

Progress in Mathematical Physics



Sergiu Klainerman
Francesco Nicolò

The Evolution Problem in General Relativity



Birkhäuser

The Evolution Problem In General Relativity

Martin Bojowald



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The Evolution Problem in General Relativity Sergiu Klainerman, Francesco Nicolò, 2012-12-06 The main goal of this work is to revisit the proof of the global stability of Minkowski space by D Christodoulou and S Klainerman Ch KI We provide a new self contained proof of the main part of that result which concerns the full solution of the radiation problem in vacuum for arbitrary asymptotically flat initial data sets This can also be interpreted as a proof of the global stability of the external region of Schwarzschild spacetime The proof which is a significant modification of the arguments in Ch KI is based on a double null foliation of spacetime instead of the mixed null maximal foliation used in Ch KI This approach is more naturally adapted to the radiation features of the Einstein equations and leads to important technical simplifications In the first chapter we review some basic notions of differential geometry that are systematically used in all the remaining chapters We then introduce the Einstein equations and the initial data sets and discuss some of the basic features of the initial value problem in general relativity We shall review without proofs well established results concerning local and global existence and uniqueness and formulate our main result The second chapter provides the technical motivation for the proof of our main theorem

The Evolution Problem of General Relativity Jakob Hansen, 2001 *Dynamics of Extremal Black Holes* Stefanos Aretakis, 2018-11-02 This Brief presents in a self contained non technical and illustrative fashion the state of the art results and techniques for the dynamics of extremal black holes Extremal black holes are roughly speaking either maximally rotating or maximally charged Astronomical observations suggest that near extremal stellar or supermassive black holes are ubiquitous in the universe The book presents various recently discovered characteristic phenomena such as the horizon instability that have enhanced our understanding of the dynamics of extremal black holes The topics should be of interest to pure mathematicians theoretical physicists and astronomers This book provides common ground for communication between these scientific communities

Particles And Fields - Proceedings Of The 1993 Workshop R Huerta, Miguel Angel Perez, Luis F Urrutia, 1994-08-01 This book is principally concerned with the relatively complex small molecules produced by plants which are important as drugs fine chemicals fragrances flavours and biologically active dietary constituents In a wide ranging series of thematic essays it covers key aspects of their role in plant ecology their metabolism in the plant their discovery characterisation and use and their significance in the diet Biotechnology including prospects for the genetic engineering of metabolic pathways for biotransformations and also for the production of biologically active proteins is the focus of the final section of the book The overall aim of the volume is to provide in each of the selected subject areas a personal critique which is readily accessible to the advanced undergraduate student and to the non specialist research worker alike

The Cauchy Problem in General Relativity Hans Ringström, 2009 The general theory of relativity is a theory of manifolds equipped with Lorentz metrics and fields which describe the matter content Einstein's equations equate the Einstein tensor a curvature quantity associated with the Lorentz metric with the stress energy tensor an object constructed

using the matter fields In addition there are equations describing the evolution of the matter Using symmetry as a guiding principle one is naturally led to the Schwarzschild and Friedmann Lemaitre Robertson Walker solutions modelling an isolated system and the entire universe respectively In a different approach formulating Einstein's equations as an initial value problem allows a closer study of their solutions This book first provides a definition of the concept of initial data and a proof of the correspondence between initial data and development It turns out that some initial data allow non isometric maximal developments complicating the uniqueness issue The second half of the book is concerned with this and related problems such as strong cosmic censorship The book presents complete proofs of several classical results that play a central role in mathematical relativity but are not easily accessible to those without prior background in the subject Prerequisites are a good knowledge of basic measure and integration theory as well as the fundamentals of Lorentz geometry The necessary background from the theory of partial differential equations and Lorentz geometry is included

Global Structure and Evolution in General Relativity Spiros Cotsakis, Gary W. Gibbons, 2014-03-12 The five lectures presented in this volume address very timely mathematical problems in relativity and cosmology Part I is devoted to the initial value and evolution problems of the Einstein equations Especially it deals with the Einstein Yang Mills Boltzmann system fluid models with finite or infinite conductivity global evolution of a new two phase model for gravitational collapse and the structure of maximal asymptotically flat vacuum solutions of the constraint equations which have the additional property of containing trapped surfaces Part II focuses on geometrical topological problems in relativity and cosmology on the role of cosmic censorship for the global structure of the Einstein Maxwell equations and on the mathematical structure of quantum conformal superspace

