Possible Influence of Gravitational Resonances in the Sun-Earth-Moon System On the Seismic Activity on Earth

Cosmic Causes and Biological Implications

ABSTRACT

The article provides evidence of how gravitational wave resonances in the system Sun-Earth-Moon may provide explanation for the existence of certain natural biological frequencies that are being discovered in various processes in living organisms. It also presents the hypothesis that such gravitational wave interference is important for living organisms, creating resonances for some frequencies, that are being used to synchronise internal biological rhythms for living organisms, and antiresonances for other frequencies, used for the internal transmission of signals between cells and organs within an organism.

INTRODUCTION

As we presumed in our previous articles[1,2], interference of gravitational waves from interacting massive objects can lead to resonance and antiresonance effects, caused by disturbances in the motion of these bodies, or by seismic disturbances of the bodies themselves. There are two possibilities: mutual gravitational wave resonance (MGR), caused by the gravitational interaction of two or more bodies with each other (for example Sun *and* Earth), or natural gravitational wave resonance (NGR) for massive objects, caused by the amplification of gravitational waves between the centre of gravity and the surface of the same object (for example, the Sun *or* the Earth). The MGR frequencies are defined by the distance, L, between objects and can be written as

$$f^{R}_{MGR}(N) = \frac{c\,(N - 0.5)}{2\,L} \tag{1}$$

The NGR frequencies on the surface of an object is determined by its radius, R, and can be written as

$$f^{R}_{NGR}(N) = \frac{c\,(N - 0.5)}{2\,R} \tag{2}$$

The corresponding MGR and NGR antiresonance frequencies are given by the following expressions

$$f^{A}_{MGR}(N) = \frac{c\,N}{2\,L} \tag{3}$$

$$f^{A}_{NGR}(N) = \frac{c\,N}{2\,R} \tag{4}$$

In all the previous expressions (1) – (4), c is the speed of propagation of gravitational waves, equal to the speed of light in vacuum and $N = 1, 2, 3, \ldots$

Resonant phenomena manifest themselves most intensely at $N = 1$, since for higher harmonics the requirements for constant R and L become far more critical and in real conditions this makes the occurrence of resonance more difficult, especially for MGR.

Generally, we do know of orbital resonances in the Solar System, that link the rotational orbital periods of different planets or moons (for example, Saturn and Jupiter, Ganymede and Io) and spin-orbital resonances that link the period of an object's own revolution about its axis and the period of its orbital rotation (for example Mercury with respect to the Sun, the Moon with respect to the Earth etc). There are more examples of this sort[3,4]. Resonance occurs when the corresponding frequencies are in a ratio of two small natural numbers:

$$\frac{f_1}{f_2} = \frac{a}{b} \quad , \qquad a,\ b = 1..N \quad (N \le N_{max}) \tag{5}$$

We assume that the MGR and NGR frequencies of the objects of the Solar System may also be in a mutual resonance or antiresonance relationship.

SEISMIC DATA ANALYSIS

In the system Sun-Earth-Moon, the Sun (with a radius of 69340 km) has an NGR frequency of $f_1 = 0.108$ Hz, while the Earth-Moon MGR frequency varies in the range $f_2 = \left[0.18 - 0.20\right]$ Hz. The ratio of these frequencies is constantly changing as a result of variations in f_2, sometimes assuming values that satisfy (5).

We analysed the results from 1 January 2023 to 25 May 2023 in greater detail. During that period the EarthMoon MGR frequency was in the range 0.18 – 0.21 Hz with a mathematical expectation of 0.19 Hz. The NGR Sun frequency equals to $f_1 = 0.108$ Hz. We will introduce the variable

$$R_f = \frac{f_2}{f_1}$$

being the ratio of resonance frequencies, being in fact a function of time, t: $R_f = R_f(t)$. For the period in question the ratio values lie in the range

$$R_f(t) = 1.17 - 1.95$$

We will also introduce the notation $R_r(n)$ for the set of values that satisfy (5) with R_f being in the above range, $N \le N_{max}$. Assuming that the gravitational wave produced by the Sun's NGR causes oscillations of the Earth, and similar oscillations are caused by the MGR of the Earth-Moon system, resonance will occur for the following R_f and R_r values, shown in the table below, $N_{max} = 12$.

