

Sarkar Singularity in Gravitational Cosmology

Najmuj Sahadat Sarkar*

Department of Physics, Mahishadal Raj College, West Bengal, India

Abstract

In this paper I have tried to derive an equation of my own using Professor Ray Chowdhury's equation which shows the constructing state of the universe just like the Ray Chowdhury equation. Hubble expansion rate and time act as special factors in my equation. In short it says we may get a singularity in the distant future not only in past.

Keywords: Raychowdhury equation • Universe • Hubble construction rate • Time • Singularity • Penrose Diagram • Collapse

Introduction

From Einstein's equation, we know that our universe is expanding. Indian physicist Amal Kumar Raychoudhury gave a solution to Einstein's equation, which is known as Raychoudhury equation. The equation is in the following form:

$$\ddot{R} / R = -(4\pi G / 3)(\rho + 3p) \quad \text{Equation (1)}$$

Here, \ddot{R} = acceleration of the universe. R is system physical distance. G stands for the gravitational constant. ρ refers to the density of matter present in the system. p refers to the positive pressure of the substance present in the system. Now let's talk about what equation (1) actually means. The R/R term on the left represents acceleration. But the term on the right indicates something else. If both p and ρ are positive, i.e. greater than zero, then the value of $(\rho+3p)$ will be much greater than zero. But according to the right-hand side of equation (1) $(\rho+3p)$ outside this term has negative sign. So $[-(\rho+3p)]$ this total term will be less than zero. But R/R means Acceleration. R/R are not negative in general. So the entire term on the right-hand side represents attenuation. That is, if a system is considered, it cannot be stable. Due to increase in P and ρ , that means the system will start to compress or collapse [1]. The reason is also quite clear that increasing P and ρ means that the system will contract, which is what the Raychowdhury equation says. Take any system where matter is acting. Now positive gravitational pressure will act in the system in the presence of matter. After that the system starts to collapse due to presence of matter and squeezing into smaller and smaller volume. That is called Singularity we can easily analyze it from Penrose diagram. This is the key point of the Ray Chowdhury equation.

Description

The equation says exactly the same thing. Although the equation I tried to explain is a different analogy, which analyses the singular state. Here I have used H and t. I got the idea from my paper "A Mathematical proof of the big crunch" (Journal of Physics and Astronomy, Vol 11/Issue 6). There was a term, which went something like this-

*Address for Correspondence: Najmuj Sahadat Sarkar, Department of Physics, Mahishadal Raj College, West Bengal, India, Tel: 6295454694, E-mail: sarkarlimon794@gmail.com

Copyright: © 2023 Sarkar NS. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Received: 03 August, 2023, Manuscript No. jaat-23-110423; **Editor Assigned:** 05 August, 2023, PreQC No. P-110423; **Reviewed:** 17 August, 2023, QC No. Q-110423; **Revised:** 22 August, 2023, Manuscript No. R-110423; **Published:** 29 August, 2023, DOI: 10.37421/2329-6542.2023.11.266

$$\dot{R} = -3\eta t^2 \times R \quad \text{Equation (2)}$$

This means $V = \dot{R} = dR/dt$, which is working as Hubble Velocity. As mentioned earlier, R is the physical distance of the system. t is the evolving time of the system. And η is a constant. Equation (2) looks a lot like $V = HR$ or Hubble Law where

$$H = -3\eta t^2 \quad \text{Equation (3)}$$

Derivative of equation (2) with respect to t;

$$R = d\dot{R}/dt = -[6\eta tR + 3\eta t^2 \dot{R}] \quad \text{Equation (4)}$$

On the right side of equation (4) we get R, Common. $d\dot{R}/dt = -R[6\eta t + 3\eta t^2 \dot{R}/R]$

Or,

$$1/R(d\dot{R}/dt) = -[6\eta t + 3\eta t^2 \dot{R}/R] \quad \text{Equation (5)}$$

Another thing, $H = -3\eta t^2$ Or, $H^2 = 9\eta^2 t^4$

Or, $H = \pm 3\eta t^2$

But I am willing to work with positive values of H. Now substituting the value of H instead of $3\eta t^2$ in equation (5) we get-

$$(1/R)(d\dot{R}/dt) = (6\eta t + H^2)$$

$$\text{Or, } R/R = -(6\eta t + H^2) \quad \text{Equation (6)}$$

Equation (6) produces a singular situation. how? First, the term on the left side of equation (6) refers to acceleration [2]. That is, I am talking about the term R/R. Now come to the term on the right. Since; -

$$t > 0 \quad H > 0$$

So $(6\eta t + H^2) > 0$ will be.

But $(6\eta t + H^2)$ has negative sign before this term. That is, $-(6\eta t + H^2)$, so the entire term will have a large negative value. As H and t increase, the term on the right-hand side will have a large negative value. But the acceleration term is not negative. This means that the system we consider is decelerating. That is, the system is generally not stable. Due to deceleration, the system will eventually form a singularity before contracting. In a way, H will act as the Construction Rate in the far future. I think H and t their direction is always one way [3]. But currently no singular situation is emerging. There is still time for that to happen. My equation is not a special equation. This is a variant of the Raychowdhury equation. Only I am giving more importance to H and T here. In short, matter can indirectly affect the rate of expansion of a system. Since the Hubble Expansion Rate will act as the Contraction Rate in the distant future, we can expect a Possible Big Crunch. As said earlier $H < 0$ cannot be. A long time ago we got a singularity, just like that I think we will get it in the future and this cycle will continue forever. Let's see if my equation is Dimensionally Consistent. First we apply $[\eta]$ to get the units of η . Here $H = 3\eta t^2$ is a number of 3, which is not so important to us. Then we can say;-

