

Homogeneous Anisotropic Bianchi Type IX Cosmological Model For Perfect Fluid Distribution With Electromagnetic Field

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Abstract We have investigated homogeneous anisotropic Bianchi type IX cosmological model for perfect fluid distribution with electro-magnetic field. The magnetic field is due to an electric current produced along x axis thus F_{12} is the only non-vanishing component of electromagnetic field tensor F_{ij} . To get a determinate model, we have assumed the condition $a = b^n$ between metric potentials, where n is constant. The various physical and geometrical aspects of the model viz pressure, density, shear, expansion factor, electromagnetic field tensor and conformal curvature are also discussed.

Keywords Bianchi type IX, Cosmological Model, Anisotropic, Perfect Fluid, Electromagnetic Field

1 Introduction

Many relativists have taken keen interest in studying Bianchi IX universe because familiar solution like Robertson Walker universe, the de-sitter universe. The Taub-NUT solutions etc. are of Bianchi IX space times. Bianchi IX cosmological models include closed FRW models. These models allow not only expansion but also rotation and shear and in general are anisotropic. In recent years cosmological models with rotation and expansion have been constructed by many research workers viz. Novello and Rebouças[1], Rebouças and Lima[2,3], Rosquist[4], Bradley and Svienstins[5], Svienstins[6], Patel and Yadava[7]. Homogeneous and anisotropic cosmological models have been widely studied in the frame work of general relativity in the search of realistic picture of the universe in its early stages because they explain a number of observed phenomena quite satisfactorily.

The observational relations for discrete sources in certain homogeneous anisotropic model have been derived by Saunders[8, 9], Tomita[10], Mac-Callum and Ellis[11].

Fraclas & Cohen[12] have investigated LRS (Locally Rotationally Symmetric) Bianchi type V universes containing stiff matter with electromagnetic field. Lorente[13,14] investigated Bianchi type cosmologies in presence of magnetic field. Assad and Soares[15] have investigated a class of exact cosmological solution of Einstein's - Maxwell

equations, which are anisotropic and spatially homogeneous. Bianchi VIII and IX locally rotationally symmetric model.

The dynamical effects of spatially homogeneous electromagnetic field on anisotropic Bianchi type IX models are studied by Waller[16]. Brill[17] studied Einstein's - Maxwell equations in a homogeneous and non-isotropic universe.

Bali and Dave[18] have investigated Bianchi type IX string cosmological model in General Relativity. Bali and Kumawat[19] have investigated Bianchi type IX stiff fluid tilted cosmological model with bulk viscosity. Tyagi and Sharma[20] investigated Bianchi IX string cosmological model for perfect fluid distribution in General Relativity.

In this paper, we have investigated homogeneous anisotropic Bianchi type IX cosmological model of perfect fluid distribution with electro-magnetic field. We have assumed that F_{12} is the only non-vanishing component of electromagnetic field tensor F_{ij} .

To get a determinate model, we have assumed the condition $a = b^n$ between metric potentials, where n is constant. The various physical and geometrical aspects of the model are also discussed.

2. Formations of Field Equations

We consider homogeneous anisotropic Bianchi type IX metric in the form

$$ds^2 = -dt^2 + a^2(t)dx^2 + b^2(t)dy^2 + (b^2 \sin^2 y + a^2 \cos^2 y)dz^2 - 2a^2 \cos y \, dz \, dt \quad (1)$$

Where metric potentials a & b are functions of 't' alone. The energy momentum tensor is taken in the form

$$T^i_j = (x + p)v^i v_j + pg^i_j + E^i_j \quad (2)$$

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A.A. Coley



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Dynamical Systems and Cosmology A.A. Coley, 2013-04-17 Dynamical systems theory is especially well suited for determining the possible asymptotic states at both early and late times of cosmological models particularly when the governing equations are a finite system of autonomous ordinary differential equations In this book we discuss cosmological models as dynamical systems with particular emphasis on applications in the early Universe We point out the important role of self similar models We review the asymptotic properties of spatially homogeneous perfect fluid models in general relativity We then discuss results concerning scalar field models with an exponential potential both with and without barotropic matter Finally we discuss the dynamical properties of cosmological models derived from the string effective action This book is a valuable source for all graduate students and professional astronomers who are interested in modern developments in cosmology

