Speed of Gravity: A Simple Experiment to Test the General Relativity Theory

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Abstract

In this article, the author has shown that LIGO-VIRGO's Gravitational wave detection does not have any scientific foundation. He has suggested a simple experiment (at a preliminary stage) that can detect the time-lagged/instantaneous seismic effect due to the fluctuation of solar activity to prove/disprove the General Theory of Relativity.

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1. Introduction

On the 14th of September 2020, LIGO celebrated the 5th Anniversary of the first Gravitational Wave detection. In the celebration publicity, they projected what they have done within these five years including "the first measurement of the speed of gravity confirming that gravity propagates at the speed of light" along with a dozen 'firsts' [1]. However, it seems that by "gravity propagates" they mean "gravitational wave propagates", but not the propagation of gravity action.

Sergei Kopeikin and Edward Fomalont in 2002 claimed that they measured the speed of gravity and that was near the speed of light which was not accepted by the physicists.

In this article, we shall suggest a simple experiment that can measure the speed of gravity matching the seismic effect and the fluctuation of solar activity as observed from the surface of the Earth. However, our suggestion is in the preliminary stage. It requires a lot of assistance from the experts in this field to make the experiment practicable.

2. Indirect Detection of Gravitational radiation (1994)

In the last part of the twentieth century, American Scientist J. H. Taylor (Noble Lecture 1994, "Binary Pulsars and

Relativistic Gravity") showed that the calculated gravitational radiation loss of the binary pulsar PSR 1913+ 16 matches well with the contraction of the orbit of that pulsar from which he claimed the existence of gravitational waves indirectly.

However, Ehlers et al., some experts on the General Relativity Theory maintain that the problem of motion and (gravitational) radiation (in the General Relativity Theory) was full of holes large enough to drive trucks through.

C. M. Will, a strong supporter of the Special and General Relativity Theories thinks that the questions raised by Ehlers et al. were still relevant: Is the quadruple formula for binary systems the actual prediction of the General Relativity Theory [2]?

Let us consider that a hypothetical binary pulsar is rotating in a stable circular orbit having a radius $r=1.750\times10^{6}$ km with a velocity u= 280 km/sec under the action of a gravitating force field. Suppose that the pulsar does not radiate. Now say a small central electromagnetic force begins to act on the pulsar such that the orbital period (P) of the pulsar changes as per the relation $dP/dt=-2.4\times 10^{-12}$. Let us calculate the ratio between the gravitating acceleration (f_g) and the electromagnetic acceleration (f_{em}) of the pulsar.

$dP/dt= (2\pi/u)\, dr/dt=-2.4\times 10^{-12}$; Therefore, $dr/dt = f_{em} =-1.07\times 10^{-10}$ km /sec^2:
$f_g= -u^2/r= -4.48 \times 10^{-2}$ km /sec^2; Therefore, $f_g/ f_{em}= 4.19\times 10^{8}$.

A minuscule EM acceleration approximately half a billionth part of the gravitational acceleration could change the orbital period of the pulsar to the same extent as measured by Hulse and Taylor.

However, if we could properly measure the electromagnetic radiation and take it into account, that acceleration should be much less. Charge loss of the pulsar and consequent alteration of the electric and magnetic fields could decrease the orbit to that minuscule amount.

Pulsars are electromagnetic bodies. Orbits of electrodynamic bodies should not be stable from electrodynamic viewpoint. Therefore, pulsars are not ideal objects to study the relation of orbital decay with esoteric gravitation radiation.

As per the current astrophysics, Gravitational radiation emission is decreasing the Earth's orbit by a diameter of a proton every day. LIGO claims that it could measure less than one-thousandth of the charge diameter of a proton. LIGO may start a global call to attract a billion-dollar investment to prove Taylor's contention for the orbital decay of the Earth and the planets!

But, at the present state of our knowledge, we could safely conclude that Taylor's matching hardly proves Gravitational wave.

3. Direct Detection (2016)

In 1968, American physicist Joseph Weber claimed that he had detected gravitational waves using his detector made up of enormous aluminium cylinders. This was sadly later disproved.

In 2014 the scientists behind the BICEP 2 telescope made an extraordinary claim that they had detected gravitational waves which are ripples in space-time. Initially hailed as the most ground-breaking discovery of the century, it was later proved to be incorrect.

