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The Problem with Reduced Mass

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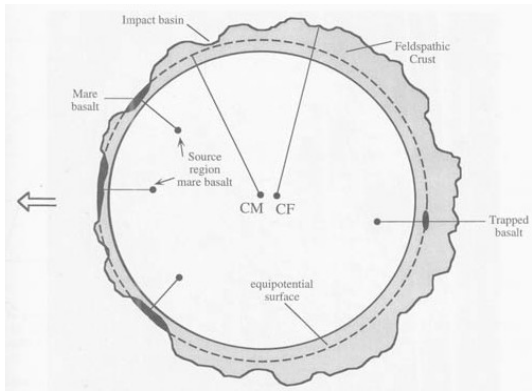

Reduced mass is defined like this*:

$$m_{\rm red} = \mu = \cfrac{1}{\cfrac{1}{m_1} + \cfrac{1}{m_2}} = \frac{m_1 m_2}{m_1 + m_2},$$

It is calculated like this:

The force exerted by body 2 on body 1 is

$$F_{12} = m_1 a_1.$$

The force exerted by body 1 on body 2 is

$$F_{21} = m_2 a_2.$$

According to Newton's third law, for every action there is an equal and opposite reaction:

$$F_{12} = -F_{21}.$$

Therefore,

$$m_1 a_1 = -m_2 a_2.$$

and

$$a_2 = -\frac{m_1}{m_2}a_1.$$

The relative acceleration between the two bodies is given by

$$a = a_1 - a_2 = \left(1 + \frac{m_1}{m_2}\right)a_1 = \frac{m_2 + m_1}{m_1 m_2}m_1 a_1 = \frac{F_{12}}{m_{\text{red}}}.$$

The problem is in that last manipulation. As you see we have a naïve addition of accelerations, to find a total acceleration. In other words, the two bodies are treated as if they are cars on a track. But according to Newton, they aren't. According to both Newton and Einstein, gravity is a field. Therefore, two bodies create two fields, and both fields cause accelerations.

Look at it this way: if we have two cars on a track accelerating at one another, we have no fields. Or, at most, we have one. We have the track, which might be called a field or a coordinate system. But no matter how you look at it, neither the track nor the cars are causing the accelerations on one another. The track is causing nothing, and that is clear. Car 1 is causing car 2 to do nothing, and the reverse. Car 1 is the cause of its own motion, and car 2 is the cause of its own motion. The acceleration is internal, for both cars: it is caused by their own engines. Therefore, both accelerations are motions relative to the track. Both cars are moving against *the same* field, but neither motion is caused by the field.

But when we study celestial bodies, none of this is true. According to Newton, the bodies create fields. Body 1 causes body 2 to accelerate via a field of acceleration that includes body 2. And the reverse. So we have two fields. By Newton's own postulates, the two accelerations should not be added. They should be integrated. We have a superposition of fields here, with one field right over the top of the other field. The accelerations should be inside one another, as it were, and we should have to integrate one acceleration into every interval of the other. That being so, what we should have is a some sort of higher order acceleration, or an acceleration with t^4 in the denominator. If body 1 is providing two orders of motion or two changes to the field, and body 2 is doing the same, we should have four orders of change.

In other words, what we have is field 1 inside of field 2, and the reverse. In such a case, you can't just add or subtract the field accelerations. You either stack them, to get t^4, or you cancel them, to get a simple velocity. In neither case would you get a normal exponent 2 acceleration as your outcome.

Someone will answer me, "What you say might possibly apply to a particle in the field, but we are not applying both fields to a particle here. We are applying one field to one body and the other field to the other body. In other words, body 1 is not in its own field. It is taken to be at the center of the field, and the accelerations there are zero. Therefore it is only in the field of body 2."

OK, fair enough. That happens to be the correct answer, as we shall see. But is that the way current physics is done? *Does* current math integrate the two fields on a body that is in both fields? No. Why not? I will be told, "Because with a particle in both fields, we would subtract rather than add or integrate. A particle between here and the Moon would feel conflicting forces in opposite directions, which would require subtraction of accelerations."

