case Therefore solutions that show such behavior are inconsistent consequences The classical theory thus shown to be physically consistent by itself It embarrassing to say the least that this observation had not been made before

**Relativistic Dynamics of a Charged Sphere** Arthur D. Yaghjian, 2022 This book takes a fresh systematic approach to determining the equation of motion for the classical model of the electron introduced by Lorentz 130 years ago The original derivations of Lorentz Abraham Poincaré and Schott are modified and generalized for the charged insulator model of the electron to obtain an equation of motion consistent with causal solutions to the Maxwell Lorentz equations and the equations of special relativity The solutions to the resulting equation of motion are free of pre acceleration and pre deceleration The generalized method is applied to obtain the causal solution to the equation of motion of a charge accelerating in a uniform electric field for a finite time interval Alternative derivations of the Landau Lifshitz approximation are given as well as necessary and sufficient conditions for the Landau Lifshitz approximation to be an accurate solution to the exact Lorentz Abraham Dirac equation of motion Binding forces and a total stress momentum energy tensor are derived for the charged insulator model Appendices provide simplified derivations of the self force and power at arbitrary velocity In this third edition some of the history has been made more accurate and some of the derivations have been simplified and clarified A detailed three vector exact solution to the Landau Lifshitz approximate equation of motion is given for the problem of an electron traveling in a counterpropagating plane wave laser beam pulse Semi classical analyses are used to derive the conditions that determine the significance of quantum effects not included in the classical equation of motion The book is a valuable resource for students and researchers in physics engineering and the history of science

**Relativistic Dynamics of a Charged Sphere** Arthur D. Yaghjian, 2022-09-29 In addition to expanding and clarifying a number of sections of the first edition it generalizes the

analysis that eliminates the noncausal pre acceleration so that it applies to removing any pre deceleration as well It also introduces a robust power series solution to the equation of motion that produces an extremely accurate solution to problems such as the motion of electrons in uniform magnetic fields      Relativistic Dynamics of a Charger Sphere Arthur D. Yaghjian,1992      Ultra-Wideband, Short-Pulse Electromagnetics 3 Carl E. Baumann, Lawrence Carin, Alexander P. Stone,2013-04-17 The first two international conferences on Ultra Wideband UWB Short Pulse SP Electromagnetics were held at Polytechnic University Brooklyn New York in 1992 and 1994 Their purpose was to focus on advanced technologies for generating radiating and detecting UWB SP signals on mathematical methods their propagation and scattering and on current as well as potential future applications The success of these two conferences led to the desirability of scheduling a third conference Impetus was provided by the electromagnetics community and discussions led by Carl Baum and Larry Carin resulted in the suggestion that the UWB conferences be moved around say to government laboratories such as Phillips Laboratory Consequently the decision was made by the Permanent HPEM Committee to expand AMEREM 96 to include the Third Ultra Wide Band Short Pulse UWB SP 3 with the Third Unexploded Ordnance Detection and Range Remediation Conference UXO and the HPEMINEM Conference in Albuquerque New Mexico during the period May 27 31 1996 Planning is now underway for EUROEM 98 in June 1998 in Tel Aviv Israel Joseph Shiloh is the conference chairman A fourth UWB SP meeting is planned as a part of this conference and Ehud Heyman will coordinate this part of the meeting The papers which appear in this volume the third in the UWB SP series update subject areas from the earlier UWB SP conferences These topics include pulse generation and detection antennas pulse propagation scattering theory signal processing broadband electronic systems and buried targets      **Neoclassical Theory of Electromagnetic Interactions** Anatoli Babin, Alexander Figotin,2016-08-04 In this monograph the authors present their recently developed theory of electromagnetic interactions This neoclassical approach extends the classical electromagnetic theory down to atomic scales and allows the explanation of various non classical phenomena in the same framework While the classical Maxwell Lorentz electromagnetism theory succeeds in describing the physical reality at macroscopic scales it struggles at atomic scales Here quantum mechanics traditionally takes over to describe non classical phenomena such as the hydrogen spectrum and de Broglie waves By means of modifying the classical theory the approach presented here is able to consistently explain quantum mechanical effects and while similar to quantum mechanics in some respects this neoclassical theory also differs markedly from it In particular the newly developed framework omits probabilistic interpretations of the wave function and features a new fundamental spatial scale which at the size of the free electron is much larger than the classical electron radius and is relevant to plasmonics and emission physics This book will appeal to researchers interested in advanced aspects of electromagnetic theory Treating the classical approach in detail including non relativistic aspects and the Lagrangian framework and comparing the neoclassical theory with quantum mechanics and the de Broglie Bohm theory this work is completely self contained      **Inside the**

