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THE MYSTERIOUS MUON

by Miles Mathis

Abstract: I will show that the atmospheric muon, now used as proof of time dilation, is not experiencing time dilation at all. In fact, the classical gravity equations, even without the fine tuning of Einstein, were always enough to explain the muon's detection at the earth's surface. The main problem has never been a problem of SR or GR, it has been a lack of knowledge in applying simple gravitational math, specifically in stacking a velocity and an acceleration in a vector situation, as in the equation $v = v_0 + at$ http://milesmathis.com/voat.html. This problem has nothing to do with Relativity, and my paper is not a refutation of Relativity or time dilation, both of which I accept. The problem is that basic textbook acceleration equations are false. Using only standard gravity equations, I will be able to take muon creation up to 270 miles, into the ionosphere where it should be, not in the lower stratosphere (9 miles) where it currently is said to be.

The muon is currently used as proof of time dilation, since without it, we are told, the muon would not live long enough to reach the surface of the earth. The muon lives only 2.2×10^{-6} seconds, and travels only about 660m under normal circumstances. But it is thought to be produced at an altitude of 15km. It *does* reach detectors on the surface of the earth, or at sea level, therefore it must be experiencing time dilation.

The problem is that physicists make this claim without applying the transforms directly to the muons they detect. Since they do not know the altitude of creation, they cannot know the distance or time. Transforms have to be done on data: that is, on measurements that are directly made in experiment. But we only detect the muons, or, in some cases, measure their energy. We cannot and do not measure time or distance, therefore we cannot apply time or distance transforms. The altitude of production is *inferred* from the energy, as is admitted.

This is a major problem since you cannot apply SR transforms to an inference. You cannot find that a body is dilated without knowing its initial state. We do not *know* the altitude of production for the muons we detect, therefore we cannot apply transforms. The current theory is circular. We claim that if the muons are dilated as we think they are, then they must come from a certain altitude. And they are able to come from that altitude because they are dilated. The theory has no content and no possible proof. If it cannot be proved, it cannot be proof of anything.

In fact, according to my corrected equations of SRhttp://milesmathis.com/long.html, a muon in approach would actually be time compressed, not time dilated. Only objects moving away from us are time dilated. Applying SR to the muon with the right math cannot give us time dilation. Therefore the phenomenon must be explained in some other manner.

This is not to say that I doubt the theory of muon creation. In fact, I can use muon creation and detection as proof of my own mechanics only because I trust the experiments. I believe in the creation and detection, as it is given to us in current journals and texts. I just don't believe in the given time dilation, since there can be no time dilation without a measurement of time or distance. You cannot claim to transform a raw detection, and the SR transform for approach should show time compression anyway.

Muon detection is easy to explain without time dilation, provided you know how to apply the ordinary gravitational field equations. Using gravity in an orthodox way, the muon arrives on the surface of the earth because it is accelerating toward the earth, not just moving at a constant velocity. This must affect the apparent time of the trip.

This simple statement is controversial because it appears to conflict with current theory in several ways. First, because the muon is in freefall, and is not in a gravitational curve, it doesn't appear that GR allows us to find a time differential due to gravity. We can find a time differential due to SR, but not to GR. In fact, it is thought that GR prevents us from accelerating the muon at all: you cannot accelerate something that is already moving at .9996678c,* not even in a gravitational field. Or, you could accelerate it a bit, but you would need a much more powerful field and more time.

We can solve this apparent conundrum if we use Einstein's equivalence principle to reverse the vector of gravity, as I have done so many times before. The reversal makes the surface of the earth move out during each dt, which makes the earth move toward the muon during each dt. The muon's trip is shorter with each passing moment, which makes the time for the trip smaller. The muon doesn't have to go as far, therefore it gets there quicker.

Although many think this is illegal, it is done all the time, even by the mainstream. Richard Feynman does it in his *Lectures on Gravitation*, section 7.2, as I have shown. To calculate a gravitational blueshift, Feynman moves the bottom of his box *up* toward light that is coming *down*. Since he is basically repeating the math of the famous Pound-Rebka Experiment of 1959, the math for that experiment must do the same thing. I have shown http://milesmathis.com/pound.html that it does in a recent paper. The Earth must be given a velocity toward the light, or no blueshift can possibly be calculated.

