

THOUGHTS ON SPACE AND TIME AND BLACK HOLES

The speed of light in a vacuum is 299,792 kilometres per second, and in theory nothing can travel faster than light, because it would take infinite energy to do so and infinite energy has infinite mass. If you could travel at the speed of light, you could go around the Earth 7.5 times in one second.

Early scientists, unable to perceive light's motion, thought it must travel instantaneously. **Empedocles** (c. 490–430 BC) was the first to propose a theory of light and claimed that light has a finite speed. He maintained that light was something in motion, and therefore must take some time to travel. **Aristotle** argued to the contrary, that "light is due to the presence of something, but it is not a movement". **Euclid** and **Ptolemy** advanced Empedocles' emission theory of vision, where light is emitted from the eye, thus enabling sight. Based on that theory, **Heron of Alexandria** argued that the speed of light must be infinite because distant objects such as stars appear immediately upon opening the eyes.



Empedocles.

Early Islamic philosophers initially agreed with the Aristotelian view that light had no speed of travel. In 1021, **Alhazen** (Ibn al-Haytham) published the Book of Optics, in which he presented a series of arguments dismissing the emission theory of vision in favour of the now accepted intromission theory, in which light moves from an object into the eye. This led Alhazen to propose that light must have a finite speed, and that the speed of light is variable, decreasing in denser bodies. He argued that light is substantial matter, the propagation of which requires time, even if this is hidden from our senses. Also in the 11th century, **Abu Rayhan al-Biruni** agreed that light has a finite speed, and observed that the speed of light is much faster than the speed of sound.

In the 13th century, **Roger Bacon** argued that the speed of light in air was not infinite, using philosophical arguments backed by the writing of Alhazen and Aristotle. In the 1270s, **Witelo** considered the possibility of light travelling at infinite speed in vacuum, but slowing down in denser bodies.

In the early 17th century, **Johannes Kepler** believed that the speed of light was infinite, since empty space presents no obstacle to it. **René Descartes** argued that if the speed of light were to be finite, the Sun, Earth, and Moon would be noticeably out of alignment during a lunar eclipse. Since such misalignment had not been observed, Descartes concluded the speed of light was infinite. Descartes speculated that if the speed of light were found to be finite, his whole system of philosophy might be demolished. In Descartes' derivation of Snell's law, he assumed that even though the speed of light was instantaneous, the denser the medium, the faster was light's speed. **Pierre de Fermat** derived Snell's law using the opposing assumption, the denser the medium the slower light travelled. Fermat also argued in support of a finite speed of light.

Over time measurements of the motion of these wave-like particles became more and more precise and, thanks to the work of **James Clerk Maxwell**, **Albert Einstein** and others, we now understand light speed to be a theoretical limit: light speed — a constant called "c" — is thought to be not achievable by anything with mass. That doesn't stop sci-fi writers, and even some very serious scientists (and novices like me), from imagining alternative theories that would allow for some awfully fast trips around the universe.

What is bothering me though is, considering the nature of space and time (as presently understood) that, from the point of light, light itself must travel indeed instantaneously. Remember, it travels at the speed of light. **Visualising light travelling at the speed of light (when time stands still) to travel from point A to point B, no time can have elapsed.** The billion of light years we see in the starlight from the early Universe exist only in our way of understanding physics. For the light itself no time has elapsed. For it, the billion of years we appear to see do not exist! Am I missing something?



The Hubble Ultra-deep field reveals galaxies galore

Let's look at this again. Time slows down as speed increases, physical experiments have proven it beyond doubt. So we can take it for granted there is a point where time will stop completely, and it is only natural to assume this point will be the speed of light in vacuum, some 300,000km per second. What would happen if this line of thinking was continued past the speed of light, what would happen to time then, past the zero point? Is it too far fetched to assume the shape of the curve would not end there, but continue through the zero time point to complete the shape of the curve in a complementary reverse trend on the other side: **Time slows down with increasing speed to zero at the speed of light, and with speeds beyond this point it will start to move backwards? Time runs backward! I am not the first to raise this point, even Stephen Hawking mentions it.**

Do we have a hope of testing this hypothesis? Reaching the speed of light seems to be forever beyond our grasp, not to mention going past it. But Nature often presents us with multiple aspects of the same problem, in different guises. Do we see this phenomena somewhere else?