Recently LIGO and VIRGO have claimed that they detected an instantaneous gravitational wave on the 14^{th} of September 2015 at 09:50:45 UTC in their two Michelson interferometers (separated by 3000 KM) simultaneously [3]. LIGO Experimenters write that in their detection "signal sweeps upwards in frequency from 35 to 250 Hz with a peak gravitational-wave strain of 1×10^{-21}." It matches with the wave-form predicted by GR for inspiral and merger of a pair of black holes (having masses $36^{+5}_{-4}\,M_\odot$ and $29^{+4}_{-4}\,M_\odot$ respectively) and the ringdown of the resulting single black hole (having mass $62^{+4}_{-4}\,M_\odot$ and gravitational radiation of $3^{-0.5}_{+0.5}\,M_\odot\,c^2$) within a fraction of a second 1.3 billion years ago[3].

3.1. Gravitational Wave Detection of LIGO-VIRGO and its Criticism from Technicalities

Wolfgang W. Engelhardt, a LIGO dissident physicist who retired from the Max-Planck-Institut für Plasmaphysik, raised some most pertinent questions on the technicalities of the experiment.

Engelhardt writes on the Gravitational wave detection of LIGO, "In order to substantiate this extraordinary claim, it is necessary to demonstrate experimentally LIGO's ability to measure a displacement of 10-18 m that is one-thousandth of a proton radius. The reader is assured that the calibration of the system can be achieved by moving the mirrors by such a tiny distance with radiation pressure [4].

"Formula (10) gives the calculable connection between displacement and the radiation power of an auxiliary laser shining on the mirror. Unfortunately no data are given as to the laser power, wave form, number of oscillations in order to compare with the documented effect that was exerted on the mirrors by the wave GW150914" as displayed in the discovery paper [4].

> *"An inquiry with the Albert Einstein Institut revealed that such data do not exist"[4].*

James Creswell et al.[5][6] of some reputable research institutes in Denmark, Hao Liu et al.[7], Brookes [8] Jackson et al. [9], Sabine Hossenfelder [10] Alexander Unzicker[11] and many others [12] have not accepted LIGO's claim.

Creswell et al. [6] opine,

> *"The results presented here suggest this level of cleaning has not yet been obtained and that the detection of the GW events needs to be re-evaluated with more careful consideration of noise properties."*

Creswell et al. [6] also write,

> *"We note, however, that a potential increase in the BBH masses would raise fundamental questions regarding their*

> *origin.” [BBH: Binary Black Hole].*

According to Hao Liu et al.[7]

> *“We have presented one such approach here and used it to analyze the data for GW150914. Cases in which the signals are too weak to permit unbiased determination and which therefore require the use of templates for signal detection should be regarded with extreme caution: It is likely that the conclusions of such analyses will be determined by theoretical preconceptions and not by the data itself.”*

Brooks [8] comments:

> *“The paper on the first detection used a data plot that was more ‘illustrative’ than precise.”*

He further adds,

> *“Jackson’s group says the decisions made during the LIGO analysis are opaque at best and probably wrong.”*

According to Jackson et al. [9],

> *“It is a truism that if gravitational waves are all you look for, gravitational waves are all you will ever find.”*

Lost in Mathematics author Sabine Hossenfelder [10] presently a Research Fellow at the Frankfurt Institute for Advanced Studies, comments on the detection:

> *“This gives me some headaches, folks. If you do not know why your detector detects something that does not look like what you expect, how can you trust it in the cases where it does see what you expect?”*

Alexander Unzicker [11] writes on the detection,

> *“Nothing is more difficult than not to deceive yourself — Ludwig Wittgenstein.”*

Most of those objections are from the consideration of the technicalities of the experiment and these technicalities are beyond the expertisation of most of the physicists. Criticisms cited above are on the technicalities of the experiment but not on the physics of the experiment.

3.2. Physical Foundation of the LIGO-VIRGO Experiment on the Detection of Gravitational Wave

The scientists of LIGO-VIRGO believe that gravitational waves cause space itself to stretch in one direction and simultaneously compress in a perpendicular direction. This causes one arm of the Michelson interferometer to get longer while the other gets shorter, and then vice versa, back and forth as long as a gravitational wave is passing towards the interferometers.