**Photon** Tony Fleming, Elizabeth Bauer, 2014-03-20 Over the past decade biophotonics has appeared as a new department within the academic structure across the globe With experimental work going back for more than a century application of the scientific method has shown the importance of biophotonics within biological and medical practice At the same time a new mathematical description of physics and biophysics has emerged Self Field Theory SFT describes the role of photon as a binding agent between an electron and a proton within atomic structures SFT is being rapidly accepted by the physics community as a distinct physical theory This is now an alternative view in addition to classical electromagnetics and the quantum theories that forms the basis of a chemical bond Atomic chemistry underpins biochemistry the pharmaceutical approach to medical therapy and has been a staple of biological and medical knowledge over the 20th century The biophoton within SFT provides another layer of structural organization that sits underneath atomic chemistry This book is the first to describe SFT's role within biophotonics and as such provides a theory of biophotonics capable of describing a wide range of experimental biophotonic phenomena Inside the Photon A Journey towards Health describes the newly discovered layer of biophotonics underlying all atomic chemistry and biochemistry As with the variety of snowflakes the range in biological species within flora for instance is dependent on this biophotonic layer of interaction within atomic and biomolecular structures A new range of energies that can be balanced only within the biophotonic states are responsible for these innumerable varieties of biological species The phonon the quantum of acoustic or vibrational energy is also described and given status alongside the photon Hence the biophonon sits aside the biophoton as an element within biological structures Sounds can create structure in the same way biophotons can use structure to communicate Therapies such as homeopathy acupuncture traditional Chinese medicines are given fresh impetus including putative understanding of mechanism Mitosis is understood via the cell cycle and how electric acoustic and magnetic fields can induce changes at the biophotonic level The possibility arises of medical therapy without invasive surgery and without the side effects of drug based therapies

**Plane-Wave Theory of Time-Domain Fields** Thorkild B. Hansen, Arthur D. Yaghjian, 1999-06-10 This invaluable book provides a comprehensive framework for the formulation and solution of numerous problems involving the radiation reception propagation and scattering of electromagnetic and acoustic waves Filled with original derivations and theorems it includes the first rigorous development of plane wave expansions for time domain electromagnetic and acoustic fields For the past 35 years near field measurement techniques have been confined to the frequency domain Now with the publication of this book probe corrected near field measurement techniques have been extended to ultra wide band short pulse transmitting and receiving antennas and transducers By combining unencumbered straightforward derivations with in depth expositions of prerequisite material the authors have created an invaluable resource for research scientists and engineers in electromagnetics and acoustics and a definitive reference on plane wave expansions and near field measurements Featured topics include An introduction to the basic electromagnetic and acoustic field equations A rigorous development of time

