On a Possible Impact Mechanism of Micro-Powerful Gravitational Radiation on Matter and Physical Processes Occurring within it

ABSTRACT

We are proposing a hypothesis describing a possible mechanism by which gravitational radiation emitted by the Gertsenshtein generator can affect ongoing processes in matter. The energy of such non-ionising radiation is too low to initiate active processes in matter but can influence those processes that are already in progress by the "parametric three-wave mixing" mechanism that is based on resonant excitation of phonons positioned in the high-frequency part of the phonon spectrum and participating in flicker-noise. At the same time, the power of the radiation emitted by the Gertsenshtein generator is minute, so the main outcome is a shift in the phonon distribution density, increasing the fraction of the high-frequency low-amplitude phonons over the low-frequency high-amplitude phonons, without changing the overall energy value. This leads to a suppression of destructive flicker-noise variations, which in turn results in more efficient reactions, fewer errors in crystallisations and dislocations, fewer biological mutations, indeed the kind of effect observed in our experiments with the Gertsenshtein generator and its impact on matter. Used in the low-frequency modulation mode the generator may cause both simple and parametric resonant effects.

INTRODUCTION

Non-ionising radiation, an example of which is the gravitational, does not possess enough energy to ionise molecules and atoms in matter, hence its name. On the other hand, it can influence processes in matter that are already in progress.

As a comparison we can look at the following situation. If we rotate the steering wheel of a stationary vehicle, it will remain still. But if the vehicle is in motion, even the smallest turn of the steering wheel will greatly affect the vehicle's trajectory and final destination without significant effort. This is very similar to the effect that non-ionising radiation has on processes already taking place in matter.

We know of multiple applications of electromagnetic waves, the most researched type of non-ionising radiation, in which they are used to influence various physical, chemical and biological processes. We mean here a non-thermal impact in which there is no heating effect on matter (when electromagnetic waves warm up matter, it is the heating effect that plays a determining role).

There are multiple publications concerning non-thermal effects on biological organisms caused by their exposure to electromagnetic radiation[1,2], as well as discussions of non-thermal effects of electromagnetic radiation in Chemistry[3]. On our behalf we were able to demonstrate the influence of non-ionising micro-powerful Gravitational Radiation (MGR) emitted by the Gertsenshtein generator on the viability of sample organisms, the kinetics of chemical reactions and phase transitions in matter[4,5]. In this article we propose a hypothesis describing the effect of MGR on matter.

CHARACTERISTIC FEATURES OF THE GERTSENSHTEIN GENERATOR

We are working with Gertsenshtein generators, in which solid-state lasers (powerful laser multimode optical spectrum diodes) are used as a source of electromagnetic radiation, and rare earth constant magnets create a magnetic field, either in a continuous wave mode or with a low frequency modulated electromagnetic radiation in the frequency range of 1–100 Hz.

Among the observed effects of the generator are the following:

- Suppression of salt crystallisation in an oversaturated solution,
- Stimulation of growth in higher plants (in some cases more than eight times),
- Stimulation and synchronisation of biological processes when using a low frequency modulation generator.

The characteristic impact time constants (at least for biological systems) are of the order of minutes.
Based on the observed effects we can try and formulate an impact mechanism of MGR on processes taking place in matter.

Impact time constants lie in the range of thermal constants of the irradiated medium or tissue, which allows us to assume that certain processes involving phonons should also participate in the impact mechanism of the generator. The power of our Gertsenshtein generators is extremely low[6], so we assume that the observed physical phenomena are resonant in nature.

However, neither the electromagnetic wave nor the generated gravitational wave at the resonant frequency of the generator (520–530 nm, about 570 THz) can directly excite phonons by any of known or hypothetical mechanism, as this frequency is well above the maximum phonon frequency in known materials under normal conditions[7].

However, the solid-state laser Gertsenshtein generators that we use produce a relatively wide radiation spectrum, composed of closely positioned maxima.
Fig.1 presents the spectrum parameters of one of the utilized types of laser diodes.
Fig.2 shows the variation of the dominant wavelength of the radiation of diode NDG7D75 with current flowing through the diode[9].
Fig.3 shows an example of the spectrum of a different multimode laser diode.

It is clear from Fig.1–Fig.3 that the spectrum of practical lasers near the dominant frequency consists of a series of closely positioned modes. This is a characteristic feature of multimode laser diodes as examined in various reviews[11,12]. It can be noted also that the shift of the dominant frequency with temperature and current through the laser is significantly greater than the interval between the spectrum maxima.

