Review of: "Speed of Gravity: A Simple Experiment to Test the General Relativity TheorySankar Hajra"

Jonathan Merrison[1]

1 Aarhus University

Potential competing interests: No potential competing interests to declare.

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 10^6m/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 100seconds, it has travelled 10^8m.

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=1.5×10^{11}m, Msun=2×10^{30}kg). For the solar tides the time scale is around 6hrs (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.