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COSMOLOGICAL ENTROPY AND SEEKING OF GENESIS OF TIME

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ABSTRACT

Influenced with symmetry of entropy and time in nature, we tried to invoke relation between entropy and time in space-time with new dimension. And also provided how Hubble's constant related with the entropy of universe.Wediscussed about how entropy of universe behaves at different temperatures and at different age's of universe. We showed that age of universe is equivalent to Hubble's constant. And showed how naturally entropy arrives from the manipulations in gravity from Einstein's equation "00". And from these results we concluded that universe is isotropic, homogeneous with negative space curvature i.e. $K= -1$ but not flat $K=0$ (which doesn't explain acceleration and deceleration of universe). From these results of gravity, entropy, temperature and time we discussed the genesis of time and proposes that at absolute zero temperature universe survives as a superconductor and that particular temperature is called as *"Critical Absolute Temperature* (T_{AB}). And genesis of time occurs at first fluxon repulsion in the absolute zero temperature of universe.

Keywords

Symmetry; Hubble's constant; Age of universe; Einstein's equation "00"; and Superconductor.

Academic Discipline And Sub-Disciplines

Astrophysics, Condensed matter physics, Cosmology, Elementary particle physics, Gravitation physics, Particle physics, Relativity, Thermodynamics, and Theoretical and Applied Mathematics.

1. INTRODUCTION

“Science is nothing more than a refinement of everyday thinking.”

We see the universe the way it is because we exist. Of course there may be some irony in that statement in fact, scientifically is it true? Perhaps answer is not apt scientifically. But one thing is clear from the scientific literature which is prevailing till now is:

1) Universe has a beginning [9].
2) A hot big bang occurs after the beginning of the universe.
3) Universe expands after big bang [3] which is generally accepted..

In order to explain the ideas that how time begins in the universe, it is necessary first to understand the generally accepted history of the universe according to what is known as the hot big bang model. The singular beginning of evolution of universe is coined with the name Big Bang. Before the big bang, the universe is thought to have had zero size, and after the Bang it has been infinitely hot. At this the universe would have contained mostly extremely light particles that are affected by only weak force and gravity and there are antiparticles. As the universe continued to expand and the temperature to drop, the rate at which particles were being produced in collisions would fallen below the rate at which they were being destroyed by annihilation. In these particles neutrinos and anti-neutrinos would not have annihilated with each other because these particles annihilate with themselves and with other particles very weakly. So it was expected that they still be around today. Neutrinos are not mass less, but they have a small mass of their own. They could be of the form of “dark matter”, with sufficient gravitational attractions to restrict the expansion of the universe and cause it to collapse [10].

In this circumstances what is the roll of time? Was it begins with universe? How entropy plays an important role in explaining time. And how gravity is most efficient generator of entropy in universe? These topics are discussed throughout the paper.

A pioneer work done in [10] paper that defined Einstein equation as equation of state. By considering space time as solid, in [8] paper a brilliant work had done to establish relation between Einstein equation and entropy. Motivated from these papers we established a relation between matter, geometry and entropy from Einstein’s equation”00”. Fruitfully that relation defined the isotropic, homogeneous and negative curvature of space-time.

2. CONVENTIONS OF PARTICLES AFTER BIG BANG

[2] “Destroy all scientific knowledge’s and just pass all things are made up of atoms to next generation.”

Big Bang is monstrous container of entropy, another such example is black hole. The big bang played out the particles. In the thick of microscopic particles, allow for a particle ***P*** that is blown from the explosion with a velocity *v→**c***. Annihilation of particles and antiparticles blown from the big bang explosion ispossible only in straight line and these particles follows straight path until any disturbance face them.