In our experiments we observed that the Gertsenshtein generator imposed a physical impact on matter while operating at various currents and at different temperatures. This allows us to assume that the resonant impact does not occur directly at the dominant frequency of the Gertsenshtein generator.

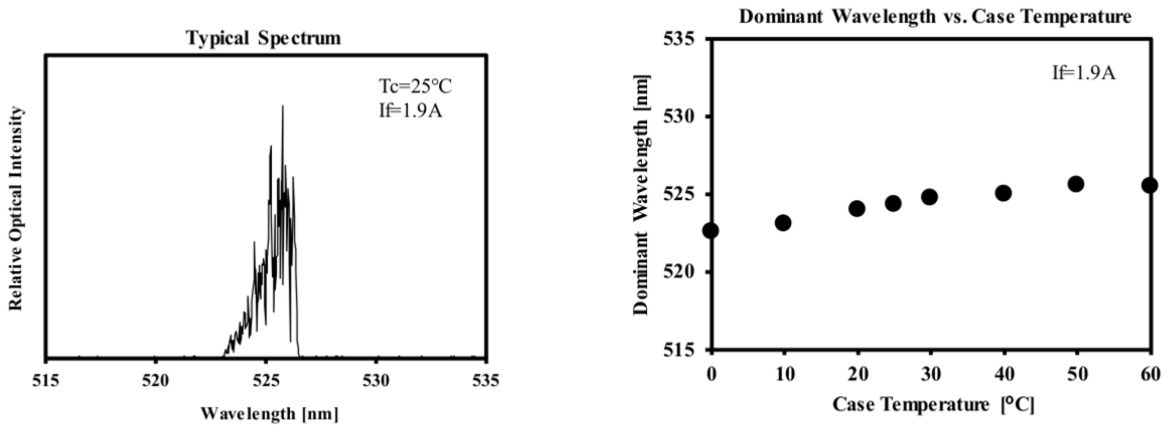

Fig.1
The spectrum of the laser diode *Nichia NDG7D75* (left) and the variation of the laser's dominant wavelength with temperature change (right) according to product documentation[8].

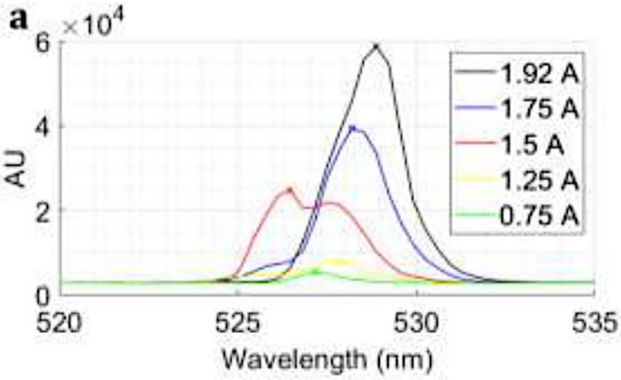

Fig. 2
Variation of the average spectrum of the diode NDG7D75 with current through the diode[9].

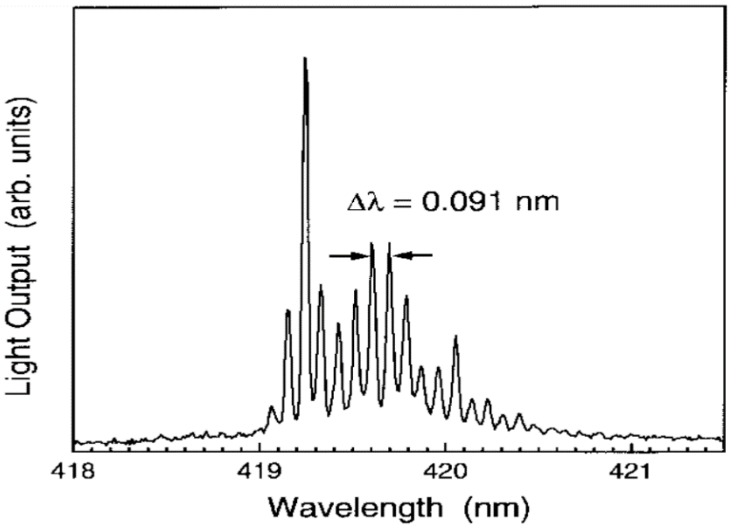

Fig.3
The experimentally obtained spectrum of InGaN–AlGaN Multiple-Quantum-Well Laser Diode[10].

