A MODEL OF UNIVERSE BASED ON TACHYONIC DARK MATTER

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ABSTRACT

As we all know tachyons are hypothetical particles. Most physicists believe that tachyons do not exist as it will break principle of causality. But those who believe that tachyons exist argue that it is a ‘difficult to discover entity’ and that is the reason why we do not know about their existence. They are considered to travel back in time. Here in this article, a thought experiment has been described and through the thought experiment, a model has been derived. The model seems to logically explain unanswered questions like the dark energy, dark matter and accelerated expansion of universe. The model tells that the cosmological constant may be dynamic. It may be useful as a simple model to give a direction for further research.

Keywords: dark energy; dark matter; accelerated expansion; cosmological constant

In the field of observational cosmology, the questions which we do not have an answer is about the dark energy, dark matter and accelerated expansion of universe. In this article, a hypothetical model has been proposed which seems to explain all three of them. We are not knowing any particle moving faster than light. The only thing we know is that our universe expands faster than light. The hypothetical model is based on the assumption that dark matter consists of tachyons.

Tachyons are hypothetical particles. They are considered as negative energy particles. Particles which travel backward in time. We know from the theory of relativity that, $E^2 = p^2 c^2 + m^2 c^4$. This equation has two solutions, a positive solution and a negative solution. The negative energy particles travel backward in time or they get absorbed even before emitted. Let us consider a thought experiment. The tachyons were formed as a result of a high energy blast. The tachyons will be absorbed back in rather than getting emitted even before blast occurs. Let us assume the blast wave propagated outside even faster than tachyons. It will not be propagated outwards but will be rather absorbed within. But since it is slower than the whole blast wave, the particles will have an existence and it will be observable that the tachons will be travelling to the origin of the blast (fig.1). Let us extrapolate the same thing to the universe.

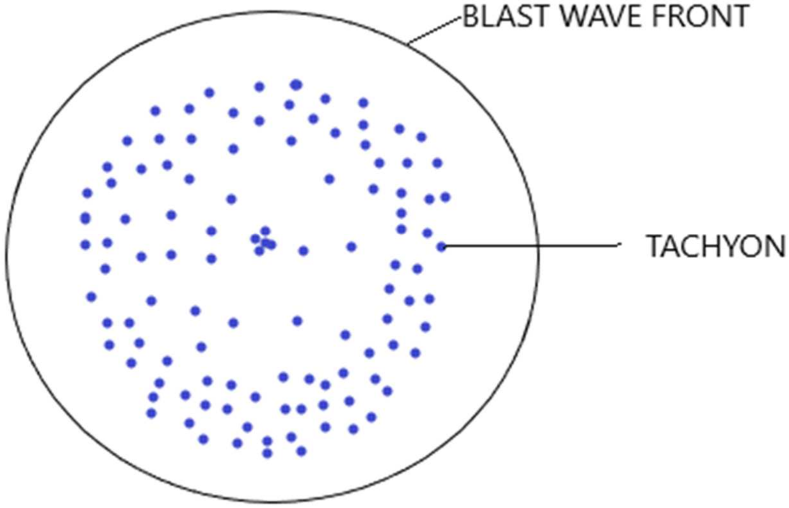

Fig 1. Tachyons travelling to the origin of high energy blast (Wave travels faster than tachyons)

