Late Chindhuji Laxmanrao Purke Shikshan Prasarak Mandal's

INDIRA GANDHI KALA MAHAVIDYALAYA

Ralegaon, Dist- Yavatmal,Maharashtra

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2nd Cycle

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Criterion-III

Research, Innovations and Extension

Q_nM 3.3.1 Number of research papers in the Journals notified on UGC CARE year wise during the last five years

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Indira Gandhi Kala Mahavidyalaya,
Ralegaon - 445402, Dist. Yavatmal (M.S.)
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Papers published per teacher in the Journals notified on UGC website
From 2019-20 to 2023-24

Academic Year	Sr. No.	Name of the teacher /Author	Title of paper	Year of Publication	Name of the Journal	ISSN number	Link to the recognition in UGC enlistment of the Journal
2019-20	1	Dr.A.Y.Shaikh	Hypersurface-homogeneous modified holographic Ricci dark energy cosmological model by hybrid expansion law in Saez-Ballester theory of gravitation	2020	Journal of Astrophysics and Astronomy	ISSN 0250-6335	https://doi.org/10.1007/S12036-019-9591-4
	2	Dr.A.Y.Shaikh	Holographic Dark Energy Cosmological Models in f(G) Theory	2020	New Astronomy	ISSN 1384-1076	https://doi.org/10.1016/j.newast.2020.101420
	3	Mr.S.V.Gore	Holographic Dark Energy Cosmological Models in f(G) Theory	2020	New Astronomy	ISSN 1384-1076	https://doi.org/10.1016/j.newast.2020.101420
	4	Mr.S.V.Gore	LCDM cosmological model with quintessence in f® theory of gravitation	2020	Journal of Astrophysics and Astronomy	ISSN 0250-6335	https://dx.doi.org/10.1007/S12036-020-9632-z
	5	Dr. S. V. Agarakar	Study of Drug-likeness Properties of Some 6-(2'- Hydroxy-3'/5'-Chloro-5'/3'-Hydroxymethyl Phenyl)-4-Aryl 3, 4 Dihydro-2(1H)-Thiopyrimidines	2020	IOSR Journal of Applied Chemistry	ISSN 2278-5736	
	6	Mr.V.D.Samarth	Agrobacterium-Mediated Transformation Of Tomato With Cry1acf Gene for Insect Resistance	2020	Juni khayat	ISSN: 2278-4632	www.junikhyat.com

2020-21	1	Dr.A.Y.Shaikh	Analysis of observational parameters and stability in extended teleparallel gravity	2020	International Journal of Geometric Methods in Modern Physics	ISSN 1793-6977	https://dx.doi.org/10.1142/S0219887820501583
	2	Dr.A.Y.Shaikh	Transist dark energy and thermodynamic al aspects of the cosmological model in teleparallel gravity	2021	Pramana – J. Phys.	ISSN 0304-4289	https://doi.org/10.1007/s12043-020-02047-z
	3	Dr.A.Y.Shaikh	Bouncing scenario of general relativistic hydrodynamics in extended gravity	2021	International Journal of Geometric Methods in Modern Physics	ISSN 1793-6977	https://doi.org/10.1088/1572-9494/abcfb2
	4	Dr.A.Y.Shaikh	Cosmic acceleration and stability of cosmological models in extended teleparallel gravity	2021	Pramana – J. Phys.	ISSN 0304-4289	https://doi.org/10.1007/s12043-020-02048-y
	5	Dr.A.Y.Shaikh	Viscous Dark Energy Cosmological Models in Brans-Dicke Theory of Gravitation	2020	Bulgarian Journal of Physics	ISSN 1314-2666	bjp2020_1-2_043-058.pdf
	6	Dr.A.Y.Shaikh	Panorama Behaviors of Holographic Dark Energy Models in Modified Gravity	2021	Foundations of Physics	ISSN 1572-9516	https://doi.org/10.1007/s10701-021-00463-8
	7	Dr.A.Y.Shaikh	Non-singular bouncing General Relativistic Hydrodynamic s cosmological models	2021	Astrophys Space Sci	ISSN 1572-946X	https://doi.org/10.1007/s10509-021-03977-9
	8	Dr.A.Y.Shaikh	Panorama behaviors of General relativistic hydrodynamics and holographic dark energy in f(R, T) gravity	2021	New Astronomy	ISSN 1384-1076	https://doi.org/10.1016/j.newast.2021.101676
	9	Mr.S.V.Gore	Cosmic acceleration and stability of cosmological models in extended teleparallel gravity	2021	Pramana – J. Phys.	ISSN 0304-4289	https://doi.org/10.1007/s12043-020-02048-y
	10	Dr.A.Y.Shaikh	Bouncing scenario of general relativistic hydrodynamics in extended gravity	20201	Commu. Theor. Phys.	ISSN 0253-6102	https://doi.org/10.1088/1572-9494/abccfb2

	11	Dr.K.G. Pawar	A Comparative study of sports emotional intelligence among combative game player.	2021	Vidyabharati int.interdisciplinary Res. journal	ISSN 2319-4979	
	12	Dr. S. V. Agarkar	Synthesis, Characterization and Comparative Study of Drug- likeness Properties of Cinnamamide Containing Heterocyclic Moiety	2021	International Journal for Innovative Research Multidisplinary Field	ISSN 2455-0620	
2021-22	1	Dr. A.Y. Shaikh	Stability and cosmic acceleration of the cosmological models in Teleparallel gravity	2022	Bulgarian Journal of Physics	ISSN 1314-2666	https://doi.org/10.55318/bgjp.2022.49.2.190
	2	Dr. S. V. Agarkar	Study Of Drug Likeliness Properties Of 1(2'-Hydroxy-3'-Nitro-5'-Methylphenyl)-3-Aryl/Heteryl-2-Propen-1-Ones	2022	Internationa Journal of Creative Research Thoughts (IJCRT)	ISSN 2320-2882	
	3	Dr.V.L.Barde	Role of Librarians in the e-Governance era	2022	Shodhsanhita Vol IX Issue1(2022)pp 28-35	ISSN 2277-7067	https://archive.org/details/shodhsamhitavol.ijuldec.2011/Shodhsamhita%20Volume%20-%20IX%20Issue%20I%20January%202022/page/227/mode/2up?view=theater
2022-23	1	Dr. A.Y. Shaikh	Exploration of General Relativistic Hydrodynamics for FRW Metric	2023	Bulgarian Journal of Physics	ISSN 1314-2666	http://www.bjp-bg.com/papers/bjp2022_4_340-361.pdf
	2	Dr. A.Y. Shaikh	An Oscillating Holographic dark energy in f(R) gravity	2023	Bulgarian Journal of Physics	ISSN 1314-2666	https://doi.org/10.55318/bgjp.2022.50.2.190
	3	Dr.A.Y.Shaikh	Pollution: Sources, Effects and Control	2023	Vidyabharati International Interdisciplinary Research Journal	ISSN 2319-4979	
	4	Mr.S.V.Gore	Exploration of General Relativistic Hydrodynamics for FRW Metric	2023	Bulgarian Journal of Physics	ISSN 1314-2666	http://www.bjp-bg.com/papers/bjp2022_4_340-361.pdf
	5	Dr.A.Y.Shaikh	Cosmic transit behaviour of the expanding cosmos in symmetric tele parallel gravity	2023	European Journal of Physics Plus	ISSN 2190-5444	https://doi.org/10.1140/epjp/s13360-023-039331-4
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			Graphene Oxide-based Ternary Composite System for Supercapacitive Application				
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	9	Mr. P. R. Jagnit	Thermokinetic studies of Co(II), Ni(II) and Cu(II) with tetradentate Schiff Base	2022	Vidyabharati International Interdisciplinary Research Journal	ISSN 2319-4979	
2023-24	1	Dr. A.Y. Shaikh	Diagnosing Renyi and Tsallis holographic dark energy models with Hubble's horizon cutoff	2023	Indian Journal of Physics	ISSN 0974-9845	https://doi.org/10.1007/s12648-023-02844-3
	2	Dr. A.Y. Shaikh	Renyi Holographic Dark Energy Model in f(R) Gravity with Hubble's IR Cut-Off	2023	East European Journal of Physics	ISSN: 2312-4334	https://doi.org/10.26565/2312-4334-2023-3-06
	3	Dr. A.Y. Shaikh	Exploring the bouncing cosmological models in symmetric teleparallel gravity	2023	International Journal of Geometric Methods in Modern Physics	ISSN 1793-6977	https://doi.org/10.1142/S0219887823502201
	4	Dr. A.Y. Shaikh	Examining the physical viability of the f(R) gravity via Observational Constraints	2023	Chinese Journal of Physics	ISSN: 0577-9073	https://doi.org/10.1016/j.cjph.2023.09.020
	5	Dr. A.Y. Shaikh	Late time cosmic acceleration with obser. constraints in symmetric teleparallel gravity	2024	Indian J.of Physics	ISSN 0974-9845	https://doi.org/10.1007/s12648-024-03151-1

	6	Mr. K. D. Jagtap	A Review: Recent Advancement in Graphene Based Titanium Oxide, Manganese Oxide and Zinc Oxide Nanocomposites as Electrode Material for Supercapacitor	2023	International Journal of Scientific Research in Physics and Applied Sciences	ISSN: 2348-3423	www.isroset.org
	7	Mr. B. H. Bhatti	Fabrication of SnO_2 doped TiO_2 Metal Oxide Sensor with Ppy layer to sense CO_2 Gas	2023	Int. Scientific Research in Physics and Applied Sciences	ISSN 2348-3423	https://www.iosrjournals.org/iosr-jac/papers/vol13-issue5/Series-1/C1305012831.pdf
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Bouncing scenario of general relativistic hydrodynamics in extended gravity

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Abstract

In this paper, we have framed bouncing cosmological model of the Universe in the presence of general relativistic hydrodynamics in an extended theory of gravity. The metric assumed here is the flat Friedmann–Robertson–Walker space–time and the stress energy tensor is of perfect fluid. Since general relativity (GR) has certain issues with late time cosmic speed up phenomena, here we have introduced an additional matter geometry coupling that described the extended gravity to GR. The dynamical parameters are derived and analyzed. The dynamical behavior of the equation of state parameter has been analyzed. We have observed that the bouncing behavior is mostly controlled by the coupling parameter.

Keywords: FRW metric, extended gravity, bouncing scenario, energy conditions

(Some figures may appear in colour only in the online journal)

1. Introduction

Observational confirmation on the accelerated expansion of the present Universe gave a new avenue of research in modern cosmology. The success of Supernova Ia [1, 2], Cosmic microwave background radiation [3, 4], weak lensing [5], large scale structure [6–8], WMAP data [9], Planck data [10] experiment groups made researchers think on the shortcomings of Einstein's general relativity (GR). The component that is instrumental which for the accelerated expansion of the Universe is known as dark energy (DE). This component has occupied 68.3% of the energy budget of the Universe.

A matter bouncing scenario has been discussed for the cosmic expansion of the Universe, as an alternative way to the inflationary paradigm [11]. It depicts that there is a transition phase of the contracting Universe towards the phase of expansion. Solomons *et al* [12] have investigated bounce behavior for anisotropic universes. Bamba *et al* [13] explored bounce cosmology from gravity and bi-gravity. Silva *et al* [14] have studied bouncing solutions in Rastall's theory with a barotropic fluid. Rip singularity scenario and bouncing Universe for Chaplygin gas as a DE model have been extensively discussed by Sadatian [15]. Astashenok [16] demonstrated the effectiveness of DE models in Teleparallel gravity.

