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Guest Commentary

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Cosmology without Special Relativity Theory

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The fact that Special Relativity is not relevant to the real world (see Comments Section, journaloftheoretics.com, vol.6-1, Feb-Mar 2004) has important implications for the calculation and interpretation of the Doppler effect, and therefore for our concept of the character and evolution of the universe, which is based, primarily, on the extreme red shift of type 1A supernovae.

The calculation of the recession velocity of these celestial objects from the observed value of the Doppler shift has, in all recent investigations, involved Special Relativity theory (SRT). In view of the contradictions within SRT, the link between Doppler shift and SRT deserves to be broken.

We can explain the Doppler effect more readily using pulses rather than waves. Suppose we have a train moving along a track and let the engine emit pulses at one-second intervals. What matters is the speed of the train relative to the velocity of propagation of sound or light. To make matters simple we call v the ratio of the speed of the train to that of sound or light. For intuitive reasons, we first consider sound. To make the illustration even easier we assume the train is speeding along at one-half the speed of sound. We assume the train is speeding away from the observer. At the beginning of the experiment the train is, say, ten sound seconds away. If the sound travels at 2 km/sec, the train, at the beginning of the experiment, is 20 km away from the observer. A second later the train is 10.5 sound seconds ahead (i.e. 21 km from the observer). At that point the engine emits a second pulse. The question is, when will the observer receive this pulse?

In the case of sound, the air carries the second pulse at the same speed as the first pulse. If we add the one second delay to the time required to travel the extra distance, we get 1 + 0.5. So the second sound will be heard at the clock time 11.5 seconds from the beginning of the experiment. The spacing of the sounds is 1.5 seconds at the receiver, even though the spacing is one second at the emitter.

In general, the formula for the spacing is 1 + v. If it were a single frequency tone that is being sent instead of pulses the received tone would be a factor 1.5 lower. In the case of light, the situation is more complicated because there is no known medium, no aether, to carry the pulse of light.

If we turn the problem around and let the light (or sound) pulses originate at the point of departure, on the ground, and ask when the observer on the train detects these, we have a more tractable problem. The first pulse, by assumption, will be detected 10 seconds after emission. The second pulse, emitted 1 second later, must travel 10.5 light-seconds to reach the place where the train is 1 second later. However, when this pulse gets to that point, the train will have moved on, since it is moving during the time that the pulse is underway. The train has advanced an additional 0.25 light-seconds. This is the famous tortoise and hare problem! The pulse actually reaches the train 2 seconds after the first pulse was emitted, not 1.5 seconds later, as was calculated in the previous case.

The formula now becomes $1/(1 - v)$ for the spacing between pulses, that is to say, with $v = 0.5$ the spacing is doubled. The received frequency is one-half the magnitude of the emitted frequency. If blue light was emitted, red light is received. The same result applies to sound.

To revert to the original problem, in which the source is on the train, we can, in the case of light, simply use the first principle of relativity. It allows us to interchange source and receiver. This does not invoke SRT!

This is not the same as in the case of sound. The first principle does not apply when there is air involved as the transmitting medium. But the principle shows that the movement of the receiver or that of the source leads to the same result in the case of light.

It follows that under Newtonian thinking, as well as under SRT, the Doppler effect for light depends only on the total separation rate between the source and receiver, just as is to be expected under symmetry. But it is larger than predicted by SRT, which is why for a given Doppler Effect the recession rate, and all that it implies in cosmology, is smaller than under SRT.

We must be careful not to push the analogy of sound and light too far. Sound is energy that is transmitted by molecules of matter, either air or solids. These molecules do not rush from source to receiver. They stay approximately in place, and mimic the vibrations impressed at the source. Light, on the other hand, is the radiant energy that moves from source to receiver. Each photon carries a signature which is its frequency, but that signature can be distorted through motion of the source or the receiver or through interaction with matter.

The result of these deliberations can, theoretically, be confirmed by using a single observer, and no clock. We need only station this observer half-way between the points A and B on the ground, between the position of the rear and of the front of the train at the beginning of the experiment.

A trip wire can be used to generate a pulse of blue light at the points A and B on the ground, as the train passes by; and simultaneously a blue pulse on, and at the front of, the train. The train is presumed to be traveling at one-half the speed of light. What the observer should notice is that the two blue pulses from the ground arrive simultaneously, while the pulse from the train will be red in color and will arrive after the other two pulses have arrived.