PHONON EXCITATION BY THE GERTSENSHTEIN GENERATOR

In the photon-phonon interaction there is a well-known mechanism of phonon excitation by two photons called “parametric three-wave mixing”[13,14]. Two optical photons with frequencies f_a and f_b, with $f_a > f_b$ can excite in matter a phonon with frequency $W = f_a - f_b$. For multimode spectra of the form shown in Fig.1 and Fig.3 such a mechanism will allow the generation of phonons with a sequence of frequencies

$$W(k) = |f(i) - f(j)| \quad , \quad i \neq j \quad , \quad i,j \leq M \quad , \quad k = 1..M(M-1)/2$$

where $f(i)$ is the frequency of i-th spectrum maximum and M is the number of maxima in the spectrum.

Fig.4 presents the hypothetical excitation spectra of phonons for the spectra of lasers shown in Fig.1 and Fig.3 respectively.

It is evident that the excitation spectrum of the phonons for both types of lasers lies in the range of 10 GHz to 2 THz (the centre of distribution is around 0.7–1.2 THz) and this is within the frequency range of phonons.

It corresponds to phonon wavelengths of around 150 nm–0.8 nm in water and biological tissues and around 500 nm–2.5 nm in metals.

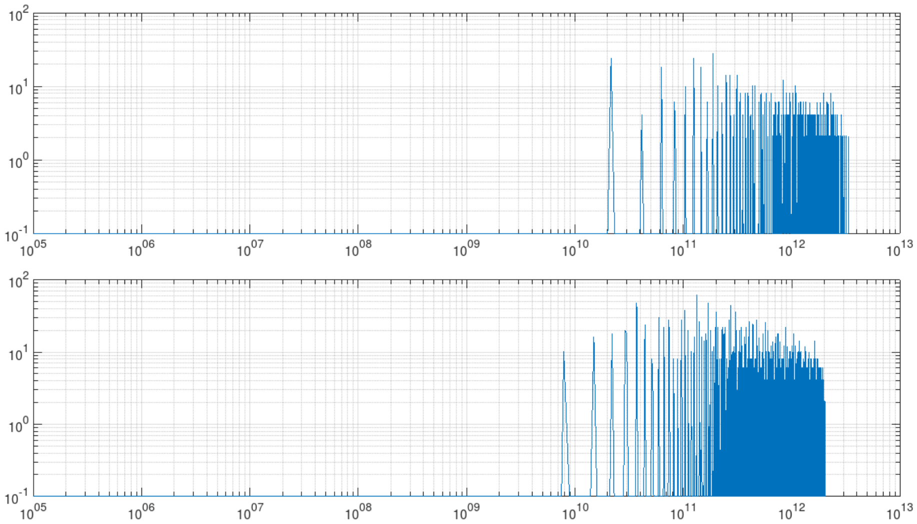

Fig.4
The phonon spectra excited by the photon spectra of Fig.1 (top) and Fig.3 (bottom).
Horizontal axis: Frequency in Hz.
Vertical axis: Number of phonons that can potentially be excited in the given mode by each type of generator, arbitrary units.

Fig.5 shows the spectrum of thermal phonons in matter at different temperatures[15]. It is evident from the graph that under normal conditions (T = 300 K) the dominant phonon wavelength is about 1 nm, which is close to the centre of distribution of the phonon spectrum excited by the Gertsenshtein generator of Fig.4.

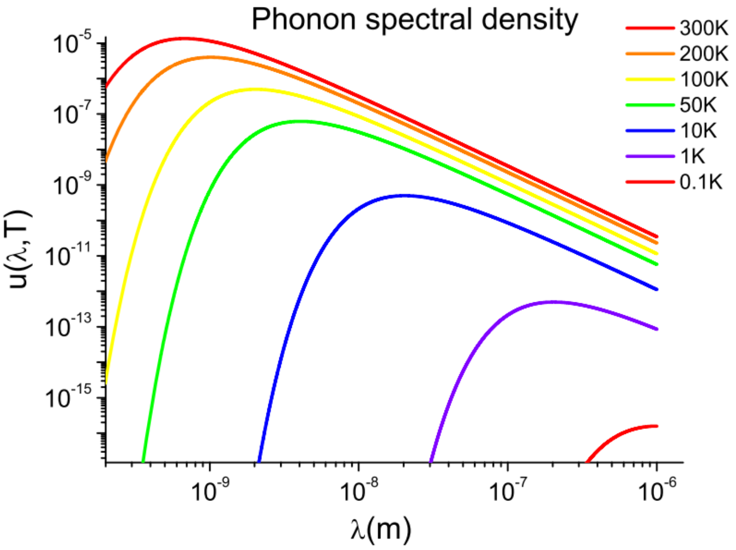

Fig.5
Horizontal axis: wavelength in meters; Vertical axis: magnitude in arbitrary units.