Brevik and Timoshkin [17, 18] obtained bounce cosmology for dark fluid matter. Cai *et al* [19–22] have discussed the non-singular bouncing cosmology whereas Cai *et al* [23] have investigated the matter bounce cosmological models in extended gravity. The various astronomical aspects of the bouncing scenario have been discussed by Brandenberger *et al* [24]. Bamba *et al* [25–27] explored bouncing cosmological models by reconstructing the method in modified theories of gravity such as Gauss–Bonnet gravity and Teleparallel gravity. de la Cruz-Dombriz *et al* [28] have analyzed the bouncing model in the extended teleparallel gravity. Minas *et al* [29] investigated the bounce realization in the framework of generalized modified gravity. Tripathy *et al* [30] have shown the increase in the rate of dynamics with the increase in the parameter value of the bouncing scale factor. Tripathy and Mishra [31] have discussed bouncing cosmological models in the frame work of a simple extended theory of gravity.

The present work is devoted to the investigation of a bouncing scenario in the presence of general relativistic hydrodynamics (GRH) in the framework of an extended theory of gravity. An isotropic FRW Universe is considered in an extended theory of gravity. The organization of the paper is as

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Regular Article

Cosmic transit behavior of the expanding cosmos in symmetric teleparallel gravity

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Abstract I study the cosmic transit behavior of the expanding cosmos in the framework of symmetric teleparallel gravity. The exact solution of field equations is obtained by employing a well-known deceleration parameter (DP) called time changing deceleration parameter $q = -1 + \frac{\gamma}{1+\alpha T^2}$, where $\gamma > 0$. The viability and physical reliability of the DP are investigated by using observational constraints. Several energy conditions are discussed in this setting.

1 Introduction

The existing cosmic expansion of the Universe stimulates the scientific communal to comprehend its essential properties. Dark energy (DE) and dark matter (DM) are the two dark fluids that make up the dark sector of our Universe, according to the sequence of earlier and more recent observational data [1–6]. An unknown form of energy that possesses high negative pressure called dark energy (DE) derives the accelerated expansion [7–9]. Several alternative ideas have been put out in the literature over the past few decades to address the Universe's current problems and uncover fresh insights. Many modified concepts have been proposed in the literature, including theories $f(R)$ [10–21], and $f(R, G)$ theory concept [22, 23], among others.

Recently, a new modified theory of gravity has attracted the interest of researchers called symmetric teleparallel (ST) gravity or $f(Q)$ gravity proposed by J.B. Jiménez et al. [24]. In Ref. [25], T. Harko examined the expansion of symmetric teleparallel gravity. Noemi looked at the underlying non-metricity gravity signals while conducting an exciting inquiry of $f(Q)$ gravity [26]. Lazkoz et al. [27] performed an intriguing study on symmetric teleparallel gravity in which a number of functions were restricted. The $f(Q)$ model also showed a similar description of an accelerated phase when subjected to the energy circumstances as described in [28]. By carrying out the singularity analysis and dynamical system analysis, Khyllep et al. [29] have shown that the $f(Q)$ gravity model is cosmologically viable. Barros et al. [30] analyzed the linear matter fluctuations are numerically evolved and the study of the growth rate of structures and predicted that the best fit parameters reveal that the tension between Planck and LSS data can be alleviated within this framework. $f(Q)$ Gravity has been studied from a wide variety of perspectives, including its covariant formulation [31], spherically symmetric configuration [32], energy conditions [28], cosmography [33], signature of $f(Q)$ gravity in cosmology [34], as an alternative to Λ CDM theory [35], and also a unique type of $f(Q)$ gravity known as the Weyl type $f(Q)$ gravity [36, 37]. Some important findings were made after studying the geodesic deviation equation for gravity [38] and many other works that were born in $f(Q)$ gravity, see, for example, [39–47]. Moreover, one can check the references [48–50] for various cosmological implications of the derived models.

By motivating and inspiring with the work mentioned in the above references in this work, I am aiming to explore the cosmological model that describes the evolution of the Universe on a large scale; I will work within the framework of the isotropic and spatially homogeneous FRW Universe in the presence of perfect fluid matter with the choice of $f(Q) = \alpha Q^{n+1} + \beta$, where α, β and n are constants, and also to verify the validity of the constructed models with the help of energy conditions.

2 Fundamental formulation in $f(Q)$ gravity theory

Consider the recommendation for $f(Q)$ action made by

$$S = \int \frac{1}{2} f(Q)\sqrt{-g}d^4x + \int L_m\sqrt{-g}d^4x, \tag{1}$$

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Hypersurface-homogeneous modified holographic Ricci dark energy cosmological model by hybrid expansion law in Saez–Ballester theory of gravitation

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Abstract. The main motive of this investigation is to study the behavior of cosmological model in the presence of matter and a modified holographic Ricci dark energy for homogeneous hypersurface in the scalar tensor theory of gravitation, proposed by Saez–Ballester (Phys. Lett. A, 113, 467 (1986)). The hybrid expansion law (Akarsu *et al.*, JCAP, 01, 022 (2014)) has been used to get a determinate solution. The physical condition that is shear scalar proportional to the expansion scalar is used to obtain the solution of the field equations. The various physical and geometrical aspects of the model are also discussed.

Keywords. Hypersurface-homogeneous space-time—hybrid expansion law—modified holographic dark energy—Saez–Ballester theory.

1. Introduction

In the last few decades, there has been considerable interest in studying alternative theories of gravitation, the most important among them being the scalar–tensor theories proposed by Lyra (1951), Brans and Dicke (1961), Nordverdt (1970), Wagoner (1970), Ross (1972), Dunn (1974), Barber (1985), Saez and Ballester (1986), La and Steinhardt (1991). Saez and Ballester (1986) have put forward a scalar-tensor theory of gravity in which the metric is coupled to a scalar field. This modification helped to solve the 'missing mass problem'. The study of cosmological models in the framework of scalar–tensor theories has been an active area of research in the last few decades. Cosmological models within the framework of the Sáez–Ballester scalar–tensor theory of gravitation have been studied by several relativists and they obtained solutions in the Sáez–Ballester scalar–tensor theory of gravitation in different contexts (Singh & Agrawal 1991, 1992; Ram & Tiwari 1998; Singh & Ram 2003; Mohanty & Sahu 2003, 2004; Reddy *et al.* 2006, 2008; Katore *et al.* 2010; Rao *et al.* 2011; Jamil *et al.* 2012; Samanta *et al.* 2013; Ghate & Sontakke 2014; Katore & Shaikh 2014b, 2015a, b).

The expansion of the universe is accelerating and are presented by two groups (the Supernova Cosmology Project and the High-Z team) (Garnavich *et al.* 1998a, b; Perlmutter *et al.* 1997, 1998, 1999; Riess *et al.* 1998, 2000, 2004; Schmidt *et al.* 1998; Tonry *et al.* 2003). A mysterious energy form called the dark energy (DE) may be responsible for the expansion and acceleration of the universe. DE obeys a simple EoS in the form $p = w\rho$, where ρ is the energy density, p is the isotropic pressure and w is the EoS parameter, which is not necessarily constant. The Wilkinson Microwave Anisotropy Probe (WMAP) measures that dark energy, dark matter and baryonic matter occupies 73%, 23% and 4% respectively, of the energy-mass content of the universe. Also, $w = -1$ is the simplest candidate of dark energy, i.e. cosmological constant with time-dependent equation of state. The quintessence, phantom, quintom, tachyon, dilaton with interacting dark energy models like holographic and agegraphic models are the other dynamical dark energy models with time-dependent equation of state that are studied to explain the accelerated expansion of the universe.

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Holographic Dark Energy Cosmological Models in $f(G)$ Theory

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ARTICLE INFO

Keywords:
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$f(G)$ theory of gravitation

ABSTRACT

In this paper, Locally Rotationally Symmetric (LRS) Bianchi type-I models with holographic dark energy within the framework of $f(G)$ theory of gravitation are thought about. So as to get determinate solutions, volumetric exponential expansion, power law expansion and hybrid expansion law are mentioned. The physical interpretations of the solution have been studied by using some physical quantities. Additionally to make the interpretation more clear for that the statefinder diagnostic pair (r, s) and jerk parameter are analyzed to characterize completely different phases of the universe.

1. Introduction

The modification of Hilbert-Einstein action are diode foundation of varied modified theories. Among the modified theories, $f(R)$theory is useful, since it preserves well-established results of the overall Relativity. Modified Gauss-Bonnet (GB) gravity or $f(G)$gravity is one altogether the modified versions of general theory of relativity (GR) by along side an arbitrary function of the Gauss–Bonnet quadratic invariant, G within the Einstein–Hilbert action (Nojiri et al. 2006). String theory by low energy effective scale is that the essential background for the motivation of $f(G)$theory (Cognola et al. 2006).Accelerated expansion of the universe, transition from deceleration to accelerating phase of the universe, satisfactory system tests, helpful within the explanation of thermodynamics Sadjadi (2011) and protection of all possible four sorts of future singularities (Bamba et. al. (2010)) are expeditiously elucidated by this theory. Using $f(G)$one will construct viable and consistent models with local constraints of general theory of relativity. Myrzakulov et al. (2011) explored this theory to review DE also as inflationary era. The validity of second law of thermodynamics in $f(G)$ gravity for dynamical (Hubble and event) horizons has been extensively studied by Sadjadi (2011) without using power-law and logarithmic entropy corrections. Jawad et. al. (2012) mentioned cosmological application of holographic Dark Energy (HDE) within the framework of modified gravity. Cojointly Jawad et. al. (2014) considered the reconstruction scenario of latest agegraphic dark energy (NADE) model and $f(G)$theory within the flat FRW space-time. Shamir (2016) studied the anisotropic universe in $f(G)$Gravity. Sharif and Fatima (2014, 2015, 2016a, 2016b, 2016c) studied energy conditions, wormhole solutions, built-in inflation, Noether symmetries also as spherical solution with conformal symmetry in $f(G)$theory respectively . Generalized Second Law of Thermodynamics (GSLT) has been studied for $f(G)$gravity by Sharif and Fatima (2014) within the framework of flat FRW universe model. Traversable wormholes by considering power-law function $f(G) = \alpha G^n$also as redshift function are discussed by Sharif and Ikram (2015). Sharif and Fatima (2016a) have found wormhole solutions in galactic halo region for $f(G)$gravity. Equivalent authors (2017a, 2017b) have studied the evolution of shear-free axially symmetric configuration in $f(G)$gravity within the presence of dark sources and conjointly mentioned the dynamics of stellar filaments with cylindrical symmetry within the context of $f(G)$gravity. Sharif and Fatima (2017) studied the dynamics of self-gravitating fluid using structure scalars for geometry within the context of $f(G)$cosmology.

In recent years, Holographic Dark Energy (HDE) models have received considerable attention to explain dark energy cosmological models. Several properties of Holographic Ricci DE are investigated (Cohen et. al. (1999), Huang and Li (2004), Zhang and Wu (2005), Granda and Oliveros (2008), Gao et al. (2009), Chen and Jing (2009), Hsu (2014)) in several contexts. Setare (2007) discussed holographic dark energy model in Brans-Dicke theory. Setare and Vanegas (2009) obtained the cosmological dynamics of interacting holographic dark energy model. Sarkar and Mahanta (2013) studied the evolution of holographic dark energy in Bianchi type-I space time with constant deceleration parameter. Holographic dark energy model has been investigated by Sarkar (2014) in Bianchi type-I universe with linearly varying deceleration parameter. Several relativists (Kiran et. al. (2014),Santhi et al.(2017a, 2017b), Raju et al. (2016)) have explored the holographic dark energy in several contexts. Non-static plane symmetric universe crammed with matter and anisotropic modified

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ΛCDM cosmological models with quintessence in $f(R)$ theory of gravitation

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Abstract. The work is the study of Bianchi type-I models with holographic dark energy in the framework of $f(R)$ theory of gravitation. The exact solutions of the field equations are deduced by considering the exponential and power-law volumetric expansion. Various physical and kinematical properties of the models are discussed. In addition to make our interpretation more clear for that we have taken the statefinder diagnostic pair $\{r, s\}$ and cosmic jerk parameter $j(t)$ to characterize different phases of the universe. The holographic scalar fields of dark energy are reconstructed and quintessence potential for both the models describing accelerated expansion of the universe is also obtained.

