Possible resonance phenomena resulting from gravitational interaction between celestial bodies of the Solar System

ABSTRACT

Our company has developed a sensor of non-ionising radiation and a network of such sensors has been established in various parts of the globe for registering intensity of non-ionising radiation. The processing and analysis of this extensive data has revealed the presence of regular maximum and minimum points that may provide evidence of possible resonance phenomena. The article presents a hypothesis that attempts to explain the existence of resonance phenomena in terms of fluctuations or oscillations of a planet about its regular orbital path. Such oscillations will cause fluctuations of the gravitational field, that will reach nearby objects of the Solar System, producing secondary fluctuations that will superpose with the original ones. Because of the finite propagation speed of gravitational waves, such a superposition may result in a phase difference producing the observed maxima or minima.

INTRODUCTION

Our company has unfolded, and is currently exploiting, a network of sensors that perform measurements of the cosmic background non-ionising penetrating radiation. In the course of processing the data obtained from the measurements we discovered regular peaks in the intensity of the radiation, with periods that are multiples of the time of propagation of electromagnetic waves between massive objects of the Solar system (Sun, the planets and their satellites). Our sensors are not sensitive to electromagnetic radiation, being shielded securely from it. The sensors measure the intensity of penetrating non-ionising radiation. The known types of such radiation today are associated with gravity, neutrino and various exotic particles.

In this article we will present a hypothesis regarding the origin of the spectral peaks registered by our sensors. The planets of our Solar system are not a significant source of neither neutrinos nor exotic particles. They are, on the other hand, massive objects, the movement of which is determined by a complex combination of varying gravitational forces, and presumably, fluctuations of gravitational waves.

At present the existence of gravitational waves has been theoretically predicted and experimentally proved. It has also been determined that their propagation speed coincides with the propagation speed of light in vacuum[1,2]. The gravitational and the electromagnetic waves have common properties (for example see [3] in References). A complete theory of gravitation is still an object of discussion, yet we tend to support the obvious hypothesis that, just like a disturbance of an electromagnetic field is propagated by an electromagnetic wave, so is a disturbance of a gravitational field propagated by a gravitational wave.

THE MODEL

Let us now assume a system consisting of two objects with gravitational interaction between them, and one of them being much larger than the other. We will call them conventionally “Earth” and “Sun”.

Let us suppose that due to an external disturbance, the Earth has changed its distance to the Sun for a short period of time. The gravitational field between the two objects has also changed as a result. The Sun will “experience” this change in time t_1, necessary for the gravitational field to cover the distance Earth to Sun. The field around the Sun will also change, and that will generate a secondary gravitational wave that will reach the Earth in time $t_2 = t_1$. Let us now assume that the Earth performs oscillations in its orbit, resulting in a regular variation of the distance between Earth and Sun. Let us suppose that these oscillations are caused by external factors. As a result, the gravitational field (as well as the attractive force) between Earth and Sun will also oscillate. Depending on the distance between the two objects and the period of oscillations, due to the speed of the gravitational wave being finite, the oscillations of the attractive force may either reinforce or suppress the original oscillations.

The equation of the Earth's disturbed motion in simplified form may be written as

$$\frac{d^2x}{dt^2} = W \tag{1}$$

The *x*-axis is directed from the Sun to the Earth, with $x = 0$ corresponding to undisturbed motion (Fig.1). *W* is the force factor causing the oscillation of the Earth about its orbit.

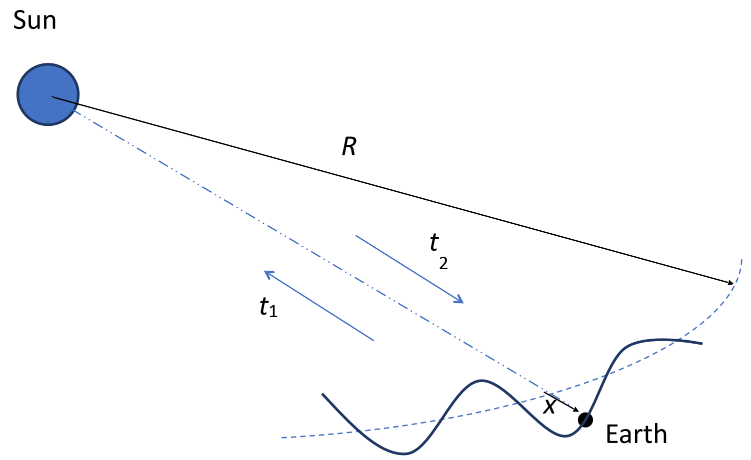

Fig.1

For an object oscillating according to

$$x = a\sin(\omega\, t)$$

we get

$$W = \frac{dx^2}{dt^2} = -\,\omega^2\, a\sin(\omega\, t)$$

regardless of what causes the oscillations, where $\omega = 2\,\pi f$ is the angular frequency of the oscillations.