$R_r(1) = 7/4$	$R_f = 1.7500000$
$R_r(2) = 9/5$	$R_f = 1.8000000$
$R_r(3) = 11/6$	$R_f = 1.8333333$
$R_r(4) = 12/7$	$R_f = 1.7142857$
$R_r(5) = 13/7$	$R_f = 1.8571429$
$R_r(6) = 15/8$	$R_f = 1.8750000$
$R_r(7) = 16/9$	$R_f = 1.7777778$

(6)

$R_r(8) = 17/9$	$R_f = 1.8888889$
$R_r(9) = 19/10$	$R_f = 1.9000000$
$R_r(10) = 19/11$	$R_f = 1.7272727$
$R_r(11) = 20/11$	$R_f = 1.8181818$
$R_r(12) = 21/11$	$R_f = 1.9090909$
$R_r(13) = 23/12$	$R_f = 1.9166667$

We can introduce a proximity measure of $R_f(t)$ to the value set (6) as

$$U_f(t) = \min\left[\left(R_f(t) - R_r(i)\right)^2\right] \quad , \qquad i = 1..13 \tag{7}$$

Furthermore, we can assume that in the proximity of local minima of $U_f(t)$ we get mutual resonance of f_1 and f_2, which may be shown through some sort of correlation with the Earth's seismic activity. In Fig.1 we present the mutual correlation function of two time-sequences: that of the seismic energy released on Earth in events with a magnitude higher than 4.3 from 1 January to 25 March 2023, and that of the functional (7) for the same period.

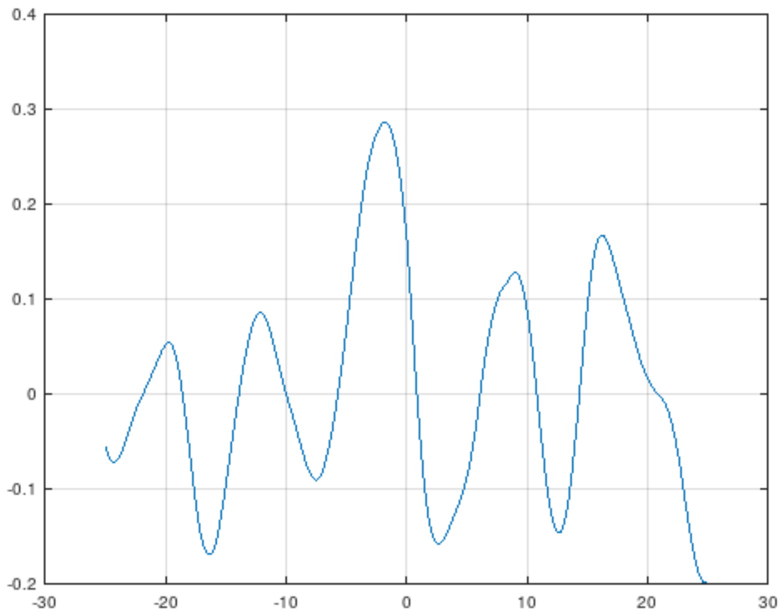

Fig.1
The mutual correlation function of seismic energy (data taken from the USGS site) and the functional (7) (ephemerides taken from the NASA Horizons Project)
Horizontal axis: Time in days

The graph itself already looks interesting. We can introduce an additional condition and demand that at the moment of possible occurrence of resonance, the angle between the Sun and the Moon as observed from the Earth should be equal to 0°, 90° or 180°. Since the gravitational wave is a quadrupole wave, resonances will manifest themselves more evidently at these angles. The above considerations can be expressed by a functional

$$U_a(t) = \min\left[\left(F_{SM}(t) - F_T(i)\right)^2\right] \quad , \quad i = 1,2,3 \quad , \quad F_T(i) = 0, 90, 180 \tag{8}$$

where $F_{SM}(t)$ is the Sun-Earth-Moon angle, t is the time. As a result, we can get the functional

$$U_{fa}(t) = U_a(t) \times U_f(t) \tag{9}$$

Fig.2 shows the function $U_{fa}(t)$ in logarithmic scale.