Literature 1989, Part 1 Astronomisches Rechen-Institut, 2013-11-11 From the reviews Astronomy and Astrophysics Abstracts has appeared in semi annual volumes since 1969 and it has already become one of the fundamental publications in the fields of astronomy astrophysics and neighbouring sciences It is the most important English language abstracting journal in the mentioned branches The abstracts are classified under more than a hundred subject categories thus permitting a quick survey of the whole extended material The AAA is a valuable and important publication for all students and scientists working in the fields of astronomy and related sciences As such it represents a necessary ingredient of any astronomical library all over the world Space Science Review Dividing the whole field plus related subjects into 108 categories each work is numbered and most are accompanied by brief abstracts Fairly comprehensive cross referencing links relevant papers to more than one category and exhaustive author and subject indices are to be found at the back making the catalogues easy to use The series appears to be so complete in its coverage and always less than a year out of date that I shall certainly have to make a little more space on those shelves for future volumes The Observatory Magazine *Current Trends in Relativistic Astrophysics* Leonardo Fernández-Jambrina, Luis Manuel González-Romero, 2008-01-11 The present volume contains the expanded lectures of a meeting on relativistic astrophysics the goal of which was to provide a modern introduction to specific aspects of the field for young researchers as well as for nonspecialists from related areas Particular emphasis is placed on the theory of black holes and evolution relativistic stars and jet hydrodynamics as well as the production and detection of gravitational waves The book is complemented by further contributions and animation supplied on the accompanying CD ROM [The Formation and Evolution of Cosmic Strings](#) G. W. Gibbons, S. W. Hawking, Tanmay Vachaspati, 1990 **Astroparticle Physics, Proceedings Of The First Ncts Workshop** Husain Athar, Guey-lin Lin, Kin-wang Ng, 2002-09-30 This volume contains detailed articles by theorists and experimentalists in the newly developing field of astroparticle physics A large variety of topics are covered These include the role of neutrinos in astroparticle physics big bang nucleosynthesis string theory and cosmology **Applied Nonlinear Analysis and Soft Computing** Hemen

Dutta, Nazibuddin Ahmed, Ravi P. Agarwal, 2023-07-20 The volume contains original research papers as the Proceedings of the International Conference on Applied Nonlinear Analysis and Soft Computing ANASC 2020 held at Gauhati University Guwahati India on 22-23 December 2020. It focuses on current research topics in applied analysis including nonlinearity, soft computing and related areas. It primarily includes topics related to pattern recognition, reaction-diffusion problem, decision making problems, inventory model, predator-prey model, logistic models, wave problems, problems in Magnetohydrodynamics, cosmological model, harmonic functions, graphs, shapes, etc. Researchers, educators, scientists and professionals interested in recent developments in applied analysis including nonlinearity aspects and soft computing should be benefited from this volume.

Relativistic Cosmology Dr. Amit Prakash, 2020-06-03 Relativistic Cosmology is an exciting update of mathematical interpretation of the universe. It is aimed primarily at advanced postgraduate students in mathematics as well as physics and astronomy but is also useful as a supplementary text at higher level as research scholars. This book deals with observational results, descriptions of special and general theory of relativity and applications of relativistic mechanics and relativistic thermodynamics to cosmology. This book is concerned mainly with various models that have been proposed to explain the large scale structure of the universe. Even a very knowledgeable student of the Cosmology will find much new information in this book. While the explanatory discussions are brief, they are sufficiently substantive to serve the subject in the question and to pique further interest in the topic. This book is not merely written or compiled; it is crafted. It is designed for a specific audience and the texture and sensory format is carefully chosen for the audience. This is a wonderful book that presents an eclectic selection of cosmological concepts and concerned calculations. It is an ideal text book for the era of precision cosmology in the accelerating universe. This book, as it is hoped, will certainly find a warm reception in the hands of the readers.