Let$t_1$be the time taken by the particle *P* to travel a distance *‘vt’* after big bang explosion. Initially it was at rest and time as t_0. Now from Einstein’s relativistic equation we have

$$\Delta t = \frac{t_1}{\sqrt{\left(1-\left(\frac{v}{c}\right)^2\right)}} \tag{1}$$

As v→c, Δ t →∞

Therefore $\Delta t = t_1 - t_0 \Rightarrow t_1 - t_0 \rightarrow \infty \Rightarrow t_1 \rightarrow \infty$ (since t_0 = 0, initial time of particle). The proper time of particle *‘P’*tends to**∞,** when the velocity of the particle tends to *‘c’.* Similarly the proper time of ***‘n’*** such particles that travel a distance *‘vt’* is given by

$$t_1 = \sum_{i=1}^{n} n \cdot \int_{t_0}^{t_1} \sqrt{\left(1-\left(\frac{v}{c}\right)^2\right)}\, dt \tag{2}$$

The proper time of particles travelling with light velocity tends to infinity. That means to an observer traveling with speed of light those particles seems to be stationary. This happens due to dilation in the time as from (1). Since *Δ t →∞,* therefore from (1) time passes slowly for those particles and the concept of time dilation is applicable to all of the particles which travel with velocity equal to ‘*c’*.

The path of particles travelling with light velocity is the straightest possible world line or null. This is generalization of the straight line. If m is mass of particle *‘P’*, then relativistic energy related to that particle is given as:

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$$E = \left(\frac{mc^2}{\sqrt{1-\left(\frac{v}{c}\right)^2}} \right) \tag{3}$$

Let particle travels a distance that is equal to the radius of expansion of universe then from Schwarzschild radius $r = 2MGc^{-2}$, *M* is replaced with relativistic mass, then:

$$r = 2GE\left(\sqrt{1-\left(\frac{v}{c}\right)^2} \Big/ c^4 \right) \tag{4}$$

Let ds is the small distance travelled by particles blown from big bang. If particle travels a distance equal to the radius of the expanding universe then the total distance *s* travelled by particle from initial position r_0 to *r* is:

$$s = \int_{r_o}^{2GE\left(\sqrt{1-\left(\frac{v}{c}\right)^2} \Big/ c^4 \right)} ds \tag{5}$$

$$s = 2GE\left(\sqrt{1-\left(\frac{v}{c}\right)^2} \Big/ c^4 \right) - r_o \tag{6}$$

$$s = \frac{r}{2}\left(\sqrt{1-\left(\frac{v}{c}\right)^2} \right) - r_o \tag{7}$$

(7) Depicts the total distance covered by particle from explosion. Relative expansion of universe as from Robertson-Walker Scale factor [6] is:

$$\iota_t = \iota_p\, a(t) \tag{8}$$

If particle travels a distance that is equivalent to ι_t (commoving distance from big bang) term in equation (8) then:

$$\frac{r}{2}\left(\sqrt{1-\left(\frac{v}{c}\right)^2} \right) - r_o = \iota_p\, a(t) \quad \Rightarrow \quad r = 2\gamma\left(\iota_p\, a(t) + r_0\right) \tag{9}$$

Here γ is $\left(1-\left(\frac{v}{c}\right)^2\right)^{-1/2}$ and ι_p distance at present time. In (9) provides the total distance travelled by particle '*P*' i.e. radius of expanded universe at certain time '*t*', as in scale factor $a(t)$. With these conventions of particles we proceed to know more about the state of particle with entropy.

3. NITTY- GRITTY OF ENTROPY OF THE UNIVERSE

[1] "The ultimate source of order, of low entropy, must be the big bang itself."

The whole universe is considered as an isolated system, which cannot exchange heat or mass with its surroundings. The universe is constantly losing usable energy and never gaining it. We logically conclude the universe is not eternal. The universe had a finite beginning -- the moment at which it was at "infinite entropy" (its most disordered possible state). *Thermodynamics first law states that total energy of the universe is constant* and t*hermodynamics second law states that entropy of the universe always increases* [7].With this background of entropy we will try to know about the entropy of universe and its relations with age of universe i.e. time. In initial stages of universe entropy is very high, with time, entropy decreases and it reaches to zero. Brian Greene in [1] showed symmetry between time and entropy as in figure 1. It means that the entropy and time in universe shows symmetry.