But gain, I know that many mainstream physicists will scream, "You can't do that! Even if Einstein's postulate allowed for the vector reversal, you can't move the Earth toward the muon, since that would take the total velocity above c. That is forbidden."

So I will pause to justify it, although I am justifying experiments their precursors have already done. Yes, according to one interpretation of Relativity, I cannot let the Earth move toward the muon while the muon is moving toward the Earth at c, because this would take the total velocity over c. However, this interpretation is wrong. It is wrong because it doesn't take into account the vector situation we have here, and the simple vector math we must do.

To clarify that, let me show you why we *can* move the Earth toward the muon while the muon is moving at the earth at c, without exceeding c. If we move the earth toward the muon, we have not increased the total velocity, taking it above c. No, we have *shortened* the distance that must be traveled, therefore we have actually *decreased* the velocity necessary to travel it. If we keep the muon at c, then t will have decreased. It is not the total velocity that has increased, it is the total distance that has decreased. Since velocity is distance over time, the velocity cannot increase with a decrease in distance. They are proportional.

I will clarify that even further, since I know that I am correcting a longstanding and universal mistake in vector addition. The mistake is in assuming that you add velocities in approach in this situation, when the opposite is true. A critic will say, "Good grief, every schoolboy knows that you add velocities in approach. If I am driving at you at 60 miles per hour and you are driving at me at 50 miles per hour, then our combined velocity is 110 miles per hour, and if we are 110 miles apart to begin with, we will collide in one hour."

All true, but in that example we are going 110 miles per hour *relative to eachother*, not to the background. To find how fast we are going relative to the background, we subtract. We subtract because we are in a vector situation. Together, we are going 10 miles an hour relative to the road, since you went 60 miles and I went -50 miles. Velocity is a vector.

If we translate that simple finding to our muon, we find that we are not really interested in how fast the muon is going relative to the earth, since, as I said in the opening paragraphs, we are not *measuring* its velocity from the earth. Yes, we are *detecting* it from the earth, but a detection is not equivalent to a velocity measurement or a time measurement. When we do these velocity and time *calculations* from a simple detection, what we are calculating is how fast the muon is going relative to the background of the muon+earth. The earth is not the background of the muon; the earth is an object, and both the muon and the earth are objects moving with regard to a background.

If we turn the earth's gravity vector around, this is easy to see. The earth must be accelerating relative to something, since acceleration is a motion and all motion is relative. The earth cannot be accelerating relative to itself. As soon as we have assigned the earth an acceleration, whether it is the old gravitational acceleration or my new expansion, we must assign a third point of reference. In my expansion, the surface is moving relative to the center, so we have the three points of reference: muon, surface, center. A Euclidean coordinate system tied to the earth's center is our background, and both the surface and the muon move relative to it.

My critic will say, "That's all as maybe, but in normal physics, the surface of the earth does not move out. Your vector reversal may be allowed in a thought problem, but in fact the earth is not moving out, as we can see with our own eyes." Well, our eyes can be deceiving, but even if I admit my critic's point here, he is still wrong as a matter of vectors. Gravity, defined as it is, as an acceleration field arrayed about a central point, creates precisely the same vectors as my explanation in the previous paragraph, with the reversed g. I reversed the vector to make the concepts clearer, but the concepts and vectors are the same whether we reverse g or not. If the field of the earth has an acceleration, then this acceleration must be relative to some non-accelerated body or field. Einstein said that all motion was relative, and that applies to accelerations just as much as to velocities. This non-accelerated "body" is a Euclidean system set up around the center of the earth. We require a background to measure or calculate the gravity of the earth: not just how it affects things like muons, but how it defines the acceleration itself. And we require this non-accelerated background whether we reverse g or not. GR contains this background, because in GR the center of the earth acts as this background. The same can be said for Newton.