General Relativity and Cosmology SUSHIL KUMAR SRIVASTAVA, 2008-06-10 The general theory of relativity and its applications to cosmology requires very deep understanding of mathematics and physics. Keeping this in mind, this self-contained textbook is written which addresses general relativity and cosmology. In this book, the attempts have been made to explain mathematicians' notions in the language of a physicist. Primarily intended for the postgraduate students of mathematics and physics, it gives equal importance to mathematical and physical aspects and thus sharpens understanding of the theory. The text covers many modern concepts and current developments in gravity and cosmology including Brans-Dicke theory, higher derivative gravity, Kaluza-Klein theory with extension to higher dimensions. Besides PG students, this book would also be useful for research scholars.

KEY FEATURES Highlights special features of general relativity and cosmology. Discusses structure formation in the universe, inflationary models and dark energy models with special focus on basic concepts. Provides problems at the end of each chapter to stimulate thinking. Reveals interconnections between required mathematical concepts. Explains how to apply mathematical concepts to physical problems. Discusses Lagrangian formulation of the field theory and action principle as it provides a powerful tool to derive field equations and energy.

momentum tensor components

Exact Space-Times in Einstein's General Relativity Jerry B. Griffiths, Jiří

Podolský, 2009-10-15 Einstein's theory of general relativity is a theory of gravity and as in the earlier Newtonian theory much can be learnt about the character of gravitation and its effects by investigating particular idealised examples. This book describes the basic solutions of Einstein's equations with a particular emphasis on what they mean both geometrically and physically. Concepts such as big bang and big crunch types of singularities, different kinds of horizons and gravitational waves are described in the context of the particular space-times in which they naturally arise. These notions are initially introduced using the most simple and symmetric cases. Various important coordinate forms of each solution are presented, thus enabling the global structure of the corresponding space-time and its other properties to be analysed. The book is an invaluable resource both for graduate students and academic researchers working in gravitational physics. **Nuclear Science**

Abstracts, 1975-10

Homogeneous Relativistic Cosmologies

Michael P. Ryan, Lawrence C. Shepley, 2015-03-08 Addressing a variety of theoretical cosmological problems and emphasizing a mathematical approach, this volume nicely complements Peebles' *Physical Cosmology* (Princeton Series in Physics, 1971). Ryan and Shepley have concentrated on the structure of models of the universe. By using a modern terminology that emphasizes the operator nature of vectors and tensors as opposed to their components in a particular coordinate system, the authors develop modern tensor analysis to the point where it can be applied to general relativistic cosmology. They then use it to describe homogeneous cosmologies in considerable detail. Both students and researchers are likely to find these techniques especially useful. Among their subjects are spaces with groups of motions, singularities, Taub-NUT, Misner space, Bianchi-type models, Hamiltonian cosmology, and perturbations in anisotropic models. A brief section on observations is also included, as is a complete bibliography. A final section presents graded exercises that underscore the potential yet unrealized in this area of study. Originally published in 1975, The Princeton Legacy Library uses the latest print-on-demand technology to again make available previously out-of-print books from the distinguished backlist of Princeton University Press. These editions preserve the original texts of these important books while presenting them in durable paperback and hardcover editions. The goal of the Princeton Legacy Library is to vastly increase access to the rich scholarly heritage found in the thousands of books published by Princeton University Press since its founding in 1905. *Gravitation, Gauge Theories and the Early Universe* B.R. Iyer, N.