If our generator emitted optical photons, then we could presume that the radiation of the generator caused the excitation of phonons with wavelengths equal to those of thermal phonons under normal conditions. Our generator, however, emits gravitational waves (gravitons?). Modern science cannot currently confirm experimentally most of the theories related to the interaction of gravitational waves with matter and other physical fields (or quasiparticles like phonons). There are, on the other hand, articles that prove, for example, that phonons can be directly excited by gravitational waves in the Bose-Einstein condensate[16].

Concerning phonons, science presently suspects that it is a quasiparticle with its own frequency and, unlike the photon, has a mass, and in fact negative mass that creates negative gravity[17]. So phonons can take part in gravitational interaction, consequently in the presence of a gravitational wave it is possible to have a resonant mechanism of direct excitation of phonons by a gravitational wave of the same frequency.

With caution, we can talk, not about the direct excitation of phonons by a gravitational wave, but about the variation of the spectral distribution density of phonons at the frequency of the gravitational wave. We can presume that the impact of the gravitational wave leads to an increase in the number of phonons of the corresponding wavelength, their negative gravity perhaps being an important discriminating feature amplifying this effect. Hence, we get a hypothesis about the excitation of high frequency phonons in matter by gravitational waves of the Gertsenshtein generator. Fig.6 shows the spectrum of thermal phonons together with the spectrum of phonons, that can be excited by the Gertsenshtein generator gravitational waves.

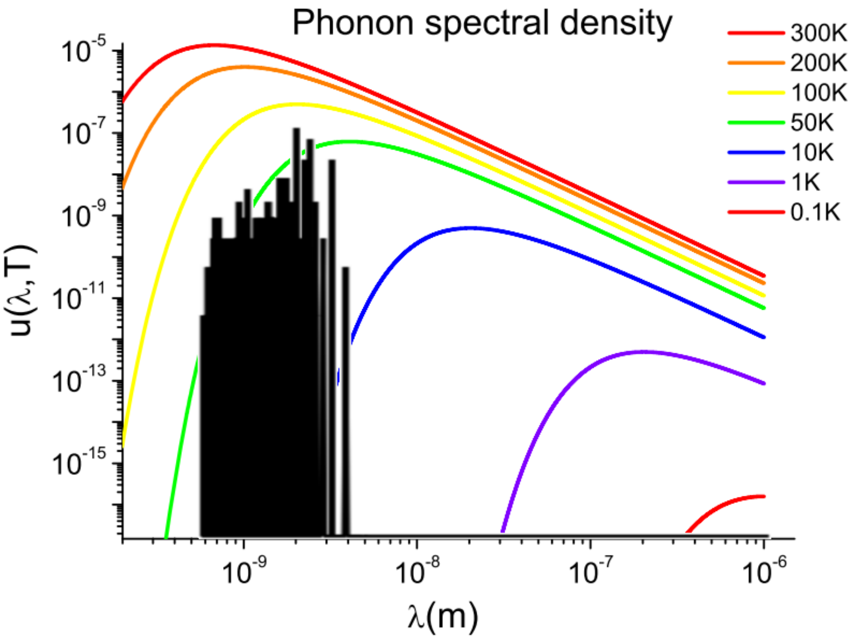

Fig.6

The spectrum of thermal phonons with respect to temperature (coloured lines) and the spectrum of phonons that can be generated as a result of the interaction of matter with the gravitational waves of the generator (black). Wavelength is plotted on the horizontal axis. The magnitude on the vertical axis is in arbitrary units.

Fig.6 shows that the spectra of the two types of phonons are consistent for temperatures higher than 50 K. And that the spectrum of phonon excitation by the generator’s gravitational wave lies in the high frequency range of the thermal phonon spectrum (in the wavelength range of 4×10^{-10} m – 4×10^{-8} m). If the impact of the gravitational wave on matter increases the probability of emission of high frequency phonons, then in isothermal conditions and in the absence of influx of external energy, for the mean temperature of matter to remain constant, it is necessary to reduce the probability of emission of low frequency phonons, since the integral of the spectrum density distribution function of the phonons should maintain a constant value.

