

## Time, Dark Matter and Einstein's Greatest Mistake

By Michael Spears.

### Abstract:

In the course of this paper I will seek to give a new explanation of two phenomena predicted by Albert Einstein in his theory of General Relativity, namely changes in time in different gravitational field strengths, and gravitational red shifts. Both of these phenomena have been confirmed by experiment, but I will show that although Einstein may have come to the correct conclusions about changes in time and red shifts in due to gravity it is possible that something other than what he explained is happening. The purpose of this paper is not to attempt to poke holes in the theory of General Relativity, rather to propose a new model for the two phenomena mentioned above.

### Aim:

To develop a new explanation for observed gravitational red shift and changes in measures of time in different gravitational fields, based on confirmed conclusions of General Relativity.

### Introduction:

According to Einstein's theory of General Relativity "in every gravitational field, a clock will go more quickly or less quickly, according to the position in which the clock is situated (at rest)". If one has two clocks, one clock situated in a stronger gravitational field, and the other in a weaker gravitational field, the clock in the stronger gravitational field goes at a rate permanently slower than the clock in the weaker gravitational field.<sup>Reference 4</sup>

Furthermore, in the theory of General Relativity Einstein predicted a "displacement of spectral lines towards the red" when the light measured comes from an object with a stronger gravitational field, and he proposed testing this experimentally as a proof of Relativity. In his words "a displacement towards the red ought to take place for spectral lines produced at the surface of stars as compared with the spectral lines of the same element produced at the surface of the earth".<sup>Reference 4</sup>

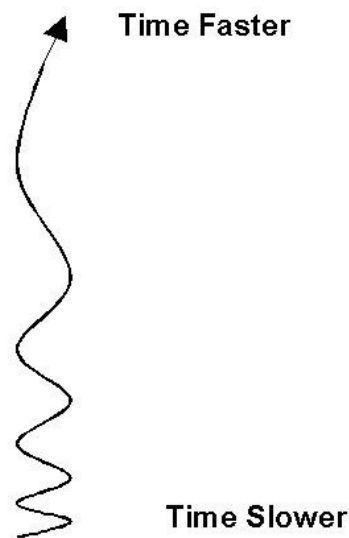
According to Stephen Hawking, Einstein proposed that light loses energy as it leaves a strong gravitational field and enters a weaker gravitational field due to gravity, causing time to appear slower closer to larger bodies of mass (like the earth, for example). This theory was tested in 1962 when two very accurate clocks were placed at the top and the bottom of a water tower. The clock at the bottom was found to run slightly slower than the clock at the top, confirming Einstein's prediction.<sup>Reference 2</sup>

I propose that although Einstein was correct in his prediction, there is an explanation for this experimental result which contradicts one of the theory of Relativity's two postulates "The speed of light in a vacuum is the same in all inertial frames of reference and is independent of the motion of the source." I wish to propose that although the speed of light in a vacuum *appears* constant, this may not necessarily be the case.

**Theory:**

Let us exaggerate the effects of this gravitational red shift and draw a diagram of these two (confirmed) proposals from General Relativity... [See Figure 1]

**Figure 1: Light Loses Energy As It Leaves A Stronger Gravitational Field & Enters A Weaker Gravitational Field.**



I would like to propose an alternative explanation for these two results from the theory of Relativity, an explanation that becomes apparent from visualising the situation.

What if, instead of remaining constant, light accelerates as it leaves a stronger gravitational field and enters a weaker gravitational field, proportional with an increase in the rate at which time advances?

Let us first develop a new definition of time, or rather, let us introduce a concept with a definition, "the speed of time". Let us measure the "speed of time" in the S.I. units seconds/earth seconds, or  $s/s_E$ , where we could take an "earth second" to be a second as measured from a particular point on the globe, for example we could make an "earth second" to be a second as measured at sea level on the equator. So if the "speed of time" is greater in a particular place, then time is moving faster at that location.

The "speed of time" could now be defined as representative of the ease with which mass and energy moves through space. If the "speed of time" is greater, i.e. if time is faster, then mass and energy move more easily through space. If time is faster, there

is less resistance to the motion of mass and energy through space. Consider this, if time is faster, chemical reactions happen faster, flora and fauna age faster, our brains work faster, is it not possible that light also moves faster?

*[Note: Why there is less resistance to the motion of mass and energy through space in weaker gravitational fields is a subject for a future paper and will not be covered here. Suffice to say that this is an effect of the curvature of space.]*

According to the above definition of time, any increase in the speed of light in a vacuum would be unnoticeable because the timing mechanism we are using to measure the speed of light in a vacuum would also move faster. Thus by this definition of time, the speed of light in a vacuum can appear to remain constant (*and it is common knowledge that by all observations the speed of light in a vacuum does appear to remain constant*) when in fact the speed of light in a vacuum is not constant. However, there is one way that an observer could notice a change in the velocity of light, and that is by the red/blue shift that accompanies this change in the velocity of light.