Historically, we have drawn the vector pointing in to indicate the motion of a particle dropped from rest, but this is not how the vector works in the math or in the field when we have a particle approaching the earth with its own velocity, as with the muon. Since the acceleration acts as an attractive force, it must combine with an incoming velocity in a vector situation that subtracts, not that adds. This is true even if we do not assign any real motion to the surface of the earth. Using conventional gravity theory, the gravity field of the earth must create a vector that combines with the muon velocity in a differential, with a negative sign. We never had any possible conflict with the limit of c here, which makes the modern failure to solve this problem that much more surprising.

If the muons are falling in the earth's gravitational field, as they are, then we cannot simply calculate the muons against the earth, as my critic did when he calculated the two cars' velocities against eachother. We have to calculate the muons and earth against a background. Which gives us a vector situation. Which gives one of the velocities a negative sign. Which forces us to subtract velocities in our equation. Which allows us to have both velocities without exceeding c.

You can refuse my vector reversal if you like. It doesn't matter. Your conventional gravitational field, whether it is the field of Newton or Einstein, must work in a vector situation *as if* the earth is moving toward the muon. This is what the attraction implies, and if you refuse to assign that motion toward the muon to the surface of the earth, you must apply it instead to the field. That is, you can slide your motion off a real object and apply it to the field, but that trick won't help you evade me or my logic. Your field vector and c will still be in opposition, and my point is proved either way.

That explanation was a bit difficult in places, perhaps, but never esoteric. As you see, the explanation is really pretty simple, once you unwind it. It is another failure of contemporary physicists to understand vector math. They can juggle very complex equations, but they cannot seem to comprehend addition and subtraction in vector spaces. We *can* propose accelerating a particle already moving at c, and it is precisely because the two implied motions are in vector opposition. The muon is moving toward the earth, so the velocities do not add, they subtract. We do not find a velocity above c here, so we do not have to break any of the laws of Relativity. The muon's own velocity never goes above c, and the total velocity of (earth + muon) never goes above c (since the real vector equation is (muon – earth).

You will say, "Even if all that is true, you still can't explain muons that way, since using the known acceleration of gravity, the surface of the earth will only move 1.1×10^{-11} m in 2.2×10^{-6}s. Turning your gravity vector around doesn't explain anything." That would be true only in the case that we take the initial velocity of the surface of the earth as zero. If the initial velocity is zero, then we can use the equation $s = ½at^2$, which does give us the very small number above. But if the earth does not have an initial velocity of zero, that equation won't work. Well, the surface of the earth does have an acceleration of $9.8m/s^2$, but it doesn't have an initial velocity of zero. Since these accelerations and velocities are relative to the center of the earth, as I have shown, the velocity at the surface of the earth during a given interval can hardly be zero. The only zero velocity in the field would be expected to be at the center of the earth. The surface of the earth is about 6,378km from the center, so it could not have a velocity of zero relative to that center. If it did, then its acceleration would also be zero. So let us see if we can develop a velocity just from the numbers we already have. If we use the above equation, $s = ½at^2$, and solve for t using 9.8 and 6,378, we get t = 1141. In a field of acceleration of 9.8, the surface of the earth is 1141s away from the center. From that we can develop the velocity: v = 6,378,000/1141 = 5,590m/s. That is just a rough estimate, since the earth's field is not 9.8 at all distances; but it gives you the idea of how things work in a gravity field.

My critic will say, "Even that won't help you, because at that velocity, the earth still goes less than a meter in the given time." True, but the earth is not moving at a constant velocity, it is accelerating from that speed. When we have the muon moving at the earth, we do not have two velocities being added, we have a velocity of c plus an acceleration of *g*.

Now to solve. I developed a velocity for the surface of the earth to prove that it could be done, and to show that if we reverse the gravity vector, the surface must have an initial velocity. But I don't wish to use that velocity in my solution. Since I have already shown that the vector situation allows us to move the earth toward the muon, even while the muon is at c, let us do the math in the simplest way possible. Let us dispense with the vector reversal and keep the earth steady. This will have the mathematical and mechanical result of giving all our motions to the muon, but it will not contradict all I have shown above. Doing the math this way is a convenience, and implies nothing about the physics involved. Although this will take the total calculated velocity of the muon alone over c, as a matter of addition, it won't concern us. Again it won't concern us, and won't break any of Einstein's rules, because due to the vector situation, the velocities aren't really added, they are subtracted. We apply them all to the muon only to simplify our math, but this in no way implies that the muon is actually going over c.