Clearly, the middle of the train will coincide with the position of the observer at the time at which the pulses from A and B are initiated, but will have moved on, by the time the pulses arrive at the position of the observer. By the argument above, the pulse from the front of the train must take longer to reach the observer. It reaches the middle of the train at the time the observer detects the pulses from A and B and therefore requires additional time to reach the observer. This also contradicts Einstein's second principle.

Physicists usually use the concept z, defined as the difference between the received and the sent wavelength divided by the sent wavelength. On the other hand, the quantity z + 1 represents the ratio of the received to the sent wavelength. This is the quantity that can be treated under multiplication, and which can be "averaged" (in the sense of a geometric mean) by taking the square root of the product. Here we call the ratio z + 1 the Doppler effect.

With v as the velocity of the body relative to the velocity of light, and z as the Doppler shift, we get that under SRT the relation between v and z is given by $v = [(z + 1)2 - 1]/[(z + 1)2 +1]$ (see Weigert & Wendker 1996, p. 266). Under the Newtonian View, we have $z + 1 = 1/(1 - v)$. This means that as long as z is less than 1, the recession velocity under the Newtonian view is less than 0.5.

The data for type 1A supernovae show that z is below one in the visual region. This implies that even the most distant, and fastest moving, stars never reached a velocity greater than one-half the speed of light. Apparently, the Big Bang wasn't all that big.

The difference between the views becomes apparent for relative separation velocities greater than a ratio of about v = 0.3. In that case, z = 0.35 under SRT, and 0.42 under the Newtonian View. The z values of Type 1A supernovae of interest lie between about 0.36 and 0.85, which is consistent with both of these views. The universe, and the Doppler shifts resulting from Type 1A supernovae data, can be shown to be consistent with a Newtonian model with a present age of about 6 billion years, and a diameter of about 5 billion light-years.

A red shift can occur because of the increase in distance between the source and the receiver, but it could also occur because (Compton) energy is lost from a wave, or photon, in the course of its journey and interaction with a denser medium. There is no reason to believe that both phenomena can't occur simultaneously in the cosmos. We cannot easily unscramble these effects and arrive at a conclusion about astronomical distances based solely on a red shift which is the result of changes in frequency caused by both motion and energy loss – as is apparently the case outside the visible region of the electromagnetic spectrum.

The bottom line: The universe is smaller and more dense than currently believed. It will likely collapse and repeat the process of star formation and explosion again and again.

Note: since writing this, I have found that the Lorentz transformation has not been correctly derived. This is now discussed, as a modification, in detail, on my web site: www.aquestionoftime.com and below:

DERIVING THE LORENTZ TRANSFORMATION - ITS RELATION TO RELATIVITY AND QUANTUM PHYSICS (MODIFIED 11-8-04)

The approaches of Lorentz, Einstein, Feynman and Rindler are compared. The question is: who, if anyone, got it right? The short but startling answer - none of the above.

The Lorentz transformation (LT) begins with the assumption that light, considered as a wave, is carried by a subtle medium, called the aether. The earth moves at velocity v with respect to this medium, and consequently the time required for the movement of light back and forth in this direction will be larger then would be the case if the earth were stationary with respect to this medium. Just how much larger is what the LT attempts to show.

A quick review of how we get to this result should be helpful. We can let L be the distance that light moves in one direction, and c the speed of light. We can then write: L = cT, L = (c-v)T', and L = (c+v)T'', where T is the time if there is no motion of the earth relative to the aether, T' the time required when the light is moving in the opposite direction to the earth's motion, and T" the time in the reverse direction. The fractional increase in time due to the movement of the earth is then given by the ratio (T"+ T')/2T which is easily seen to be [c/(c-v) + c/(c+v)]/2. It takes a little algebra to arrive at the formula:

T"+T' = 2T/[1 – v*2/c*2].

This is the first step in deriving the Lorentz transformation. Since the denominator is always less than one, this shows that the round trip time is always increased if there is motion of the earth relative to the aether, and the light moves back and forth in this direction. So far so good. Einstein gets the same result by substituting, for the aether, the assumption that the speed of light is independent of the movement of the source.

Both Lorentz and Einstein then proceed to split this expression into two equal parts that multiply together, and obtain for each leg an average increase, and therefore a needed contraction factor, given by:

sqrt[(T"+T')/2T] = 1/sqrt(1-v*2/c*2).

