5 Dynamics of Magnetized String Cosmological Model in $f(R, T)$ Gravity Theory

5.1 Introduction

Some recent observational data of high red-shift from Ia supernovae (Riess et al.(1998), Perlmutter et al.(1999), Vishwakrma (2002)), cosmic microwave background (CMB) anisotropy (Netterfield et al.(2002)), large scale structure (LSS) (Spergel et al.2003), have suggested that our universe is undergoing a late-time cosmic acceleration. It is held that the accelerating expansion is driven by the negative pressure, which tends to increase the rate of expansion of the universe. In recent years, several sources of DE such as cosmological constant (Padmanabhan (2003)), quintessence (Martin (2008)), techyons (Padmanabhan and Chaudhary (2003)), phantom (Alam et al.(2004)), k-essence (Chiba et al. (2000)) , chaplygin gas (Bento et al. (2002)) etc have been proposed and extensively studied by many workers.

During last decade, there has been several modifications of general relativity

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to explain late time acceleration of the universe and dark energy. Modified gravity theories provide certainly a way of understanding the problem of DE and the possibility to reconstruct the gravitational field theory that would be capable to reproduce the late-time acceleration. A number of alternative models have been proposed in the framework of general relativity to explain the role of DE in the present cosmic acceleration. Harko et al. (2011) have proposed a generalization of $f(R)$ gravity known as $f(R,T)$ gravity theory involving the dependence of the trace T of energy momentum tensor T_{ij}. The dependance of T may be induced by exotic imperfect fluids or quantum effects. They have derived the corresponding field equations in metric formalism for several forms of $f(R,T)$. They have also argued that, due to coupling of matter and geometry, this gravity theory depends only on the source term, representing the variation of matter stress- energy tensor with respect to the metric. The cosmic acceleration in $f(R,T)$ theory results not only from geometrical contribution, but also from the matter content. The astrophysical and cosmological implication of $f(R,T)$ gravity have been extensively investigated by several author. Shamir et al.(2012), Shri Ram et al.(2013), Chandel and Shri Ram (2013) investigated spatially homogeneous Bianchi types model with perfect fluid in $f(R,T)$ gravity theory. Chakraborty (2013) has studied the $f(R,T)$ gravity taking into account of the conservation of stress energy tensor. Sharif and Zubir (2012) have studied non-equilibrium of thermodynamics, whereas Azizi (2013) has examined the possibility of wormhole geometry in $f(R,T)$ theory. Katore and Shaikh (2012) have obtained the solution of $f(R,T)$ gravity in the framework of Kantowaski-Sachs space-time in the presence of perfect fluid distribution. Rao and

Nilima (2013) have presented a spatially homogeneous and anisotropic Bianchi type VI_0 space time filled with perfect fluid in general relativity and also in the framework of $f(R,T)$ gravity theory. Recently, Singh and Singh (2014) have presented the cosmological viability of reconstruction of modified $f(R,T)$ gravity.

The study of cosmic string has received considerable attention in cosmology as they play important role in the structure formation and evolution of universe. The gravitational effects of cosmic strings in general relativity have been extensively studied by Kibble and Turok (1982), Vilenkin (1981), Goetz (1990), Letelier (1983), Stachel (1980) etc. There is no direct evidence of strings in the present day universe, but the cosmological model of the universe which evolve from a string dominated era and end up in a particle dominated era are of physical interest. Matraverse (1988) has investigated a class of exact solutions of Einstein's field equations with a two parameter family of cosmic strings. Krori et al. (1990) have obtained spatially homogeneous models of Bianchi types- II, VI_0, VII and IX in the presence of strings. Banerajee et al. (1990) have presented Bianchi type I strings cosmological models with and without a source free magnetic field. Tikekar and Patel (1992) have studied Bianchi type III space times with strings in the presence of magnetic field. Shri Ram and Singh (1995) have obtained exact solutions in string cosmology with and without magnetic field. Singh (2002) has presented Bianchi type V cosmological models for massive string in the presence and absence of of the magnetic field. Pradhan et al.(1997) have studied string cosmological models in the presence and absence of source-free magnetic field. It deserves mention that Ahmad and Pradhan (2014) have presented a class of Bianchi type V cosmological models for a special choice of $f(R,T) = f_1(R) + f_2(T)$. Recently, Sharma and Singh (2014) have obtained a Bianchi type II string cosmological model with magnetic field in $f(R,T)$ gravity.