Keywords. Bianchi type-I—holographic dark energy—quintessence—$f(R)$ theory of gravitation.

1. Introduction

High-red-shift supernova, cosmic microwave background fluctuation, galaxy clustering and large-scale structures have confirmed the cosmic acceleration (Riess *et al.* 1998; Perlmutter *et al.* 1999; Spergel *et al.* 2003; Bennett *et al.* 2003; Tegmark *et al.* 2004a' b). These recent observations of the universe from astrophysical data informed an entire abrupt picture of accelerated expansion of the universe. The major part of the universe includes dark matter and dark energy with high negative pressure which causes expansion of the universe. Modified or alternative theories of gravity are attracting many researchers to explain late-time acceleration of the universe and dark energy. Several modified theories such as $f(R)$ gravity (Capozziello 2002; Caroll *et al.* 2004), $f(T)$ gravity (Ferraro & Fiorini 2007), $f(R, T)$ gravity (Harko *et al.* 2011; Houndjo 2012), $f(G)$ gravity (Zhao 2012), etc., are receiving keen interest now a days. Buchadahl (1970) proposed $f(R)$ gravity to generalize Einstein's general theory of relativity. It is adopted to explain the accelerated expansion and structure formation of the universe. A new type of isotropic cosmological models without singularity in $f(R)$ was presented by Starobinsky (1980). For the sake of cosmologically valuable $f(R)$ models, the $f(R)$ theory is treated as most suitable among the various modified theories of gravitation. In this theory the functions of the Ricci scalar are the higher-order curvature invariants. The exact solution of cosmological models in context of $f(R)$ gravity has been investigated by Capozziello *et al.* (2008). Nojiri and Odintsov (2008) have proposed the coalition of early time expansion and late time acceleration applicable to $f(R)$ gravity models. The expansion of the universe due to anisotropic fluid in $f(R)$ gravity has been discussed by Sharif and Kausar (2011). Katore *et al.* (2016) discussed Bianchi type-I cosmological models which is applicable to the early era of evolution of the universe in $f(R)$ gravity.

The nature of dark energy can also be investigated in keeping with some basic quantum gravitational principles and one of that is holographic dark energy principle. It states that the number of degrees of freedom of a physical system should scale with its bounding area rather than with its volume. For the solution of the dark energy problem, the holographic dark energy is another candidate based on the holographic principle which was firstly advocated by

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Analysis of observational parameters and stability in extended teleparallel gravity

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In this paper, we have investigated the stability of General Relativistic Hydrodynamics (GRHD) model in a Friedmann–Robertson–Walker space-time with the volumetric power law in teleparallel gravity. The basic equations are derived along with its thermodynamical aspects. Thermodynamic temperature and entropy density of the model are also obtained. The state finder diagnostic pair and jerk parameter are analyzed to characterize different phases of the universe and the well-known astrophysical phenomena such as look-back time, the luminosity distance with redshift are derived. The model shows an accelerated expansion with inflationary era in the early and the very late time of the cosmic evolution. The GRHD model is stable at the early phases of the universe and is unstable at late times.

Keywords: FRW space-time; extended teleparallel gravity; state finder pair; stability analysis.

Mathematics Subject Classification 2020: 83D05

1. Introduction

The experimental results of high redshift supernovae, cosmic microwave background anisotropy and galaxy clustering confirmed the cosmic acceleration of the universe (Riess *et al.* [32], Bennet *et al.* [8], Spergel *et al.* [45], Riess *et al.* [33], Tegmark *et al.* [46]). The reason cited for this accelerated expansion is possibly the presence

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ORIGINAL ARTICLE

Non-singular bouncing General Relativistic Hydrodynamics cosmological models

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Abstract We have studied Friedmann–Robertson–Walker (FRW) cosmological models within the presence of General Relativistic Hydrodynamics (GRH) in General Relativity. Exact solutions of the field equations are deduced by considering the special form of the average scale factor considered by Abdussattar and Prajapati (Astrophys. Space Sci. 331:657, 2011), constraining the deceleration parameter and a special form of deceleration parameter by Singh and Debnath (Int. J. Theor. Phys. 48:351, 2009). The value of the deceleration is always negative which represents an inflationary accelerating model of the universe. The cosmic jerk parameter is positive, throughout the entire life of the universe which ensures an accelerated expansion. The Phantom, Chaplygin gas, and Tachyon fields are discussed. The scalar field values of tachyon and phantom increase with time, while the scalar potential values of tachyon and phantom decrease with time.

Keywords FRW metric · General relativistic hydrodynamics · General relativity

1 Introduction

Einstein's theory of general relativity plays a major role in cosmological consequences involving compact objects such as neutron stars and black holes. The production of relativistic radio jets in active galactic nuclei, explained by either hydrodynamic or electromagnetic mechanisms, involves rotating supermassive black holes. Taub (1978) introduced the concepts of general relativistic hydrodynamics. Inactive galaxies the central object is likely to be a black hole and energy is transported from the inner 10 pc out to 100 kpc or more (Begelman et al. 1984). The equations governing the dynamics of relativistic astrophysical systems are an intricate set of coupled, time-dependent partial differential equations, comprising the general relativistic hydrodynamics and magnetohydrodynamics equations (GRHD/GRMHD hereafter) and Einstein's gravitational field equations. The imitation of GRHD problems is of countless prominence to the astrophysics communal. Banyuls et al. (1997) established the complete derivations of GHRD equations. Pons et al. (1998) presented the procedure to solve the GHRD equations by using any of the Special Relativistic Riemann Solvers. Font et al. (2002) explored High–Resolution Shock capturing schemes to derive the solutions of the equations of GHRD. Baiotti et al. (2003) discussed the ability of the GHRD code and carried out long-term accurate evolutions of the linear and nonlinear dynamics of isolated relativistic stars. Liu et al. (2004) developed GHRD code with viscosity for the solutions of the Navier-Stokes equation. Font (2005) discussed the formulations of the GRHD/GRMHD equations using Godunov-type schemes. Font (2007, 2008) studied comprehensive formulations of the equations of GHRD and MHD. Kovtun (2019) studied linearized stability in first-order relativistic viscous hydrodynamics. Shaikh and Mishra (2020) investigated the stability of General Relativistic Hydrodynamics model in a Friedmann–Robertson–Walker space-time with the volumetric power law in teleparallel gravity. Shaikh and Mishra (2021) have framed bouncing cosmological model of the

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Transist dark energy and thermodynamical aspects of the cosmological model in teleparallel gravity

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Abstract. In this article, the perfect fluid is introduced for plane symmetric space–time in the framework of teleparallel gravity using hybrid expansion law (HEL). The behaviour of accelerating Universe is discussed by considering the depiction model of $f(T)$ gravity, i.e. $f(T) = T^n$. The geometrical and physical parameters of the model are studied. An effective equation of state (EoS) has been investigated in the cosmological evolution with perfect fluid. The basic equations of thermodynamics have been deduced and the thermodynamical aspects of the model have been discussed. Thermodynamic temperature and entropy density of the model are also obtained. The statefinder parameters and jerk parameter analysis are discussed for our obtained model to distinguish our model from other dark energy models.

Keywords. Plane symmetric model; perfect fluid; $f(T)$ gravity.

PACS Nos **98.80.Jk; 04.50.Kd; 04.20.Jb**

1. Introduction

The observational data such as type Ia supernovae, cosmic microwave background (CMB) and baryonic acoustic oscillations (BAO) confirm that the Universe is undergoing accelerated expansion [1–6]. Dark energy is a hypothetical form of energy which drives the accelerated expansion of the Universe. To explain the cosmic acceleration of the Universe, several modified theories of gravity such as $f(R)$ [7], $f(T)$ where T is the torsion scalar in teleparallel [8] and $f(R, T)$ where R is the Ricci scalar and T is the trace of the energy–momentum tensor [9] and so on have been evolved. The torsion term T in the teleparallel scenario is transformed from the curvature term R in general relativity, which modifies T to $f(T)$ by an arbitrary function with a varying action known as $f(T)$ gravity [10–13]. Bamba *et al* [14] studied exponential and logarithmic equation of state (EoS) models and concluded that the crossing of phantom divide line is observed in combined model only. Sharif and Rani [15] showed the graphical representation of k-essence in $f(T)$ gravity. Wang [16] obtained spherically symmetric solutions in $f(T)$ gravity. The existence of relativistic stars was investigated by Bohmer *et al* [17]. Linder [18] elaborated two new $f(T)$ models. Bamba and Geng [19] explored the thermodynamics in equilibrium and non-equilibrium descriptions for apparent horizon in $f(T)$ gravity. Charged wormhole solutions in $f(T)$ gravity with non-commutative background have been extensively explored by Sharif and Rani [20]. Sharif and Rani [21] analysed the dynamical instability of a spherically symmetric collapsing star in the context of $f(T)$ gravity. $f(T)$ Gravity has been extensively studied in literature by several eminent researchers [14,16,22–38]. Motivated by the above investigations, we have studied cosmological evolution for depiction model of $f(T)$ by using plane-symmetric Universe with hybrid expansion law (HEL).

2. $f(T)$ Gravity formalism

Now let us consider the action by generalising the teleparallel gravity, i.e. $f(T)$ theory as

$$S = \int [T + f(T) + L_{\text{matter}}]ed^4x. \tag{1}$$

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Cosmic acceleration and stability of cosmological models in extended teleparallel gravity

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Abstract. In this paper, we study the model of $f(T)$ gravity in the presence of dark matter and modified holographic Ricci dark energy (MHRDE) in locally rotationally symmetric (LRS) Bianchi type-I space–time. To achieve a physically realistic solution of the field equations, we have considered volumetric power and exponential expansion laws. We plot the corresponding cosmological parameters for dark energy components in terms of redshift; thereafter we investigate the accelerated expansion of the Universe. The physical and geometrical parameters of the models are also discussed in detail. The Statefinder diagnostic pair and jerk parameter are analysed to characterise completely different phases of the Universe.

Keywords. Locally rotationally symmetric Bianchi type-I space–time; modified holographic Ricci dark energy; $f(T)$ gravity; stability factor.

PACS Nos 04.20.–q; 98.80.Jk; 04.20.Jb

1. Introduction

High-red-shift supernova, cosmic microwave background fluctuation, galaxy clustering and large-scale structures have confirmed cosmic acceleration [1–10]. Dark energy (DE) is assumed to be the best candidate to explain the present cosmic acceleration. It is also believed that 96% of the Universe consists of DE and dark matter (DM). The cosmological constant, quintessence, Phantom, K-essence, holographic dark energy (HDE) and modified holographic Ricci dark energy (MHRDE) are various candidates of DE [11,12]. The modified gravity models are the natural gravitational alternatives for DE [13,14]. Several relativists showed their interest in the modified gravitational theory, the $f(T)$ gravity [15–17], to explain the acceleration of the cosmic expansion. Einstein [18] promulgated that in the linear model, the $f(T)$ theory can be directly reduced to the teleparallel equivalent of general relativity (TEGR). Linder [19] proposed two new $f(T)$ models to explain the accelerating expansion of the Universe. Karami and Abdolmaleki [20] achieved the polytropic gas, the standard Chaplygin gas, the generalised Chaplygin gas and the modified Chaplygin gas models of DE. Sharif and Rani [21] investigated anisotropic Universe in the context of $f(T)$ gravity. The resolution of DM problem in the light of $f(T)$ gravity is considered by Jamil *et al* [22,23]. Setare and Darabi [24] obtained the phantom phase of the Universe using the power-law solution. Rodrigues *et al* [25] obtained Bianchi type-I, type-III and Kantowaski–Sachs anisotropic cosmological models. Jamil and Yussouf [26] studied $f(T)$ models within the Kantowaski–Sachs Universe. Krššák and Saridakis [27] obtained the covariant formulation of $f(T)$ gravity. Ferraro and Guzmán [28] examined the extra degree of freedom in $f(T)$ gravity. Ferraro and Guzmán [29] formalised the Hamiltonian in the teleparallel gravity. Toporensk and Tretyakov [30] investigated cosmological perturbations in teleparallel gravity.

