John Hall (April 20, 2019 Revision), Litchfield Park, AZ 85340, USA,

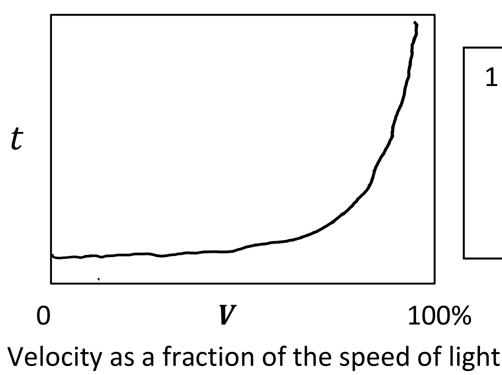
This Time - The Misinterpretations of Einstein's Theories of Special Relativity and Gravity

In 1905 Albert Einstein published four papers that changed the way we view the very small, the very large, the time we live in, and the very space of our existence. Einstein's third paper, simply titled "On the Electrodynamics of Moving Bodies" lays out the thought experiment involving the speed of light and the relationship between observed and actual time. Although there are no diagrams in his paper, the math and logical proofs are there, and they are very specific. To summarize, Einstein's formula proves that since the speed of light is constant, and a light particle bouncing back and forth between two mirrors would visually appear to travel different distances relative to a traveler traveling close to the speed of light and an observer on a stationary platform. If the distance the light appears to travel is different, and the speed of light is constant, then the times on the synchronized clocks must be different.

Einstein's formula (Special Relativity) for this time experiment looks something like this:

$$t_{\Delta} = \frac{t}{\sqrt{1 - V^2 \,/\, c^2}}$$

Where t_{Δ} is time change, t is time, V is velocity, and c is the speed of light. When values are inserted to the variables, using 1 second for the initial time variable, and increasing values for the velocity, then the extremes of the time changes appear to take shape. This is the beginning of the common misinterpretations of the relativity of time (time vs age).



1 Day at: 50% speed of light = 1.5 days difference
75% speed of light = 1.5 days
95% = 3.2 days
99.999999999999% = 20,0000 years

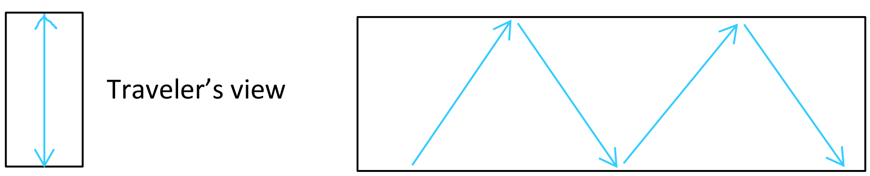
Einstein further states near the end of his paper "Thus, when v=c, W becomes infinite. Velocities greater than that of light have – as in our previous results – no possibility of existence". This quote is from Section 10, and Einstein was referring to W as the motion of an electron, but as it pertains to the Special Relativity formula, if V (velocity) is a number greater than c (speed of light – approximately 299,792,458 meters per second or 186,282 miles per second), then the formula does not work, as the square root of a negative number does not exist.

Einstein mentions time more than 50 times in his paper but does not mention any age differences of the observer or the traveler in his experiment, not even once. I believe there are two distinct and separate events that need clarification, time and age.

Once again, Einstein was very specific about the conditions of his experiment, including the description of "time". I am not trying to disprove Einstein's theory of the relativity of time, only to clarify the common misinterpretations of Einstein's Special Relativity theory as it pertains to the age difference between the traveler (traveling near the speed of light) and the stationary observer.

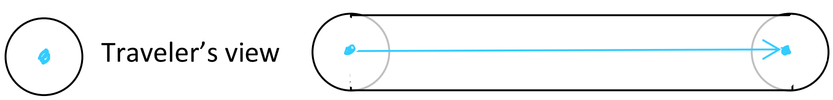
Einstein describes the conditions of his thought experiment as follows:

A stationary observer and a traveler have synchronized clocks, and the traveler has a device with reflective surfaces on both ends for the purpose of bouncing a light particle back and forth, perpendicular to the observer (up and down). The traveler would observe the light bouncing up and down (assuming the traveler could see a light particle travel at the speed of light), but as the traveler's velocity increased, the observer would see a different image of the traveler's device. Instead of the light particle appearing to travel up and down, the path of the light particle would appear to travel at an angle up, and then at an angle down, seemingly increasing the distance the light has traveled.