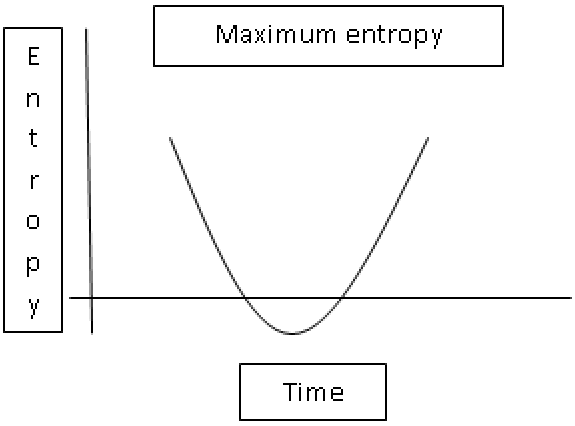

Figure 1:Symmetry between entropy and time of universe

The Big bang explosion increased the temperature of dense universe to very high that that produced large amount of heat. The infinitesimal entropy of the system can be given as:

$$dS = {}^{-dQ}\!/_{T} \tag{10}$$

Where *dQ (PdV)* is change in heat corresponding to temperature '*T'* and the total entropy of the universe is integration of such infinitesimal systems and is given by:

$$S = \sum_A S_A \tag{11}$$

Where '*A'* represents different types of particles say 1, 2, 3…, and '*S'* represents the entropy. In another way it is represented as

$$S = -\int_{T_1}^{T_2} Q\left({}^{1}\!/_{T}\right)\, dT \tag{12}$$

Where *dT* is the temperature change)

3.1 ENTROPY AT PARTICULAR TIME AND TEMPERATURE

"What is the origin of cosmological entropy?"

Entropy is defined as the measure of the unusable energy in a closed or isolated system. We have an expression [5] to determine the entropy of the universe at a particular time *t* of universe and given by:

$$S = A\left(3c^2/32\pi G_a\right)^{1/4}(t)^{-1/2} \tag{13}$$

Where, *S* = Entropy of universe.

c = velocity of light

G = Gravitational constant.

t = time of universe (age of universe).

A = a parameter with dimension $M^2L^{-3}T^2\Phi^{-1}$ (different type of particles)

By introducing Robertson- Walker scale factor with Hubble's constant in (13), we have:

$$S = A\left(3c^2/32\pi G_a\right)^{1/4}\left(\frac{a(t)}{\dot{a}(t)}\right)^{-1/2} \tag{14}$$

$$S = A\left(3c^2/32\pi G_a\right)^{1/4}\left(\frac{1}{H}\right)^{-1/2} \tag{15}$$

Here '*H'* is Hubble's constant. From (15) we can obtain a relation of entropy driven acceleration of universe

$$\frac{1}{H} = \frac{A^2}{S^2}\left(3c^2/32\pi G_a\right)^{1/2} \;(or)\; \frac{a(t)}{\dot{a}(t)} = \frac{A^2}{S^2}\left(3c^2/32\pi G_a\right)^{1/2} \tag{16}$$

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As from Table (1), we can see drastic change in entropy of universe at different instances of time. This drastic change in entropy is due to the acceleration of universe and formation of massive objects in it. Relativistic nature of entropy is shown in relation that obtained from (14) and (2):

$$S = A\left(3c^2/32\pi G_a\right)^{1/4}(\Delta t)^{-1/2}\left(1-\left(v/c\right)^2\right)^{-1/4} \tag{17}$$

(17) Can be interchanged to obtain a relation that determines time at certain given entropy of universe.

$$\Delta t = \frac{1}{S^2}\left(A^2\left(3c^2/32\pi G_a\right)^{1/2} \Big/ \left(1-\left(v/c\right)^2\right)^{1/2}\right) \tag{18}$$

$$t_1 = \frac{1}{S^2\gamma^2}\left(A^2\left(3c^2/32\pi G_a\right)^{1/2}\right) \tag{19}$$

