Will Solar Oscillations Spoil the LISA experiment?

Abstract.
A conjecture is discussed whereby the gravitational mass of an object depends on its mass/radius ratio. If the conjecture is true then solar oscillations of the sun would cause large signals for LISA. These signals would be greater than those produced by gravitational waves from distant sources, and potentially spoil the experiment.

John Hunter, physics graduate from the University of York, john@gravity.uk.com

1. LISA

LISA is the proposed mission from NASA that will detect gravitational waves by accurately monitoring the separation between three widely separated spacecraft (lisa.nasa.gov/). The separation of the spacecraft (arm length) will be approximately 5x10^9m. Gravitational waves are expected to change the arm lengths by 10^-11m, in the millihertz frequency range.

2. Conjecture - the gravitational mass of an object depends on the mass/radius ratio.

It has long been known that the universe is near critical density, the flatness problem.
This is equivalent that, for each mass m

$$mc^2 - \frac{GMm}{R} = 0 \qquad (1)$$

where the second term represents the combined contributions to the potential energy due to the rest of the universe, of mass M, up to the Hubble radius R.
If we consider that the value of G is such as to maintain equation (1) then

$$G = \frac{Rc^2}{M} \qquad (2)$$

For a large stationary mass, of radius r, (1) is amended to (a result from **viXra:0908.0005**)

$$mc^2 - \frac{GMm}{R} - \frac{Gm^2}{r} = 0 \qquad (3)$$

which gives

$$G_{effective} = \frac{c^2}{(M/R + m/r)} \qquad (4)$$

so, from (2)

$$G_{effective} = \frac{c^2}{\left(\frac{c^2}{G} + \frac{m}{r}\right)} \qquad (5)$$

A similar result to (5) is obtained if we consider that the gravitational self-binding energy reduces both the inertial and gravitational mass of a body, as in **viXra:0908.0004.** The total internal energy reduces to

$$mc^2 - \frac{Gm^2}{r} \qquad (6)$$

and the inertial and gravitational mass reduce to

$$m(1 - \frac{Gm}{rc^2}) \qquad (7)$$

The conjecture has not been proved true or false. In the form of (7), even data from binary pulsars would not be conclusive, as the strong equivalence principle is not violated.

3. Solar Oscillations

Solar oscillations occur typically in the millihertz range, the range to which LISA will be most sensitive. The oscillations can occur in different types and different modes.
http://bison.ph.bham.ac.uk/background.php
http://en.wikipedia.org/wiki/Helioseismology

4. The effect of Solar Oscillations on LISA

Equation (5) shows a possible reduction in the value of G (or equivalently gravitational mass) of the sun, during its oscillations. The designers of LISA have assumed that the gravitational mass of the sun is independent of its density. According to the conjecture above, solar oscillations might alter the suns gravitational mass, and hence the orbital position of LISAs three satellites.

Using (5), or similarly G(effective) = G(1-Gm/rc^2),

Gm/rc^2 is about 10^-6 for the sun, and its radius might vary by a factor of about 10^-9
So G(sun) may vary by a factor 10^-15

This would cause a change in LISAs arm lengths of factor 10^-15, which might be of the order of 10^-6m for LISA (arm lengths will be 5x10^9m) – much larger than the anticipated effect from gravitational waves, which is expected to be of the order of 10^-11m

The conjecture has not been shown to be either true or false - but with such an expensive and complicated project, shouldn't NASA consider this possibility and design the experiment accordingly? They could design LISA to avoid the possibility of the experiment being spoilt.

Private communications have been made with Professor Roxburgh (Queen Mary College London) and Oliver Jennrich (LISA project scientist) warning of the possible disturbance. Although it is thought (arXiv:0904.1943v1) that solar oscillations might be observed by LISA, the possible effects of the conjecture have still not been considered by the LISA team.

5. References (included in the above)