If the light particle appears to travel a greater distance, then Einstein's formula states time must be adjusted. I disagree, and here is why:

Imagine the exact same experiment Einstein described, only this time there are two light particle devices. One of the devices is perpendicular to the observer, and the other device is parallel to the observer.



In this scenario, the distances the two light particles travel would be different, but the time would be the same, which would not be consistent with the math using Einstein's formula. Time itself does not change, but the calibration of the clocks may need to be adjusted for the observer, due to the delay of the reflection of light.

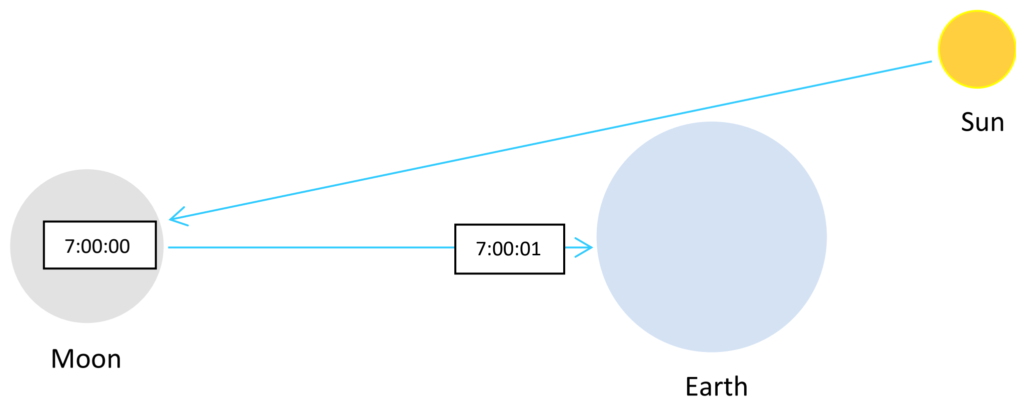
An alternative thought experiment may help explain these time and velocity discrepancies. I use Einstein's formula for time relativity, but with some minor variable changes for light luminosity and reflection diminishment.

The visual passage of time and the age of a traveler traveling at high speed relative to a stationary observer can be explained with the following formula (Special Relativity Light) and thought experiment:

$$R_{\Delta} = \frac{L}{\sqrt{1-V^2/c^2}}$$ Special Relativity Light

Where R is the reflective diminishment factor, L is luminosity, V is velocity, and c is the speed of light.

Imagine a stationary observer on Earth, and a traveler on the Moon. The traveler on the Moon has a digital LED clock with seconds displaying. The LED clock emits its own light (as opposed to reflective light), but the Moon and the traveler are visible only by the reflection of the sun behind the Earth. Light from the sun takes approximately 8 minutes and 20 seconds to get to the Earth, another 1.3 seconds to get to the Moon, and then another 1.3 seconds to reflect the image of the Moon and the traveler back to Earth. The light traveling directly from the clock is not reflected light, therefore takes half the time to travel to the Earth compared to the reflected light from the sun. This is the starting point of the experiment.



Now imagine the traveler on the Moon with the LED clock instantaneously travel away from the Earth at close to the speed of light, let's say 99% the speed of light for 7 days. The source of the reflected light from the sun would take an additional 7 days to reach the Moon, plus the 1.3 seconds from the original location of the Moon to the Earth, essentially making the Moon and the traveler disappear, but the light transmitting from the LED clock would initially only be delayed by one second, as light travels at 186,000 miles per second no matter what. The observer would only be able to see the LED clock. The Moon and the traveler would not have any light reflecting from them, which would be the same effect as a black hole with no reflected light escaping.

If after 7 days of the Moon traveling away from the Earth near the speed of light, the Moon then suddenly stops. The light traveling from the sun that has been following the Moon would then immediately reflect light back towards Earth. That reflected image would then take 7 days to reach the Earth, making the first images of the Moon and the traveler 14 days delayed. The image of the LED clock will have slowed as if half the time had elapsed, as every second traveling away takes the same amount of time for the image of the clock to get back to Earth.

$$t_D = 2t\frac{v^2}{C^2}$$

Reflection Time Delay

t_D - Reflection time delay
t – time traveled
v – Velocity (from light source)
c – Speed of light

Immediately after the 7 days of the Moon traveling away from the Earth, the Moon then travels toward the Earth at near the speed of light. The reflections of the Moon, the reflections of the traveler, and the LED clock emissions will all be traveling at the speed of light. Since the Moon, the traveler, and the LED clock are traveling near the speed of light, the image of the LED clock will change for only the amount of time the Moon was stopped before starting the trip back to the Moon's original location near Earth.