Equations (13), (14), (15), (16) and (19) can be used successfully to calculate the entropy, the relative change in entropy, acceleration of the universe and age of the universe. From equations (7) and (19) the radius of expanded universe or distanced travelled by the particle (red shift) *'P '* with an acceleration equal to the rate of expansion of universe can be calculated as:

$$\frac{\frac{r}{2\gamma} - r_0}{u} = \frac{1}{S^2\gamma^2}\left(A^2\left(3c^2/32\pi G_a\right)^{1/2}\right) \tag{20}$$

$$r - r_0 2\gamma = \frac{2u}{S^2\gamma}\left(A^2\left(3c^2/32\pi G_a\right)^{1/2}\right) \Rightarrow r = \frac{2A^2u}{S^2\gamma}\left(3c^2/32\pi G_a\right)^{1/2} + r_0 2\gamma$$

$$r = \frac{A^2u}{S^2\gamma}1.3\times10^{13} + r_0 2\gamma \tag{21}$$

As the expansion of the universe continues its temperature decreases. To calculate the temperature at particular time [5] or at particular entropy or at particular acceleration of universe following relation were derived.

$$T = 1.52\times10^{10}\cdot(t)^{-1/2}\, Kelvins \Rightarrow T = \left((t)^{-1/2}\Big/G\right) Kelvins \tag{22}$$

$$T = \frac{1}{S\gamma\cdot 1.52\times10^{10}}\left(A^2\left(3c^2/32\pi G_a\right)^{1/2}\right)^{1/2} \tag{23}$$

$$T = \frac{GA}{S\gamma}\left(3c^2/32\pi G_a\right)^{1/4} \Rightarrow T = \frac{1.66A}{S\gamma^{1/2}} \tag{24}$$

The entropy, the age and Hubble's constant of the universe were calculated from equations (13), (14), (15), (16), (19), (22), and (24) at certain temperatures of universe, which are tabulated in table 1. The numerical values in table (1) are very much in agreement with the same values in the literature.It successfully provides the information about the age of universe which is equivalent to the Hubble's constant as quoted in [6]. the present age of universe is 13.7 billion years then its temperature is 0.7 $^*K$, entropy is $1.21\text{x}10^{-4}$ $J/^*K$ and Hubble's constant value is $4.33\text{x}10^{20}$ *s* i.e. equivalent to 13.7 billion years. With this we have established a relation between time of universe, entropy of the universe and temperature of the universe. Above established equations would be utilized in the next sections to know how entropy, time and temperature of universe effect the affect the gravity and space-time.This is possible only when above equations are linked with general theory of relativity.

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Table 1. This table consists of numerically calculated age of the universe, entropy of the universe and value of Hubble's constant at different temperature of the universe.(**A is a parameter with Dimension $M^2L^{-3}T^2\Phi^{-1}$.**)

Temperature (T) $(^\circ K)$	Time (t) in (seconds) Age of universe	Entropy (S) $(J/^\circ K)$	Hubble's constant (H^{-1})(Seconds)
10^{32}	$2.25\text{x}10^{-44}$	$\text{Ax}1.68\text{x}10^{28}$	$2.25\text{x}10^{-44}$
10^{11}	0.02	$\text{Ax}18.59\text{x}10^{6}$	0.018
10^{10}	0.2	$\text{Ax}5.63\text{x}10^{6}$	0.20
$3\text{x}10^{9}$	24.98	$\text{Ax}5.04\text{x}10^{5}$	24.98
$5\text{x}10^{7}$	$8.99\text{x}10^{4}$	$\text{Ax}8.40\text{x}10^{3}$	$8.99\text{x}10^{4}$
$4.42\text{x}10^{7}$(@)	$14\text{x}10^{9}$	Ax21.30	$13.98\text{x}10^{9}$
$9\text{x}10^{3}$	$2.78\text{x}10^{12}$	Ax1.51	$2.78\text{x}10^{12}$
273	$3.02\text{x}10^{15}$	Ax0.046	$3\text{x}10^{15}$
3	$2.50\text{x}10^{19}$	$\text{Ax}5.04\text{x}10^{-4}$	$2.498\text{x}10^{19}$
0.7	$4.32\text{x}10^{20}$	$\text{Ax}1.21\text{x}10^{-4}$	$4.33\text{x}10^{20}$
0	t=0	0	H=0

@. Age of the universe is in accordance with the Hubble's constant i.e. Age of universe $\approx \frac{a(t)}{\dot{a}(t)}$

4. SPACE -TIME, MATTER AND ENTROPY

[1] "Gravity is the most efficient generator of entropy in universe.

