

# About Gravity, part 2 :

## Spacetime bending, time dilation and equivalence principle

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### Abstract

The article explains an experiment designed to prove if gravity is caused or not by spacetime bending. A prediction is made about gravity and general relativity. The goal is a better understanding of gravity needed in order to create a better theory of gravity or better, a unified theory.



Note : My first language is french and I am writing this article in English so that it can be understood by more people. Syntax errors in this document does not reflect the IQ of the author.

Gravity is still mysterious to this day. We have had two major theories to explain it and although they give the same results here on earth, they are very different. The first, from Sir Isaac Newton, states that two masses will attract each other. The second, from Albert Einstein, states that a mass will bend spacetime and that this bending will actually causes masses to move towards one another so the gravity is actually the consequence of spacetime bending. Both theories are unable to explain dark matter for instance so eventually a third theory would be needed. Since one theory explains that the gravity is the cause of movement and the other theory explains that spacetime bending is the cause and gravity is the consequence, we need to figure out once and for all which path to follow to get a better theory. Einstein's theory seems to attract more votes but it would be nice to have an experiment that rules out completely one way of thinking so that we know if gravity is the cause or the consequence for what we're observing. This article aims to find that path by proving once and for all if general relativity is true or false. The definitive experiment has not been done because I do not have access to an atomic clock but the experiment itself is simple to do for a university with the resources needed.

## **Newton vs Einstein :**

Newton's theory was based on incomplete information, he couldn't know about galaxies, or even the speed of light. His theory has a major flaw, he thought that gravity was instantaneous but we now know that it moves at the speed of light.

Einstein's theory correct some of Newton's errors but he didn't know about what is called dark matter for instance and his theory isn't perfect either. The main difference between both is that general relativity uses spacetime to explain the gravitational force.

Newton states that gravity is a force created by the presence of masses. Gravity is the cause for what we observe. Einstein states that gravity is the consequence of spacetime bending.

Einstein also states that spacetime bending causes time dilation, the difference in time measurement caused by two clocks that would be at different gravitational potential. This time dilation has been observed in atomic clocks inside GPS satellites when their time is compared with earth-based clocks.

This difference between the two theories is very important, even if their formulas give the same acceleration results here on earth, what causes gravity is important to know if we hope to find a unified theory for all the fundamental forces. What if Newton was nearer to the truth and time dilation was the consequence of gravity itself ? Here is a way to know for sure.

## **Trust, but verify :**

Trusting other people's results is correct, but verifying is better. If casting doubt on general relativity didn't give you a good enough hint, I will add that I like to verify whenever possible. This is why I have done an experiment to confirm something : I used two oven crystals ( OCXO clocks ) to measure time dilation between one that only feels gravity and another that feels an acceleration force in a centrifuge. The speed is too low to have any time dilation effect but the acceleration can be set to 1g ( not turning at all), 2g, 5g, 10g,... Using an accelerometer I was able to know in real time the combined g force felt by the clock in the centrifuge while the other received only 1g. The results are as expected from the equivalency principle : an acceleration force of 1g makes a clock about 40 microseconds slower per day, just like we can measure from GPS satellites.

## **A possible Contradiction ?**

General relativity predicts that if you are closer to the center of gravity of a massive object, then time dilation will make the time slower. ie: in earth's core, an atomic clock would move slower than on earth's surface and a clock in space would move even faster.

The centrifuge experiment seems to show that an acceleration force makes a clock move slower.

These two facts seem to contradict each other since you would feel no gravity in the center of a planet because you would be pulled equally in every direction. According to general relativity time should flow slower in the center of a planet but if we consider that the acceleration force slows down a clock then time should be faster because you feel no acceleration in the center of a planet. If an acceleration force slows down a clock on the surface, then the acceleration force felt by gravity should also slow down time. Why then would time go slower in the center of a planet where you do not feel any acceleration force ?

## **Equivalence principle contradiction :**

This apparent contradiction also means that we could know the difference between an acceleration caused by gravity and an acceleration force caused by something else because time dilation would not be equal between both. In empty space with no acceleration there would be no time dilation but in the center of a planet where you'd feel no gravitational force there would be time dilation. This seems to contradict the equivalency principle.