No, if it is in both fields, it should require integration, but this integration would give us a velocity in one direction or the other instead of an acceleration with four t's. Or, near the middle of the fields, it should work that way, with an integration of accelerations. Closer to one body or the other, one acceleration should dominate, and we could estimate an answer without integrating, *with one acceleration only.*

Another problem is that if we can add accelerations in the naïve manner they did above, we should be able to add them in the same way in similar vector cases. For example, if gravity were a field where accelerations could be added like that, then the Sun's field should add with the field of Mercury, on Mercury, and things should weigh a lot on the far side of Mercury and be vacuumed into the Sun on the near side. On the Earth, people would weigh more at night than during the day, since both the Sun and Earth are pulling them down at night. During the day the Sun would be pulling them off the Earth. That doesn't happen, so we know gravity doesn't work that way.

I will be told that centrifugal forces balance those forces from the Sun, but we have no evidence of centrifugal forces in celestial mechanics and loads of evidence against them. The lack of crustal tides on the Moon is final proof of that, and no intelligent person would require more or more obvious proof. See the diagram above**, which I think I am going to start publishing in every paper I write. That is the Moon, and the front "tide" is negative, as you see.

The only evidence we have *for* centrifugal forces is that people don't weigh more at night, and things like that. But that isn't evidence, that is arguing in circles. It is assuming we have force fields which would cause people to weigh more at night without centrifugal forces; then noticing that people don't weigh more at night; therefore, we must have centrifugal forces. But of course the problem can also be answered by giving up on the force fields of Newton. We don't have them, therefore we don't need centrifugal forces to explain why people don't weigh more at night. People don't weigh more at night because they were never in a force field or an acceleration field to begin with.

We can see this just by going to the day/night line on the Earth. In other words, instead of looking at a person nearest the Sun or farthest from the Sun, we put a person sideways to the Sun, just where the Sun is on the horizon, at dawn or dusk. According to the current fields, that person would have the same pull from the Earth as any other person. But he would have a pull toward the Sun from the Sun. That pull would tend to scoot him forward. If he were on ice skates, he would skate toward the Sun. Then, we add a centrifugal force, which, in this case, we are told completely offsets the pull toward the Sun. In this case, it is equal and opposite, and we have balance. Unfortunately, that means the person is responding to the Sun in a different manner than the Earth is. The Earth *doesn't* feel a centrifugal force that is equal to the force from the Sun, for if it did, it would fly off at a tangent instead of orbiting. Remember that according to Newton, the Earth has a tangential velocity that is not caused either by the Sun or by a centrifugal force. So we have three vectors here. In Newton's diagram, the centripetal acceleration is balancing the tangential velocity, or curving it into an orbital "velocity". It is not balancing the centrifugal motion. The centripetal acceleration cannot balance *both* the centrifugal motion and the tangential motion; or, even if we assume it is, it cannot be spending its entire force balancing the centrifugal force. If it is spending its entire force balancing the centrifugal force, as is equal and opposite, then nothing is balancing or curving the tangential motion of the Earth, and the Earth must move off on that tangent. For this reason, the current math and explanations are just pettifogging. They claim to be following Newton, but they aren't even doing that. They are just knocking old equations around to suit themselves, ignoring the hard questions.

We can see this again if we decide to accept the current explanation. Once again, according the current explanation, the person sideways to the Sun is balanced because the centripetal and centrifugal effects from the Sun are balanced. But in that case, the person should feel an internal tide. If the person is feeling both forces, they balance only his position. But they are still forces, and strong ones at that. In other words, the person should be pulled front to back, like taffy. The Earth can't be blocking any forces, even if gravity were blockable (which it isn't). The person is right out there in the wind, with the Sun right in his eyes on the horizon. His nose should be tweeked in the direction of the Sun, and his buttocks should be pulled out behind him like some bodacious hooker.

Of course we experience nothing of the kind at dawn or dusk, so all talk of centrifugal forces is bushwa.