Accelerating Expansion Gordon Belot, 2023-08-24 Accelerating Expansion explores some of the philosophical implications of modern cosmology focused on the significance that the discovery of the accelerating expansion of the Universe has for our understanding of time geometry and physics The appearance of the cosmological constant in the equations of general relativity allows one to model universes in which space has an inherent tendency towards expansion This constant introduced by Einstein but subsequently abandoned by him returned to centre stage with the discovery of the accelerating expansion This pedagogically oriented essay begins with a study of the most basic and elegant relativistic world that involves a positive cosmological constant de Sitter spacetime It then turns to the relatives of de Sitter spacetime that dominate modern relativistic cosmology Some of the topics considered include the nature of time and simultaneity in de Sitter worlds the sense in which de Sitter spacetime is a powerful dynamical attractor the limited extent to which observation can give us information about the topology of space in a world undergoing accelerated expansion and cosmologists favourite sceptical worry about the reliability of evidence and the possibility of knowledge the problem of Boltzmann brains

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General physics, relativity, astronomy and plasmas ,1997 Evolution Equations David Ellwood,Igor Rodnianski,Gigliola Staffilani,Jared Wunsch,2013-06-26 This volume is a collection of notes from lectures given at the 2008 Clay Mathematics Institute Summer School held in Zurich Switzerland The lectures were designed for graduate students and mathematicians within five years of the Ph D and the main focus of the program was on recent progress in the theory of evolution equations Such equations lie at the heart of many areas of mathematical physics and arise not only in situations with a manifest time evolution such as linear and nonlinear wave and Schrödinger equations but also in the high energy or semi classical limits of elliptic problems The three main courses focused primarily on microlocal analysis and spectral and scattering theory the theory of the nonlinear Schrödinger and wave equations and evolution problems in general relativity These major topics were supplemented by several mini courses reporting on the derivation of effective evolution equations from microscopic quantum dynamics on wave maps with and without symmetries on quantum N body scattering diffraction of waves and symmetric spaces and on nonlinear Schrödinger equations at critical regularity Although highly detailed treatments of some of these topics are now available in the published literature in this collection the reader can learn the fundamental ideas and tools with a minimum of technical machinery Moreover the treatment in this volume emphasizes common themes and techniques in the field including exact and approximate conservation laws energy methods and positive commutator arguments Titles in this series are co published with the Clay Mathematics Institute Cambridge MA

Transactions of the International Astronomical Union Jean-Pierre Swings,2012-12-06 The XIXth General Assembly of the International Astronomical Union was held in New Delhi India from November 19 to 28 1985 It was dedicated to the memory of a former IAU President Professor M K V Bappu who tragically passed away on August 19 1982 On the occasion of the Delhi General Assembly the IAU Minor Planet Center announced that Minor Planet asteroid No 2596 henceforth will carry the name Vainu Sappu The full text of the announcement reads 2596 VAINU BAPPU 1979 KN diameter about 8 kilometers period 5 years 4 months mean distance from the Sun around 450 million kilometers Discovered 1979 May 19 by R M West at the European Southern Observatory Named in memory of Manali f Proceedings of the 2nd Canadian Conference on General Relativity and Relativistic Astrophysics A. A. Coley,Charles Chester Dyer,Brian Owen Joseph Tupper,1988 *Canonical*

Gravity and Applications Martin Bojowald, 2010-12-23 Canonical methods are a powerful mathematical tool within the field of gravitational research both theoretical and experimental and have contributed to a number of recent developments in physics Providing mathematical foundations as well as physical applications this is the first systematic explanation of canonical methods in gravity The book discusses the mathematical and geometrical notions underlying canonical tools highlighting their applications in all aspects of gravitational research from advanced mathematical foundations to modern applications in cosmology and black hole physics The main canonical formulations including the Arnowitt Deser Misner ADM formalism and Ashtekar variables are derived and discussed Ideal for both graduate students and researchers this book provides a link between standard introductions to general relativity and advanced expositions of black hole physics theoretical cosmology or quantum gravity