In this chapter, we discuss Bianchi type V string cosmological model in the presence of magnetic field in $f(R,T)$ gravity theory. The paper is organized as follows: In Sec.(5.2), we present the metric and field equations. We obtain exact solution to the field equations by using the hybrid expansion law in Sec.(5.3). In Sec.(5.4), we discuss the physical and kinematical feature of the cosmological model. In Sec.(5.5), we check the stability of corresponding solutions. Finally, some concluding remarks are given in Sec.(5.6).

5.2 The Metric and Field Equations

We consider spatially homogeneous and anisotropic Bianchi type V metric given by

$$ds^2 = dt^2 - A^2dx^2 - e^{-2x}(B^2dy^2 + C^2dz^2) \tag{5.1}$$

where A, B, C are cosmic scale functions.

The gravitational field equations (1.23), for function $f(R,T) = f_1(R) + f_2(T)$, become

$$f_1'(R)R_{ij} - \frac{1}{2}f_1(R)g_{ij} + (g_{ij}\Box - \nabla_i\nabla_j)f_1'(R) = 8\pi T_{ij} + f_2'(T)T_{ij} + \left(f_2'(T)p + \frac{1}{2}f_2(T)\right)g_{ij} \tag{5.2}$$

where a prime denotes differentiation with respect to the argument. The equation for standard $f(R)$ gravity can be recovered for $p = 0$ (the dust case) and $f_2(T) = 0$. Here we consider the particular forms of the functions $f_1(R) = \nu_1(R)$ and $f_2(T) =$

$\nu_2(T)$. We further assume that $\nu_1 = \nu_2 = \nu$ so that $f(R,T) = \nu(R+T)$. Then Eq.(5.2) can be rearranged as

$$\nu R_{ij} - \frac{1}{2}\nu(R+T)g_{ij} + (g_{ij}\Box - \nabla_i\nabla_j)\nu = 8\pi T_{ij} - \nu T_{ij} + \nu(2T_{ij} + pg_{ij}). \quad (5.3)$$

Assuming $(g_{ij}\Box - \nabla_i\nabla_j)\nu = 0$, we obtain

$$R_{ij} - \frac{1}{2}Rg_{ij} = \left(\frac{8\pi + \nu}{\nu}\right)T_{ij} + \left(p + \frac{1}{2}T\right)g_{ij}. \quad (5.4)$$

The energy momentum tensor for a perfect fluid containing one dimensional cosmic string together with magnetic field is given by

$$T_{ij} = (\rho + p)u_i u_j - pg_{ij} + \lambda x_i x_j + E_{ij} \quad (5.5)$$

where p is the isotropic pressure, ρ is proper energy density of a cloud of strings with particle attached to them, λ is string tension density, u^i is the 4-velocity vector of the particles, x^i is a unit space like vector in the direction of strings.

Without loss of generality we choose x direction as the direction of the strings along which the magnetic field is assumed to be present, i.e.

$$x^i = \left(\frac{1}{A}, 0, 0, 0\right). \quad (5.6)$$

In a comoving coordinate system, we have

$$u^i = (0, 0, 0, 1). \quad (5.7)$$

Thus

$$u_i u^i = -x_i x^i = 1, \quad u_i x^i = 0. \quad (5.8)$$

In (5.5), E_{ij} is the electromagnetic field tensor which is given by (Lichnerovich (1967))

$$E^i_j = \overline{\mu}\left[|h|^2\left(u_i u^j + \frac{1}{2}g^j_i\right) - h_i h^j\right] \quad (5.9)$$

where $\overline{\mu}$ is the magnetic permeability, h_i the magnetic flux vector defined by

$$h_i = \frac{\sqrt{-g}}{2\overline{\mu}} \epsilon_{ijkl} F^{kl} u^j. \tag{5.10}$$