""Entropy is a property of matter and energy."

In the literature of astrophysics and cosmology, Einstein's equation in general theory of relativity is cornerstone. He formulated an equation that depicts relation between space-time geometry and energy. That equation [6] is as follows:

$$G_{ij} = -\frac{8\pi G}{c^4} T_{ij} \qquad (25)$$

Where,

$$G_{ij} = R_{ij} - \frac{1}{2} g_{ij} R \qquad (26)$$

R_{ij} is Ricci tensor, R is curvature.

g_{ij} is metric tensor.

T_{ij} is energy momentum tensor.

In this equation there are some first order equations that possess initial values in second order equations. Einstein's equation"00" is an initial value equation of scalar factor [6]. Then from left part we have:

$$R_{00} = -3c^{-2}\frac{\ddot{a}}{a},\ R = -\frac{6c^{-2}}{a^2}\left(a\ddot{a} + \dot{a}^2 + Kc^2\right),\ g_{00} = 1$$

$$G_0^0 = -3c^{-2}\frac{\ddot{a}}{a} - \frac{1}{2}\left(-\frac{6c^{-2}}{a^2}\left(a\ddot{a} + \dot{a}^2 + Kc^2\right)\right)$$

$$G_0^0 = \frac{3c^{-2}\dot{a}^2}{a^2} + \frac{3K}{a^2} \tag{27}$$

In the components of four-tensor T^{ik} i.e. energy momentum tensor, $c^{-1}T^{i0}$ is the density of the i^{th} component of four-vector p^i. Now initial value of energy momentum tensor is $T^{00} \approx c^2\rho_0$. Division of one tensor by another is not supported in general. This is because of the impossibility of knowing which component of the numerator is being acted upon the denominator in solving it. The only exception is division by a scalar. In this case, the tensor is simply being rescaled and each component of the original tensor is divided by the scalar value. That's why we took initial values of Einstein's equation.

Now Einstein's equation "00" is as follows:

$$\frac{3c^{-2}\dot{a}^2}{a^2} + \frac{3K}{a^2} = \frac{8\pi G}{c^4}\rho_0$$

$$\frac{\dot{a}^2}{a^2} + \frac{Kc^2}{a^2} = \frac{8\pi G}{3c^2}\rho_0$$

By differentiating above equation and taking ρ_0 as $p_0 = p_0(\rho_0)$ (which is relation between energy variation in volume and adiabatic expansion of perfect fluid) we have:

$$2\frac{\ddot{a}^2}{a} + \frac{\dot{a}^2}{a^2} + \frac{Kc^2}{a^2} = -\frac{8\pi G}{3c^2}p_0 \tag{29}$$

From equation (10) we introduce entropy term in (25) and also in Einstein's equation"00" (29), thus obtained result is:

$$R_{ij} - \frac{1}{2}g_{ij}R = -\frac{1}{4}\frac{A^4}{S^4a^2}T_{ij} \tag{30}$$

$$2\frac{\ddot{a}^2}{a} + \frac{\dot{a}^2}{a^2} + \frac{Kc^2}{a^2} = -\frac{1}{4}\frac{A^4}{S^4a^2}p_0 \quad \text{(Or)} \quad 2\frac{\ddot{a}^2}{a} + \frac{\dot{a}^2}{a^2} + \frac{Kc^2}{a^2} = -\frac{1}{4}\frac{A^4}{S^4a(t)^2}p_0 \tag{31}$$

Here Einstein's equation provides an origin for cosmological entropy as that expressed in above equations. Semi classical Einstein's equations were unable to provide entropy accompanying the production of matter. But above equation incorporates that notion and able to provide entropy accompanying the production of matter. Equation (30) gives a relation between gravity and entropy i.e. an inverse relation. If gravity at particular region in universe is more, then entropy at particular region will be less. Equation (30) & (31) gives generating equation for entropy of universe. From (31) we can obtain an equation for entropy, that as follows:

$$S^4 = -\frac{A^4}{4}\left(\frac{p_0}{2\ddot{a}^2a + \dot{a}^2 + Kc^2}\right) \tag{32}$$