HDE models have received considerable attention in describing the accelerated expansion of the Universe. Depending on the entropy–area relation of black holes (Cohen *et al* [31], Hsu [32], Gao *et al* [33]) and in the light of holographic principle, the standard holographic dark energy (HDE) is defined and characterised by

$$\rho_D = 3c^2 M_{pl}^2 L^{-2},$$

where c is a numerical constant. Granda and Oliveros [34] elaborated the concept of HDE. Setare [35]

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Panorama Behaviors of Holographic Dark Energy Models in Modified Gravity

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Abstract

A class of solutions of field equations in $f(R,T)$ gravity proposed by Harko et. al. (2011) for a Bianchi type I (Kasner form) space–time with dark matter and Holographic Dark Energy (HDE) is mentioned. Exact solutions of field equations are obtained with volumetric power and exponential expansion laws. The negative value of the deceleration parameter represents the present acceleration of the universe. It is observed that EoS parameter of HDE is a decreasing function, converges to the negative value in Power-law model whereas in exponential model, it behaves like cosmological constant. The overall density parameter approaches to some constant values close to 1 which is in agreement with the observational data of the universe. The physical and geometrical parameters of the models are discussed in detail. The statefinder diagnostic pair and jerk parameter are analyzed to characterize completely different phases of the universe.

Keywords Modified gravity · Bianchi type-I space–time in Kasner form · HDE

1 Introduction

Observational data from the Cosmic Microwave Background (CMB), Type Ia Supernovae (SNe) and Large Scale Structure (LSS) indicates that our universe is accelerating and expanding [1–3]. Dark Energy (DE) is the bizarre cosmic fluid having strong negative pressure which makes the universe to accelerate and expand. The cosmological constant Λ is the simple candidate of the DE. The quintessence scalar field models [4, 5], the phantom model [6, 7], k-essence[8–10], tachyon field [11, 12], Chaplygin gas [13, 14], Holographic Dark Energy [15, 16] are the various important candidates of DE. Modifications of general relativity are attracting more

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ORIGINAL PAPER

Late time cosmic acceleration with observational constraints in symmetric teleparallel gravity

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Abstract: We have probed spatially homogeneous anisotropic Bianchi type-I universe in $f(Q)$ gravity in the presence of dark matter, Tsallis holographic dark energy (THDE) and Rényi holographic dark energy (RHDE) were the goals of this research, where Q denotes the non-metricity scalar. It is presumable that the Lagrangian $f(Q)$ depends linearly on Q. In order to arrive at the answer, the model parameter was constrained using the 30 observational Hubble data (OHD) in the range $0 \leq z \leq 2.36$. We estimated model parameter using the Markov Chain Monte Carlo (MCMC) approach and found that the model and observations appeared to be in good agreement. In order to find the precise solution of the field equations, we take into account a time-varying deceleration parameter (DP) in this work. This parameter creates an accelerating universe. For the foreseeable future of the universe's evolution, the physical and kinematical characteristics of both hypotheses are thoroughly examined. Strong energy conditions (SEC) are in violation, indicating that the cosmos is expanding more quickly. But, weak energy conditions (WEC) and dominant energy conditions (DEC) are behaving positively, supporting the validity of the theory.

Keywords: Deceleration parameter; $f(Q)$ Gravity; LRS Bianchi type-I space-time

1. Introduction

Our universe is currently expanding faster than previously thought, according to a number of cosmological measurements [1–14]. The origin of this rapid phase is ascribed to a mysterious material called dark energy (DE). The negative-pressure DE makes up 73% of the current universe's energy density. Gravitational modification of the conventional theories of gravity, leading to altered theories of gravity using different invariants reliant on certain features such as scalars, torsion, curvature, etc., is one method for comprehending this unusual component of the cosmos. The various modified theories include the $f(R)$ theory [15–17], where f is a general differentiable function of the curvature R, generalized teleparallel gravity, $f(T)$ [18–20] theory, contributing to the gravitational interaction through the torsion scalar T, the Gauss–Bonnet theory and its modified version involving the Gauss–Bonnet invariant G [21, 22], the $f(R,T)$ theory where T is the trace of the energy–momentum tensor [23], and so on. Jiménez et al. [24] were the first to introduce the idea of symmetric teleparallel gravity. The $f(Q)$ theory also serves as a general relativity-compatible teleparallel gravity substitute. Gravitational interactions in symmetric teleparallel gravity are described by the non-metricity Q. In Ref. [25], Harko examined the expansion of symmetric teleparallel gravity. Noemi looked at the underlying non-metricity gravity signals while conducting an exciting inquiry of $f(Q)$ gravity [26]. By presenting Lagrange as a polynomial function of redshift z, Lazkoz et al. [27] imposed a robust set of constraints on $f(Q)$ gravity. The $f(Q)$ model also showed a similar description of an accelerated phase when subjected to the energy circumstances as described in [28]. By carrying out the singularity analysis and dynamical system analysis, Khyllep et al. [29] showed that the $f(Q)$ gravity model is cosmologically viable. According to Barros et al. [30], by studying the linear matter fluctuations are numerically generated and looking at the growth rate of structures, the tension between Planck and LSS data can be lessened within this framework. The first hint that the universe's ΛCDM behavior might be at odds with the non-metric nature of $f(Q)$ gravity comes from Anagnostopoulos et al. [31]. Solanki et al. [32] examined the role of bulk viscosity in order to comprehend the accelerated expansion of the

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POLLUTION: SOURCES, EFFECTS AND CONTROL

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ABSTRACT

We undoubtedly hear the word "pollution" every day at school, college, and the office. Newspapers, internet journals, and other types of media also use the word. What is it, then, and why is it considered harmful? When pollutants poison the natural environment, it results in changes that have a negative impact on our everyday lives. The primary constituents or parts of pollution are pollutants, which are typically waste products in a variety of forms. Our ecosystem and the balance of the environment are both disturbed by pollution. Our lives have developed and modernized to the point where pollution is at an all-time high, contributing to both global warming and human illness. According to the polluter-pays principle, whomever causes pollution should be held accountable for the harm they cause. It has to do with financial responsibility. Any company or person is in charge of handling and caring for the garbage they produce, and they should be held liable for any harm it may cause. Imagine a factory that generates a variety of wastes that may harm the earth, water, and air. The factory is encouraged to treat the trash before releasing it thanks to the polluter pays principle. The factory is responsible for making up for any environmental harm brought on by its trash, including any deaths, health problems, property losses, and environmental harm.

1. Introduction

The poisoning of water bodies by hazardous chemicals is one of the main causes of water pollution. As can be seen from the aforementioned example, discarded plastic bottles, cans, and other garbage damage aquatic bodies. These lead to water contamination, which hurts the entire environment in addition to people. These pollutants release toxins that move up the food chain and finally reach humans. In most instances, the result is harmful only to the local population and species, but it can also have an effect on a larger scale. The oceans receive over 6 billion pounds of trash each year. Other types of undesired materials are discharged into different water bodies in addition to industrial effluents and untreated sewage. These can include everything from oil spills to nuclear waste, the latter of which can make large areas inhabitable.

2. Water pollution:

The polluting of water bodies is referred to as water pollution. Water pollution occurs when industrial and agricultural effluents contaminate water bodies such as rivers, lakes, oceans, groundwater, and aquifers. All lifeforms that depend on water, whether directly or indirectly, suffer when it is polluted. Years may pass before you notice the impacts of tainted water.

2.1. Sources of Water Pollution

Urbanization, deforestation, industrial effluents, social and religious practices, use of detergents and fertilizers, and agricultural run-offs-use of insecticides and pesticides-are the main causes of water pollution in India.

2.2. Effects of Water Pollution

The type of contaminants present and their concentration determine the impact of water pollution. In determining the amounts of pollution, the location of water bodies is also crucial. Urban areas' surrounding water bodies are very polluted. This is the outcome of industrial and commercial facilities discharging trash and hazardous materials. Aquatic life is significantly impacted by water pollution. It alters their behaviour and metabolism, which results in disease and eventual death. Dioxin is a toxin that affects many processes, including reproduction, unchecked cell development, and cancer. Fish, chicken, and meat all bioaccumulate this compound. Before reaching the human body, toxic chemicals move up the food chain. The food chain may be significantly impacted by water contamination. The food chain is thrown off. Lead and

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Examining the physical viability of the $f(R)$ gravity via observational constraints

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ABSTRACT

$f(R)$ gravity is an extension of Einstein's General Relativity derived from relaxing the hypothesis that the Hilbert-Einstein action for the gravitational field is strictly linear in the Ricci curvature scalar R and explains the late-time cosmic acceleration of the Universe. We investigate the spatially homogeneous and isotropic Friedmann-Robertson-Walker (FRW) line element filled with two fluids, with the first being pressureless matter and the second being the Renyi holographic dark energy (RHDE) in this study. In this scenario, the Hubble horizon H acts as an infrared (IR) cutoff. In this regard, the effects of IR cutoff with the Hubble horizon on the traits of RHDE models have been researched. The volumetric power law expansion and the two models of $f(R)$ i.e. $f(R) = R + \delta R^n$ and $f(R) = R - \zeta_R^2$ are taken into consideration for the solution of the field equations. The estimated model parameter values that would best fit and work with current observational datasets. This estimation uses 1048 points from the Pantheon supernovae datasets and 30 points from the Hubble datasets. The likelihood function and Bayesian analysis are integrated with the Markov Chain Monte Carlo (MCMC) method at the 1 σ and 2 σ confidence levels. It is crucial to remember that $f(R)$ is a rising function of$R$, demonstrating the model's plausibility. For both models, the equation of state (EoS) value is close to a Quintessence zone. The model behaves in a ΛCDM (ΛCold Dark Matter) like manner, as shown by the fact that the statefinder diagnostic pair falls to$(r = 1, s = 0)$. The $Om(z)$ parameter shows a discrete behaviour.

1. Introduction

The phenomenon of the current accelerated expansion of the Universe is considered one of the confusing cosmic mysteries currently in the scientific area, which has created a great controversy among researchers today [1–5]. The present-day cosmos experiences an accelerated expansion due to almost mystical energy with a large negative pressure called Dark Energy (DE) [6–9].An alternate approach for examining the Universe and its accelerating expansion is provided by modified gravity theories. Several parts of modified theories of gravity are suitable in Ref.[10]. As a result of alterations to the Einstein-Hilbert action, a number of modified theories, including $f(R)$ gravity [11–16], $f(T)$ gravity [17–20], and $f(G)$gravity [21–23], have been put out in the literature. The Ricci scalar R, also known as a common Einstein-Hilbert action, serves as the foundation for the $f(R)$ theory. The authors of Nojiri et al. [24] gave a good overview of gravitational modified theories. Theoretically comprehensive dark energy principles are covered in Ref.[25].Using the Noether symmetry method, the authors in Ref.[26] displays spherically symmetric solutions. In Ref. [27], Hollenstein and Lobo examined the exact solutions of $f(R)$ gravity coupled to nonlinear electrodynamics within the presence of static spherically symmetric

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ORIGINAL PAPER

Diagnosing Renyi and Tsallis holographic dark energy models with Hubble's horizon cutoff

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Abstract: This study focuses on the cosmic evolution of a scenario with dark energy and matter in the background of flat FLRW metric within the context of $f(T)$ gravity theory. We examined the Renyi holographic dark energy and Tsallis holographic dark energy models with Hubble's cut-off in this work. The Renyi HDE and Tsallis HDE energy densities are increasing functions of z, supporting the expanding behavior of the universe. The models move through the quintessence phase ($-1 < \omega_{de} < -0.33$), then towards the Λ CDM model, and finally slopes to the phantom area ($\omega_{de} < -1$) for the value of $\delta = 4.5$; however, for the value of $\delta = 4$, the model moves through the quintessence region. The models vary from ΛCDM era to the quintessence era. Additionally, the validity of our models is checked via statefinder diagnostic parameters.