This is the so called gamma factor which plays a crucial role in 20th century physics.

That there is no need to take the square root becomes obvious if, using the first equation, we write (T' + T")/2, the average increase due to motion, on the left hand side, and divide this by T, the time it takes for each leg of the journey in the absence of motion. The right side is then simply the factor 1/ [1 – v*2/c*2], which is the fractional increase, on the average, for each leg of the journey - no square root is involved; this is gamma squared.

This can also be seen as a problem in the relationship between mathematics and physics: If two factors multiply, or physically, if a second factor follows and acts on a first factor, as for example in the Doppler effect, the ‘average’ is a square root. In the Doppler effect a stretch of a time interval on one leg of a journey is followed by second stretch on the return path. Similarly if I stretch a rubber band by a factor 2, and then do a second stretch, by a factor 8, the total is 2x8 = 16, and not 2+8=10. That would justify taking the square root of the total as an ‘average’ in the sense of a geometric mean. But in the case of time, whether on the round trip of a plane, or the round trip of light, the time going adds to the time returning – they do not multiply, and therefore an arithmetic average rather than a square root is required – and that average is already implicit in the first formula.

Richard Feynman in his famous book „Lectures on Physics“, vol 1, 1963, also presents an analysis of the M&M experiment. He arrives at the same formula as Lorentz and Einstein, but does not get there directly. It is clear that he is uncomfortable with Lorentz’s derivation**. Although he gets to the same formula it does not have the same meaning as for Lorentz and Einstein**. He does not take the square root at the point where everyone calculates the round trip time in the direction of the earth’s motion. Instead, he argues that, in the perpendicular direction, in the M&M experiment, the time is also increased. The M&M experiment does not correspond to the requirement that the path in the perpendicular direction cancels out the movement of the earth The perpendicular path of the light to the mirror, from the source, is increased due to the movement of the apparatus while the light is in motion – and similarly for the return path. He introduces another variable T’“ to denote this increased time in the perpendicular direction. Because it is the hypotenuse of a right triangle, he finds the increase T’“/T is given by sqrt[1/(1 – v*2/c*2)], the gamma factor! He then compares T’ + T“ to 2T’“, and since

$$(T' + T'')/2T''' = (T' + T'')/2T \times T/T'''$$

he gets

$$1/\mathrm{sqrt}(1 - v*2/c*2) = 1/(1 - v*2/c*2) \times \mathrm{sqrt}((1 - v*2/c*2).$$

Feynman correctly answer the question „Given the set up of the M&M experiment how much greater is the time of the round trip parallel to the motion of the earth in comparison with the round trip perpendicular to that motion“. He does not answer the question „How great is the effect of motion of the earth compared to no motion“. These are two different questions – they cannot have the same answer.. So although he gets the same formula, it does not mean the same thing as for Lorentz and Einstein. It is the ‚right’ answer (mathematically right) to the wrong question – but no one seems to have noticed.

It is important to realize that the ratio (T’ + T“)/2 to T’“ which Feynman obtains cannot be the same as the ratio (T’ + T“)/2 to T which Lorentz and Einstein seek – so either Lorentz or Feynman gets the wrong answer. Rindler, also analyzes the M&M experiment and comes up with the same formula as Feynman! So Lorentz and Einstein came up with the wrong answer to the right question, while Feynman and Rindler came up with the right answer to the ‚wrong’ question. And all get the same formula!

What is true is that the M&M experiment should have come up with a result consistent with the gamma factor – if the hypotheses, as to the propagation of light, of either Lorentz or Einstein were realized. Of course the M&M experiment, and its null effect, is inconsistent with these hypotheses, - which is why a shrinkage of space (and time) was required to account for the negative result, while maintaining the validity of the theories. But the correction needs to be applied with respect to the viewpoint of Lorentz and Einstein – not Feynman and Rindler, since the last two deal with an artifact of the experiment rather than the essence of the theory. The alternative hypothesis, that the speed of light should, and can only be measured in the coordinate system in which the source is at rest has been unavailable. Whether the aether theory at the beginning of the 20th century, or Special Relativity at the beginning of the 21st, physicists are unable to break through a view of nature that has become dogma – as has, today, the use of the incorrect formula for the LT in all branches of physics.

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