## **Proof that Gravity is the cause, or the consequence :**

If gravity is caused by spacetime bending and time dilation is also caused by spacetime bending then we should see that time flows slower in earth's core compared to a clock on the surface. If spacetime does not exist and gravity itself is the cause for time dilation then we should see that time flows faster in earth's core compared to a clock on the surface. This is something we can verify using a simple experiment. The fact that time dilation is bigger in earth's core even if you do not feel gravity would be proof that spacetime bending is the cause for what we observe.

## **My prediction :**

Since I have no access to atomic clocks, I decided to make a simple prediction instead of experimenting. General relativity predicts that time would be faster in space, then normal on earth, and slower in earth's core. My theory is that time dilation is caused by any acceleration force and not by the presence of a mass. Therefore I predict that time would be measured equally in the center of a planet or in zero gravity in space or in free fall, but it would be slower on the surface where you feel an acceleration force. Yes, to be clear my prediction is that general relativity failed to explain gravity and that there is no such thing as spacetime bending. The acceleration force is what causes time dilation.

## **The experiment :**

It would be too hard to really put a clock in earth's core but it would be easy to simply get nearer to the core by simply having an atomic clock inside a submarine deep under sea level. As long as gravity starts to feel smaller, time should start to flow faster even if relativity predicts that time flows slower nearer to earth's center. An easier way of doing the same test if using a very accurate atomic clock would be to add a massive object above the atomic clock. This will add a gravitational force pulling up so even if a massive object should add to time dilation and slow down the clock, my prediction is that the gravity pull upward will cancel some of earth's gravity and the atomic clock would measure time faster with a massive object above it.

## **How can time dilation be explained if spacetime bending doesn't exist ?**

Einstein and others before him predicted time dilation and it seemed very counter intuitive to many so when it was actually measured it looked like the perfect proof of relativity. Here is how time dilation really happens ( if general relativity is false). Imagine you use a rubber rope to spin a rock around you. The rock moves in a perfect circle. Now if you start to move and accelerate going forward then the rock will move in the shape of an ellipse instead of a circle. Now imagine the electron doing the same thing. The electron always move at the same speed but instead of doing a circle, it does an ellipse. The average speed of the electron is the same but the distance is longer for a complete orbit around the nucleus, therefore the number of rotation per seconds gets slower. The atomic clock's precision depends on the number of rotation per second of the electron so when the clock accelerates and the electron does fewer rotations per seconds then the clock measures time to be slower. This is why the acceleration force itself is what slows down the atomic clocks. This is why time dilation occurs but it does not mean that spacetime was bent. Real Time was never affected.

## **The consequence on time measurement :**

If earth's orbit around the sun changed and we could complete an orbit in 100 days, we wouldn't say that time flows faster. The same thing should apply to an electron : The fact that the orbit of the electron changes doesn't mean that time flows faster or slower, it only means that it takes more time for a complete orbit of the electron. Of course, the current definition of time is based on the number of orbit of an electron around it's nucleus but the definition adds that it is of an "unperturbed" cesium-133 atom. Unperturbed should also mean that the atom is not be subject to any acceleration force so in that case the atom should be in zero-gravity. Any clock that is not in zero gravity should have an accelerometer to detect the acceleration force felt by the clock and compensate so that the clock measure time exactly like an unperturbed cesium-133 atom would measure. If using ideal accelerometers, such a clock would work well on earth and in space with no need to adjust the GPS clocks everyday.

**In conclusion**, there seem to be contradiction in the general relativity theory and there is a simple way to distinguish if gravity is caused by spacetime bending or if gravity is the cause of time dilation. The experiment is simply to put an atomic clock deep underwater and see if it measures time slower ( like general relativity predicts ) or faster ( my prediction ). This will allow us to move in the right direction for our next theory of gravity, or even better, a unified theory. My current understanding of gravity is that Newton describes it better than Einstein but that it moves at the speed of light, and gravitational waves can themselves be curved by gravity. Time flows at the same speed for every object but an acceleration force will seem to make time flow slower for an object because it reduces the number of rotation per seconds that the electrons do around their nucleus. Finally, this not only means that general relativity was an error, but also that we do not measure time correctly : An 'unperturbed' atom means that for a clock to read time correctly, it should not be affected by any acceleration force, because this perturbs that atom. Atomic clocks on earth are subject to a gravitational force and their atoms are therefore perturbed.