Review of: "Light Speeds in Stretching and Compressing Spaces"

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Potential competing interests: No potential competing interests to declare.

The author presents a legitimate question to a complex matter, based on the intuitive notion that the speed of light in vacuum is affected in some manner by the stretching (compression) of space-time (his point b), and asks for a proper consideration of this point.
My comments will only restate the usual interpretation of the experiment in two different frames, and make the connections with the points made by the author.

1) Lorentz frame:
Since the effect of the gravitational wave (GW) on the space-time metric is weak, an usual procedure is to work in a locally flat Lorentz frame, and include gravitational effects as forces. In particular, in the Lorentz frame of the beam splitter the tidal force of the GW makes the free mirrors move, while the laser wave is not affected (the Lorentz time is essentially proper time, and the Lorentz coordinates measure proper length, so that the speed of light is not affected). In this way, phase differences result, as in usual interferometers, from differences in optical lengths.
In this interpretation point b) of the author does not apply; the speed of light is that of flat space-time. This would also answer the point made by the author about the necessity to support the assumption about the constancy of the speed of light: the theory indicates that at the level of approximation required the speed of light is the same as that measured when there is no GW.

2) Free-falling frame:
In the reference frame of the beam splitter and mirrors as free falling, their coordinates are of course fixed, but the phase of the laser light is affected by the GW: the proper length changes (differently in each arm), resulting in the change of the wavelength (but not of the frequency, because, in this frame too, the time coordinate measures practically proper time), pretty much as light propagating in a material medium. In fact, if one thinks of the spatial coordinates in this frame as distances, the mirrors are fixed, while the effective speed of the laser light is different in each arm, as if each were filled with different material media (whose properties were time dependent).
This interpretation is closer to the author's point b), but note however that now the mirrors are "fixed".

The detailed calculations in both frames give of course the same result for the expected interference pattern.