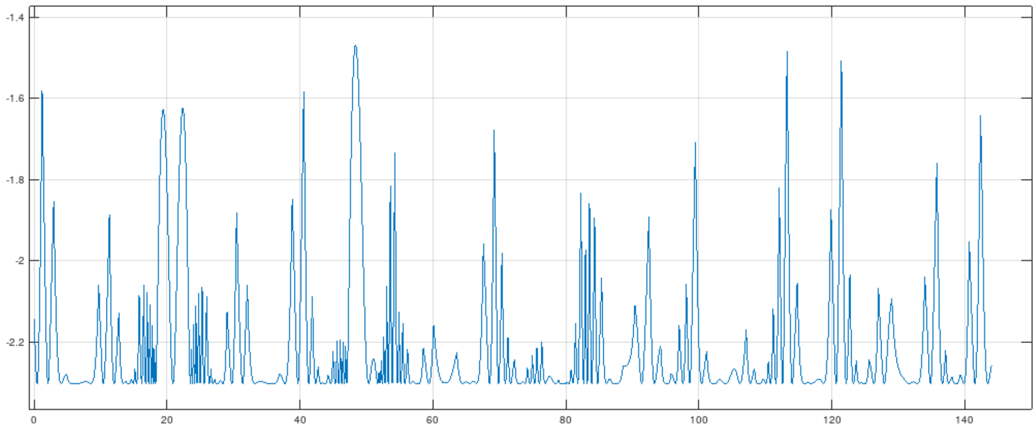

Fig.2

Horizontal axis: Time in days

Vertical axis: $\log\left(U_{fa}(t)\right)$

The smaller the value of U_{fa} the higher the probability of getting resonance.

Functional (9) can be modified as follows:

$$I_{fa}(t) = \frac{1}{\log\left(U_{fa}(t)\right)} \tag{10}$$

so that the highest probability of occurrence of resonance corresponds to a maximum of the functional.
When we calculate the mutual correlation function of the time sequence array for the released seismic energy using the functional (10) we get Fig.3.

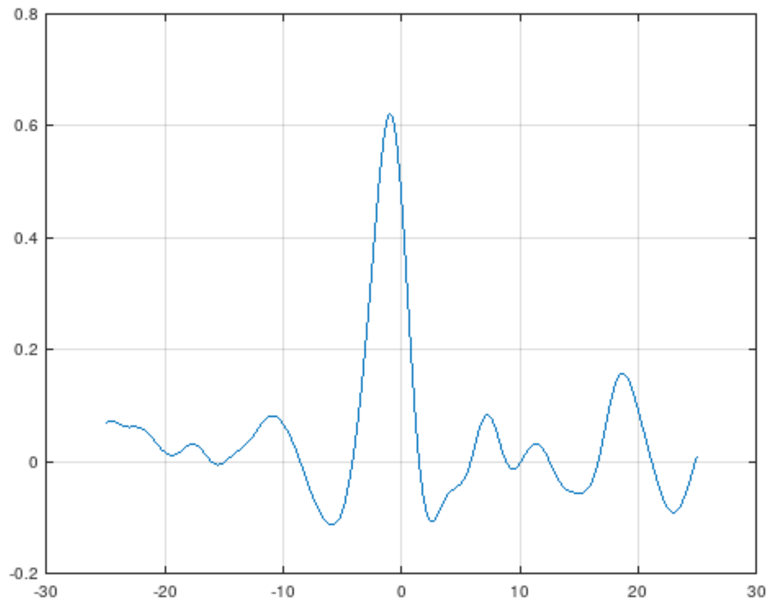

Fig.3
Mutual correlation function of the release of seismic energy and functional (10).

