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# A tachyon interaction model that explains many of the mysteries in physics

## Abstract

It is theorized that space is filled with a gas-like fluid of neutral tachyons that do not interact directly with conventional sub-light matter except via gravity. As these tachyons collide, they briefly interact, giving rise to short-lived virtual particle pairs whose effects can be observed. The tachyons can account for many unexplained phenomena such as dark matter, large-scale variations in the fine structure constant, $\alpha$, and the acceleration in the expansion of the universe as well as removing the need for renormalization in quantum electrodynamics.

## INTRODUCTION

There are a number of poorly explained phenomena in modern physics, missing mass on the galactic scale, the accelerated expansion of the universe, incompatibility of relativity and quantum mechanics (collapse of quantum states), and the need for renormalization in quantum electrodynamics. A number of theories have been proposed to resolve these issues such as modified Newtonian mechanics (MOND)[1-4] dark matter[5], string/membrane theory[6] and loop quantum gravity[7]. Each provides partial solutions to these issues but none completely explains the observations.

A tachyon interaction model is proposed whereby the Universe is filled with a gas-like state of neutral faster-than-light (tachyonic) particles[8-10] that interacts with normal matter only through gravity and whose interactions give rise to short-lived virtual particle pairs that do have an affect conventional sub-light matter. This theory explains many of the above-mentioned phenomena while being consistent with reported experimental observations.

## DISCUSSION

An accepted basic rule of the theory of relativity[11] is that nothing can travel faster than light. However, further analysis shows that a correct statement of the theory is that nothing moving slower than the speed of light can move faster than light while anything moving faster than light cannot move slower than light. It would seem that there is therefore no direct interaction between objects moving slower than the speed of light with objects moving faster than the speed of light. Indeed, attempts to observe such interactions in the past have failed. Even so, a patent has been published purporting to generate tachyons[12]. However, the accepted model for black holes states that a singularity at the center of a black hole interacts gravitationally with objects outside the black hole's event horizon. This is despite the fact that the event horizon is equivalent to the barrier posed by the speed of light. If black-hole theory is acceptable then it can therefore be assumed that objects moving faster than the speed of light would interact gravitationally with objects moving slower than the speed of light.

A tachyon particle[8-10,13],[9] if it exists, is a particle that travels faster than light. It has many properties that are very far from our intuitive experience. The observed mass ($m$) of an object is related to its rest mass ($m_0$) by equation 1, where $v$ is speed and $c$ is the speed of light.

$$m = \frac{m_0}{\sqrt{1-\frac{v^2}{c^2}}} \quad (1)$$

For a tachyon, the denominator in equation 1 is imaginary. Since the observed mass must be real, the rest-mass must be imaginary. If we were to travel at high speed, but less than the speed of light, then we would experience time passing slowly and distances being shortened. To a tachyon observer, time would pass at an imaginary rate and distances would become imaginary but the tachyon would experience a real velocity (calculated by dividing imaginary time by imaginary distance) that is less than the speed of light. Such particles would gain speed as they lose energy and lose speed as they gain energy but can never reduce their speed to below that of light. They cannot be charged otherwise they would emit Cherenkov radiation and speed up to infinite speed and zero energy. Actually, the minimum energy is not quite zero due to zero-point energy therefore maximum speed is not infinite although it would be extremely fast. Even neutral tachyons are theorized to lose energy through gravitational Cherenkov radiation but the effect is very small effectively making neutral tachyons stable on the timescale of the age of the universe[14]. Calculations show that tachyons would lose energy and quickly accelerate to effectively infinite speed due to the early expansion of the Universe[15]. However, this applies to tachyons that do not interact with each other and ignores tachyons coming from outside the observable universe. In the hypothesis presented here, tachyons can enter from outside the observable universe since they travel faster than light. Therefore they are unaffected by the expansion of the Universe prior to entering it and can still be present with finite speed and non-zero energy.

In this paper, it is theorized that neutral tachyons exist and fill space like a gas and interact by colliding with each other. However, they areable to pass through ordinary matter interacting only gravitationally with it.

Tachyons colliding nearly head-on would briefly be travelling slower than the speed of light. However, while slower, they would have to have imaginary observed mass. Tachyons colliding at shallower angles may be seen to observers moving at high sub-light speeds to collide at greater angles. Therefore, different observers will see different tachyon collisions briefly travelling slower than light. This is just what is inferred by models invoking virtual particles. A particle and its antiparticle can come into existence for a brief period time before annihilating. The effect of tachyon collisions with sub-light matter has been considered previously[9]. A tachyon colliding with a sub-light particle looks like two tachyons colliding with a sub-light particle and disappearing causing a change in momentum of the sub-light particle. Such collisions are not observed in normal circumstances[9]. However, this is consistent with the emergence of a real particle emerging from the interaction of virtual particles with a strong field. The tachyon collision model is a simpler model than that proposed in membrane-theory where coincident (or colliding) branes and anti-branes have a tachyonic field excitation that cancels out the tension in the branes[16]. This is one form of tachyonic field condensation that produces conventional particles[17].