Keywords: Tsallis HDE; Renyi HDE; FLRW metric; Teleparallel gravity

1. Introduction

Our universe is experiencing accelerated expansion that has been validated by many cosmological observations such as Type 1a Supernova [1, 2] and cosmic microwave background radiation [3, 4]. Two theories potentially explain the universe's rapid expansion: (i) a mysterious force called Dark Energy (DE) (see [5–8] and references therein), and (ii) a modification of the General Theory of Relativity [9–15]. Moreover, WMAP estimates that nearly 73, 23, and 4% of our universe filled up with dark energy, dark matter and normal matter, respectively [16]. There are other types of dark energy models, including quintessence [17], k-essence [18], Chaplygin gas [19], holographic dark energy [20, 21], new agegraphic dark energy [22], and others. Existing measurements, in accordance with [23], point to a cosmic constant, i.e. $\omega \approx -1$. A useful tool for explaining the cosmic expansion at this time is the study of the holographic dark energy model [24] in the context of the holographic principle (HP) [20, 21]. There are other reading materials accessible (check references for illustration [25–42]). Assuming c is an arithmetic constant, the energy density of the HDE is written as $\rho_{de} = 3c^2 M_p^2 L^{-2}$.

System entropy (S), the IR (L), and UV cutoffs are correlated in $L^3\Lambda^3 \leq S^3$ [24]. Following their work in [43], the authors have presented $S_\delta = \gamma A^\delta$ (the horizon entropy of a black hole), where (i) A denotes the area of the horizon, (ii) δ denotes the non-additivity parameter, and (iii) γ deflects an unspecified constant. The consequence of this is $\Lambda^4 \leq \left(\gamma(4\pi)^\delta\right) L^{2\delta-4}$ [24]. Many dark energy models have been developed to represent or comprehend the accelerated phase of the universe; however, the challenge of distinguishing the numerous contenders is now required. To be able to discern between various conflicting cosmological scenarios, including dark energy, a sensitive and detailed analysis of dark energy ideas is needed. The long-range nature of gravity, the enigmatic character of space–time, and the fact that the Bekenstein entropy is a non-extensive entropy measure have all recently contributed to this. To examine cosmological and gravitational phenomena, the generalized entropies, or Tsallis and Rényi entropies, have been assigned to the horizons. Many extended entropy formalisms have been used to explore cosmological and gravitational events, but Tsallis and Rényi entropies produce the most accurate universe model. The horizon is given Tsallis and Rényi entropies in order to study the cosmic repercussions. Tsallis HDE, Renyi HDE, and Sharma Mittall Holographic Dark Energy (SMHDE) believe that the universe is made up of both interacting

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Exploring the bouncing cosmological models in symmetric teleparallel gravity

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In this study, the bouncing cosmological models have been presented in the non-metricity-based gravitational theory, the $f(Q)$ gravity, where Q be the non-metricity scalar. The two bouncing cosmological models, one in which the Lagrangian $f(Q)$ is assumed to have a linear dependence on Q and the other in which it has a polynomial functional form have been shown. It has been obtained that the parameters of the models largely depend on the behavior of the models. The equation of state (EoS) parameter shows the bouncing behavior of the Universe. It should be highlighted that the built-in cosmological models go against the energy requirements. The kinematical and physical characteristics of the models are also analyzed.

Keywords: FRW metric; $f(Q)$ gravity; bouncing scenario.

Mathematics Subject Classification 2020: 83

1. Introduction

Numerous cosmological discoveries, including supernova, CMB radiation anisotropy, large-scale structure, and baryon acoustic oscillation, have demonstrated that the universe is expanding more quickly, at least in its advanced stages of evolution. Modified gravity theories and dark energy models are two distinct explanations for the cause of the Universe's current acceleration. Dark energy (DE) is analogous to an enigmatic fluid with negative pressure that defies gravity and speeds up the Universe's expansion. The cosmological constant that characterizes the Λ dominant Cold Dark Matter (CDM) paradigm is the most straightforward DE candidate (ΛCDM). In the literature, a number of modified ideas have been put forth, including theories $f(R)$ [1–3], $f(T)$ [4–6], $f(T,B)$ [7], $f(R,T)$ [8,9], $f(Q,T)$ [10,11], $f(G)$ [12], and $f(R,G)$ theory concept [13,14], etc. Gravitational ideas have been extensively studied in the modern era. The concept of symmetric teleparallel

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RENYI HOLOGRAPHIC DARK ENERGY MODEL IN *f(R)* GRAVITY WITH HUBBLE'S IR CUT-OFF[†]

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In the present study, a homogeneous and anisotropic LRS Bianchi type-I universe model is considered with an interacting dark matter and Renyi holographic dark energy model (RHDE) in $f(R)$ gravity. The deceleration parameter (DP) shows a signature flipping for a universe which was decelerating in past and accelerating at present epoch. Therefore, the DP is a most physically justified parameter to analyze the solution of cosmological model. In order to find an exact solution of the field equations of the model, the shear scalar is considered to be proportional to the expansion scalar. We have considered $f(R)=bR^n$, the depiction model of $f(R)$ which is the function of Ricci scalar R. The physical and geometrical characteristics of the universe model have been studied.
Keywords: *f(R) Gravity; RHDE; dark matter; Cosmology; Bianchi type-I space-time*
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INTRODUCTION

Observational cosmic data show that our Universe is currently expanding at a faster rate [1–5]. Dark energy (DE), which has negative pressure and accounts for 70% of the exotic component, is what propels the universe's cosmic expansion [6–9]. To investigate the universe and its accelerated expansion, modified theories of gravity provide an alternative approach. Some appropriate characteristics of modified theories of gravity are found in [10]. In the literature, several modified theories, including $f(R)$ gravity [11–15], $f(T)$ gravity [16–20], and $f(G)$ gravity [21–23] have been proposed with the changes of the Einstein–Hilbert action. Many researchers have worked on modified theories of gravity in recent past on different aspects of Cosmology [24-34]. In fact, the Ricci scalar $f(R)$ theory uses a conventional Einstein-Hilbert action that contains an arbitrary function R. The authors of Nojiri et al. [35] provided a comprehensive overview of modified theories of gravitation. Theoretical models of workable dark energy are described in [36]. The Noether symmetry technique is used to show spherically symmetric solutions in [37]. The exact solutions of static spherically symmetric space-times in $f(R)$ gravity coupled to nonlinear electrodynamics have been studied by Hollenstein and Lobo [38]. $f(R)$ gravity has been studied by a number of researchers in various cosmological contexts [39–53].

Holographic dark energy (HDE) has a variety of characteristics that have been studied in [54–58]. In [59–61], the holographic concept serves as the foundation for the potential of HDE. The HDE theory is also a helpful approach for addressing the DE conundrum in [62]. It was put forth based on the quantum characteristics of black holes (BH), which have been thoroughly studied in the literature to research quantum gravity. Studying the cosmic ramifications of holographic dark energy is more natural because Newton's gravitational constant is made dynamical in the Scalar Tensor Theory. According to [63], the holographic principle refers to a system's entropy, which is determined by its surrounding surface area rather than its volume. If we assume that the infrared (IR) cutoff is equal to the size of the universe, then the holographic energy density is rather near to the dark energy density. We can discover the cosmological characteristics of the vacuum energy with the aid of the HDE theory. The decreased Planck mass $M_p^2=8\pi G$ and the numerical constant d are used to calculate the HDE energy density $\rho_{de}=3d^2M_p^2L^{-2}$. Numerous investigations have examined the interaction of holographic dark energy with matter using various IR cutoffs, including particle horizons, future horizons, and Hubble horizons. The authors of [64] suggested an IR cut-off made up of local Hubble scale values and temporal derivative Hubble scales. Sheykhi et al. in [65] explore the astrophysical implications of New Holographic DE (NHDE) by using the Hubble radius $L=H^{-1}$ as the system's IR cutoff. Many extended entropy formalisms have been used to investigate cosmological and gravitational events, but Tsallis and Renyi entropies offer the most accurate universe model. Sharma-Mittal HDE is compatible with the expansion of the universe and it is stable whenever it dominates the cosmos. The horizon is assigned to the Tsallis and Renyi entropies to investigate the cosmic ramifications. The generalized entropies

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Bouncing cosmological model with general relativistic hydrodynamics in extended gravity

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In this paper, in an extended theory of gravity, we have presented bouncing cosmological model at the backdrop of an isotropic, homogeneous space-time, in the presence of general relativistic hydrodynamics (GRH). The scale factor has been chosen in such a manner that with appropriate normalization, the quintom bouncing scenario can be assessed. Accordingly, the bounce occurs at $t = 0$ and the corresponding Hubble parameter vanishes at the bounce epoch. The equation of state (EoS) parameter and the energy conditions of the model have been analyzed. The violation of strong energy condition further supports the behavior of extended gravity. As the bouncing cosmology suffers with instability, this model also shows the similar behavior.

Keywords: Extended gravity; bouncing cosmology; general relativistic hydrodynamics; stability analysis.

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Panorama behaviors of general relativistic hydrodynamics and holographic dark energy in $f(R,T)$ gravity

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ARTICLE INFO

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LRS Bianchi I
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HDE
Modified gravity

ABSTRACT

The main motive of this study is to investigate behaviors of general relativistic hydrodynamics in the form of perfect fluid and holographic dark energy for anisotropic and homogenous space-time in the framework of $f(R,T)$ gravity. The field equations are solved using (i) the shear scalar of the metric is proportional to the expansion scalar which results a relationship between metric potentials and (ii) special law of variation of Hubble's parameter (Berman (1983)) that yields constant deceleration parameter. The cosmological parameters like energy density, EoS parameter, statefinder parameters, jerk parameter, thermodynamic temperatures and entropy densities of the models are obtained and discussed their physical significance in the light of the recent scenario of accelerated expansion of the universe and cosmological observations. The well-known astrophysical phenomena, namely the Hubble parameter $H(z)$, luminosity distance (d_L) and distance modulus $\mu(z)$with redshift are studied.

1. Introduction

In the past decades, numerous works have been done in $f(R,T)$theory of gravity due to the growing interests on the modified theories in which the Ricci scalar R is exchanged with an appropriate functional form of R and trace of energy momentum tensor T (Harko et. al. (2011)) and consequently is a forthright inference to $f(R)$gravity (see references Capozziello, 2002; Felice and Tsujikawa, 2010;Capozziello and Laurentis, 2011; Nojiri et al. 2021). Modified gravity is extremely promising approach to dark energy. Special attention is paid to $f(R)$modified gravity which may be constrained from cosmological/ astrophysical observational data. The simplest purely gravitational models in 3 + 1 space-time dimensions are provided by $f(R)$ gravity which modifies and generalizes Einstein gravity by incorporating a new phenomenological function of the Ricci scalar R, $f(R)$(see references Capozziello et al. 2005 ; Nojiri and Odintsov, 2006 ; Amendola et al., 2007a, 2007b; Appleby et al., 2011 ; Odintsov et al., 2020 ; Odintsov and Oikonomou, 2020 ; Oikonomou, 2021a, 2021b).

