Research Ideas and Outcomes 4: e25606
doi: 10.3897/rio.4.e25606

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Research Idea

Gravitational Wave Speed: Undefined. Experiments Proposed

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Reviewable v1

Received: 08 Apr 2018 | Published: 10 Apr 2018

Citation: Russell D (2018) Gravitational Wave Speed: Undefined. Experiments Proposed. Research Ideas and Outcomes 4: e25606. https://doi.org/10.3897/rio.4.e25606

Abstract

Since changes in all 4 dimensions of spacetime are components of displacement for gravitational waves, a theoretical result is presented that their speed is undefined, and that the Theory of Relativity is not reliable to predict their speed. Astrophysical experiments are proposed with objectives to directly measure gravitational wave speed, and to verify these theoretical results. From the circumference of two merging black hole's final orbit, it is proposed to make an estimate of a total duration of the last ten orbits, before gravitational collapse, for comparison with durations of reported gravitational wave signals. It is proposed to open a new field of engineering of spacetime wave modulation with an objective of faster and better data transmission and communication through the Earth, the Sun, and deep space. If experiments verify that gravitational waves have infinite speed, it is concluded that a catastrophic gravitational collapse, such as a merger of quasars, today, would re-define the geometry and curvature of spacetime on Earth, instantly, without optical observations of this merger visible, until billions of years in the future.

Keywords

Gravitational waves; Spacetime; Gravitational collapse; Electromagnetic burst; Black holes; Laser Interferometer Gravitational-Wave Observatory; Quasar.

Background

Gravity is a characteristic of mass, which defines the geometry and curvature of the spacetime continuum, so gravitational waves re-define the geometry and curvature of spacetime, itself. All science students are taught never to ignore data that may contradict prior theories, because that would preclude new discoveries and prevent new theoretical understanding. Many scientists have made this fundamental error in discounting disturbances arriving simultaneously at both Hanford, Washington and Livingston, Louisiana detectors of the Laser Interferometer Gravitational-Wave Observatory (LIGO), because they have assumed that nothing can travel faster than the speed of light, so gravitational waves must propagate through space at the speed of light. But, a consistent quantum gauge field theory of General Relativity has not been found, and gravitons have not been found to exist in our dimensional reality, which would be a pre-requisite. So, the Theory of General Relativity cannot be relied upon to predict gravitational wave speed. We have a duty to question any detection of gravitational waves that are reported to travel at the speed of light. Although, signals have been clocked travelling from one LIGO detector to the other at the speed of light, there is no proof that those signals were, in fact, gravitational waves. The speed of gravitational waves has never been directly measured. Every different kind of wave has a characteristic speed, so it is not logical to assume that gravitational waves and light both travel at the same speed. China's X-ray observatory, Hard X-ray Modulation Telescope, has begun its study of black holes and neutron stars, which may find origins of gravitational waves associated with X-ray bursts. Our Moon creates gravitational waves having a Lunar frequency, modulated by our Sun. LIGO has never detected these waves. Of course, they are much weaker than those made by merging black holes, but this is more than offset by our Moon's close proximity with LIGOs detectors, due to an inverse square law governing how gravity weakens with increasing distance. Future space-based detectors, such as Laser Interferometer Space Antenna (LISA) by European Space Agency, and TianQin and Taiji, both proposed by China, will be better able to detect such local, low-frequency gravitational waves.

Alleged gravitational waves, reported by (Abbott et al. 2016) of LIGO, showed two characteristics of electromagnetic bursts: they travelled between detectors at the speed of light; and they had short duration. Electromagnetic bursts throughout the spectrum have been detected almost at the same time as gravitational waves were reported to have been detected (Jet Propulsion Laboratory 2017), (European Space Agency 2017). Dheeraj Pasham, MIT astronomer, said that upon accretion of mass, black holes emit X-ray bursts and radio bursts with a time lag, along with relativistic particle jets, which absorb and, later, re-emit electromagnetic bursts in other frequencies, and which accounts for the time lag (Bartels 2018). Durations of short gamma-ray bursts are similar to signals, reported to be gravitational waves, called "chirps", by LIGO (Abbott et al. 2016).

Weak seismic waves almost constantly travel through the Earth. Imagine two planes on either side of and at a small angle to a plane pependicularly bisecting an imaginary line connecting the two LIGO detector sites. These planes pass through the Earth across the most geologically active regions on Earth. If each of these two planes are at the correct angles with respect to this imaginary line connecting the two LIGO sites, then seismic wave-fronts from tremmors originating from anywhere in the Earth on these planes would arrive at both LIGO sites with a small time-difference, such that the signal would appear to travel at the speed of light from one LIGO site to the other. LIGO detectors are far more sensitive than conventional seismometers in their ability detect the tiny differential changes in length of the crust of the Earth in one direction compared with that in a perpendicular direction, caused by such weak seismic waves, even though the LIGO detectors are isolated from vibrations in the Earth. Therefore, there is a need to directly and independently measure the speed of gravitational waves, and to find out, if they have actually been detected.

Theoretical Results

Speed is defined to be distance-change per time-change. But, with gravitational waves the definition of speed loses its meaning, because both space and time are changing, and time-change is, actually, one component of a 4-dimensional distance-change. Gravitational waves should be called, spacetime waves, because they re-define the geometry and curvature of spacetime, itself, rather than something travelling through spacetime. Since there is no quantum field theory of gravitation, which is consistent with all laws of physics, and since the Theory of Relativity does not apply to something re-defining a curvature of spacetime, itself, it cannot be relied upon to predict the speed of gravitational waves. A result is: the rate of propagation (speed) of a re-definition of the curvature of spacetime by gravitational waves (spacetime waves) is undefined. Another result is: gravitational wave signals should not be expected to correspond in time with their optically observable astronomical counterparts, due to the same gravitational event.