Virtual particles can only exist for a period such that the product of their momentum and distance travelled at the speed of light is less than the Plank constant. It is convenient to consider the mass of a virtual particle as imaginary. Conventional quantum electrodynamics gives rise to infinite series that must be renormalized to remove infinites[19]. The tachyon interaction theory provides a more elegant solution by producing only a finite number of tachyon collisions and therefore a finite number of virtual particles. This removes the need to renormalize infinities.

This single theory would lead to a number of interesting phenomena that are currently explained by multiple theories and observations: virtual particles, Hawking radiation[18], quantum electrodynamic renormalization[19], modified Newtonian dynamics (MOND)[1,2]. dark matter[5]. dark energy[20], the accelerating universe[21,22], phantom energy[23] and quintessence[24].

In effect, tachyon collisions are a hidden variable in quantum theory. It is widely accepted that hidden variables cannot explain all of quantum theory and non-local phenomena[25] but that does not preclude the existence of some hidden variables.

Tachyons travelling at finite speeds in a tachyon gas would be attracted gravitationally to large scale concentrations of matter, possibly on the scale of galaxies or larger. This would apparently reinforce gravitational attraction between conventional matter at large scales meaning that the excess density of tachyons is a candidate for the missing dark matter[5].

In the early Universe, the density of conventional matter was higher so the concentration of tachyons would also be expected to be higher. This would lead to greater gravitational attraction and more virtual particles. The reduced concentration of tachyons today may affect the acceleration in the expansion of the Universe. These virtual particles may affect many things such as the fine structure constant, $\alpha$, that is reported to vary over very large distances[26-29]. These observations are still controversial. However, the original report of variations across the Universe is 6 ppm. From this observation, one can estimate the density of tachyonic matter. Given that known matter in the universe accounts for 30% of the gravitational attraction and the other 70% is excess tachyons that account for 6 ppm of the total tachyon density, then the mean tachyon density is $4 \times 10^5$ times the mean density of known matter in the Universe. Of cause, this is a very rough estimate.

Tachyons can travel through black holes and beyond the observable limits of the universe. A tachyon collision with certain orientations on the event horizon of a black hole would give rise to Hawking radiation by generating a virtual particle pair that comes into permanent existence by extracting energy from the black hole. It should be noted that black holes and Hawking radiation[18], while widely accepted to exist, have never been directly observed and so remain theoretical entities.

Measurements of type Ia supernovae show that the expansion of the universe is accelerating[21,22]. This acceleration is currently explained by a number of theories such as dark energy[20], phantom energy[23] and quintessence[24]. Reduced tachyon density in the mature universe allows the universe to expand faster today when it is less dense than it was in the past. This means that the acceleration will become less in the future since most of the excess tachyon density has dispersed compared to the young universe. This means that there would be no big rip[23] but rather the universe expands indefinitely with a gradual decrease in acceleration. Current measurements are insufficient to differentiate between these two scenarios[30].

Variations in the tachyon density would affect everything that invokes virtual particles, electrical and magnetic attraction, electromagnetic induction, strong and weak nuclear force, quantized emission of photons, the Casimir effect, van der Waals forces and the fine structure of electromagnetic spectra.

A major criticism of this theory would be that the existence of tachyons negates the principle of causality. However, tachyon interaction theory with a nearly uniform and random distribution of tachyons would, for all intents and purposes, yield a universe in which the causality principle is generally obeyed just as we observe. There are a number of other theories being seriously considered by the scientific community that break the causality principle. For example cosmological inflation[31] is faster-than-light movement that contravenes the causality principle. Indeed, there is no proof in physics that time has to always travel forward and it has been suggested that the universe condensed from higher dimensional states that did not have a time-directionality.

It is not certain that the tachyon interaction theory actually contravenes causality. Published analyses of tachyons propose that if a particle appears to travel backwards in time it is equivalent to a particle of negative mass-energy travelling forwards in time[8]. Since negative mass-energy has never been observed it is more reasonable to propose that any tachyons theorized to travel backwards in time have negative mass-energy and can be reinterpreted as tachyons of positive mass travelling forwards in time. An example in the literature is of a hypothetical collision between a tachyon and a sub-light particle, which does not occur according to the tachyon interaction theory nor has it been observed. Under certain conditions, this hypothetical collision yields a negative mass-energy tachyon moving backwards in time. This can be reinterpreted as two positive mass-energy tachyons colliding and combining with the sub-light particle, a model that does not contravene causality. Therefore the tachyon interaction theory does not necessarily preclude causality.

## CONCLUSIONS

The tachyon interaction theory proposes that a gas-like state of interacting faster-than-light particles pervades the universe. It is proposed that these particles interact gravitationally with conventional matter and, when they collide, indirectly *via* virtual particles. This is a single hypothesis that explains a wide variety of physical phenomena on all scales including large scale gravitational anomalies and virtual particles that were previously explained by multiple and differing theories.

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