It is suggested that due to the matter-energy coupling, the leading model of $f(R,T)$ theory depends on source term representing the variation of energy-momentum tensor. With the progress of the cosmological restoration of $f(R,T)$ gravity, Houndjo (2012) conferred the transaction of matter dominated point to an acceleration period. Houndjo and his collaborators (2012) well thought-out cosmological scenario centered on $f(R,T)$ restored numerically from Holographic DE. Jamil and his colleagues reconstructed cosmological models in $f(R,T)$gravity and explored that the dust fluid reproduces ΛCDM, phantom-non-phantom era and the phantom cosmology. Also in 2012, Jamil et al. researched the violation of the first law of black hole thermodynamics for (R,T) gravity. Jamil et al. (2012a, 2012b), Ahmed and Pradhan (2014), Sahoo and Sivakumar (2015), and Pradhan et al. (2015) have investigated the cosmological models in $f(R,T)$ gravity in different context .A new class of cosmological models in $f(R,T)$ gravity is extensively explored by Ahmed et al. (2016) and concluded that the models obtained are perfectly new and physically acceptable. Shabani (2016) investigated cosmological consequences of generalized Chaplygin gas (GCG) along with the baryonic matter in $f(R,T)$theory of gravity and found that the derived models are compatible with type Ia supernova data. Shaikh and Katore (2016) derived the exact solutions in modified theory of gravitation. Sahu et al. (2017) discussed the cosmic transit and anisotropic models in this modified gravity and obtained that the behavior of the cosmic transit from a decelerated phase of expansion to an accelerated phase to get the dynamical features of the universe. Sahoo et al. (2017) investigated bulk viscosity in the framework of $f(R,T)$ gravity and found that the models, with bulk viscosity matter component, show an acceleration of the universe. AlsoSahoo and his colleagues (2017) studied magnetized strange quark matter for $f(R,T) = R + 2f(T)$ model and concluded that the model begins with big bang and ends with a Big Rip. Shaikh and Wankhade (2017) investigated Hypersurface-Homogeneous cosmological model in $f(R,T)$theory of

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Exploration of General Relativistic Hydrodynamics for FRW Metric

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Abstract. The work is devoted to FRW Universe within the presence of General Relativistic Hydrodynamics (GRH) in the frame work of general theory of relativity.Exact solutions of field equations are obtained for power law expansion, volumetric exponential expansion and hybrid expansion law. The phantom, Chaplygin gas and tachyon fields are discussed in details.

KEY WORDS: FRW, GRH, General Relativity.

1 Introduction

Einstein's theory of general relativity acts a most important character in astrophysics. General Relativity and Relativistic Magneto-Hydrodynamics play a key part in the depiction of gravitational collapse prominent to the establishment of compact objects (neutron stars and black holes). The recreation of General Relativistic Hydrodynamics (GRH) problems is of countless significance to the astrophysics communal. In Ref. [1], Relativistic hydrodynamical codes experienced a considerable development in the period of nineties. An outline of Relativistic Hydrodynamics was carved by Taub [2]. Eulderink and Mellema in [3] used a broad view of Roe's approximate Riemann solver numerical method to unravel the calculations of GRH. A common and useful technique to crack the GRH equations by means of the Special Relativistic Riemann Solvers is obtained in [4]. Shibata [5] explored the fully self-consistent relativistic hydrodynamics code. A short-term outline of GRH and GRMH, with an importance on their appropriateness for progressive arithmetical effort with High–Resolution Shock Capturing methods (HRSC schemes) has been completed (see their in references [6–11]). A three-dimensional code for the elucidation of the coupled structure of the Einstein equations and GRH are constructed and validated in

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Cosmic acceleration and stability of cosmological models in extended teleparallel gravity

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Abstract. In this paper, we study the model of $f(T)$ gravity in the presence of dark matter and modified holographic Ricci dark energy (MHRDE) in locally rotationally symmetric (LRS) Bianchi type-I space–time. To achieve a physically realistic solution of the field equations, we have considered volumetric power and exponential expansion laws. We plot the corresponding cosmological parameters for dark energy components in terms of redshift; thereafter we investigate the accelerated expansion of the Universe. The physical and geometrical parameters of the models are also discussed in detail. The Statefinder diagnostic pair and jerk parameter are analysed to characterise completely different phases of the Universe.

Keywords. Locally rotationally symmetric Bianchi type-I space–time; modified holographic Ricci dark energy; $f(T)$ gravity; stability factor.

PACS Nos 04.20.–q; 98.80.Jk; 04.20.Jb

1. Introduction

High-red-shift supernova, cosmic microwave background fluctuation, galaxy clustering and large-scale structures have confirmed cosmic acceleration [1–10]. Dark energy (DE) is assumed to be the best candidate to explain the present cosmic acceleration. It is also believed that 96% of the Universe consists of DE and dark matter (DM). The cosmological constant, quintessence, Phantom, K-essence, holographic dark energy (HDE) and modified holographic Ricci dark energy (MHRDE) are various candidates of DE [11,12]. The modified gravity models are the natural gravitational alternatives for DE [13,14]. Several relativists showed their interest in the modified gravitational theory, the $f(T)$ gravity [15–17], to explain the acceleration of the cosmic expansion. Einstein [18] promulgated that in the linear model, the $f(T)$ theory can be directly reduced to the teleparallel equivalent of general relativity (TEGR). Linder [19] proposed two new $f(T)$ models to explain the accelerating expansion of the Universe. Karami and Abdolmaleki [20] achieved the polytropic gas, the standard Chaplygin gas, the generalised Chaplygin gas and the modified Chaplygin gas models of DE. Sharif and Rani [21] investigated anisotropic Universe in the context of $f(T)$ gravity. The resolution of DM problem in the light of $f(T)$ gravity is considered by Jamil *et al* [22,23]. Setare and Darabi [24] obtained the phantom phase of the Universe using the power-law solution. Rodrigues *et al* [25] obtained Bianchi type-I, type-III and Kantowaski–Sachs anisotropic cosmological models. Jamil and Yussouf [26] studied $f(T)$ models within the Kantowaski–Sachs Universe. Krššák and Saridakis [27] obtained the covariant formulation of $f(T)$ gravity. Ferraro and Guzmán [28] examined the extra degree of freedom in $f(T)$ gravity. Ferraro and Guzmán [29] formalised the Hamiltonian in the teleparallel gravity. Toporensk and Tretyakov [30] investigated cosmological perturbations in teleparallel gravity.

HDE models have received considerable attention in describing the accelerated expansion of the Universe. Depending on the entropy–area relation of black holes (Cohen *et al* [31], Hsu [32], Gao *et al* [33]) and in the light of holographic principle, the standard holographic dark energy (HDE) is defined and characterised by

$$\rho_D = 3c^2 M_{pl}^2 L^{-2},$$

where c is a numerical constant. Granda and Oliveros [34] elaborated the concept of HDE. Setare [35]

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Holographic Dark Energy Cosmological Models in $f(G)$ Theory

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ARTICLE INFO

Keywords:
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ABSTRACT

In this paper, Locally Rotationally Symmetric (LRS) Bianchi type-I models with holographic dark energy within the framework of $f(G)$ theory of gravitation are thought about. So as to get determinate solutions, volumetric exponential expansion, power law expansion and hybrid expansion law are mentioned. The physical interpretations of the solution have been studied by using some physical quantizes. Additionally to make the interpretation more clear for that the statefinder diagnostic pair (r, s) and jerk parameter are analyzed to characterize completely different phases of the universe.

1. Introduction

The modification of Hilbert-Einstein action are diode foundation of varied modified theories. Among the modified theories, $f(R)$theory is useful, since it preserves well-established results of the overall Relativity. Modified Gauss-Bonnet (GB) gravity or $f(G)$gravity is one altogether the modified versions of general theory of relativity (GR) by along side an arbitrary function of the Gauss–Bonnet quadratic invariant, G within the Einstein-Hilbert action (Nojiri et al. 2006). String theory by low energy effective scale is that the essential background for the motivation of $f(G)$theory (Cognola et al. 2006).Accelerated expansion of the universe, transition from deceleration to accelerating phase of the universe, satisfactory system tests, helpful within the explanation of thermodynamics Sadjadi (2011) and protection of all possible four sorts of future singularities (Bamba et. al. (2010)) are expeditiously elucidated by this theory. Using $f(G)$one will construct viable and consistent models with local constraints of general theory of relativity, Myrzakulov et al. (2011) explored this theory to review DE also as inflationary era. The validity of second law of thermodynamics in $f(G)$ gravity for dynamical (Hubble and event) horizons has been extensively studied by Sadjadi (2011) without using power-law and logarithmic entropy corrections. Jawad et. al. (2012) mentioned cosmological application of holographic Dark Energy (HDE) within the framework of modified gravity. Cojointly Jawad et. al. (2014) considered the reconstruction scenario of latest agegraphic dark energy (NADE) model and $f(G)$theory within the flat FRW space-time. Shamir (2016) studied the anisotropic universe in $f(G)$Gravity. Sharif and Fatima (2014, 2015, 2016a, 2016b, 2016c) studied energy conditions, wormhole solutions, built-in inflation, Noether symmetries also as spherical solution with conformal symmetry in $f(G)$theory respectively . Generalized Second Law of Thermodynamics (GSLT) has been studied for $f(G)$gravity by Sharif and Fatima (2014) within the framework of flat FRW universe model. Traversable wormholes by considering power-law function $f(G) = \alpha G^n$also as redshift function are discussed by Sharif and Ikram (2015). Sharif and Fatima (2016a) have found wormhole solutions in galactic halo region for $f(G)$gravity. Equivalent authors (2017a, 2017b) have studied the evolution of shear-free axially symmetric configuration in $f(G)$gravity within the presence of dark sources and conjointly mentioned the dynamics of stellar filaments with cylindrical symmetry within the context of $f(G)$gravity. Sharif and Fatima (2017) studied the dynamics of self-gravitating fluid using structure scalars for geometry within the context of $f(G)$cosmology.

In recent years, Holographic Dark Energy (HDE) models have received considerable attention to explain dark energy cosmological models. Several properties of Holographic Ricci DE are investigated (Cohen et. al. (1999), Huang and Li (2004), Zhang and Wu (2005), Granda and Oliveros (2008), Gao et al. (2009), Chen and Jing (2009), Hsu (2014)) in several contexts. Setare (2007) discussed holographic dark energy model in Brans-Dicke theory. Setare and Vanegas (2009) obtained the cosmological dynamics of interacting holographic dark energy model. Sarkar and Mahanta (2013) studied the evolution of holographic dark energy in Bianchi type-I space time with constant deceleration parameter. Holographic dark energy model has been investigated by Sarkar (2014) in Bianchi type-I universe with linearly varying deceleration parameter. Several relativists (Kiran et. al. (2014),Santhi et al.(2017a, 2017b), Raju et al. (2016)) have explored the holographic dark energy in several contexts. Non-static plane symmetric universe crammed with matter and anisotropic modified

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ΛCDM cosmological models with quintessence in $f(R)$ theory of gravitation

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Abstract. The work is the study of Bianchi type-I models with holographic dark energy in the framework of $f(R)$ theory of gravitation. The exact solutions of the field equations are deduced by considering the exponential and power-law volumetric expansion. Various physical and kinematical properties of the models are discussed. In addition to make our interpretation more clear for that we have taken the statefinder diagnostic pair $\{r, s\}$ and cosmic jerk parameter $j(t)$ to characterize different phases of the universe. The holographic scalar fields of dark energy are reconstructed and quintessence potential for both the models describing accelerated expansion of the universe is also obtained.

Keywords. Bianchi type-I—holographic dark energy—quintessence—$f(R)$ theory of gravitation.