As the lengths of the arms change during the propagation of gravitational waves, so too do the distances traveled by each laser beam. A beam in a shorter arm will return to the beam splitter before a beam in a longer arm. Then, the situation reverses.

So, when a gravitational wave passes through the Michelson Interferometer, its detector will register a fringe shift that should be the measure of the strength of the passing gravitational wave.

The LIGO-VIRGO scientists assume that the speed of light in both the spaces that are steadily stretching and steadily compressing is the same 'c' as that of light in free space.

According to Maxwell, the speed of light in free space is 'c' which is well-verified by experiments. SRT accepts this proposition. But this speed of light is fully dependent on the permeability and permittivity of the medium through which light propagates.

Now if free space is steadily compressed and steadily stretched, it is evident from physics that the permeability and permittivity of that space must change and thereby the speed of light in that space should change if not otherwise proved by experiment.

But it has not been proved to this day by experiments that the speed of light is the same 'c' in the stretched and contracted spaces contrived by the relativists.

To justify the theoretical foundation of the LIGO-VIRGO experiments, LIGO-VIRGO experts should prove, through an independent experiment, that the speed of light is indeed the same 'c' in those steadily stretching and compressing spaces, just as it is in free space. They have not done this yet. Therefore, the GW detection process of the LIGO-VIRGO does not have any scientific foundation [12].

This simple argument from physics nullifies the claim of LIGO-VIRGO instantly. No other arguments are seemingly necessary to rubbish the claim further.

4. Speed of Gravity

As to Newton, the action of gravitation is instantaneous, whereas as per Einstein, this action too travels with the speed of light, and the latter consideration has been used by LIGO and VIRGO. However, whether the action of gravitation is instantaneous or time-lagging has not been demonstrated in any reliable experiment just like many other propositions of the relativists.

Maxwell's equations show that light travels with a speed of 'c' in the free space. This famous equation of Maxwell is called the homogeneous wave equation. This equation does not tell us anything about the speed of the electric and magnetic fields in the free space.

However, the Lorenz gauge condition which is generally used in the calculation of time-dependent electromagnetic fields has a similar form to that of the homogeneous wave equation except the right-hand side of the equation not being 0. Therefore, Lorenz Gauge, sometimes called the inhomogeneous wave equation may imply that the speed of the electric field/ magnetic field in free space is ‘c’. Any experiment in electrodynamics does not contradict this conclusion. Albert Einstein accepts this conclusion.

In the case of Newton’s law of gravity, the gravitational force acts instantly. No experiment to this day contradicts this conclusion. No retarded effect of gravity action has been registered to this date.

But many physicists believe that gravity should have speed and Albert Einstein thinks that gravity has the speed of ‘c’.

One important point to remember here is that the electric field and the magnetic field are medium-dependent fields but gravity acts independently of the type of medium.
Therefore, we should not jump to any conclusion on the speed of gravity from the consideration of prevailing covariant faith in physics.

To know the truth a correct simple experiment free from mathematical jugglery should be done.

5. A Suggested Experiment to know the Speed of Gravity

We know that “Maximum quake frequency occurs at times of moderately high and fluctuating solar activity. Terrestrial solar flare effects which are the actual coupling mechanisms that trigger quakes appear to be either abrupt accelerations in the earth's angular velocity or surges of telluric currents in the earth's crust”[13].

Fluctuations in solar activity have many such effects on seismic activity, which could be studied accurately. The fluctuations of solar activity could also be accurately and continuously photographed. Now, matching this fluctuation with seismic activity, it is possible to know whether there is a time lag of 499 seconds between the physical effects and electromagnetic effects propagated from the Sun to the Earth.

However, I have received a practical suggestion from Jonathan Merrison of the Department of Physics and Astronomy, Aarhus University in this regard that we are conveying to the readers.