Here F^{kl} is dual electromagnetic field tensor and ϵ_{ijkl} is Levi-Civita tensor density. We assume that the current is flowing along x-axis, so magnetic field is in yz-plane. Thus $h_1 \neq 0, h_2 = 0 = h_3 = h_4$ and F_{23} is the only non-vanishing component of F_{ij}. This leads to $F_{12} = 0 = F_{13}$ by virtue of (5.10). We also find that $F_{14} = 0 = F_{24} = F_{34}$ due to the assumption of infinite electrical conductivity of the fluid (Maartens (2000)). A cosmological model which contains a global magnetic field necessarily anisotropic since the magnetic vector specifies a preferred spatial direction (Bronnikov et al. (2004)).The Maxwell's equations

$$F_{ij;k} + F_{jk;i} + F_{ki;j} = 0 \;\; and \;\; F^{ij}_{\;;j} = 0 \tag{5.11}$$

lead to $\frac{\partial F_{23}}{\partial t} = 0$ (since F_{23} is the only non-vanishing component and $F_{ij} = -F_{ji}$), which further leads to

$$F_{23} = I = constant. \tag{5.12}$$

For $i = 1$, Eq.(5.10) leads to the non-zero component of the magnetic flux vector which is given as

$$h_1 = \frac{AI}{\overline{\mu} BC}. \tag{5.13}$$

Since $|h|^2 = h_l h^l = h_1 h^1 = g^{11}(h_1)^2$, we get

$$|h|^2 = \frac{I^2}{\overline{\mu}^2 B^2 C^2}. \tag{5.14}$$

Using Eqs.(5.13) and (5.14) into Eq.(5.9), the non zero components of E_i^j for the line element (5.1) are given by

$$E_1^1 = \frac{I^2}{2\overline{\mu} B^2 C^2} = -E_2^2 = -E_3^3 = E_4^4. \tag{5.15}$$

In comoving coordinates, the field equations (5.4) together with Eqs.(5.1) and (5.5) lead to the following system of equations:

$$\frac{\dot{A}\dot{B}}{AB}+\frac{\dot{B}\dot{C}}{BC}+\frac{\dot{C}\dot{A}}{CA}-\frac{3}{A^2}=\left(\frac{16\pi+3\nu}{2\nu}\right)\rho-\frac{\lambda}{2}-\frac{p}{2}+\left(\frac{8\pi+\nu}{\nu}\right)\frac{I^2}{2\overline{\mu}B^2C^2}, \quad (5.16)$$

$$\frac{\ddot{B}}{B}+\frac{\ddot{C}}{C}+\frac{\dot{B}\dot{C}}{BC}-\frac{1}{A^2}=-\left(\frac{16\pi+3\nu}{2\nu}\right)p+\frac{\rho}{2}-\left(\frac{16\pi+3\nu}{2\nu}\right)\lambda+\left(\frac{8\pi+\nu}{\nu}\right)\frac{I^2}{2\overline{\mu}B^2C^2}, \quad (5.17)$$

$$\frac{\ddot{A}}{A}+\frac{\ddot{C}}{C}+\frac{\dot{A}\dot{C}}{AC}-\frac{1}{A^2}=-\left(\frac{16\pi+3\nu}{2\nu}\right)p+\frac{\rho}{2}-\frac{\lambda}{2}-\left(\frac{8\pi+\nu}{\nu}\right)\frac{I^2}{2\overline{\mu}B^2C^2}, \quad (5.18)$$