First let us introduce a new definition, “the speed of light as measured from the perspective of someone on earth”, and give it the value  $c_E$  measured in the S.I. units of metres/earth second or  $m/s_E$ . Let us now consider the situation where light is leaving the surface of the earth, and consider also the proposal that  $c_E$  increases gradually as light leaves a stronger gravitational field and enters a weaker gravitational field and think about what might happen if light does indeed accelerate as it leaves the surface of the earth. If  $c_E$  was to gradually increase as light leaves the surface of the earth, one would definitely expect the wavelength to increase proportionally to this increase in the speed of light, due to the first law of thermodynamics. Since the energy of light is given by the relation  $E_E = hf_E$  and  $c_E = \lambda f_E$ , (*where energy, frequency and the speed of light are measured relative to the S.I. units of “earth seconds”*) if  $c_E$  increases, then for the energy of light to remain constant  $f_E$  must remain constant, this is achieved by an increase in wavelength. This increase in wavelength does create the false impression that the energy of light decreases as it leaves a stronger gravitational field and enters a weaker gravitational field, however I am proposing that this is simply an illusion due to the increase in the “speed of time”, that is, if one takes the perspective of a stationary observer in the stronger gravitational field. If one were to follow the beam of light one would notice the energy decreasing, but if one remains in the same inertial reference frame then one would observe that the velocity of light increases, the wavelength of light increases proportionally and the frequency (and therefore the energy) of light remains constant.

If a second (for example) becomes shorter, but the velocity of an object being observed increases proportionally, then the velocity of the object can appear to remain constant because the distance it travels in this shorter second will be less than the distance travelled in a longer second. So if light were to accelerate proportional to an increase in the “speed of time”, this change in velocity would be unnoticeable, since what one refers to as a second (for example) has become shorter, and less distance can be travelled by light in a shorter period of time. Therefore, the only way that this increase in the velocity of light would be observable would be due to the resultant red shift, which would be caused by the energy of light remaining constant as its velocity

increases. (*Of course, this is from the perspective of an observer in a constant inertial reference frame.*)

This hypothesis for these two experimental results can be easily justified, although it seems unusual that light may accelerate as it leaves a stronger gravitational field rather than decelerate, in fact this proposal could be expected from the first law of thermodynamics and from the equation for the momentum of light. The first law of thermodynamics states that energy can neither be created nor destroyed, but can only be converted to other forms of energy. Therefore, one would expect that a beam of light leaving a strong gravitational field would not lose energy due to gravity, since the “lost” energy of the light would have to be converted to another form of energy, and the energy of light is given simply as  $E = hf$ , there is no gravitational potential energy of light, the energy of light is based solely on its frequency. There is another characteristic of light, however, that should be taken into account, an equation that Einstein developed,  $E = pc$ . Rather than the traditional equations, let us consider these equations from the perspective of someone on earth, so we will use  $E_E = hf_E$  (*Note: Planck’s constant  $h$  is a constant independent of the “speed of time”*) and  $E_E = p_E c_E$ . From the perspective of an observer on the surface of the earth, if the energy of light remains constant as light leaves the surface of the earth, but the velocity increases, then the momentum of light must decrease due to gravity since the momentum of light is inversely proportional to velocity. So although the acceleration of light as it leaves a stronger gravitational field and enters a weaker gravitational field seems unusual at first, actually it makes a lot of physical sense, since the velocity of light increasing while the energy remains constant means that the momentum of light decreases due to gravity.

The idea that although light does not experience acceleration due to gravity, but rather travels at different velocities dependent on the strength of the gravitational field may seem unusual since it is known that the path of light can be bent by gravity. This is justified by the proposal that the momentum of light changes due to gravity, as explained above. So although light does not accelerate due to the effects of gravitational acceleration, the path of light could theoretically be bent by a change in the momentum of light due to gravity.

So now, if we interpret the “speed of time” to be representative of the ease with which mass and energy moves through space, and if we propose that light accelerates as it leaves an area where time is slower and enters an area where time is faster, we would then infer that objects of mass would do likewise. Is there any evidence for such a proposal?

If we take a varying light speed in different gravitational fields into account when considering Einstein’s energy/mass equivalency equation,  $E_E = m_E c_E^2$ , then for the energy of an object of mass to remain constant, by the first law of thermodynamics, when  $c_E^2$  increases,  $m_E$  must decrease. Now considering Kinetic Energy, if Kinetic Energy =  $\frac{1}{2} m_E v_E^2$  and  $m_E$  decreases, then  $v_E^2$  must increase proportionally. After all, what is mass but a measure of the energy required to move an object through space? So not only would light travel at a faster velocity in a weaker gravitational field (from the perspective of an observer on Earth) but objects of mass would also travel faster, since their mass would decrease (from the perspective of an observer on Earth).