We can see from the graph that the correlation coefficient between the released seismic energy and the functional (10) reaches the value of 0.62, and that the maximum point of the released energy has a delay, with respect to the functional that describes the moments of most probable resonance occurrence, of approximately a full day (1390 minutes). The correlation coefficient of 0.62 seems to be quite significant, taking into account the probabilistic character and large number of factors, which the release of seismic energy depends upon. The delay of seismic energy release with respect to the functional (7) can be explained by causality. Specifically, a day's delay appears perhaps because of the relatively high Q-factor of the Earth as an oscillating system, which may lead to a cyclotronic amplification of the gravitational resonance.

As a preliminary result we can say the following:
The data analysis concerning the times of the release of seismic energy on Earth allows us to state that there is a correlation of the amount of released energy with the periods of possible occurrence of gravitational wave resonances in the system Sun (as NGR) and {Earth + Moon} (as MGR).
That is the oscillations of the Earth at the Sun's NGR frequency will occasionally get a reinforcement from the Earth-Moon system (and probably other planetary groups and configurations as well). Since the Sun's NGR frequency is constant (especially in the time frame of the existence of life on Earth) it could definitely become a part of physical and biological phenomena.

BIOLOGICAL IMPLICATIONS

Indeed frequencies close to the NGR Sun frequencies (0.108 Hz, a period of 9.3 sec) are found in the fluctuations of the solar wind[4,5,6] and the fluctuations of the Earth's magnetosphere[7]. The biological aspect of it is even more interesting. Currently, official science has no data concerning the reception and generation of gravitational waves by living organisms. We think though that the problem is in the science rather than in the actual gravitational waves. For example, electromagnetic signals controlled the activity of the cardiovascular and nervous systems of animals long before the invention of the ECG and EEG, the discovery of electromagnetic waves or even human evolution.

Life is permeated with rhythms, they are a necessity, and have been so throughout the whole process of biological evolution. Here is a well-known quote from the German physiologist Ulrich Ebbecke: “All vital functions of our organism, respiration, blood circulation, the activity of nerve cells, are performed with a specific periodicity and rhythmicity. Our life in general is a continuous transition between calmness and activity, fatigue and rest. And in it, like the tides of the sea, reigns the great rhythm, arising from the connection of the life processes with the rhythm of the Universe.”

Biological rhythms themselves cannot be constant, but are maintained by biochemical reactions, their frequencies should change due to changes in the surrounding temperature, the condition of the organism etc. In practice, however, rhythms demonstrate sufficient stability, which in general is also essential for the efficient functioning of the organism. It is presumed that stability is supported by rhythm entrainment, the ability of biological oscillators to capture oscillatory signals of a nearby frequency. At the same time these signals do not necessarily need to have a biochemical nature; multiple cases and mechanisms have been described in which electromagnetic, acoustic, mechanical and gravitational signals have been captured.

Chronobiology, the science of biorhythms, is currently rather a science of hypotheses, but most of them assume that the rhythms of an organism are linked in a single mutually synchronised system. And that this system is additionally synchronised by natural external physical rhythms.

However, in the part of the Universe so far discovered by science, there aren’t so many natural rhythms, especially stable ones, that could be perceived by all living organisms on Earth. In fact, besides the regular change of day and night (circadian rhythm), the tidal influence of the Moon, their inter-combined frequencies and harmonics[8], nothing else is known. But these are slow rhythms. Some organisms have a lifecycle that lasts less than a day or even a few hours. Organisms need rhythms of higher frequency, and in nature they can be found in multitude (some known biological rhythms have frequencies higher than 1000 Hz). The hypothesis that rhythms with a frequency of the order 1000 Hz (period equal to 1 ms) are synchronised based on the external circadian rhythm (with a period of 24 hrs, around 8.6×10^7 ms) sounds inconsistent and is totally antiphysical. Such a synchronisation mechanism (if it is ever implemented in biological systems) is extremely complicated, while rhythms of such high frequencies are typical for relatively simple biological processes at the subcellular level. Neither can the relative stability of rhythms of electrical activity of the brain, cardiovascular and nervous systems be explained by synchronisation with circadian rhythms. For the efficient synchronisation of biological rhythms, we need external rhythm drivers of comparable frequencies.