During this 14-day round trip, the traveler on the Moon will have experienced the LED clock progress as if it was on Earth, and the traveler will be 14 days older. The observer on Earth will experience the reflection of the Moon and the reflection of the traveler dim away to nothing for 14 days. The image of the LED clock will slow to half speed for 14 days (displaying 7 days elapsed briefly upon return), as the light emitted from the LED clock on the last second before stopping will take an additional 7 days to return to Earth. The light emitting from the LED clock on the return trip will not be visible to the observer on Earth until the moment before arrival. The light from the away trip will be traveling back to Earth just ahead of the Moon during the entire return trip. During the Moon's return trip, the light reflecting from the Moon and the traveler will be just ahead of the objects, as light travels at the speed of light and the Moon and the traveler are traveling near the speed of light. The time emitted from the LED clock will still be on its way back to Earth all the way up to the moment of arrival back to the original position.

After 14 days of travel, the clock emissions will only have reached day 7. Since it takes 7 days for light to reach the Earth from 7 days away, and the Moon's return trip is near the speed of light, the entire return trip would not have many emissions of light to observe. Upon arrival, all reflections and emissions will be caught up to real time.

The traveler and the observer will both be 14 days older and the clock will have 14 days elapsed as well. The misinterpretations of time travel and age difference cannot apply, as Einstein specifically describes his event as relative to the observer. The images from the observer's point of view are simply delayed observations of the events.

Spacetime and Gravity

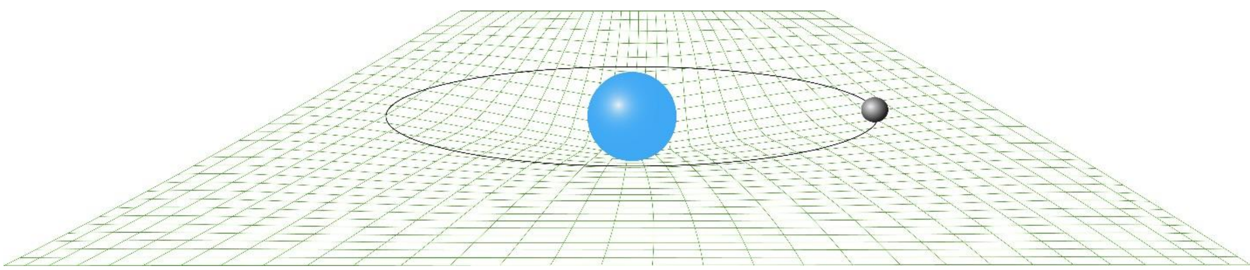
Einstein brought space and time together over a hundred years ago. The fabric of space has been used to describe the effects of gravity ever since. The mathematical forces of gravity can be easily measured, and look something like this:

$$F = G\frac{m_1 m_2}{r^2}$$

F – Magnitude of the force between the objects
G – Gravitational constant
r – Distance between the two objects
m – Mass of object 1 and object 2

On Earth, the math works out to 9.8 m/s as the force of gravity. That is not in dispute. The big question is what causes gravity, and where does it come from?

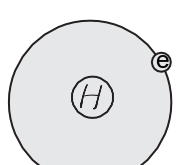
Einstein explains gravity as mass distorting the fabric of space, causing a gravity well that causes objects to continuously fall towards the greater mass. Much like a bowling ball in the center of a trampoline and marbles spinning around the center mass being held away by centrifugal force.



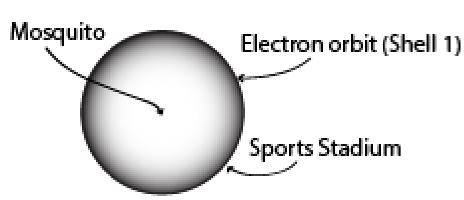
The bowling ball example only works on Earth, where the force of gravity is in one direction, down. In space, there isn't an up or a down, so the continuous falling into a gravity well does not paint an accurate picture of the force of gravity caused by the warping of the fabric of space. I offer an alternative explanation that looks something like this:

In order to get the full picture of what causes gravity, we need to begin with the very small and the fabric of spacetime. I believe Einstein's theory that gravity is the warping of the fabric of spacetime, but the reason for the warping may be described differently.

Until recently, the space between the nucleus of an atom, and the electron shells surrounding the center was not fully understood. The size and scale of atoms can now be compared to a mosquito in the center of a sports stadium as the nucleus and the outside of the stadium as the first orbiting shell.