When the rotational velocities of galaxies was first studied, it was discovered that stars on the outskirts of galaxies are moving too rapidly to be held together by gravity. Astrophysicists have therefore assumed that most of the mass in the universe must be unknown. If there was extra undetected mass towards the outskirts of galaxies then there would be enough mass for galaxies to be held together by gravity, this assumed unknown matter in the universe is now commonly referred to as “dark matter”. However if we consider that time is faster in weaker gravitational fields, and if we propose that objects of mass move faster in weaker gravitational fields, could it be possible that this change in the “speed of time” on the outskirts of galaxies might account for the rotational velocities of galaxies without the need for the theoretical “dark matter”? This is a possibility well worth investigating, and would be the ultimate proof of the hypothesis I am proposing in this paper. An explanation of the rotation curves of galaxies by the application of this simple idea would result in the end of the theory of Relativity, and the need for a new theory to be developed.

Another factor well worth pointing out is that if objects of mass move faster in weaker gravitational fields, then this could explain how a variable speed of light has gone unnoticed when studying the local solar system. If Neptune, for example, is actually further away from us than it appears (*since light accelerates as it travels towards the outskirts of the solar system due to entering a weaker gravitational field*) then why have we not noticed that our present theory of gravity doesn't quite work for the solar system? If time was faster on the outskirts of the solar system, then although light may accelerate as it travels towards Neptune and thus Neptune would be further away from earth than it appears, Neptune would also be moving faster than it appears, proportional to the increase in the “speed of time”. So although Neptune may be further away the velocity of Neptune's orbit would also be greater, so the size of the solar system could well be a very clever optical illusion. However, this cannot be tested, but only inferred as a direct result of my hypothesis, a hypothesis whose ultimate proof would come in the form of the explanation of galactic rotation curves.

The simplest method of testing this hypothesis is to use Einstein's equation for changes in frequency due to gravitational field strength, and then compare with changes in time in a galaxy. Einstein used the equation  $(\nu_0 - \nu)/\nu_0 = GM/c^2 r$  <sup>Reference 4</sup> to describe changes in frequency as a function of mass and distance from centre of mass. However if, for example, one were to bounce an emr signal off a satellite orbiting the Earth, then that emr signal would accelerate as it leaves the Earth and the speed of time increases, and that satellite would actually be further away from the Earth than it appears, so the value being used for r needs to be adjusted slightly. Then when one applies the adjusted equation to the gravity in a galaxy one can determine how much the speed of time changes throughout the galaxy, from the centre to the outskirts. When time changes, gravitational acceleration towards the centre of the galaxy changes proportionally to the change in time squared, and adjusted values for gravitational acceleration towards the centre of the galaxy can be determined. These should show a correlation to an adjustment of the equation mentioned previously  $(\nu_0 - \nu)/\nu_0 = GM/c^2 r$ .

## Discussion & Conclusion:

Although Einstein achieved the correct experimental results regarding the measure of time in different gravitational fields, and the correct experimental results regarding gravitational red shift of light, there exists another possible explanation for these results that defies one of the two postulates of the theory of Relativity. It may very well be possible that light accelerates as it leaves a stronger gravitational field and enters a weaker gravitational field. One could then propose a new definition of time, or rather, “the speed of time”, defining this quantity as representative of the ease with which mass and energy moves through space, and given the S.I. units seconds/earth second, or  $s/s_E$ . Since the “speed of time” is greater in weaker gravitational fields, one could infer that there is less resistance to the motion of mass & energy through space in weaker gravitational fields.

This alternative explanation, although a contradiction of Einstein’s theory of Relativity, makes a lot of physical sense. It may seem unusual at first that light accelerates as it leaves strong gravitational fields, which is the opposite of what one would expect. But if one takes into account the law of the conservation of energy, and remembers the equation for the momentum of light, then it is quite a reasonable proposal. If the momentum of light were to decrease as light leaves a strong gravitational field, and if the energy were to remain constant, then the velocity of light should consequently increase. (*From the perspective of an observer in a constant inertial reference frame*)

If it is true that the speed of light increases in weaker gravitational fields, then it follows from Einstein’s mass/energy equivalency equation that mass would decrease proportional to an increase in the speed of light squared. If mass decreases and Kinetic Energy remains constant, it follows that velocity squared of an object of mass in motion also increases with a decrease in mass. Since the speed of light may not be constant but only appears constant due to the proportional change in the “speed of time”, this would explain how it could be that the solar system is different proportions to what is presently believed, the size of the solar system could be a very clever optical illusion. It may be possible that this hypothesis explains the rotational velocities of galaxies without the need for the theoretical “dark matter”. An explanation of “dark matter” is a possibility that requires further investigation, as it would be the ultimate proof my alternate explanation for the two phenomena of changes in time in different gravitational field strengths, and gravitational red shifts.

## References:

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