Indeed we do! Time appears to be similarly affected by density of mass as with speed. This could, of course, also be considered the same effect, with the energy/mass involved in acceleration. But here, in the physical world, we have numerous object to study, from planets to stars and Black Holes. **On Earth the effect has been confirmed with timing devices at various elevations. It is generally attributed to the gravitational effect, but with my way of explaining Gravity (as a pressure of empty Space) it is just the change in this pressure resulting from differing energy/mass arrangements.**

The effect is most clearly demonstrated by our understanding of Black Holes. Black Holes form (the way it is generally understood today) when the mass/density of an object reaches the point where the velocity needed to escape from it reaches (and exceeds) the speed of light. So, not even light can shine from the object, it is black. **Einstein visualised this by assuming mass/density of matter deforming and bending space so it actually closes in on itself, preventing light from reaching out.**

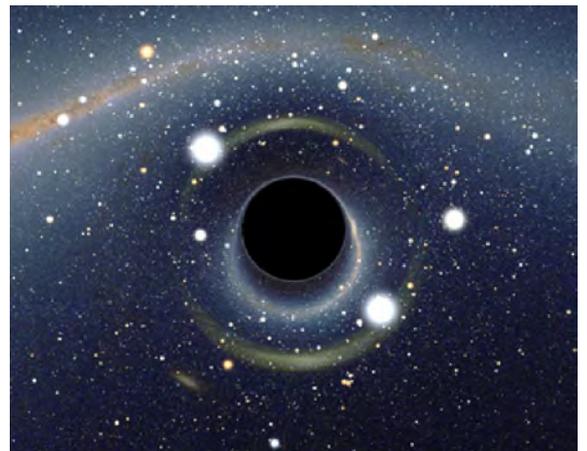
For me, it is the pressure of empty space trying to contain and displace the mass of an object, including light, the energy of which of course also has mass. As we have seen above, anything that affects the pressure of Space also affects time, and around a Black Hole that pressure has not

only reached the point needed to stop time, it has actually exceeded it! What does that mean? In Black Holes (and I think there is sufficient evidence that they do exist) Nature has shown us that time can be made to stop, to actually go beyond, and as I propose, be made to go backwards. In Black Holes everything, Matter, Space and Time reset themselves to the beginning. There is no more matter, no more information, no history. It is pure energy, at a density and temperature created by the containing space, waiting to burst forth in a Bang beyond its Event Horizon, when through Hawking Radiation the appropriate level for instant release is reached and time runs forward again. Is a Black Hole Nature's way of hiding the reversal of time from us, to prevent us from (as Hawking jokingly says) "...jumping in a Black Hole to regain our youth"? Has Time really gone backwards or is it now a new universe? Who can tell?

This can of course happen with small Black Holes with just a few solar masses to create relatively related regions, or with a huge million- and billion-solar mass galactic Black Hole, to form a new "universe". The Hawking Radiation preceding the outburst could be the Microwave Background that is currently claimed to be proof of a Big Bang event.

I would like to think the whole process is just a cycle in an endless, infinite and eternal Cosmos, where regions exist for a while autonomously with their own Space and Time, until they merge back into the great unknown, ready to be reborn again, endlessly.

AK, with Wikipedia Notes



Simulated view of a black hole in front of the Large Magellanic Cloud. Note the gravitational lensing effect, which produces two enlarged but highly distorted views of the Cloud. Across the top, the Milky Way disk appears distorted into an arc