Hydrogen Atom



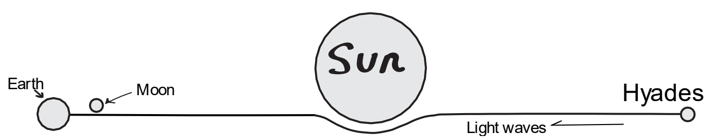
Hydrogen Atom to Scale

Imagine the fabric of space, beginning with the space between the orbits of electrons in an atom, bringing the fabric of spacetime down to the atomic level. There are specific numbers of electrons that can occupy different layers or orbits around the nucleus of every atom. As the number of protons and neutrons increase, so do the orbits and electrons surrounding the atom. The heavy atoms have more protons and neutrons, and an enormous amount of space between the outer shell and the center of the nucleus relative to the size of the atom. It is commonly understood that the force that holds the electrons in orbit is an electromagnetic force. I submit that the layers of the fabric of spacetime contributes to the order and layers of atoms, and ultimately forms the pressure of gravity pushing form the outside inward, not a mystical graviton particle pulling to the center of mass.

If no two things can occupy the same space at the same time, and matter displaces the fabric of spacetime outward in all directions, ultimately the fabric of space is the force pushing back, causing the effects of the forces of gravity.

Therefore, gravity is the force of the displacement of the fabric of spacetime relative to the density and mass of an object. In other words, the Earth does not pull you in, the pressure of the fabric of spacetime is pushing you to the center of the mass. Einstein predicted this warping of space with his theory of General Relativity in 1916, but it took another 4 years for someone to prove it. Sir Arthur Eddington's negative photograph captured the group of starts (Hyades) that were positioned behind the sun at the time of the eclipse.

Solar Eclipse - May 29, 1919



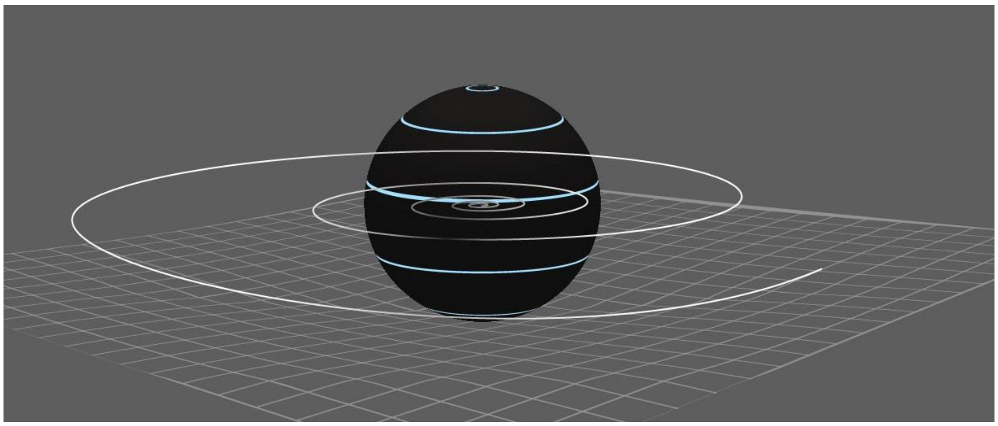
This was the first evidence of the effects of mass on the fabric of spacetime, but I believe a gravity bubble, instead of a gravity well, is a more accurate way to describe the warping of space. Imagine the force of gravity as near infinite bubble layers of pressured (displaced by mass) spacetime. Much like a force field or a cloaking device in science fiction movies, or like the smoke trail passing over a wing in a wind tunnel.

Black Holes, Light, and Gravity

Black holes and dark matter would be good examples of the lack of space between particles of matter. If black holes are the product of collapsed stars, or even matter that didn't get created into atoms from whatever beginning there was, it is evident the warping of space is tremendous. So much so, that nothing can escape, not even light. That may not be entirely accurate.

Consider the moments of a massive star before the fuel of the star (Hydrogen and Helium) runs out, and the event of becoming a black hole is soon to begin. The volume (or diameter) of the star would likely be very large, and the star would also most likely be spinning at some rate of speed. The earth, for example, rotating one revolution in 24 hours, has a surface speed of about 1,000 miles per hour. The bigger the diameter of the star the faster the outer most portion of the star is traveling. Once the fuel gets to the point where the mass of the star can no longer support the volume of the star, collapsing of the star begins.