Let us assume that faster than light particles formed during big bang[1]. As we all know cosmic inflation was faster than light. It is supposed to be a mere expansion of space time. Let us assume that it occurred faster than tachyons. Then the tachyons formed might have started travelling towards the centre of universe because faster than light particle travel backwards. They are supposed to travel into the origin of the blast or big bang. They might have started exerting a force opposite to the big bang. That may be the reason why the expansion of universe slowed down after the cosmic inflation in big bang [2,3]. These particles might have been accelerating for four billion years. Once their acceleration became more than the negative acceleration due to the residual force of big bang, they might have started moving from periphery to the centre. They may be exerting a force towards centre of universe on the cosmic objects. This may be what we call dark matter[4,5]. Since the energy density of such particles is decreasing from the periphery of the universe, the residual force of big bang is getting upper hand and the residual big bang force may be our dark energy. That may be the reason why we see the accelerated expansion of the periphery of universe more than the speed of light. The space where the acceleration due to dark matter is negated by the residual force of big bang, the universe will expand slow. Dark matter may be causing an accelerated contraction in the centre of universe. The increased gravitational energy of cosmic objects by virtue of getting closer may initiate a big crunch (all the mass getting back to the original state). Today we know that black holes can explode[6]. The matter which will remain after big crunch will be like a large black hole. So, such an explosion of the big black hole may be the big bang we are calling. If this hypothesis is true, then the universe is in an oscillation between big bang and big crunch.

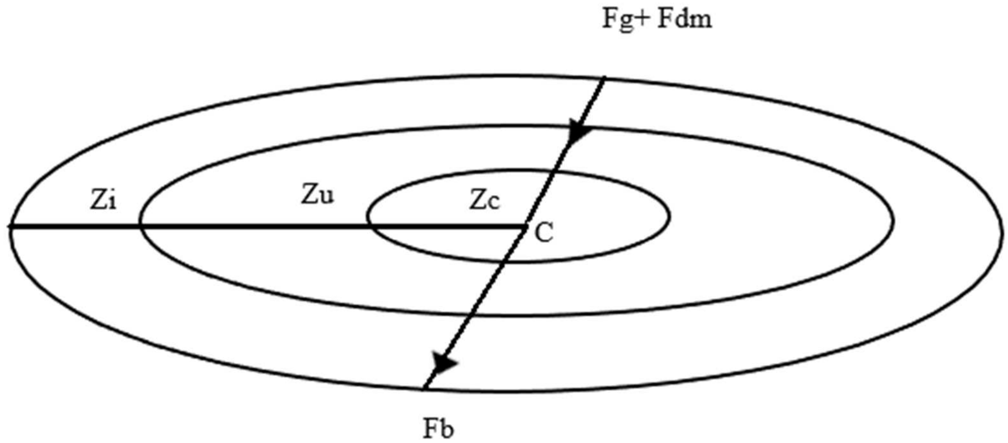

Fig 5. A hypothetical 2D representation of the model of universe

The above figure is a hypothetical representation of universe divided into three zones. A zone of accelerated expansion (inflation) or Zi, a zone of relatively uniform expansion, Zu and a zone of accelerated contraction Zc. C is the centre of universe. Recent observation is that the accelerated expansion of universe is at different rates in different directions[7]. This model can explain such an observation. If earth is located at zone Zu, the observers will see the expansion at different rates and significant difference will be appreciated. If we are placed in the farthest part of zone Zu, the zone of accelerated contraction may be out of our observable universe. The forces acting on universe are represented as due to dark energy (Fb), due to gravitational energy (Fg), due to dark matter (Fdm) and other potential forces represented as Xp. Therefore, Fb > Fg + Fdm + Xp is the present scenario. Once the matter come together, the gravitational potential energy of universe may start to increase. Till that time, the universe will have a phase of expansion. Ultimately, the energy of the total system will be conserved. We can prove this hypothesis by ascertaining whether there is a gradient of dark matter density in the universe. Let us examine the Einstein's equation representing universe, $R\mu\nu - 1\ 2\ Rg\mu\nu + \Lambda\ g\mu\nu = 8\pi GT\mu\nu$. Here Λ represents the cosmological constant. In an expanding universe value of Λ is positive. In a shrinking universe, the value is negative. But in this model, the space time is expanding at present and will start shrinking in future. So in our model, the cosmological constant is dynamic.

CONCLUSION

A thought experiment was conducted on the motion of tachyons. As a result, a hypothetical model was derived. The hypothetical model can explain the dark matter, dark energy and the accelerated expansion of universe. This model gives a dynamic cosmological constant. This model may be used as a model for explanation of cosmological observations in universe. But the existence of tachyons has to be proved experimentally for this model to be proven valid.

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