Above equation interprets the behavior of entropy with respect to energy density and space time geometry. The term *($A^4/4$)* is some constant with dimensional formula $M^2L^{-3}T^2\Phi^{-1}$. Entropy is a parameter which naturally present in universe and it trigger the expansion & contraction of universe. In following paragraphs we will see how entropy and matter defines space geometry. Above equation is interpreted as:

$$S^4 = -\left(\frac{A^4}{4}\right)\left(\frac{p_0}{Kc^2}\right)\left(1 + \frac{2\ddot{a}^2a + \dot{a}^2}{Kc^2}\right)^{-1} \tag{33}$$

By expanding the right part in above equation, we get

$$S^4 = -\left(\frac{A^4}{4}\right)\left(\frac{p_0}{Kc^2}\right)\left(1+(-1)\frac{2\ddot{a}^2 a+\dot{a}^2}{Kc^2}+\frac{(-1)(-2)}{2!}\left(\frac{2\ddot{a}^2 a+\dot{a}^2}{Kc^2}\right)^2+\frac{(-1)(-2)(-3)}{3!}\left(\frac{2\ddot{a}^2 a+\dot{a}^2}{Kc^2}\right)^3+\ldots\right)$$

Above expansion is valid when $\left|\frac{2\ddot{a}^2 a+\dot{a}^2}{Kc^2}\right|<1$

$$S^4 = -\left(\frac{A^4}{4}\right)\left(\frac{p_0}{K^2c^4}\right)\left(Kc^2-2\ddot{a}^2 a+\dot{a}^2\right) \qquad (34)$$

Figure 2.Negative curvature in space time (K=-1)

Since K = +1, -1, and 0: are the values of curvature as described in [6]. Now we have only two possibilities of *K*. When *K=0* then entropy will be -∞, as per physics there is no -∞, so entropy is zero. If *K=-1*, then entropy will be positive. As a result above equation defines space as hyperboloid as it possess negative curvature i.e. *K=-1*. Thus entropy, geometry and matter in equation fortuitously defined space with negative curvature. These results with respect to the space-time, entropy, and temperature of universe governs the big bang, time of inflation, expansion of universe and contraction of universe (figure 4).

In nutshell, it is possible to explain the life of universe by using equation (34). Equation (34) is called as entropy generator equation. This equation thrive homogeneity, isotropy and contribute to the expansion of universe (figure 2). In figure 2, the black dot represents a system of particle that drifted along with the expansion of universe and current position of it shows its state in the universe. In the next section from the equation (34) which explains the life of universe, an attempt is made to know the genesis of time in universe.

5. GENESIS OF TIME

"If I can't picture time, I can't imagine time."

Numerical valuescalculated for entropy in table 1 shows that entropy of universe decreases with time due to decrease in temperature as from (10). From (30) & (31), as entropy of universe decreases effect of gravity increases. That effects total volume of universe and due to increase in gravity, universe get contracted to a point (30) i.e. *K=0* (zero curvature). At *K=0*state,the gravity, density and pressure would be very high. Equation (24) andnumerical values in table 1, as entropy