Everyone else who has looked at this problem has tried to apply the old equation $v = v_0 + at$, which fails to help us here. Even before Einstein forbid us from exceeding c, this equation couldn't solve problems like the muon problem, where particles approaching the earth at c were supposed to be accelerated by g. It doesn't solve our current problem because it only gives us a tiny correction, one that is frankly counter-intuitive. A particle going c in a gravity field should be accelerated more than that, supposing that it can be accelerated at all. But rather than pull apart that basic equation [I have done that now http://milesmathis.com/voat.html, showing the equation is false in all cases], let us ask how long it would take to accelerate a particle in freefall from zero to c in the earth's gravitational field. Let us pretend that the earth's field is constant at all distances, and that we can allow bodies to freefall as long as we like. In that case, we lose the v_0 in the equation above, and it reduces down to $c = at$. Solving for t gives us $3.0591067142857 \times 10^7$ s. Since the acceleration is constant, the average velocity is c/2, and the distance traveled is therefore $4.58548560580009 \times 10^{15}$m.

So it takes this hypothetical particle almost a year to go from rest to c. Now, a nice question is, how far would it travel in the *next* second? In other words, how far would it travel if we continued accelerating it past c, at the same rate of 9.8? Easy, since we just add a second to the time and solve: $x = 2.989 \times 10^8$m. How far would it travel in the next 2.2×10^{-6} seconds?: x = 617m.

Hopefully, you see what I have done. Rather than assume that the muon is accelerated independently of its velocity, we assume that it is accelerated as if it were already in freefall. We assume the earth cannot tell the difference between a body it has been accelerating for a long time and a body that just arrived or was just created. In other words, the earth accelerates the velocity, not the body. In a gravitational field, the equation $v = v_0 + at$ doesn't work. In that equation, the acceleration is independent of the velocity. But we want to accelerate the velocity. To do that without calculus, you do it as I just did it.

My critic will say, "Very ingenious, since you doubled the distance traveled by the muon. It would have traveled 660m and you have added another 617m. This would double the "lifetime" of the muon as well, if we gave it to the time instead of the distance. Unfortunately for you, we don't require a doubling, we require a increase of 50x. Your muons are still 13,723m short of the surface of the earth."

Sad that my critic still can't comprehend my numbers, this far into the paper. I didn't just find that the muon traveled another 617 meters on top of the 660; no, I found that the muon was traveling 617 meters *while* it was traveling 660 meters. Remember, it would travel 660 meters in no field at all. Then I found that a gravitational field would accelerate it 617 meters. I found, specifically, that the gravitational field would accelerate a particle that far in an interval of that length, **assuming the particle never had an independent velocity of its own**. Remember, we accelerated this particle from zero, so the particle had no velocity uncaused by the field. So if we want to find how far the muon can travel during that same interval, with both the acceleration of gravity and its own velocity of c, we can't just add the two numbers. We have to multiply them, giving us 660 x 617 = 407,220m.

If my math were complete, the muon could be over 27 times higher than it is currently proposed to be and still reach the earth. But my math is not complete. I let the acceleration of the earth be 9.8 over the entire trip of the muon, but the acceleration of the earth is not 9.8 at an altitude of 268 miles. It varies over the trip, going from about 8.62 at the start to 9.8 at the end. I will not do the full math, I will simply estimate a new number. Our average acceleration will be 9.21, which gives us x = 660m, which increases our altitude to 435,600m, putting us way up into the ionosphere.