The regular variation of distance between the Earth and Sun due to these oscillations will lead to a regular variation of the attractive force between them. This gravitational increment is given by

$$dF = -\left(\frac{M}{(R+x)^2} - \frac{M}{R^2}\right) \tag{2}$$

where

$M = G\left(m_1 \bullet m_2\right)$	–	the gravitational factor
m_1, m_2	–	masses of the objects (Earth, Sun)
G	–	the universal gravitational constant

Considering that the amplitude of oscillations *x* is much smaller than *R*, and therefore at any rate, $x \ll R$, we can expand the first term in expression (2) to get

$$dF = -\,M\left(\frac{1}{R^2} - \frac{2\,x}{R^3} - \frac{1}{R^2}\right) = \frac{2\,M}{R^3}x = c\,x \tag{3}$$

Taking into account this gravitational increment, expression (1) can be written as

$$\frac{d^2x}{dt^2} = W + c \bullet x(t - \tau) \qquad (4)$$

where τ is the gravitational response delay. This delay is equal to the sum of time intervals necessary for the gravitational interaction (gravitational wave) to travel from the Earth to the Sun and for the secondary wave to travel from the Sun back to Earth.

In the assumption that gravitational interaction (gravitational wave) propagates at the speed of light we can deduce that

$$\tau = \frac{2R}{c} \qquad (5)$$

where *R* is the distance between Earth and Sun (Fig.1), *c* is the speed of light in vacuum.
Depending on how τ is related to the oscillating period, *T*, of Earth, where

$$T = \frac{2\pi}{\omega}$$

the gravitational increment may reinforce or suppress the oscillations.

Equation (4) is a Delayed Differential Equation (DDE). The solution can be found numerically by using any one of the well-known numerical methods. We used the iterative Runge-Kutta method of 4th order at every step of integration.

By introducing additional restrictions, (4) can be used to estimate *dF* analytically as a function of τ in the form

$$dF \sim -C\cos\varphi\,, \qquad \varphi = \frac{2\pi\tau}{T} \qquad (6)$$

where *C* is a constant. The results of the numerical integration verify that (6) is an adequate expression to the problem conditions.

Fig.2 shows a typical dependency of the gravitational increment *dF*, in arbitrary units, on the relative delay factor r_t where

$$r_t = \frac{\tau}{T}$$

The graph was obtained by numerical integration of equation (4) for different values of τ.

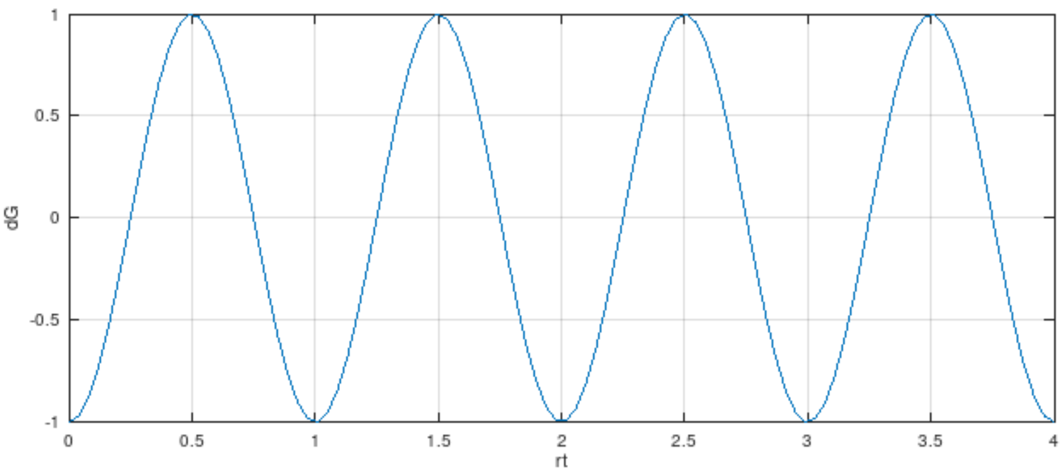

Fig.2

We observe that when $dF > 0$ oscillations are intensified, while when $dF < 0$ they become weaker. The function has a period equal to $T_r = 1$. At values of $r_t = N - 0.5$ we register maximum points of the function *dF*, while at $r_t = N$ we register minimum points, where $N = 1, 2, 3, \ldots$ is the set of natural numbers. The point $r_t = 0$ presents no interest since the absence of delay in the gravitational response is unrealistic according to modern physical conceptions.