$$\frac{\ddot{A}}{A}+\frac{\ddot{B}}{B}+\frac{\dot{A}\dot{B}}{AB}-\frac{1}{A^2}=-\left(\frac{16\pi+3\nu}{2\nu}\right)p+\frac{\rho}{2}-\frac{\lambda}{2}-\left(\frac{8\pi+\nu}{\nu}\right)\frac{I^2}{2\overline{\mu}B^2C^2}, \quad (5.19)$$

$$\frac{2\dot{A}}{A}-\frac{\dot{B}}{B}-\frac{\dot{C}}{C}=0. \quad (5.20)$$

5.3 Solutions of Field Equations

Eq.(5.20), on integration, gives

$$A^2=BC \quad (5.21)$$

where the constant of integration is absorbed into scale functions. From Eqs.(5.18)-(5.19) and using Eq.(5.21), the metric functions can explicitly written in terms of the average scale factor a

$$A(t)=a, \quad (5.22)$$

$$B(t)=ka\exp\left(l\int\frac{dt}{a^3}\right), \quad (5.23)$$

$$C(t)=k^{-1}a\exp\left(-l\int\frac{dt}{a^3}\right) \quad (5.24)$$

where k and l are constants.

We can determine the cosmic scale functions A, B, C from Eqs. (5.22)-(5.24) if the average scale factor $a(t)$ is explicitly known. Several ansatz for $a(t)$ can be used to evaluate integrals in these equations. The power-law and exponential law cosmologies can be used only to describe epoch based evolution of the universe because of the constancy of deceleration parameter. For instance, these cosmologies do not exhibit the transition of universe from deceleration to acceleration. Recently, Akarsu et al.(2013) considered the following ansatz for the scale factor of the universe

$$a(t) = a_1 t^{\alpha} e^{\beta t} \tag{5.25}$$

where $a_1 > 0$, $\alpha \geq 0$ and $\beta \geq 0$ are constants. They referred this generalized form of the scale factor as the hybrid expansion law, being the mixture of power-law and exponential-law cosmologies. Kumar (2013) has studied the dynamics of Bianchi type V model by considering the hybrid expansion law for the average scale factor. In hybrid cosmology, the universe exhibits transition from deceleration to acceleration.

Inserting Eq.(5.25)) into Eqs.(5.22))-(5.24), and integrating we obtain the scale functions as follows:

$$A(t) = a_1 t^{\alpha} e^{\beta t}, \tag{5.26}$$

$$B(t) = k a_1 t^{\alpha} e^{\beta t} \exp\{-l a_1^{-3} (3\beta)^{3\alpha-1} \gamma[1-3\alpha, 3\beta t]\}, \tag{5.27}$$

$$C(t) = k^{-1} a_1 t^{\alpha} e^{\beta t} \exp\{l a_1^{-3} (3\beta)^{3\alpha-1} \gamma[1-3\alpha, 3\beta t]\} \tag{5.28}$$

where γ denotes the lower incomplete gamma function. For the scale functions to be realistic, we must have $\alpha \leq 1/3$.

5.4 Physical and Kinematical Behaviors

For the line element (5.1), the matter energy density and pressure are given as

$$\rho = \frac{\nu^2}{(16\pi + 2\nu)(8\pi + 2\nu)} \left[\frac{(48\pi + 6\nu)}{\nu} \left(\frac{\alpha + \beta t}{t} \right)^2 + \frac{2\alpha}{t^2} - \frac{(16\pi + 4\nu)l^2}{\nu(a_1 t^{\alpha} e^{\beta t})^6} - \frac{(48\pi + 8\nu)}{\nu(a_1 t^{\alpha} e^{\beta t})^2} - \left(\frac{8\pi + \nu}{\nu} \right)^2 \frac{I^2}{\overline{\mu}(a_1 t^{\alpha} e^{\beta t})^4} \right], \quad (5.29)$$