> *“An experimental determination of the speed of gravity (or change in gravity) I think would be extremely beneficial to the science community. The issue is relevant and even controversial with regard to modern theories of gravity.*
>
> *If I understand correctly then the suggested experiment is NOT to use the LIGO/VIRGO GW instruments, but instead to use terrestrial seismometers to sense solar flare arrival at Earth compared to light travel. It is not clear whether the seismometers should directly measure the solar flare or sense some reaction by the Earth.*

> *I would suggest supporting this idea with some crude (rough order of magnitude) calculations which could indicate whether some kind of sensors would be capable of detecting this. I have tried to do this myself below; by comparing the effect with the solar tides which are detectable (maybe to around 1% accuracy), though I think not with seismometers.*
>
> *Instead of a solar flare (which is low mass) I have taken a Coronal Mass Ejection event which can have a mass of around 10^{12}kg and velocity of around 10^{6}m/s (they have similar energy to a solar flare i.e. around 10^{24} J). Taking a time scale for the coronal mass ejection to be 100 seconds, it has travelled 10^{8}m.*
>
> *The tidal forces produced by the sun are measurable on the Earth (solar tides) and are related to the gradient in the solar g (at earth) dgsun/dr = G. Msun/R^3 where R is the distance to the sun and Msun is sun's mass (R=1.5x10^{11}m, Msun=2x10^{30}kg). For the solar tides the time scale is around 6 hrs (between tides).*
>
> *Comparing the effect of a Coronal Mass Ejection to the solar tides we see that the distance change is around 10^{3} (r/R or even $(R-r)^3$ compared to R^3) the time is around x200 faster, but the dominant factor is that the mass is 10^{18} smaller. This is very small. If it was 10^{3} or even 10^{-6} then I think that it might be measurable, but I would expect this not to be measurable unless there is something that I am not understanding.*
>
> *However, if you are suggesting that the LIGO/VIRGO GW instruments try to look for a Coronal Mass Ejection then I think that this idea might have a valid argument. If I again try to perform a rough order of magnitude calculation to compare the claimed GW signal (from the assumed black holes) then I find this, (note that I am just guessing values here I am not using proper values obtained by them);*
>
> *Assume distance to observed BBH = 5GPc =10^{26} m, masses involved =10^{3} Msun, velocities involved v <c < 10^{8} m/s.*
>
> *Assuming the signal deceases as Mv/r^2 (r distance to the GW generator) then the;*
>
> *Signal from Coronal Mass Ejection/Signal from BBH = $(10^{12}/10^{33}).(10^{6}/10^{8})/(10^{11}/10^{26})^2 = 10^{-21}.10^{-2}.10^{30} = 10^{7}$*
>
> *So a Coronal Mass Ejection should give a much bigger signal (10^{7} times bigger), though I think actually the GW signal is a dipole effect and should decrease as 1/r3 but this would make the factor even larger. Obviously, some of my assumptions may be flawed, but maybe you could perform a similar calculation to support your idea".*

Our suggestion is in the preliminary stage and we expect the contributions of experts in this field to make the experiment successful.

6. Conclusion

Electromagnetic fields, electric charges and light possess momenta and energies that we can experience with our sense organs. Therefore, these are real physical entities (objects).

All objects are subject to gravitation and they are carried with the Earth at the near vicinity of its surface, and they experience Coriolis force when they are part of the Earth System and move with respect to that system.

All electromagnetic entities do act similarly and this simple consideration is equivalent to the Special and General Relativity Theory of Albert Einstein [14][15].

Many physicists all over the world are challenging the ultra-mundane validity of Einstein's Physics. Tounsi[16] does not believe in the equivalence principle operating for the nano-bodies. Spavieri [17] does not accept that the one-way speed of light is 'c', Stephen Crothers exposes the flaws of the Special and General relativity. Cynthia K. Whitney thinks that "Newton was surely wrong to insist that gravitational action is instantaneous. But Einstein was probably too casual in suggesting that the speed of gravitational action is like the speed of light".

Physical Interpretation Relativity Theory London organised by the Late Dr M.C. Duffy published numerous papers challenging the foundation of the relativity theory. Many dedicated rational physicists associated with David de Hilster's John Chappell Natural Philosophy Society along with Roger Anderton, Dennis P. Allen Jr., and many others have been conducting weekly discussions on the fallacies of the Relativity Theory regularly.

Penniless rational physics is fighting hard against the billion-dollar phantom physics.

We are confident of the victory of rationality in physics shortly. Phantom physics must not survive.

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