We propose the following hypothesis:
The rhythm drivers for at least some key biological rhythms are gravitational waves, arising as a result of natural or mutual gravitational wave resonances in the Solar System. Natural resonances will have a very high frequency stability, while mutual resonances will change their frequency as the distances between the interacting objects of the Solar System change as well.
Furthermore, we assume that signals with the gravitational wave **resonance** frequencies serve as rhythm **drivers** for organisms, while the corresponding **antiresonance** frequencies are used by the organisms for signal transmission between cells, organs and systems, that is they are **signal frequencies**. There is a low level of external noise at antiresonance frequencies, which makes their use for transmitting signals within an organism extremely efficient. A similar mechanism has been described for electromagnetic wave of the millimetre range on living organisms[9].

MGR OF SUN, EARTH AND MOON

To confirm our hypothesis, we can present some results obtained by modern science. For simplicity we will concentrate on objects of the Solar System, that have the greatest gravitational influence on living organisms on the Earth’s surface: Sun, Moon, Earth. We will also limit our presentation to natural gravitational wave resonances and antiresonances as phenomena with the greatest stability. The main frequencies of natural resonance and antiresonance are shown in the table below.

Object	Resonance frequency	Antiresonance frequency
Sun	0.108 Hz	0.22 Hz
Earth	11.78 Hz	23.56 Hz
Moon	43.1 Hz	86.3 Hz

Resonances first:

0.108 Hz (0.11 Hz)	LFO Mayer waves, detected in the oscillations of arterial blood pressure[10], on EEG[11], and can even synchronise with each other[12,13]
11.78 Hz (12 Hz)	One of the main frequencies of an active conscious brain
43.1 Hz (43 Hz)	The rhythm frequency of the Central Nervous System in mammals, at least in the part that is responsible for controlling pain[14,15,16]

It is harder with antiresonances. Signals at these frequencies are generated by the organism, as we presume, therefore are extremely weak and incredibly difficult to be detected in vivo. Though rather sporadically, nevertheless, there have been discoveries of biological activity at these frequencies.

0.22 Hz	Particular rhythms were discovered at frequencies close to 0.22 Hz by physiologists[17,18,19] and neurophysiologists[20]
23.56 Hz	A signal at a frequency of 23.6 Hz (24 Hz) is used in Sensonica Vega devices for the stimulation of cell respiration. This frequency is also known to neurophysiologists[21,22,23,24] including the self-synchronisation of neurone clusters[25]
86.3 Hz	Signals at the frequency of 86 Hz is very efficient in suppressing pain[26]

For the sake of clarity, we concentrated on three objects (Moon, Sun and Earth) and only on NGR's. But we presume that biological rhythms are influenced by other objects of the Solar System (predominantly Venus and Jupiter with their satellites presumably), as we have written in a previous article[27], and intend to address this issue in subsequent discussions.

CONCLUSIONS

A hypothesis about the occurrence of gravitational wave resonances in the system Sun-Earth-Moon has been proposed and some evidence of how this mechanism is manifested in practice has been obtained, by analysing time sequences of the seismic activity on Earth. Based on this, we proposed a hypothesis about the synchronisation of biological rhythms of living organisms by gravitational wave resonances in the Solar System. Moreover, we think that gravitational wave resonances are used by living organisms for the synchronisation of their own natural rhythms by implementing the mechanism of rhythm entrainment, while the corresponding antiresonance frequencies are used by the organisms for the transmission of signals between cells, structures, organs and systems in an organism for the support of its functionality.

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