The maximum points of *dF* correspond to the strongest intensification of the oscillations (resonance), minimum points of *dF* correspond to the highest weakening of oscillations (antiresonance). Having in mind the actual form of the function *dF* we can obtain the oscillating periods corresponding to resonance and antiresonance effects as functions of the distance between Earth and Sun.
For maximum points:

$$r_t = \frac{\tau}{T_{max}} = N - 0.5, \qquad \tau = \frac{\lambda}{c} = \frac{2R}{c} \qquad \Longrightarrow \qquad T_{max}(N) = \frac{2R}{c\,(N-0.5)} \tag{7}$$

For minimum points:

$$r_t = \frac{\tau}{T_{min}} = N, \qquad \tau = \frac{\lambda}{c} = \frac{2R}{c} \qquad \Longrightarrow \qquad T_{min}(N) = \frac{2R}{c\,N} \tag{8}$$

where $\lambda = 2R$ is the wavelength of the gravitational wave, *c* is the speed of light.
The corresponding expressions for the frequencies for maximum and minimum points are the following:

$$f_{max}(N) = \frac{c\,(N-0.5)}{2R} \tag{9}$$

$$f_{min}(N) = \frac{c\,N}{2R} \tag{10}$$

where $N = 1, 2, 3, \ldots$
Below are the frequency values for the first three values of $N = 1, 2, 3.$
Resonance frequencies:

$$f_{max} = \quad \frac{1}{4} \bullet \frac{c}{R}, \;\; \frac{3}{4} \bullet \frac{c}{R}, \;\; \frac{5}{4} \bullet \frac{c}{R} \tag{11}$$

Antiresonance frequencies:

$$f_{min} = \quad \frac{1}{2} \bullet \frac{c}{R}, \;\; 1 \bullet \frac{c}{R}, \;\; 2 \bullet \frac{c}{R} \tag{12}$$

The physical model presented here is extremely simplified and does not take into account various other circumstances, including possible attenuation of the oscillations, variation of various parameters with time, non-linear effects and so on. On the other hand, the numerical experiments show that the positions of maximum and minimum points will remain unchanged within a broad range of variation of the parameters used in the model. When, for example, we introduce into the model attenuation of the oscillations and *R* and *m* as variables, we observe a decrease in the amplitude of maxima and minima as *N* increases (which is expected in terms of physical principles), while the position of maxima and minima remain unchanged. The absolute value of the gravitational increment itself is not large, but we need to keep in mind that the motion of all objects of the Solar System is determined by the gravitational interaction, that will vary when the distance between object varies. These variations are comparable with the value of the gravitational increment.

CONCLUSION AND FURTHER DISCUSSION

A hypothesis has been presented that assumes the existence of gravitational waves and hence their property to superpose, by applying the same principles that would be used for conventional waves. This hypothesis explains well the results that we get from processing the data we received from our network of sensors of non-ionising, penetrating radiation, especially when regarding the maxima and minima in terms of resonance and antiresonance phenomena.

Confirmation of the existence of resonance and antiresonance gravitational phenomena was also obtained during a joint analysis of data received from seismic activity on the Earth's surface and the mutual configuration of massive objects in the Solar System for the years 2000 – 2023. (XXXXXXX)

It should be noted that, if the hypothesis presented in this article is correct, then we might observe quantisation of the orbital radii of the objects performing orbital motion under the influence of gravitational forces. Concerning star systems, including our own Solar System, the planetary oscillations, either of their own nature or caused by any other reason like the motion of satellites or tectonic movement etc., produce gravitational waves that, depending on the period (or frequency), will further result in either a suppression of oscillations and hence a stable orbital radius of the planet, or a reinforcement of the oscillations, which may result in an unstable orbit, especially in astronomical time scales.

It is obvious that resonance gravitational effects should be characteristic of all objects that interact by gravitational forces, that is for all objects with a mass.

For further information on gravitational resonances refer to our article "Gravitational resonances and their possible role in the functioning of living organisms".

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