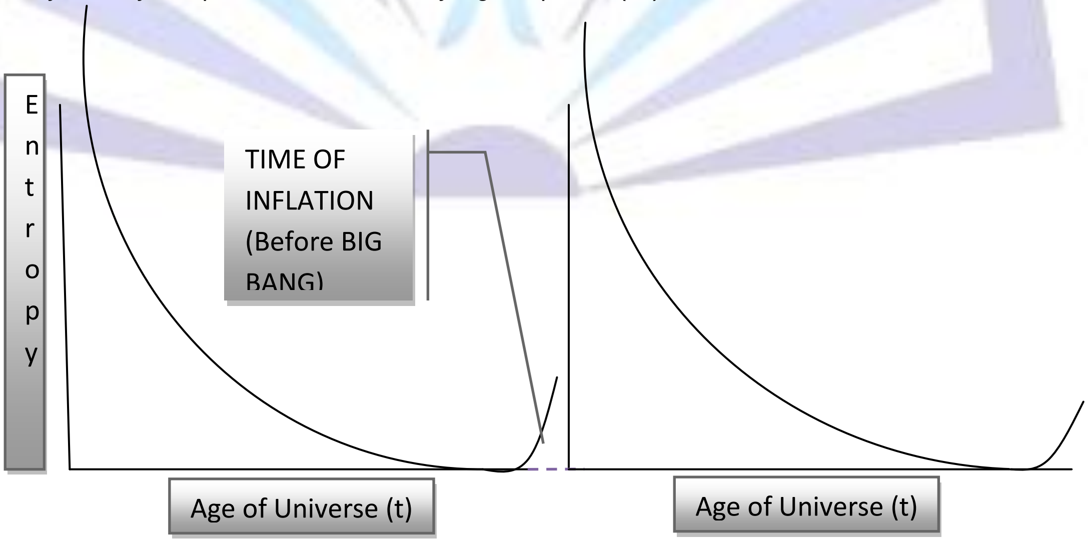

Figure 4.Plot between entropy of universe and age of universe (on the basis of table 1).

reaches to zero, then from Third law of thermodynamics the temperature of the universe approaches to absolute zero degree Kelvin. This much temperature is not experienced till now. All the matter in universe is concentrated at this highly dense point. Second Law of thermodynamics state that heat could never spontaneously move from a colder body to a hotter body. There is no trace for hotter bodies at this stage of universe. So, as a system approaches absolute zero, it should eventually draw energy from whatever systems are present near to it. In case of our universe it is not possible since there is no energy left at absolute zero state. If we think for a while it will draw from neighbor that is meaningless because in section 4 we assumed adiabatic expansion of universe and also we don't know anything about its neighbor.

Since absolute zero state of universe doesn't possess energy, therefore particles are at rest. Previously proper time of particle $\Delta t \rightarrow \infty$, but now Δt is zero i.e. $\Delta t = t_0$. In this circumstance the point at which particles concentrated with so much density felt a high pressure. This condition is in such a way that, a small disturbance changes the total configuration of that particular system i.e. Dominos effect. This particular situation is called as big crunch at which whole universe is crunched to a point*K=0*. As explained above whats the matter a minute disturbance that creeps toward big bang. In big crunch entropy of the system is zero. These are the conditions which explains singularity. Hence big crunch represents a singularity. Black hole is another example for singularity.

Absolute zero Kelvin is a temperature at which if any metal exist then, that conducts with zero resistance effectively. Such types of materials are known as superconductors. Generally absolute zero temperature is impossible practically. But that happens in the singularity which we defined previously i.e. in the case of big crunch and black holes. Overall what we want to say is "*big crunch acts like perfect superconductor*"**.** Superconductors conduct super currents at very low temperature. Since big crunch possess absolute temperature, as a result it also conduct super currents. This conductivity is known as superconductivity. Superconductivity excludes of interior magnetic fields. So this big crunch excludes of interior magnetic fields. Big crunch now consists of particles like fluxons (like mesons) around which super current exist. And the temperature at which big crunch becomes a superconductor is known as "*Critical Absolute Temperature" of Big Crunch denoted by "*T_{AB}"because it becomes so at absolute temperature.And big crunch adumbrated as in figure 3.

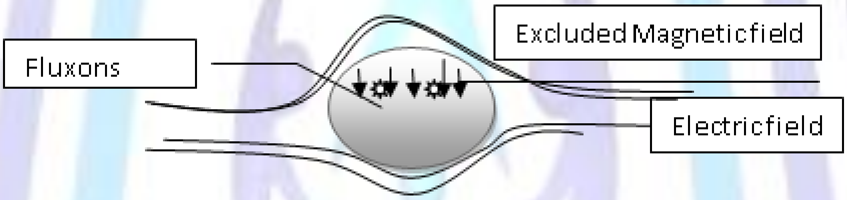

Figure 3. Big Crunch as superconductor (exhibiting properties of superconductivity)