Take note that the two numbers match. We came into the problem knowing that the muon traveled 660m with no acceleration, then found it was accelerated 660 by the field of the earth. Coincidence? No, of course not. We found that number precisely because the field is accelerating the initial velocity, not the muon. The initial velocity is not added at the end, as in the naive equation $v = v_0 + at$. The initial velocity is integrated into each and every differential of acceleration, as it must be. Which means the initial distance traveled during each differential is also integrated into the field acceleration. This gives us the equations

$$v_f = v_0 + 2v_0^2 t$$
$$x = v_0^2 t^2$$

And this allows us to estimate the distance traveled in the field by simply squaring the distance traveled outside the field.

$$x_0 = v_0 t$$
$$x = x_0^2$$

Those equation are rough, and some have not been satisfied by this verbal math that I like to do. So here are the full equations, so that you can see exactly why 660 comes up twice.

$c = at_0$

$d_0 = ct_0/2 = c^2/2a$

$d = v_f(t + t_0)/2 = a(t + t_0)/2$

$d = a[(c/a) + t]^2/2 = [(c^2/a) + 2ct + at^2]/2$

$\Delta d = d - d_0 = (c^2/2a) + (2ct/2) + (at^2/2) - (c^2/2a)$

$\Delta d = ct + (at^2/2)$

Because t is very small in this problem and c is very large, the second term is negligible. This makes the distance traveled during each interval due to the acceleration almost equal to the distance traveled due to c. This is why there is no acceleration variable in my equations above: it can be ignored when the time period is so small. A field of 9.8 will act pretty much like a field of 1 or a field of 100.

Some will say, "Why didn't you just give us those new equations to begin with, instead of leading us through all that talk of expanding Earths and so on?" I really wish I could have, but these new equations beg all those questions, unfortunately. By themselves, these new equations show a velocity over c, which is currently forbidden. I am squaring c here, notice. So I had to explain precisely why that mathematical manipulation was allowed here. I had to go to some length to shows its logic and legality.

This finding will be of great use to physicists, supposing some few of them dig out long enough to recognize it. Their current number for altitude of muon creation is about 9 miles, which is way too low. They have kept it low purposely to blend more easily with this time dilation theory. The higher they create the muons, you see, the more dilation they need. They already have *gamma* at around 39, which is embarrassing enough. Any additional altitude will just make that number go higher. But they need the muon creation to be much higher than 9 miles, since as it is, they have muon production just above the troposphere, in the lower levels of the stratosphere. That doesn't make any sense. My number, which comes out to be about 270 miles, is much better, since we are then in the upper levels of the ionosphere. In the ionosphere, we would expect muon creation. We need those ions for muon creation, and there just aren't enough of them at 9 miles to explain the number of muons we see.

Some will say, “That all works out pretty well, but didn't you say that the muon was time compressed? In another paper, you say that time compression is indeed equivalent to life extension, and this explains life extension in particle accelerators, where particles are approaching detectors. Shouldn't you have to calculate time compression here?”

No, I shouldn't *have to* calculate time compression here, since I have shown that neither time compression nor time dilation is necessary to explain the detection of the muon at sea level. Given the muon's *known* lifespan, I have been able to take its altitude up to 270 miles, with no discussion of Relativity. We can do a time transform if we like, and yes, it will show time compression and apparent life extension with the muon in approach. But there is no physical reason to do a time transform here, since 1) we don't require it to explain anything, and 2) we still aren't *measuring* the time or distance the muon has gone. In other words, I haven't devised an experiment above in which we are measuring the distance directly. We are not going up to 270 miles, creating muons, then measuring their arrival at sea level. I am just using gravity equations to show that the gravity field of the earth can appear to accelerate particles that are already at c, and that it can do it without contradicting Relativity. It can do this because the gravity field acts physically or mechanically as a vector pointing out from the center. It acts to decrease the effective distance the muon must travel, and because it acts like this in the equations, it must act like a vector pointing out.