$$p = \frac{\nu^2}{(16\pi + 2\nu)(8\pi + 2\nu)} \left[\frac{(32\pi + 6\nu)}{\nu t^2} + \frac{16\pi}{\nu(a_1 t^{\alpha} e^{\beta t})^2} - \frac{(48\pi + 6\nu)}{\nu} \left(\frac{\alpha + \beta t}{t} \right)^2 - \frac{(16\pi + 4\nu)l^2}{\nu(a_1 t^{\alpha} e^{\beta t})^6} - \frac{I^2(64\pi^2 + 3\nu^2 + 32\pi\nu)}{\nu^2 \overline{\mu}(a_1 t^{\alpha} e^{\beta t})^4} \right] \quad (5.30)$$

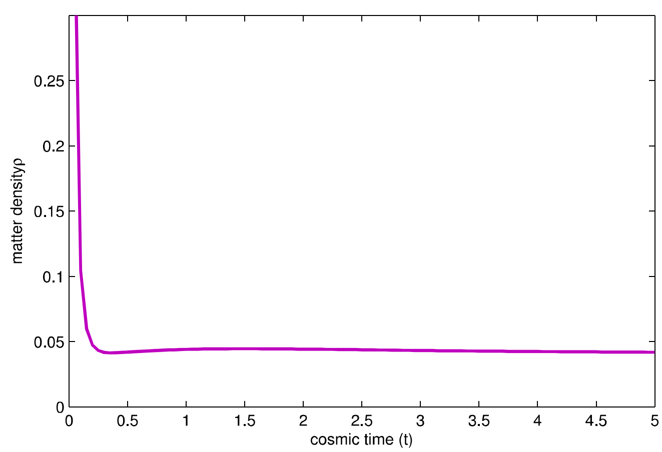

Figure 5.1: Variation of density ρ with time t for $\alpha = 0.12$, $\beta = .83$, $a_1 = 1.2$, $l = .78$ $\overline{\mu}$=1.00001

The string tension density λ for this model is given as follows:

$$\lambda = \frac{I^2}{\overline{\mu}(a_1 t^{\alpha} e^{\beta t})^4}. \quad (5.31)$$

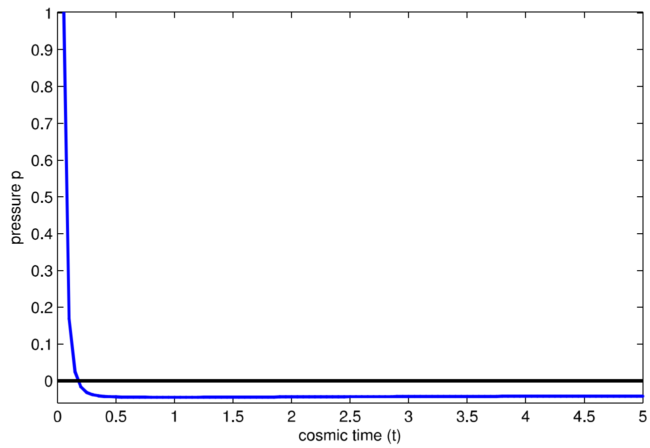

Figure 5.2: Variation of pressure p with time t for $\alpha = 0.12$, $\beta = .83$, $a_1 = 1.2$, $l = .78$ and $\overline{\mu}$=1.00001

The particle energy density ρ_p of the model has the value

$$\rho_p = \rho - \lambda = \frac{\nu^2}{(16\pi + 2\nu)(8\pi + 2\nu)} \left[\frac{(48\pi + 6\nu)}{\nu} \left(\frac{\alpha + \beta t}{t} \right)^2 - \frac{(16\pi + 4\nu) l^2}{\nu (a_1 t^\alpha e^{\beta t})^6} + \frac{2\alpha}{t^2} - \frac{(48\pi + 8\nu)}{\nu (a_1 t^\alpha e^{\beta t})^2} - \left(\frac{192\pi^2 + 5\nu^2 + 64\pi\nu}{\nu^2} \right) \frac{I^2}{\overline{\mu} (a_1 t^\alpha e^{\beta t})^4} \right] \quad (5.32)$$