Much like a figure skater spinning around with their arms initially spread out and as the skater brings the mass of their arms inward, the spinning rate increases, dramatically. Due to the conservation of angular momentum, as the radius decreases the linear velocity increases proportionately. As the star collapses into itself, the rotation rate of the star can reach sever hundred revolutions per second, making the surface of the mass reach speeds up to 84% the speed of light, which is just over 150,000 miles per second.



If you imagine a super massive black hole spinning hundreds of times per second, the speed of the surface at the equator would be pushing the speed of light. This event is not an imaginary thought experiment, but actual matter traveling at an extraordinary rate of speed. The black hole NGC 1365 is reported to be spinning at 84% of the speed of light. That's around 150,000 miles per second. If light travels at 186,000 miles per second, then very little light would have any chance of reflecting. If the former star is no longer emitting its own light, then any light coming from the now black hole would now only be reflected light. The reflected light would be diminished by the speed of the reflecting surface, making whatever light reaches the surface has very little chance of reflecting outwardly.

There are several other factors involved in considering the properties of black holes and how they effect light and gravity. We can readily understand a super massive black hole in the center of every galaxy, holding the spinning mass of gas, stars, and solar systems together like one big family. We can also see the effects of what appear to be an unseen force causing stars to orbit around it like comets around the sun.

First, imagine a star much like our own reaching the end of its life cycle 5 billion years from now, collapsing into itself and becoming a small black hole about 5 miles wide. Although our sun does not have enough mass to become a black hole, the mass as a star is greater than the mass as a black hole. Any planets, gases, stars, solar systems, or galaxies that weren't heading to the new black hole buffet before the star became a black hole would certainly not change course and head to something that has less gravity. If anything, the remaining planets orbiting our former sun would increase their distance from the former Sun.

Now consider the gravitational forces of any mass, including black holes. The forces of gravity are inversely proportionate to the distance from the center of the mass. For every mile you travel away from a massive black hole, the warping of the fabric of space and the force of gravity diminishes greatly. Since light has no mass, the only effects gravity would have on light would be the curvature of the warped fabric of space that the light is traveling through. Light emitted from stars and galaxies from behind the black hole would be visible do to lensing, and there would be a phenomenon like that of an atmosphere as what is commonly called the event horizon. The event horizon in general relativity is a region in spacetime beyond which events cannot affect an outside observer. The theoretical point of no return.

The event horizon is thought of as the point where gravity is too great for anything, including light to escape. That would be assuming you are observing the surface of the black hole from a stationary position. Imagine a traveler in a spacecraft capable of reaching speeds near the speed of light. While the traveler is orbiting over the Earth, traveling at speeds of over 400 miles per second (that's 24,000 miles per hour) the effects of gravity from the Earth are negligible as centrifugal force and gravity are cancelling each other out. Now imagine the traveler has made the long journey to the nearest black hole and wishes to get as close as possible for that magical selfie with a black hole in the background. If the traveler is visiting the black hole NGC 1365, an approach speed of 150,000 miles per second (9,000,000 miles per hour) would be necessary to match the speed of the surface of the black hole. At that speed, the effects of the enormous gravitational forces upon the traveler would not be noticed, until the sudden stop at the surface of the black hole.

With a high approach speed into a black hole there wouldn't be any stretching or shrinking of space or time. The traveler would already be traveling near the speed of light, so all the image delays and time distortions from an observer's point of view of the traveler would have already taken place. The images of time appearing to stop will be apparent by the observer, but they would be the same as my Moon and LED clock example, just delayed images. The traveler would have aged the same amount as the observer, all the way up to the point of impact.

Einstein's "elevator" thought experiment explained the lack of feeling gravity's pull while falling in an elevator, and Douglas Adams quote "It's not the fall that kills you; it's the sudden stop at the end", sum up the event of a traveler passing through the event horizon.

Centrifugal force and gravity may also play major roles in the area of the event horizon. Centrifugal force may be acting upon the mass of the black hole, preventing the enormous mass from becoming a 100% singularity (void of space), increasing the radius of the black hole, and therefore decreasing the effects of gravity itself near the surface of the black hole.

Einstein's theories do not prevent anything with mass to travel close to the speed of light, but his formulas imply infinite energy is required. The energy of a black hole spinning at enormous speeds is kinetic energy, which is keeping in line with all of Einstein's relativity formulas. The reasons black holes cannot spin faster than the speed of light may be many, including centrifugal force. When Einstein used the speed of light as the universal constant in his formulas, the relativity factor becomes the limitation of anything beyond the speed of light.