Professionals in this field will say I still haven't done all the math, so my analysis in incomplete. They will say something like this, "You are creating a strawman, since we would never claim the man at the day/night line is balanced due to centrifugal and centripetal forces alone. We would never make one equal to the other. The best of us admit what you say, which is that the man, like the Earth, must have an orbital velocity. So the man, like the Earth, has his centripetal force from the Sun balance both the centrifugal force and the orbital motion. Feynman has drawn diagrams that explain this very simply, if you would only look at them. We all agree with him." Problem is, I have seen these simple diagrams that Feynman draws, and they are garbage. I fully critiqued one of these diagrams in my paper on Eotvos and Dicke. But let us say that he is right. Let us say that the man and the Earth are in orbit in the same way, and that the centripetal force is balanced by both the centrifugal force and orbital motion. Even so, the man has one more force than the Earth has, in any argument, and that is the force from the Earth. The Earth is pulling the Man along, but the Earth is not pulling itself. So the situations don't match no matter what.

Let us follow the Newtonian mechanics exactly, since Feynman is using Newton not Einstein to explain this. Since a velocity requires only an initial force, not a continuous force, the man can be put into orbit by one interval worth of Earth's gravity at that point. At the day/night line, the Earth is pulling on him at a tangent to the Sun, therefore a few minutes of gravity is sufficient to start him orbiting. Once at speed, he will orbit according to the old equation $a=v^2/r$. That all looks fine until you study it more closely. Because if you look hard, you will see that gravity isn't even keeping him on the Earth. After the first few minutes, he has achieved Solar orbit, and doesn't need anything else to keep him in that position. He would stay there if you turned off gravity. Gravity is only making him weigh something instead of nothing, but it isn't determining his position in the field. You will say, "Fine, I have no problem with that." But that doesn't stick to the precious Feynman illustrations, which stick to Newton, who told us that gravity keeps us from drifting up into the atmosphere and eventually into space. And it isn't the common opinion regardless.

And it isn't consistent. Let us move the man to another point, say the far side of the Earth from the Sun, in the middle of the night. There the gravity vector from the Earth is different (in direction), so the four vectors of the man aren't the same. The man is farther from the Sun, so that centripetal vector is less, but the radius is more, so the centrifugal vector should be more. Also, the orbital velocity has to be the same, or the man would outrun the Earth. But to stick to the $a=v^2/r$ equation, the man should be going faster than at the first point, since he is further from the Sun. If that equation is still in effect, he should weigh less, since he wants to outrun the Earth but can't, due to the gravity of the Earth holding him down. In other words, he wants to fly off at the tangent, but can't. To fly off at the tangent, he would rise from the surface of the Earth. That would make him weigh less. If he has a vector that would tend to make him rise, it would tend to make him weigh less. These are just some of the paradoxes that physics likes to ignore. They have to ignore them because they can't answer them. I like to highlight them because I can. I answer them by throwing out all the old assumptions and starting over. There is no centripetal force, no centrifugal force, no orbital velocity, and no pull. Every facet of the current explanation is disastrously wrong.

You can't ever add accelerations as they do above. And you don't need to integrate in the two-body problem either, since each of the two bodies is in only one field. It is not in its own field. But we do need to integrate in some problems. In some real cases, the math of gravity does work like my first math above. We do find integrated forces. We have seen this in my math from the muon problem, where I showed that when we are working with gravity fields, the old equation $v = v_0 + at$ does not work. We can't just add the initial velocity (of c), we have to integrate it into each interval of acceleration. The Earth's field doesn't just accelerate the muon, it accelerates the velocity. With the muon, we do get a sort of cubed acceleration, with t^3 in the denominator.

This means that in some situations, we *would* expect to integrate accelerations, to find a compound acceleration of the form d/t^4. If we accelerated a particle straight down toward the Earth, it would have its own acceleration inside the acceleration of the Earth, so it would experience four changes, or d/t^4. The Moon cannot be treated as such a particle, but we can imagine such a particle.