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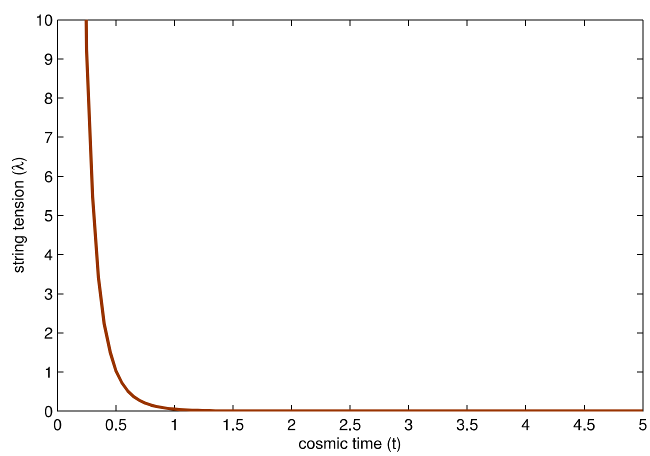

Figure 5.3: Variation of string tension density λ with time t for $\alpha = 0.12$, $\beta = .83$, $a_1 = 1.2$, $l = .78$ and $\overline{\mu}$=1.00001

The deceleration parameter of Bianchi type-V model is

$$q = -\frac{a\ddot{a}}{\dot{a}^2} = \frac{\alpha}{(\alpha + \beta t)^2} - 1. \quad (5.33)$$

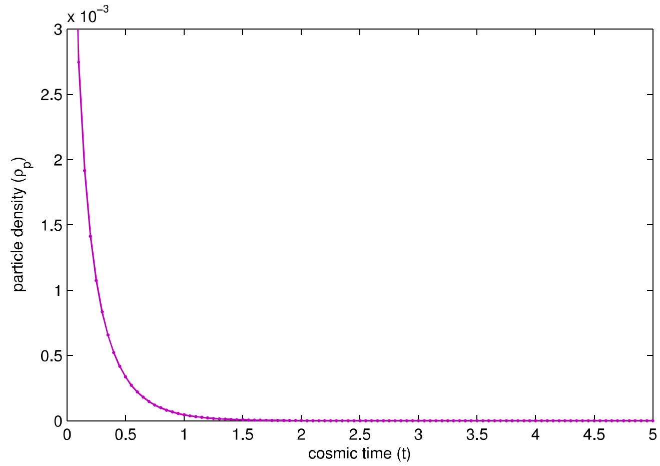

Figure 5.4: Variation of ρ_p with time t for $\alpha = 0.12$, $\beta = .83$, $a_1 = 1.2$, $l = .78$ and $\overline{\mu}$=1.00001

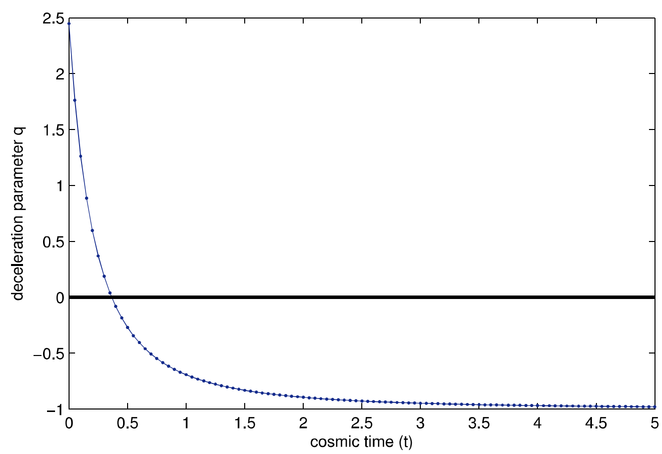

Figure 5.5: Variation of deceleration parameter q with time t for $\alpha = 0.12$, $\beta = 0.83$

From Fig.(5.5), we observe that the present universe with hybrid expansion law evolves with variable deceleration parameter and transition from deceleration to acceleration takes place at

$$t = \frac{\sqrt{\alpha} - \alpha}{\beta} \tag{5.34}$$

where α should be in the range $0 < \alpha < 1$.