Finally, in closing, I will repeat what I have said in other papers: I agree with Relativity, for the most part. If we do direct measurements on a muon, we will not be able to measure it going over c. Likewise, if the muon measured us, it would not be able to measure a velocity over c. However, that fact does not impact this paper, since in calculating an altitude for the muon and in analyzing its trip, we aren't measuring its velocity. We are calculating a distance, which is not at all the same thing. I know some will still not accept my analysis, which shows that the vectors in this problem must subtract. They will stick to their interpretation of SR which says we cannot produce any vector pointing at an object going c, since that would create a total velocity above c. However, to answer this, I simply offer them the blue-shift of light. To create a blue-shift, you have to have a vector pointing at light, while the light is going c. The waves cannot possibly be shortened unless the receiver has a velocity relative to the source of emission, and the vector of this velocity must be opposite to the c-vector. This is already known and accepted. So we allow vector situations like this all the time. We only forbid assigning numbers to the vectors, because that would break a rule of Relativity. I hope you see how absurd that is: allowing the assignment of vectors, but disallowing them sizes. I have shown that allowing them sizes does not contradict Relativity, therefore the whole question has been a tempest in a teapot.

I would also point out that those who scoff at my math because the math shows the muon going over c are guilty of gross hypocrisy. They will not allow me to exceed c in any equation, when their equations in this very problem often exceed c. They have their muon going 15,000m in 2.2 x 10^{-6} seconds, which is a raw velocity of 22.7 times the speed of light. They will explain that in Relativity, velocity is no longer x/t, but that isn't true. In fact, 22.7c *is* the measured velocity in this problem, according to their inferences, and the velocity transform is meant to transform the measured velocity into the real or local velocity. In other words, .9996678c is v' here, and 22.7c is v. They never do a velocity transform for you because they can't figure out how to use Einstein's velocity transform, but that is the way it should work. They hide all their math, in which c is exceeded all the time, and then attack anyone who creates any equation that exceeds c, even when it is clear that this math is breaking no law of Relativity.**

To say it one final time, in my equations, the muon is not going over c. The raw velocity is 660c, yes, but no real object is going that fast in any system, neither in its own nor anybody else's system. That number is a result, not a real velocity. It is a result of applying all the motions in the math to the muon, but that is just a convenience. The earth's field also has a motion here, and integrating the two motions gives us a number over c. That is not forbidden by Relativity.

My critic will say, "Are you claiming the earth has velocity of 659c here? That is the only other motion we have, right?" No, I am not claiming that the earth or the earth's field has a velocity of 659c. The earth's field has an acceleration, and you can't derive a velocity that way from an acceleration. My critic is once again just doing bad math. He is taking a distance traveled by two objects in approach, one of which is accelerating, and then dividing that distance by the time of one of the objects. This number is over c, so a rule has been broken, he says. But no rule has been broken, since you cannot legally assign that velocity to either object or to both of them. Velocity is simply not defined that way. Nothing is actually going 660c, and nothing is being measured to have gone 660c, so no rules of Relativity have come into play. This is easy to see by giving the surface of the earth the acceleration. This shows that the distance in the math isn't the real distance. The distance 270 miles isn't the distance traveled by either object or both objects, in either system. It is the distance that will *seem* to be traveled by one object, in the math, if we prevent the other object from moving. But since, physically, we need two separate motions to explain the mechanics and the math, the number 270 miles doesn't apply to any real parameter. The number 270 miles is an integral, but the real motions are causing differentials. The rules of Relativity apply to the real motions and the differentials, not to these integrals.

[To see an analysis of the SR transforms in the muon problem, you may go to my second paper on the muon.]

Conclusion: A poor understanding of vector math caused physicists to believe that the muon and other incoming particles could not be accelerated by the earth's gravitational field. They tried to add the motions, taking the total above c. But as a matter of vectors, the motions subtract. The distance between the approaching objects gets smaller, which means the velocities must subtract, not add. Once this is recognized, and the gravity field is fully understood, the muon can be accelerated without any conflict with Relativity or the limit of c. Furthermore, in the gravitational field, the equation $v = v_0 + gt$ does not apply. Instead, when we are accelerating particles already at c, we must integrate the acceleration with c, in order to find a total distance traveled. You do not add freefall to the local velocity, you integrate the two.

*This is the speed the current model believes the atmospheric muon is going, according to the value of *gamma* of 38.8.
**You can read my second paper on the muon to see how current Relativists fudge through their own equations.