Suppose a minute disturbance is introduced due to high pressure and repulsion between electric fluxons, then the superconducting stage would become unstable. This creates an electric flux in big crunch. These electric fluxons possess positive half spin, due to that they repel from each other. Along with high pressure this repulsion between electric fluxons increases instability. Since magnetic fluxonsposses negative half spin which were in excluded magnetic field, always attract electric fluxons. That further adds to instability. In big crunch the first fluxon particle repulsion establishes space and time coordinates. *This first repulsion between fluxons moves them to another fluxon thus time begins at this repulsion.*Space and time both took birthwith first repulsion between fluxons. "*Hence genesis of time occurs at first repulsion between fluxons"*. This instability at sudden increases exponentialy and rises the temperature of that highly dense state of crunched universe. Though there is exponential rise ininstability, the temperature doesn't change suddenlyfrom "*Critical Absolute Temperature" denoted by "*T_{AB}"and superconducting state continues because big crunch is a mixture of different particles. The time taken to overcome "*Critical Absolute Temperature"* is known as inflationary time or time of inflation. This inflation increases entropy of the system i.e. highly dense state. At sudden a big explosion takes place that is big bang. The time interval between Big Crunch and Big Bang is known as time of inflation (figure 4).

It is clear from above discussions that time of the universe starts with the first fluxon particle repulsion in superconducting state of Big Crunch. This sharply points the genesis of time of the universe. The very origin of the universe takes places before the inflationary period but the shape of universe still remains with curvature *K=0.* Only after big bang the curvature becomes *K=-1* and universe starts expands as explained in the previous sections.

6. CONCLUSION

Triumphantly we discussed topics relating entropy, temperature of universe, time, gravity, matter and Hubble's constant. We established equations relating entropy of universe, time of universe and Hubble's constant, andcalculated those parameters at different temperatures of universe. The numerical values of entropy of universe, time of universe and Hubble's constant at different temperatures of universe are in agreement with the numerical values in the literature. Table-1 provides information about age of the universe which is in accordance with the Hubble's constant i.e. Age of universe $\approx \frac{a(t)}{\dot{a}(t)}$. The symmetric nature of entropy and time gives an idea about how entropy and time of universe are related to each other. This relation is very much helpful in calculating the entropy of universe at certain temperature and age of universe. By using general theory of relativity we explained the relativistic nature of entropy which is new in scientific literature. We established relation between gravity and entropy in Einstein's field equation. From Einstein's equation "00" we obtained an equation that generates entropy and we can call equation (34) as entropy generator in space-time. Equation (34) shows the isotropic,and homogenous space with negative curvature (hyperboloid) that is most possible curvature of universee. This is possible only when Einstein's equation is represented in terms of entropy.

With the symmetric nature of entropy and time, and from entropy generator equation in space-time we tried to explain the genesis of time. Entropy, gravity and negative curvature of universe are main reasons that are responsible for accelerating and decelerating universe. At Big Crunch due to zero entropy it would have absolute zero temperature at which Big crunch acts likesuperconductor with "Critical Absolute Temperature". At this state due to very high pressure and superconductivity, creates a disturbance in the Big Crunch which creeps down through inflationary phase to Big Bang. With the *first repulsion between fluxons in superconducting state of Big Crunch due to minute disturbance leads to genesis of time of universe.*

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Author's biography with Photo

I'm Rakesh Teja Konduru,research scholar in Indian Institue of Technology Delhi. I finished M.Sc from Jawaharlal Nehru Technological University, Hyderabad in 2013. I started research on cosmology in B.Sc (2010). Since then I'm working in this field. I'm very much interested in topics like general relativity and higher dimensions. On higher dimensions topic I have presented papers in several national and international conferences in India. Along with these interests, I'm also working in the fields related to the weather forecasting and climate change. I did project in Space Application Centre, Ahmedabad in the field of weather forcasting. In the project we introduced a statistical model to forecast the thunderstorms. That model was successfully used in the launch of PSLV-C21 satellite in 2012 from Sriharikota by Indian Space Research Organisation. That model can be successfully utilized in the operational forecast of thunderstorms. Currently I'm working in the field of climate change and climate modelling in IIT Delhi.