The directional Hubble parameters H_x, H_y, H_z and the average Hubble parameter H are given by

$$H_x = \frac{\alpha}{t} + \beta, \tag{5.35}$$

$$H_y = \frac{\alpha}{t} + \beta + l(a_1 t^{\alpha} e^{\beta t})^{-3}, \tag{5.36}$$

$$H_z = \frac{\alpha}{t} + \beta - l(a_1 t^{\alpha} e^{\beta t})^{-3}, \tag{5.37}$$

$$H = \frac{\alpha}{t} + \beta. \tag{5.38}$$

The expansion scalar θ and shear scalar σ of the model have values:

$$\theta = 3\left(\frac{\alpha}{t} + \beta\right), \tag{5.39}$$

$$\sigma^2 = (a_1 t^{\alpha} e^{\beta t})^{-6}. \tag{5.40}$$

The anisotropy parameter(A_m) is given by

$$A_m = \frac{2l^2}{3}\left(\frac{\alpha}{t} + \beta\right)^{-2}\left(a_1 t^{\alpha} e^{\beta t}\right)^{-6}. \tag{5.41}$$

For the present model, from Figs.(5.1) and (5.4), we observe that $\rho \geq 0$ and $\rho_p \geq 0$. Figs.(5.3) and (5.4) depict that the large values of λ and ρ_p in the beginning suggest that the string dominates the early universe but for sufficiently large time, λ and ρ_p become negligible. Therefore string disappears from for large time. We observe that the spatial volume V is zero at $t = 0$. At this epoch the expansion scalar is infinite, which shows that the universe starts evolving with zero volume at $t = 0$, with big-bang scenario. From Eqs.(5.26)-(5.28), we find that the spatial scale factors A, B, C are zero at the initial epoch $t = 0$. Hence the model has a point-type singularity.The spatial volume increases with time. The physical and kinematical quantities ρ, p, θ and σ all diverge at $t = 0$. As $t \to \infty$, the volume becomes infinite whereas shear scalar approaches to zero and Hubble parameter and expansion scalar attain constant values. From Figs.(5.1) and (5.2), we find that the energy density and pressure are gradually decreasing functions of time. The energy density attains the positive constant value, whereas matter pressure assumes negative constant value as $t \to \infty$, which shows that the universe is dominated by DE at late time causing the accelerated expansion of the universe. The expressions in Eqs.(5.29), (5.30), (5.31) and (5.32) indicate that the magnetic field is linked with ρ, p, λ and ρ_p respectively. We observe that, $A_m \to 0$ as $t \to \infty$, which shows that the universe approaches isotropy for large time. We also observe that the effect of magnetic field in the early time is considerably high which is eventually zero at late time.

5.5 Stability of the Solutions

In this section, we will study the stability of the solutions with respect to metric perturbations. Perturbations of the fields of a gravitational system against the background evolutionary solution should be checked to ensure the stability of the solutions (Chen and Kao (2001)). Here the perturbation will be considered for all three expansion factor a_i via

$$a_i \to a_{B_i} + \delta a_i = a_{B_i}(1 + \delta b_i). \tag{5.42}$$

We focus our attentions on the variables δb_i instead of δa_i. Accordingly, the perturbations of the volume scalar $V_B = \Pi_{i=1}^{3} a_i$, directional Hubble factors $\theta_i = \frac{\dot{a}_i}{a_i}$, the mean Hubble parameter $\theta = \Sigma_{i=1}^{3} \frac{\theta_i}{3} = \frac{\dot{V}}{3V}$ are shown as follows:

$$V \to V_B + V_B \Sigma_i \delta b_i, \quad \theta_i \to \theta_{B_i} + \Sigma_i \delta b_i, \quad \theta \to \theta_B + \frac{1}{3}\Sigma_i \delta b_i. \tag{5.43}$$