$$[H] = [\eta][t]^2$$

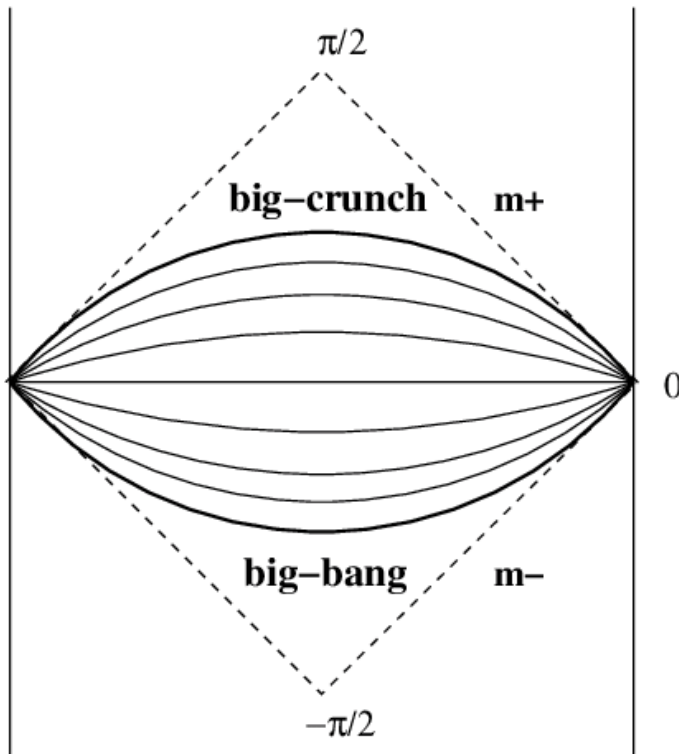


Figure 1. Penrose diagram for a contracting system.

$$\text{Or, } [\eta] = [H]/[t]^2$$

$$\text{Or, } [\eta] = \text{km/s}^2/\text{Mpc}$$

The units of the terms on the right-hand side of equation (6) will be,

$$[\eta][t] + [H]^2 = \text{km/s}^2/\text{Mpc} + \text{km}^2/\text{s}^2/\text{Mpc}^2$$

$$= (\text{km/s}^2/\text{Mpc})(1 + \text{km}/\text{Mpc})$$

$$= (\text{km/s}^2/\text{Mpc})(\text{Mpc} + \text{km})/\text{Mpc}$$

Now we can apply a convention. $1\text{Mpc} \gg 1\text{km}$

From here it can be said, $(\text{km/s}^2/\text{Mpc})(\text{Mpc}/\text{Mpc}) = \text{km/s}^2/\text{Mpc}$

Now let's consider the term on the left side i.e. R/R .

$$[R] = [dv/dt] = \text{km/s}^2 \text{ Again, } [R] = \text{Mpc So,}$$

$$[R]/[R] = \text{km/s}^2/\text{Mpc}$$

That is, the unit on the right side and the unit on the left side are equal to each other. My equation is completely Dimensionally Consistent [4]. Now I want to find the value of η at $H=3\eta t^2$. First, the current value of $H=70 \text{ km/s/Mpc}$ and the current value of $t, t=5 \times 10^{17}\text{s}$. So:-

$$H=3\eta t^2$$

$$\text{Or, } \eta = H/3t^2$$

$$\text{Or, } \eta = 70/(75 \times 10^{34})$$

$$\text{Or, } \eta = 9 \times 10^{-35} \text{ Km/s}^2/\text{Mpc}$$

In this case η is a constant, whose value is very close to zero (Figure 1).

Conclusion

My equation is also a 2nd order differential equation like Prof. Raychoudhuri's. And just as his equation had a negative sign on the right-hand side, my equation has a negative sign on the right-hand side, which is very useful for contracting systems. But the equation implies something quite unstable. If there is enough matter in the system, the combined gravity of the matter will compress everything back into a singular state. And to explain all those conditions, Sarkar singularities are needed. Because the hubble expansion rate will act as the constructing rate in the far future. This construction is only for the presence of matter. This does not mean that $H < 0$. This is not possible, because H is always positive. But the presence of matter is somehow generating this construction. Sarkar Singularity indirectly reveals the truth of Raychoudhuri equation. Just as we got the Singularity in the past, we will surely get the Singularity in the distant future.

Acknowledgement

None.

Conflict of Interest

None.

References

1. Raychaudhuri, Amalkumar. "Arbitrary concentrations of matter and the Schwarzschild singularity." *Phys Rev* 89 (1953): 417.
2. Raychaudhuri, Amalkumar. "Condensations in expanding cosmologic models." *Phys Rev* 86 (1952): 90.
3. Raychaudhuri, Amalkumar. "Relativistic cosmology. I." *Phys Rev* 98 (1955): 1123.
4. Raychaudhuri, Amalkumar "Relativistic and Newtonian cosmology." *Z Astrophys* 43 (1957): 161.

How to cite this article: Sarkar, Najmuj Sahadat. "Sarkar Singularity in Gravitational Cosmology." *J Astrophys Aerospace Technol* 11 (2023): 266.