1. Introduction

High-red-shift supernova, cosmic microwave background fluctuation, galaxy clustering and large-scale structures have confirmed the cosmic acceleration (Riess *et al.* 1998; Perlmutter *et al.* 1999; Spergel *et al.* 2003; Bennett *et al.* 2003; Tegmark *et al.* 2004a, b). These recent observations of the universe from astrophysical data informed an entire abrupt picture of accelerated expansion of the universe. The major part of the universe includes dark matter and dark energy with high negative pressure which causes expansion of the universe. Modified or alternative theories of gravity are attracting many researchers to explain late-time acceleration of the universe and dark energy. Several modified theories such as $f(R)$ gravity (Capozziello 2002; Caroll *et al.* 2004), $f(T)$ gravity (Ferraro & Fiorini 2007), $f(R,T)$ gravity (Harko *et al.* 2011; Houndjo 2012), $f(G)$ gravity (Zhao 2012), etc., are receiving keen interest now a days. Buchadahl (1970) proposed $f(R)$ gravity to generalize Einstein's general theory of relativity. It is adopted to explain the accelerated expansion and structure formation of the universe. A new type of isotropic cosmological models without singularity in $f(R)$ was presented by Starobinsky (1980). For the sake of cosmologically valuable $f(R)$ models, the $f(R)$ theory is treated as most suitable among the various modified theories of gravitation. In this theory the functions of the Ricci scalar are the higher-order curvature invariants. The exact solution of cosmological models in context of $f(R)$ gravity has been investigated by Capozziello *et al.* (2008). Nojiri and Odintsov (2008) have proposed the coalition of early time expansion and late time acceleration applicable to $f(R)$ gravity models. The expansion of the universe due to anisotropic fluid in $f(R)$ gravity has been discussed by Sharif and Kausar (2011). Katore *et al.* (2016) discussed Bianchi type-I cosmological models which is applicable to the early era of evolution of the universe in $f(R)$ gravity.

The nature of dark energy can also be investigated in keeping with some basic quantum gravitational principles and one of that is holographic dark energy principle. It states that the number of degrees of freedom of a physical system should scale with its bounding area rather than with its volume. For the solution of the dark energy problem, the holographic dark energy is another candidate based on the holographic principle which was firstly advocated by

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AGROBACTERIUM-MEDIATED TRANSFORMATION OF TOMATO WITH CRY1ACF GENEFOR INSECT RESISTANCE

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Abstract:

Tomato plant has been transformed with Cry1AcF gene and 14 putative events were found to be positive for both nptII and cry1AcF. In further advancement of thesepositive events 7 events showninheritance in Mendelian ratio i.e. 3:1 in T1 generation and also these putative events were positive for the ELISA testin T0 and T1 generations..Bioefficacy has also tested against *H. armigera* for T1 events and four putative events shown maximum mean mortality as Bst4(84.5± 4.32%),Bst5(82.5±4.78%),Bst8(96±1.78%) and Bst10(92.5±2.43%). Thus this studyindicates that Cry 1AcF gene effective against *H. armigera*resistance in tomato.

Key words:S. lycopersicum; A. *tumefaciens*; Cry1AcF gene

Introduction

Tomato (*Solanum lycopersicum*) is one of the major vegetable crop cultivated in India for its nutritional and commercial values (Mueller *et.al.*, 2005).India contributes 8.6% of world tomato productionand having 20.70 million tonnes production with yield 25.98 tonnes/ha(FAOSTAT 2017).Insect pests and diseases are serious threats to the tomatoes and may damage up to 45-48% of tomato plants resulting significant loss of tomato yield up to 35- 40% in India (*Bhupendra Koul et.al. 2014*).Many insect-pests, and diseases attacks tomatoparticularly polyphagous lepidopteran insect like *Helicoverpaarmigera,* a fruit borer which mainly damagesthe fruit, while *Spodoptera litura* damages theleaves that affects the tomato productivity(Albaje*set.al.*,1988).Both *H. armigeraand S. litura* are serious pests to several important crops world over and particularly in India, including tomato. Cry genes from *Bacillus thuringiensis*widely being used for developm:nt of insect, particularly Lepidoptera, resistant transgenics (Tiwari *et.al.*, 2011, Shelton 2012).Bacillus thuringiensis (Bt), has been successfully transformed in several crop plants like cotton, maize, soybean, rice, canola and potato (Sanahuja

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Review Article

A Review: Recent Advancement in Graphene Based Titanium Oxide, Manganese Oxide and Zinc Oxide Nanocomposites as Electrode Material For Supercapacitor

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Abstract — Modern times have seen an increase in the use of non-renewable fossil fuels for energy, raising grave concerns for the survival of humankind worldwide. Building an environmentally friendly, reasonably priced, reliable, and renewable energy storage system is therefore essential. Supercapacitors are a promising energy technology because of their superior cycle stability, better power density, and quick charge and discharge times. Supercapacitors have been identified as one of the most promising energy storage technologies among other systems. The materials used for the electrodes are crucial in enhancing the supercapacitor's accuracy in terms of capacitance, power, and energy density. The composition of the electrode materials and the kinds of electrolyte in particular control the capacitors' electrical and thermal characteristics. In this mini reviews paper, we overview on graphene based titanium oxide, manganese oxide and zinc oxide nanocomposites as an electrode material for supercapacitors.

Keywords — Supercapacitors, Graphene, titanium oxide, manganese oxide and zinc oxide and nanocomposites.

1. Introduction

Supercapacitors have much higher capacitance values than traditional capacitors. Supercapacitors have lower voltage limits, which can even eliminate the performance difference between rechargeable batteries and conventional electrolytic capacitors. [1] Issues related to modern society's dependence on fossil fuels include rising fuel prices, pollution, global warming, and geopolitical concerns. Mitigating these problems is an increasingly important goal that can be achieved through the development of alternative energy sources and storage technologies. As a result, interest in high-performance, high-energy-density energy storage systems has recently increased.

[2] The slow charge-discharge rate, short life cycle, and high battery weight limit its application in wearable and wearable devices. Currently, supercapacitors are receiving countless considerations due to their important properties such as high energy density, high power density, light weight, fast charge-discharge rate, and long life. [3] The performance of inexpensive and environmentally friendly energy storage and conversion components, mainly required by electrical energy storage systems, such as batteries and capacitors, depends on the properties physics and chemistry of electrode materials.[4] In this study, metal oxides such as MnO2, ZnO, TiO2 along with graphene were effectively studied.

Specifically, we specifically discussed the latest materials for supercapacitor applications and their future developments.

[5] The combination of carbon materials with polymers/metal oxides or both has been found to have higher specific capacitance due to the combination of redox reaction of the metal oxide and surface area/ Graphene has a higher electrical conductivity than its individual form due to its positive synergistic effect. [6] Recently, transition metal oxides such as TiO2, ZnO, MnO2, etc. can improve the electrochemical performance of carbon-based supercapacitors, as they can contribute pseudocapacitance to the total capacitance, in addition to the double-layer capacitance provided by the carbon material. However, most of them are uncommon and expensive. Therefore, there is a need to explore more desirable materials for applications in the CE field [7].

2. Classification of Supercapacitor

The electrochemical device capable of storing charge greater than normal capacitors and supplying it at a higher rate than a

Photovoltaic applications of SnO_2 gas sensor

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Abstract

Tin oxide is a remarkable chemical in today's research because to its unique electrical and optical properties. Because of its huge band gap (3.6 eV), it is used as a core material in a wide range of important applications, including optoelectronics, spintronics, photovoltaics, thin-film transistors, photocatalysis, dielectrics, sensors, and transparent electronics. Thin film technology provides various advantages in the solar industry, including low cost, low material and energy consumption, and ease of use. Solar cells made from SnO_2 thin films have the potential to open up new technical paths for power production, with conversion efficiencies ranging from 15% to 20%. The authors examine and outline potential areas of SnO_2 research for photovoltaic and gas sensor applications. The data obtained will indicate the possibility of designing physical, chemical, magnetic, and optical characteristics of SnO_2 for sensing and photovoltaic applications.

Keywords: Tin oxide, Photovoltaic, Thin film, Gas sensors.

1. Introduction

Material science is the systematic investigation of any material to determine its varied characteristics and qualities. It covers a wide variety of applications, from manufacturing nanoscale gadgets to developing novel materials at the atomic level. In the current context, we are dealing with a number of difficulties linked to traditional energy sources, global warming, soil and water contamination, climate change, sanitation, and so on. Our primary objective is to alleviate these issues by bringing new technologies and advanced materials. Nanotechnology and thin films play an essential role in dealing with such challenges. As stated by **[1]**, this can be used to enhance the performance of currently used materials and develop new functional materials. This is because they not only offer good opportunities to study the optical, electrical, and thermal properties in quantum confinement, but they also provide crucial understandings of the functional units involved in the fabrication of nanoscale electronic, optoelectronic, and magnetic devices.

ZnO, TiO_2, and SnO_2 are the most studied metal oxides due to their unique global uses. Tin oxide is the best option for photovoltaic investigations since it is plentiful, affordable, and non-toxic. The primary goal of this research is to learn more about the functioning of SnO_2 and to identify potential research topics for future applications in photovoltaics and gas sensors **[2]**.

2. Overview of Tin Oxide and its Properties

From the past several decades semiconducting (Metal) oxides such as ZnO, TiO_2 and SnO_2 have been demonstrated to be an essential class of transparent conducting oxides (TCO) for use in solar cells and gas sensors. Tin oxide is the most common material used in optoelectronics because to its low electrical resistance and high transmittance in the visible range **[3]**. Tin oxide is a good option for these uses due to its large band gap (3.6 eV) and strong excitation binding energy (130 MeV). It is the only group-IV oxide that exhibits transparent properties and excellent conductivity in the visible range of (300–800 nm). Bulk

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Research Paper

Fabrication of SnO_2 doped TiO_2 Metal Oxide Sensor with Ppy layer to sense CO_2 Gas

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Abstract — In this study, an optically flat glass plate was used in the development of a thick film sensor that was based on an Al_2O_3 substrate that was finer and more porous. The XRD pattern for the B3 sensor seems to point towards a rather tiny crystalline size.. SEM analysis was used to identify the B3 sensor's increased porosity. As the CO_2 gas concentration rises, the sensor resistance reduces at room temperature, enhancing sensitivity because surface oxygen vacancies on TiO_2 and SnO_2 function as donors. The sensor on an $80SnO_2$:$20TiO_2$ composition with PPy as the roofing layer showed the maximum sensitivity among the constructed sensors, 0.5912 at 250 ppm, whereas it is less for other compositions.

Keywords — *SnO_2, TiO_2, Al_2O_3, Sensitivity, Thick Film, Nanocomposites.*

1. Introduction

For the identification of target molecules, it is necessary to distinguish between of "volatile organic compounds, real-time security warnings, and clinical diagnostics, practical applications" need gas sensors with an exceptionally high level of sensitivity and selectivity. Semiconducting tin oxide (SnO_2) is held in very high esteem as a candidate for use as a gas-sensing material on account of its extraordinary reactivity to changes in gaseous environments as well as its great chemical stability [1]. One of the most popular sensors for detecting gases is the metal oxide sensor, which has a high level of stability, good selectivity, and other properties. The sensing procedure for SnO_2 sensors is described in this work, along with a survey and analysis of the several techniques used in order to enhance the gas detection capabilities of SnO_2-based sensors by doping, dynamic responsiveness, and sensor array improvements. It is possible that the composite sensor will significantly increase the gas sensor's ability to detect hazardous and potentially toxic gases. [2].