It can be shown that the metric perturbations δb_i, of the linear order in δb_i, obey the following equations:

$$\Sigma_i \delta\ddot{b}_i + 2\Sigma\theta_{B_i}\delta\dot{b}_i = 0, \tag{5.44}$$

$$\delta\ddot{b}_i + \frac{\dot{V}_B}{V_B}\delta\dot{b}_i + \Sigma_j \delta\dot{b}_j\theta_{B_i} = 0, \tag{5.45}$$

$$\Sigma\delta\dot{b}_i = 0. \tag{5.46}$$

From Eqs. (5.44) , (5.45) and (5.46)) , it can easily be seen that

$$\delta\ddot{b}_i + \frac{\dot{V}_B}{V_B}\delta\dot{b}_i = 0 \tag{5.47}$$

where V_B is the background volume scalar. Here

$$V_B = a_1^3 t^{3\alpha} e^{3\beta t}. \tag{5.48}$$

Substituting for V_B in equation (5.47) and integrating, we obtain

$$\delta b_i = c_i t^{\frac{-3\alpha}{2}} e^{\frac{-3\beta t}{2}} \quad \text{Wittaker}M\left(\frac{-3\alpha}{2}, \frac{3\alpha}{2} - \frac{1}{2}, 3\beta t\right) \tag{5.49}$$

where c_i is a constant of integration. Therefore, the actual fluctuations for each expansion factor $\delta a_i = a_{B_i}\delta b_i$ are given by

$$\delta a_i = c_i t^{\frac{-\alpha}{2}} e^{\frac{-\beta t}{2}} \quad \text{Wittaker}M\left(\frac{-3\alpha}{2}, \frac{3\alpha}{2} - \frac{1}{2}, 3\beta t\right). \tag{5.50}$$

From Eq.(5.50), we observe that δa_i approaches zero for large t since α is positive. Consequently, the background solution is stable against the perturbation of the graviton field.

5.6 Conclusions

In this chapter, we have studied dynamics of spatially homogeneous and Bianchi type V string cosmological model with perfect fluid in the presence of magnetic field in $f(R,T)$ theory of gravity. We have obtained exact solutions of the field equations for Bianchi type V space-time in $f(R,T)$ gravity theory by considering hybrid expansion law for the average scale factor that yields power-law and exponential law cosmologies in its special cases. We observe that the hybrid expansion law provides an elegant description of the transition from the deceleration to cosmic acceleration, which is an essential feature for dynamic evolution of the universe. We observed that the spatial volume V is zero at $t = 0$. Therefore, the model has point-type singularity at $t = 0$. At this epoch, all the physical and kinematical parameters diverse. As time increases, these parameter decrease. As $t \to \infty$, spatial volume becomes infinite. As $t \to \infty$, θ and H assume constant value and hence the universe expands forever with the dominance of dark energy. We also find that in early stages of evolution string dominates the universe but for large time it becomes negligible. The energy density and pressure have infinite values at $t = 0$ but as $t \to \infty$, energy density attains a positive constant value whereas pressure becomes negative which shows the universe is accelerated expanding for late times with the dominance of DE. The contribution of magnetic field is exhibited in the expression of the physical parameters ρ, p, λ and ρ_p. From Eq.(5.31), we find that λ is zero when $I = 0$, which shows that in the absence of magnetic field, strings disappear, and hence we obtain a Bianchi type V perfect fluid cosmological model in $f(R,T)$ gravity theory. We have also checked the stability of solutions by cosmological perturbation method and have shown that our model is stable. We also observe that Bianchi type V space time starts with high anisotropy, but at the later stages of the evolution of universe it becomes isotropic, which is consistent with present day observations.