Proceedings of the Second Marcel Grossmann Meeting on General Relativity International Centre for Theoretical Physics, 1982

The Fifth Marcel Grossmann Meeting on Recent Developments in Theoretical and Experimental General Relativity, Gravitation and Relativistic Field Theories D. G. Blair, David G. Blair, Michael J. Buckingham, 1989

Evolution Problems of General Relativity Jacob Hansen, 2005

Encyclopedia of Mathematical Physics Jean-Pierre Francoise, Gregory L. Naber, Sheung Tsun Tsou, 2006 The Encyclopedia of Mathematical Physics provides a complete resource for researchers students and lecturers with an interest in mathematical physics It enables readers to access basic information on topics peripheral to their own areas to provide a repository of the core information in the area that can be used to refresh the researcher's own memory banks and aid teachers in directing students to entries relevant to their course work The Encyclopedia does contain information that has been distilled organised and presented as a complete reference tool to the user and a landmark to the body of knowledge that has accumulated in this domain It also is a stimulus for new researchers working in mathematical physics or in areas using the methods originating from work in mathematical physics by providing them with focused high quality background information Editorial Board Jean Pierre Fran oise Universit Pierre et Marie Curie Paris France Gregory L Naber Drexel University Philadelphia PA USA Tsou Sheung Tsun University of Oxford UK Also available online via ScienceDirect 2006 featuring extensive browsing searching and internal cross referencing between articles in the work plus dynamic linking to journal articles and abstract databases making navigation flexible and easy

Proceedings of the Fourth Marcel Grossmann Meeting on General Relativity, Held at the University of Rome "La Sapienza", 17-21 June, 1985: Parallel sessions Remo Ruffini, 1986

Solutions of the Constraint Equations in General Relativity Satisfying "hyperboloidal Boundary Conditions" Lars Andersson, Piotr T. Chruściel, 1996

Whispering the Techniques of Language: An Psychological Journey through **The Evolution Problem In General Relativity**

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Table of Contents The Evolution Problem In General Relativity

1. Understanding the eBook The Evolution Problem In General Relativity
 - The Rise of Digital Reading The Evolution Problem In General Relativity
 - Advantages of eBooks Over Traditional Books
2. Identifying The Evolution Problem In General Relativity
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an The Evolution Problem In General Relativity
 - User-Friendly Interface
4. Exploring eBook Recommendations from The Evolution Problem In General Relativity
 - Personalized Recommendations

- The Evolution Problem In General Relativity User Reviews and Ratings
- The Evolution Problem In General Relativity and Bestseller Lists
- 5. Accessing The Evolution Problem In General Relativity Free and Paid eBooks
 - The Evolution Problem In General Relativity Public Domain eBooks
 - The Evolution Problem In General Relativity eBook Subscription Services
 - The Evolution Problem In General Relativity Budget-Friendly Options
- 6. Navigating The Evolution Problem In General Relativity eBook Formats
 - ePub, PDF, MOBI, and More
 - The Evolution Problem In General Relativity Compatibility with Devices
 - The Evolution Problem In General Relativity Enhanced eBook Features
- 7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of The Evolution Problem In General Relativity
 - Highlighting and Note-Taking The Evolution Problem In General Relativity
 - Interactive Elements The Evolution Problem In General Relativity
- 8. Staying Engaged with The Evolution Problem In General Relativity
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers The Evolution Problem In General Relativity
- 9. Balancing eBooks and Physical Books The Evolution Problem In General Relativity
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection The Evolution Problem In General Relativity
- 10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
- 11. Cultivating a Reading Routine The Evolution Problem In General Relativity
 - Setting Reading Goals The Evolution Problem In General Relativity
 - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of The Evolution Problem In General Relativity
 - Fact-Checking eBook Content of The Evolution Problem In General Relativity

- Distinguishing Credible Sources
- 13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
- 14. Embracing eBook Trends
 - Integration of Multimedia Elements
 - Interactive and Gamified eBooks

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