domain and frequency domain plane wave representations The formulation of time domain frequency domain and static planar near field measurement techniques with and without probe correction Sampling theorems and computation schemes for time domain and frequency domain fields Analytic signal formulas that simplify the formulation and analysis of transient fields Wave phenomena such as electromagnetic missiles encountered only in the time domain Definitive force and power relations for electromagnetic and acoustic fields and sources Sponsored by IEEE Antennas and Propagation Society     **A New Perspective on Relativity** Bernard H. Lavenda, 2012 9 Nonequivalence of gravitation and acceleration 9 1 The uniformly rotating disc in Einstein's development of general relativity 9 2 The Sagnac effect 9 3 Generalizations of the Sagnac effect 9 4 The principle of equivalence 9 5 Fermat's principle of least time and hyperbolic geometry The rotating disc 9 7 The FitzGerald Lorentz contraction via the triangle defect 9 8 Hyperbolic nature of the electromagnetic field and the Poincare stress 9 9 The Terrell Weinstein effect and the angle of parallelism 9 10 Hyperbolic geometries with non constant curvature 9 11 Cosmological models 10 Aberration and radiation pressure in the Klein and Poincare models 10 1 Angular defect and its relation to aberration and Thomas precession 10 2 From the Klein to the Poincare model 10 3 Aberration versus radiation pressure on a moving mirror 10 4 Electromagnetic radiation pressure 10 5 Angle of parallelism and the vanishing of the radiation pressure 10 6 Transverse Doppler shifts as experimental evidence for the angle of parallelism 11 The inertia of polarization 11 1 Polarization and relativity 11 2 Stokes parameters and their physical interpretations 11 3 Poincare's representation and spherical geometry 11 4 Polarization of mass 11 5 Mass in Maxwell's theory and beyond 11 6 Relativistic Stokes parameters     **Relativistic Dynamics of a Charged Sphere** Arthur D. Yaghjian, 2005     **The Atomic World Spooky? It Ain't Necessarily So!** Theo van Holten, 2016-12-09 The present book takes the discovery that quantum like behaviour is not solely reserved to atomic particles one step further If electrons are modelled as vibrating droplets instead of the usually assumed point objects and if the classical laws of nature are applied then exactly the same behaviour as in quantum theory is found quantitatively correct The world of atoms is strange and quantum mechanics the theory of this world is almost magic Or is it Tiny droplets of oil bouncing round on a fluid surface can also mimic the world of quantum mechanics For the layman for whom the main part of this book is written this is good news If the everyday laws of nature can conspire to show up quantum like phenomena there is hope to form mental pictures how the atomic world works The book is almost formula free and explains everything by using many sketches and diagrams The mathematical derivations underlying the main text are kept separate in a peer reviewed appendix The author a retired professor of Flight Mechanics and Propulsion at the Delft University of Technology chose to publish his findings in this mixed popular and scientific form because he found that interested laymen more often than professional physicists feel the need to form visualisations of quantum phenomena     **Self-Field Theory** Tony Fleming, 2011-12-20 This is the first text to be written on the topic of Self Field Theory SFT a new mathematical description of physics distinct from quantum field theory the physical theory of choice

by physicists at the present time SFT is a recent development that has evolved from the classical electromagnetics of the electron's self fields that were studied

**Inconsistency, Asymmetry, and Non-Locality** Mathias Frisch, 2005-03-31  
Electrodynamics has largely been ignored by philosophers of science due to what Mathias Frisch says is a mistaken view that it is conceptually unproblematic Part of the goal of this book is to show that classical physics while successful in describing phenomena has some very interesting conceptual problems worth discussing The other goal of the book is to argue that the theory electrodynamics a core theory of modern physics and one that's widely held leaves out some important aspects of scientific theorizing namely that the notion that consistency is over valued and that an inconsistent theory can still be successful

**Interactions** Vincent F. Hendricks, Klaus F. Jørgensen, Jesper Lützen, Stig A. Pedersen, 2007-01-17 The main theme of this anthology is the unique interaction between mathematics physics and philosophy during the beginning of the 20th century In this book ten renowned philosopher historians probe insightfully into key conceptual questions of pre quantum mathematical physics The result is a diverse yet thematically focused compilation of first class papers on mathematics physics and philosophy and a source book on the interaction between them