Polypyrrole (PPy) is a developing intelligent material with several uses in optical, electrical, and electrochromic devices and sensors. In recent years, PPy has emerged as a particularly effective alternative for detecting volatile organic compounds (VOCs), thanks to its selectivity and sensitivity towards target gas molecules. This has made it a very popular choice in this area. In order to construct better sensing devices, work has been done to develop PPy-based sensors with reliable mechanical and electrochemical performance. The goal of this work is to design better sensors. [3]. Because air includes a variety of poisonous chemicals that are dangerous to human health, gas sensors have drawn interest in academic domains and industrial settings [4]. The harmful gases may result in "asthma, skin burning, nausea, vomiting, sleepiness, cancer, lung problems, weight loss, etc". [5].

SnO_2, TiO_2, ZnO, In_2O_3, and WO_3 all have benefits in terms of stability. Scientists have studied various SnO_2 mechanisms, formations, and fundamental characteristics for many years. SnO_2 is the most crucial component for semiconductor sensors in terms of both application and fundamental research. However, low-concentration biogas and odors cannot be detected with SnO_2 thick film for gas alarms [6]. The preparation conditions, dopant, and grain size of SnO_2-based materials, which have a substantial impact on their chemical and physical qualities, are well understood to affect their sensing capabilities. In the presence of humidity, the DC-electrical resistance of SnO_2 doped with TiO_2 sensors was investigated, and SnO_2 and TiO_2 doped with Al_2O_3 were proven effective humidity-detecting materials. The fundamental goal of this study is to build a CO_2 gas sensor in a multi-layer design using a layer of polypyrrole and SnO_2-doped TiO_2. Tin dioxide (SnO_2)-based chemiresistors have a faster gas sensing response than conducting polymer-based chemiresistors, however, they must be used at high temperatures (>200 °C).

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Study of Drug-likeness Properties of Some 6-(2'- Hydroxy-3'/5'-Chloro-5' /3'-Hydroxymethyl Phenyl)-4-Aryl 3, 4 Dihydro-2(1H)-Thiopyrimidines

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Abstract: *The prepared 6-(2'- Hydroxy-3'/5'-Chloro-5'/3'-Hydroxymethyl Phenyl)-4Aryl 3, 4 Dihydro-2(1H)-Thiopyrimidines were evaluated for their drug-likeness properties by using Data warrior software of Osiris property explorer. The toxicity related risk as tumorogenicity, mutagenicity, irritation, and reproduction effectivity and various physico-chemical properties like clogP, solubility, drug-likeness and drug score were also calculated. The results of this study of drug-likeness properties of synthesized compounds were found encouraging.*

Key Words: *Drug-likeness, OSIRIS property calculator, Thiopyrimidines.*

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I. Introduction

The study of concepts drug-likeness properties are very important for any newly synthesized molecules, because it may leads to drug discovery. The different structural and molecular properties such as hydrophobicity, hydrogen bond character, molecule size etc. are evaluated in order to know whether the newly synthesized compound or predicted compound is exhibiting properties similar to the known drugs or not.

In the present study attempts were made to know the above mentioned properties for the various thiopyrimidines synthesized.

II. Method And Materials

6-(2'- Hydroxy-3'/5'-Chloro-5'/3'-Hydroxymethyl Phenyl)-4Aryl 3, 4 Dihydro-2(1H)-Thiopyrimidines were prepared by refluxing a mixture of 1-(2-hydroxy 3'/ 5'-chloro-5'/3' hydroxymethyl phenyl-3-aryl-2-propern-1-one, thiourea and KOH in methanol for 6 hours. The synthesized compounds were characterized by physical properties and spectral studies. The elemental analysis, Mol. formula, Mol. weight data is given in the table-1 and reaction scheme as shown below (fig.1) and general structure of compound as shown in fig.2.

The Drug-likeness properties of compounds were studied by using Data warrior software of Osiris property explorer. The predication of the Osiris calculations is a fragment based approach and the occurrence frequency of each fragment is determined within the collection of traded drug and within collection of the non-drug-like commercially available chemicals. By using the Osiris property explorer the different physico-chemical properties such as clogP, solubility, drug-likeness and drug score were studied. The Osiris property explorer also predicted the toxicity related risks as tumorogenicity, mutagenicity, irritation, and reproduction effectivity of synthesized compound.

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STUDY OF DRUG LIKELINESS PROPERTIES OF 1(2'-HYDROXY-3'-NITRO-5'-METHYLPHENYL)-3- ARYL/HETERYL-2-PROPEN-1-ONES

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ABSTRACT

Chalcones are reported to possess varied physiological and biological activities. The activities exhibited are antibacterial, insecticidal, antirhinovirus, antipicornivirus, pesticidal, herbicidal, fungicidal, germicidal, carcinogenic, antitubercular, antiparasitic and anti-inflammatory activity.

The complex balance of various molecular properties and structure features which determine whether particular molecule is similar to known drug is known as Druglikeness property. The drug likeliness properties of synthesized compounds were determined using various tools like ADMET Predictor, QikProp, Molinspiration and Osiris drug like property calculators. These properties, mainly hydrophobicity, electronic distribution, hydrogen bonding characteristics, molecule size and flexibility and of course presence of various pharmacophoric features influence the behavior of molecule in a living organism, including bioavailability, transport properties, affinity to proteins, reactivity, toxicity, metabolic stability and many others.

In the present work attempts were made to study the druglikeness properties synthesized compounds druglikeness properties of 1(2'-hydroxy-3'-nitro-5'-methylphenyl)-3- aryl/heteryl-2-propen-1-ones using Osiris drug like property calculators and Toxicity Prediction Tools. The comparative study of the various physico-chemical properties like clogP, solubility, drug-likeness and drug score and also toxicity related risks as tumorogenicity, mutagenicity, irritation, and reproduction effectively were calculated of synthesized compounds by the methodology developed by Osiris. The results of this study of drug-likeness properties of synthesized compounds were found to be encouraging.

KEY WORDS

Chalcones, Prediction, Comparison, Drug-likeness, OSIRIS property calculator.

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Synthesis, Characterization and Comparative Study of Drug-likeness Properties of Cinnamamide Containing Heterocyclic Moiety

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ABSTRACT:

In the present research work synthesis and characterization of (E)-3-Substituted phenyl-1-piperidino-2-propen-1-one and (2E)-1-(piperazine-1-yl)-3-substituted phenyl prop-2-en-1-one Cinnamamides containing Piperidine, Piperazine heterocyclic moieties and screening of antimicrobial activities were carried out. The synthesized Cinnamamides prepared were firstly employed for studying their drug-likeness properties by using data visualization and analysis tool before carrying out antimicrobial activities. The comparative study of the various physico-chemical properties like clogP, solubility, druglikeness and drug score and also toxic related risks as tumorogenicity, mutagenicity, irritation, and reproductive effectivity were calculated of synthesized compounds by the methodology developed by Osiris. The results of this study of drug-likeness properties of synthesized compounds were found to be encouraging.

KEY WORDS:- *Synthesis, Drug-likeness, OSIRIS property calculation, Heterocyclic moiety, Cinnamamide*

1. INTRODUCTION:

The concepts of drug likeness is an important characteristic for any molecule widely integrated into initial stage of lead and drug discovery. The different structural and molecular properties like hydrophobicity, hydrogen bond character, molecular size etc. are evaluated in order to determine whether the predicted compound is similar to the known drugs or not. Drug-likeness deduce as a tender balance in molecular properties affecting pharmacodynamics, pharmacokinetic of molecules which ultimately affects their absorption, distribution metabolism, excretion and toxic for human body such as drug[2]. The molecular properties involved molecular weight, hydrophobicity, electronic distribution, hydrogen bond acceptors and donors, solubility, and other concerned properties[3].

Actually the strategy of chemists in their drug research is to discover new chemical compounds which highly resemble drugs with respect to the key physicochemical and biological properties, with the information that find for drug like properties may help to achieve decent pharmacodynamics and pharmacokinetic properties. In other word the motto of medicinal chemists is to design and discover structure that can be improve to leads, leads that can be optimized to candidates and candidates that will become valuable drugs[3].

Now generally the Lipinski's rule of Five (RO5) is used to determine the drug likeness of the evaluated drug molecules[4]. The complete chemical information remains preserved from studies of molecular properties because the molecular properties have to be logically and quantitatively represented as molecular descriptors. From the suitable molecular descriptors used for correctly predicating the drug likeness of a molecule is important for the screening the drug like molecules.

Methods for dug likeness predication involves from simple counting schemes like Lipinski's "rule of five" to machine learning approaches like artificial neural network and support vector machines. Lipinski's "rule of five" is a finding approach for predicting drug likeness starting that molecules having molecular weight greater than five hundred, logP greater than five, hydrogen bond doors greater than five and hydrogen bond acceptors greater than ten have poor absorption or permeation. This rule describes only the molecular properties related with pharmacokinetic of molecule which refers to the absorption, distribution metabolism, excretion and toxic (ADMET) properties of bioactive compounds in a higher organism[5]. There is no consideration for pharmacodynamics aspect of molecules which deal with drug action on the body or on microorganisms and other parasites within or on the body. Moreover there are many demerits of this rule among existing drugs and vice versa, and therefore, fulfillment the rule of five does not offers that a molecule is drug-like. Drug likeness was a broad term used to define absorption, distribution metabolism, excretion and toxic (ADMET) properties of a drug molecule[6-11].

Heterocyclic compounds it may be natural or synthetic have been immensely explored for their profound applicability in the field of industrial, agricultural and medicinal chemistry. Cinnamamide containing heterocyclic moiety with a various of biological properties[1], like central nervous system depressant, anticonvulsant, muscle relaxant, anti-allergic, antineoplastic, antitumor, anesthetic, analgesic and anti-infective activities and anti-infective activities[12-19], etc. In agrochemical field, insecticidal, their avian repellent, herbicidal activities, and several excellent cinnamamide

Role of Librarian in the Changing Society

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Abstract

The article describes that the role of Library and focuses on library professional in changing landscape of information societies. In this paper describes the role of librarian in libraries, which have collection in form of e-books, digital documents and various databases and common access to the internet. The Society of knowledge has been creating by modern libraries. The library professionals are consistently open to any changes in their field and excited to improve their skills and knowledge. Libraries have been in existence for numerous years; nevertheless, in the contemporary digital era, where we at our fingertips access to an infinite array of information, a new customary of knowledge accomplishment have emerged.

Key Words

Information Society, Knowledge society

Introduction

The libraries are sometimes seen as the silent, unassuming foundations of civilization. libraries really play a crucial and profoundly transformational role in society. A human civilization or society has several definitions. It describes a group of people who live together in a community, have common interests, and may have unique institutions and practices.

Libraries are the collectors and caretakers of our heritage they are organizers of the knowledge in the book they collect-adding value by cataloguing, classifying and describing them, as public institutions, they provide equitable access for all people. They take the knowledge of the past and present and lay it down for the future. Libraries have been a marginal theme. The situation is changing. One of the most important components of free access to information, which is essential to the development of a democratic information society, is libraries.

Libraries serve as gateways to knowledge and culture, providing numerous opportunities for learning that can drive economic, social, and cultural progress. These institutions are essential because they are one of the most effective ways to make information accessible for the development of culture, economy, and society. In essence, libraries offer a means for institutions to access knowledge, ideas, and culture. Communities depend on libraries to raise awareness among marginalized groups, empowering them with information about upcoming opportunities in the market for skill development and employment in various societal sectors.

Information Society - The arrival of the information age has led to the emergence of what is commonly known as the "Information Society". However, there is no universally accepted definition for this term. Modern researchers describe the information society as a society where information is extensively utilized in economic, social, cultural, and political aspects of life. It is a society that heavily relies on communication and information processing, playing a significant role in the national income and serving as a source of livelihood for the majority of the population. This information society has witnessed a rapid spread in the popularity of the internet and electronic mass media. Within a few years, analog technology has been replaced by digital technology, giving rise to a new society often referred to as the digital, Web, internet, or computer society. In this society, information has become the most sought-after and valuable commodity.