Proposals and Objectives

Collapsing orbits of two black holes would have final (circular) orbital circumference of about 3.14159 (pi) times a sum of the two radii of their respective relativistic event horizons. Assuming their orbital speed is nearly the speed of light, their orbits are eccentric and spirally collapsing, and estimates of the two respective relativistic event horizon radii of the two merging black holes are made, it is proposed that an estimate of the total duration of the final ten orbits of such a merger be made. The objective is to compare this total duration with the 0.2 second duration of gravitational wave signals called, "chirps", reported by (Abbott et al. 2016) of LIGO.

With an objective of verifying these theoretical results, it is proposed to look for gravitational waves arriving at the same instant at all detectors, which do not correspond in time with any optically observable, gravitational collapse events. Spacetime waves detected at all detector sites at once, would be expected to arrive far in advance of any optically observable astronomical event, due to the same gravitational source event, because optical signal speed is limited to the speed of light.

It is proposed to develop technology to place a modulation on carrier gravitational waves (spacetime waves), such as those made by our Moon, with an objective of enabling faster and better transmition of information through the Earth, through our Sun, and through deep space. A hypothesis is that such a modulation can carry information at a speed significantly faster than the speed of light, and perhaps, almost instantly. Detection of such modulated signal speed would verify that this hypothesis is true, and it would verify the above theoretical results. Another hypothesis is that such modulations can carry information without corruption through the Earth and through the Sun. So, it is proposed to detect such signals, after they pass through the Earth to verify this.

An astrophysical experiment to measure speed of spacetime waves, directly, is proposed by measuring a time of optimal Earth-Moon-Sun line-up, optically, and then comparing it with a time of maximum orbital-bulge, due to this line-up, of an artificial satellite, like a space station. If the time of maximum satellite orbital-bulge is much earlier than the time of Earth-Moon-Sun line-up, then this would prove that gravitational waves travel much faster than the speed of light. This experiment must be repeated many times to reduce the standard deviation in these measurements, until results become significant. A better, but more difficult, experiment would be done during a Moon-Earth-Sun line-up with an observer on the Moon, when it is on the opposite side of Earth from the Sun. The time of maximum orbital bulge of an artificial satellite orbiting the Moon, due to this line-up, would be compared with a time of optimal line-up, optically. Similar experiments could be done with an observer on one of the larger moons of Jupiter. Space-based atomic clocks may be used for such experiments, and as a way to detect the time-dimensional component of spacetime waves.

Conclusions

Gravitational waves (spacetime waves) are believed to travel through entire planets and stars, without corruption. Therefore, even if these waves propagate only at light-speed, development of a new field of engineering to modulate spacetime waves should yield faster communication and better data transmission, through the Earth, through the Sun, through the galaxies, and through deep space, without corruption of data. This would eliminate dead-zones, where spacecraft are out of communication with ground control centers, for example. If the above theoretical results are proven by experiment to be correct, then this new field of engineering may, yield almost instantaneous communication throughout the Universe.

Electromagnetic bursts at some range of frequencies may be responsible, by some unknown means, for disturbing the LIGO detectors and for creating an illusion of passing gravitational waves. Alternatively, weak seismic waves originating from any point, which is almost at the same distance from the two LIGO detector sites, would arrive at both of these sites with such small time-difference that, if the angle of direction of motion of their wave-fronts were correct, they would create a seismic illusion of gravitational waves appearing to travel at the speed of light from one detector site to the other. This small set of weak seismic waves may have been mistaken for gravitational waves by LIGO, because it is designed to measure small differential changes in length of the crust of the Earth in one directrion as opposed to a perpendicular direction, which may be produced by seismic waves, as well as thought to be produced by gravitational waves. Proposed space-based, orbiting laser interferometer gravitational wave detectors, such as LISA, TianQin, and Taiji, would not be affected by such seismic illusions.

If spacetime waves are found by experiment to have infinite speed, and if they originated from a gravitational collapse a billion light-years away, for example, and if such collapse were optically observed at the present time on Earth, then they would have arrived here a billion years ago. Conversely, if spacetime waves from a gravitational collapse a billion light-years away were detected on Earth, today, then light from it would arrive on Earth a billion years from now. Since supermassive black holes are believed to be up to about 13 billion light years away, and since gravitational singularities are theoretically expected to interact with each other, no matter how far apart they may be, they are much closer to each other than they appear to be, optically. If it is verified by experiment that spacetime waves re-define the geometry and curvature of spacetime everywhere in the Universe at once, and if supermassive quasar black holes 13 billion light years away were to merge, today, then, the resulting catastrophic gravitational collapse and re-definition of the geometry and curvature of both space and time would be felt here on Earth, instantly, without astronomical optical observation of this merger visible, until 8 to 9 billion years after the death of our Sun in the future. Many quasar black holes may have already merged, especially those beyond 13 billion light-years away from Earth, and formed an immense gravitational singularity a long time ago, toward which all black holes at the center of galaxies, including our own, may be accelerating. Observed background radiation may have originated from the relativistic event horizon of such a singularity and red-shifted due to its immense, relativistic mass by both Special and General Theory of Relativity red-shifts. The resulting gravitationally collapsing space would create an illusion of an expanding Universe, because it would form a vortex in which every galaxy having a central black hole would appear to have an accelerating recession velocity from any point of reference in the vortex with the exceptions of a few blue-shifted galaxies, which are either close enough to each other to be gravitationally interacting, like Andromeda and Milky Way, or are on an imaginary collapsing sphere at the same radius with our own galaxy from this singularity. Mapping this sphere by plotting locations of all blue-shifted galaxies may allow astronomers to find the direction and position of its center, which would be the origin of this gravitationally collapsing space.

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