Synchrotron Light Daniele Pelliccia, David M. Paganin, 2025-08-25 This textbook provides the first comprehensive overview of synchrotron physics at an introductory level covering the fundamental underpinning physics and combining rigorous treatment of the main concepts with a fresh outlook rich in images and graphics Aimed at students and practitioners alike this book describes all topics in a way that requires only undergraduate knowledge in physics and mathematics and with only a few exceptions all results are derived from first principles The book also emphasizes the relevance of the synchrotron light concept throughout the broader fabric of physics covering areas such as special relativity classical electrodynamics quantum theory astrophysics optical physics classical mechanics and computational physics As well as basic concepts related to the generation of synchrotron light by charged particles in accelerators and their special relativity and classical electrodynamics underpinning this textbook also covers quantum mechanical and quantum optics descriptions of synchrotron light emission the key role played by synchrotron light emission in the cosmos and the generalisation of the concept of synchrotron emission to interactions other than the electromagnetic interaction Taking the reader on a journey across the landscape of physics this book aims to unite a number of often disconnected communities of learners and practitioners through the connecting thread of synchrotron light

*Understanding Inconsistent Science* Peter Vickers, 2013-08-22 Peter Vickers examines inconsistent theories in the history of science theories which though contradictory are held to be extremely useful He argues that these theories are actually significantly different entities and warns that the traditional goal of philosophy to make substantial general claims about how science works is misguided

*Scientific and Technical Aerospace Reports*, 1993

**A Comparison Between Lorentz's Ether Theory and Special Relativity in the Light of the Experiments of Trouton and Noble** Michael Heinrich Paul Janssen, 1995

Boston Studies in the Philosophy of Science, 2006

*Quantenmechanik*

IV Oliver Tennert, 2024-05-17 In einer umfassenden Darstellung entwickeln und vertiefen die vier Bände dieses Lehrbuchs das Gebäude der nichtrelativistischen Quantenmechanik weshalb sie auch bestens als Nachschlagewerk geeignet sind Der vierte Band beginnt mit einem ausführlichen Kapitel zur nichtrelativistischen Quantenelektrodynamik QED traditionell als Quantentheorie der Strahlung bezeichnet und leitet dann über in die relativistische Quantentheorie Eine sorgfältige Behandlung der Möglichkeiten und Grenzen einer relativistischen Quantenmechanik sowie eine gründliche Untersuchung von Symmetrien in der relativistischen Quantentheorie schließen das Lehrbuch ab Besonderheiten Auch komplizierte Zusammenhänge werden illustrativ und klar erklärt Zahlreiche mathematische Einschübe erläutern allgemeine mathematische Zusammenhänge Besondere Highlights des Buches sind eine ausführliche Diskussion der Lamb Verschiebung und des Casimir Effekts einschließlich der in diesem Zusammenhang offenbar werdenden Problematik der Renormierung sowie die Analyse der Einteilchen Interpretation in der relativistischen Quantenmechanik und die Betrachtung von Gruppenkontraktionen im Übergang von relativistischen zu nichtrelativistischen Symmetriegruppen und ihrer Darstellungen Inhalt 1 Quantisierung des elektromagnetischen Feldes 2 Relativistische Quantenmechanik 3 Symmetrien in der Quantenmechanik II Zielgruppe Das Buch richtet sich sowohl an Bachelor als auch an Masterstudierende sowie ihre Lehrenden Aufgrund seines mehrbändigen Charakters der breiten Themenvielfalt und Bezügen zu wissenschaftlichen Originalarbeiten allerdings ein Muss für jedes Bibliothekregal einer in der Physik tätigen Person Vorkenntnisse Vorausgesetzt werden Kenntnisse der Theoretischen Mechanik der Elektrodynamik und der Speziellen Relativitätstheorie sowie der Analysis der linearen Algebra und der Funktionentheorie



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