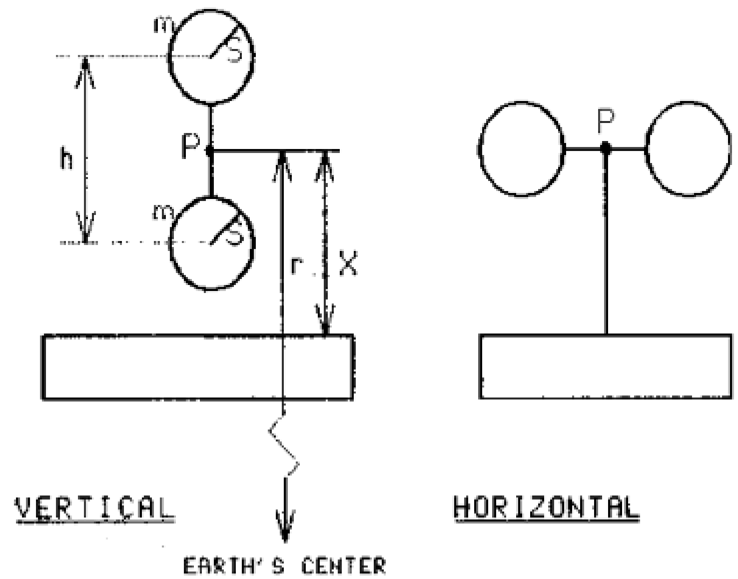
Comparison of Newtonian[1] And Le Sagean Gravity

by

James Hanson

Walter van der Kamp asked me if I would investigate the difference between the gravitational attraction, in the following experiment, between the Newtonian action-at-a-distance and Le Sage's gravific fluid model. I shall not recount Le Sage's theory here for it was covered starting with issue number 40 of the *Bulletin of the Tychonian Society.* The suggested experiment is shown in the figure below.



Two spheres of mass m and radius s are rigidly connected so that the center-to-center distance is *h.* Furthermore, the center point *P* is rigidly connected to

---

[1] This article is reprinted from *The Bulletin of the Tychonian Society*, no. 40, pp. 21-24, September, 1985.

the earth at a distance x above the earth. It is desired to compute the difference between the forces at point P for the vertical and horizontal orientations for both the Newtonian and Le Sagean cases, where

$$d = F_V - F_H$$

and then, finally, to compute the difference between the Newtonian and Le Sagean models,

$$D = d_N - d_L$$

The Newtonian case may be written immediately,

$$d_N = \frac{C_N}{(r + h/2)^2} + \frac{C_N}{(r - h/2)^2} - \frac{2C_N}{r^2}$$
$$= \tfrac{1}{2}C_N r^{-2}(3[h/r]^2 + \tfrac{5}{4}[h/r]^4 + \tfrac{7}{16}[h/r]^6 + \tfrac{9}{64}[h/r]^8 + \ldots)$$

where M is the mass of the earth and where the series expansion is obtained by combining over a common denominator and then applying polynomial division. The constant factor GmM has been denoted by C_N.

The Le Sagean case is quite complicated. I have derived the attraction for this case but have not yet published the same. Hence I shall simply state the result where C_L is a constant which enters much as does C_N in the Newtonian case. It is truly not constant, but is a Machian parameter which depends on the geometry and motion of the entire universe. It varies slightly over great distances and in an experiment it can be taken to be truly constant. Let $B(x,y,z)$ represent the following power series:

$$B(x,y,z) = x^{-2}(1 + x^{-2}(y^2 + z^2)/6 + x^{-4}(3y^4 + 10y^2z^2 + 3z^4)/40 + \ldots)$$

then:

$$d_L / d_N = B(r + h/2, S, r - x) + B(r - h/2, S, r - x) - 2B(r, s, r - x)$$

The first two terms of this sum represent the force in the vertical orientation and the third term the force in the horizontal orientation.

Expanding out the terms of order r^{-2} gives:

$$d_L = \frac{C_L}{(r+h/2)^2} + \frac{C_L}{(r-h/2)^2} - \frac{2C_L}{r^2} + C_L A$$

where A represents the additional terms over those present in the Newtonian form (see the expression for d_N above),

$$\begin{aligned} A &= (1/6)(s^2+[r-x]^2)([r+h/2]^{-4}+[r-h/2]^4-2r^{-4}) \\ &= (1/6)(s^2+[r-x]^2)(20[h/2]^2r^{-6}+69[h/2]^4r^{-8}+\ \ldots\ ) \\ &\approx (5/6)s^2r^{-6},\ s=h \end{aligned}$$

where, once again, polynomial division has been used and where h has been set equal to s in order to maximize A. Note that the Le Sagean case depends slightly on x and s whereas the Newtonian case is independent of x and S. Finally, we compute:

$$\begin{aligned} D = d_N - d_L &= (C_N - C_L)\left(\frac{1}{(r+h/2)^2} + \frac{1}{(r-h/2)^2} - \frac{2}{r^2}\right) - C_L A \\ &= \tfrac{3}{2}(C_N - C_L)h^2r^{-4} + (\tfrac{5}{8}[C_N - C_L]h^4 - \tfrac{5}{6}C_L s^2)r^{-6} \end{aligned}$$

where the first two terms in the expansion for dN have been used. This difference is only a mathematical one, for either one or neither of the theories is correct. However, whichever theory one *elects* to use, the values of C_N and C_L would be numerically identical unless the experiment were conducted over a long time interval and in different places, in which case C_L would change. Hence setting $C_L = C_N$ and denoting the density of the spheres by w gives:

$$D = (10\pi/9)GMws^5r^{-6} = -(\tfrac{5}{4})r^{-2}d_N,\ s=h$$

Being very optimistic, Set $w = 10^{-3}$ gm cm and s = 100 cm, and note that G=6.67x10^{-8}dyne-cm^{-2}-gM^{-2}, M=5.97x10^{27} gm and r=6.38x10^{-8}cm. Hence D=-2x10^{-21} dyne, an imperceptible difference.

I do not believe that such static experiments have much potential for discerning between these two models for gravity. However, dynamic experiments may; such as with pendulums, artificial satellites, and planets, in which the effect is integrated over time and in which large or rapidly rotating bodies may participate. For example, I have used Le Sage's theory to obtain the claimed planetary perihelion precessions. This effect is extremely small, amounting to only a few seconds of arc per century.

Like Einsteinian dynamics, Le Sagean dynamics depends on the translatory and rotational motions of the pertinent bodies and, to a lesser extent, on the distribution of matter throughout the universe. I have developed expressions for the static case, as were used herein, however, I have not, as yet, developed suitable expressions for the moving case in three dimensions. The effects of rotation seem to be of the order of those in relativity. And, since in our experiment we seek to compare theory with observation by examining a difference of a difference D, it may well be that if the spherical masses are rotating very rapidly that D may be increased sufficiently so as to be in the measurable range.