You will say, "Wait, you have said that we can't add the accelerations, and that with the Moon we don't need to integrate. So what is the solution?" The solution is that the two-body problem must be solved from one or other of the two bodies, almost like relativity. In the math above they say they are finding a "relative" acceleration by adding, but they aren't, really, are they? A relative acceleration is an acceleration of one body relative to the other. But that isn't what they are finding, is it? What they are finding is an absolute acceleration, or an acceleration relative to an absolute field. In other words, they are finding what they think would be a combined acceleration measured from an absolute point, a point not on either body. Again, it is like cars on a track. They are trying to find the combined acceleration as measured from the track. But that is not a relative acceleration, by either the classic definition of relative or the Einstein definition of relative. A relative acceleration should be one body relative to the other, directly, with no use of the absolute or underlying field. And they haven't found that, because their math is not designed to find it. Anytime you add accelerations like that, you are doing God's eye accelerations, not relative accelerations.

The answer is that the central body defines the acceleration of the field in the two-body problem. And the central body is simply whichever body you take as central. You have to solve the problem from one field or the other: you cannot solve from both simultaneously. There is no math that can solve from two fields simultaneously. For this reason, you only use the one acceleration. You do not add or integrate in the two-body problem.

Funny that the same physicists who teach you that there is no absolute field after Einstein, and who teach you that you have to pick a point of view (hence the term "relative"), forget all that when they start doing celestial mechanics. They seem to think that if they add some transforms to their calculations at the end, they will have "relativized" their answer. But of course that isn't how it works. To be consistent, they must either teach and believe in relativity, or not. They must believe in an absolute field, or not. They cannot browbeat anyone who so much as mentions the word "ether", and then turn around and start doing math like the math above, which assumes an absolute track under their accelerations.

You will now say, "OK, but doesn't that conflict with what you said about the particle in between the two big bodies? If we are integrating forces, aren't we measuring from the field? We include both accelerations, right?" Well, that isn't the two-body problem, is it? It is a three-body problem, since the particle is a third body. And yes, we use both accelerations, and we integrate. But we aren't measuring from the field, we are measuring from the third body. I will also point out here, because it is convenient to do so, that integrating the accelerations won't solve the real problem, since we have to include the charge fields of both bodies as well. If you want to calculate the motion of a body between here and the Moon, you have to include all four fields: both gravity accelerations and both charge fields. Unless the middle body is very small, you may have to take into account its charge and radius as well (as I do in the Lagrange point math). What is more, you have to use solo gravity accelerations, not the raw accelerations given now in books (which are, unknowingly, unified field accelerations). To get the right answer, you have to separate the charge field from the gravity field, do calculations in both fields, then recombine them. You also have to integrate the fields.

That is why the math above and all math like it is pushed. They don't have the charge field, so they have to do something to finesse an answer. If you study their math, you will see that it normally takes a whole line of pushes to get anything like the right answer for a real body like the Moon or a satellite. First they push the accelerations, as above in the two-body problem. Then they bring in centrifugal forces when it suits them, and maybe Coriolis forces, too. Then they feed everything through gigantic equations, usually ones that have been curved or tensorized or gauged or something, so that they can apply more and more little tweeks. Only then do you get a number.

For example, I was recently writing a paper on eccentricity, and I went to the science sites to grab the current equation for eccentricity. Unfortunately, I ran across the variant equation which includes reduced mass.

$$e = \sqrt{1 + \frac{2EL^2}{m_{\text{red}}\alpha^2}}$$

Just by looking at the variables, I could tell that was a terrible mess. I have already shown that L, the angular momentum, is currently misdefined, and now I have shown the same thing with reduced mass. Since E, orbital energy, is a function of the reduced mass, it is false too. And the other variable α is also a fudge, since it comes out of the inverse square law, which is not properly understood. All four variables here are garbage, so the equation is garbage. It is pushed in four different ways to achieve the answer they think they need. It has four variables and every one of them is wrong.

*This is the math at Wikipedia and all other science and math info sites.
***Encyclopedia of the Solar System*, 1999. p. 253.