Mukunda, C.V. Vishveshwara, 2012-12-06 This book evolved out of some one hundred lectures given by twenty experts at a special instructional conference sponsored by the University Grants Commission, India. It is pedagogical in style and self-contained in several interrelated areas of physics which have become extremely important in present-day theoretical research. The articles begin with an introduction to general relativity and cosmology as well as particle physics and quantum field theory. This is followed by reviews of the standard gauge models of high-energy physics, renormalization group, and grand unified theories. The concluding parts of the book comprise discussions in current research topics such as problems of

the early universe quantum cosmology and the new directions towards a unification of gravitation with other forces In addition special concise treatments of mathematical topics of direct relevance are also included The content of the book was carefully worked out for the mutual education of students and research workers in general relativity and particle physics This ambitious programme consequently necessitated the involvement of a number of different authors However care has been taken to ensure that the material meshes into a unified cogent and readable book We hope that the book will serve to initiate and guide a student in these different areas of investigation starting from first principles and leading to the exciting current research problems of an interdisciplinary nature in the context of the origin and structure of the universe **The Young**

Universe Richard Taillet, 2022-10-11 The Young Universe presents four major physical and astrophysical themes related to these extreme phases of the primordial universe In particular it presents the physics of the primordial plasma and the concepts of quantum and particle physics necessary to describe this extreme state It discusses the cosmological background radiation and explores inflation an extremely rapid expansion phase that is believed to have occurred very early in cosmological history and to have shaped our present universe The book also provides a synthesis of the dark matter problem

Waves And Stability In Continuous Media - Proceedings Of The 15th Conference On Wascom 2009 Antonio Maria Greco, Salvatore Rionero, Tommaso Ruggeri, 2010-04-29 This book contains recent contributions in the field of waves propagation and stability in continuous media The volume is the sixth in a series published by World Scientific since 1999

"WASCOM 2009" Antonio Maria Greco, 2010 Contains contributions in the field of waves propagation and stability in continuous media **Cosmology** Prof Peter Coles, Prof Francesco Lucchin, 2003-04-04 This is the 2nd edition of a highly successful title on this fascinating and complex subject Concentrating primarily on the theory behind the origin and the evolution of the universe and where appropriate relating it to observation the new features of this addition include An overall introduction to the book Two new chapters Gravitational Lensing and Gravitational Waves Each part has a collection of exercises with solutions to numerical parts at the end of the book Contains a table of physical constants The addition of a consolidated bibliography **Literature 1992, Part 1** Astronomisches Recheninstitut, 2013-11-11 Astronomy and

Astrophysics Abstracts appearing twice a year has become one of the fundamental publications in the fields of astronomy astrophysics and neighbouring sciences It is the most important English language abstracting journal in the mentioned branches The abstracts are classified under more than a hundred subject categories thus permitting a quick survey of the whole extended material The AAA is a valuable and important publication for all students and scientists working in the fields of astronomy and related sciences As such it represents a necessary ingredient of any astronomical library all over the world

Modern Cosmology in Retrospect B. Bertotti, 1990-10-25 Modern cosmology aims to determine the origin evolution and ultimate fate of the Universe This is an area of modern science that has engendered fierce debates which have captured public interest This book recounts the development of modern cosmology in chapters contributed by many of the leading

protagonists It is a fascinating account of physical and observational cosmology the great cosmological debates important observations and the riddle of dark matter The enormous controversy surrounding the Big Bang theory is retold in personal recollections from H Bondi W McCrea and Fred Hoyle This is followed by chapters on the discovery of cosmic radio waves and the contributions made by radio astronomers to current cosmology The book concludes with a tribute to some of the pioneers of cosmology **Journal of Mathematical and Physical Sciences** ,1989 **Galaxies and Cosmology** Vittorio Canuto,Bruce G. Elmegreen,1988 This is a treatment of the fundamentals of cosmology and galaxies discussed from theoretical experimental and observational perspectives and providing a basic reference source for both specialists and non specialists Articles from non equilibrium relativistic cosmology to the evolution of galaxies are included

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