Our hypothesis may be formulated in the following way:
Gravitational waves from the generator form a series of closely positioned modes. Modes with frequencies f_1 and f_2, with $f_1 > f_2$, by the mechanism of three-wave mixing can resonantly interact with thermal phonons in matter, causing an increase in the density of phonons of frequency

$$f_3 = f_1 - f_2$$

For radiation sources used in our generator, f_3 lies in the region of high frequency phonons (at room temperature). Since we do not have any significant transfer of energy from the generator to matter, then it means that the increase in density of high energy phonons should be compensated by a decrease in density of low frequency phonons, in order for conservation laws to be obeyed.

MACROSCOPIC EFFECTS

The proposed hypothesis explains the variations in the spectrum of thermal phonons in matter by the Gertsenshtein generator, presumably emitting gravitational waves. We have not discussed yet the macroscopic impacts that the generator may have.

Here we need to address such a universal phenomenon as flicker-noise. This is noise that is present everywhere, from atomic and molecular level through all kinds of chemical, physical, electrical, biological processes and up to astrophysical levels and social constructions. A distinctive feature of this noise is the inverse relationship of power to frequency, $P \sim 1/f$. In transfer and diffusion processes flicker-noise is a mandatory attribute[18]. The testing processed we have used to demonstrate the effect of our generator also belong to this class. Currently we have experimentally proven that our generator will have an effect on biological (biochemical) processes, phase transitions and chemical reactions.

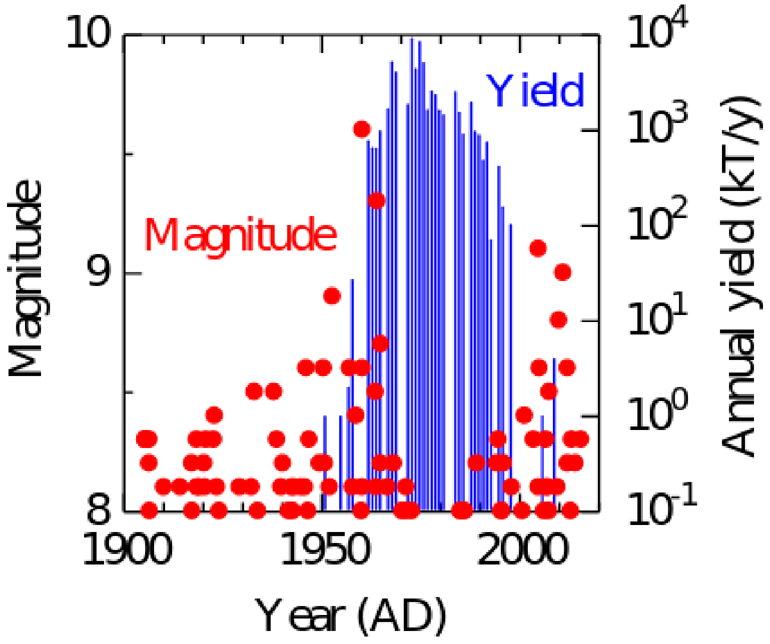

Fig.7
The magnitude of gigantic earthquakes in a year (red) and the energy produced in the process of underground nuclear tests (blue)[25].

There are several theories about the nature of flicker-noise, including some that are based on its phonon nature[19,20]. Phonons will contribute to flicker-noise, having a considerable influence on fluctuations that make up this noise[21,22,23].

We will maintain the assumption stated earlier, that the impact of the Gertsenshtein generator on matter leads to variation of the density distribution spectrum of phonons, increasing the fraction of high frequency phonons at the expense of low frequency ones, while the integral of distribution (if there is no change in the temperature of matter) remains constant. This spectrum variation assumingly affects the type of noise that accompanies the testing process.

To understand how exactly the noise changes, we will refer to a known example. Seismic activity on Earth demonstrates pronounce flicker-noise properties[24]. In an everyday sense this means that more powerful earthquakes take place (on average) less frequently than weaker ones. It was noted that there is a dependency between the frequency of extremely powerful earthquakes and the conduction of underground nuclear tests, as shown in Fig.7 [25].

We examined this issue in greater detail and analysed the distribution of earthquake magnitudes for 16 years before the prohibition of underground nuclear tests (1980 – 1996) and 16 years after the prohibition. Fig.8 shows the frequency distribution of earthquakes of various magnitude. Data about the earthquakes was taken from the USGS site.

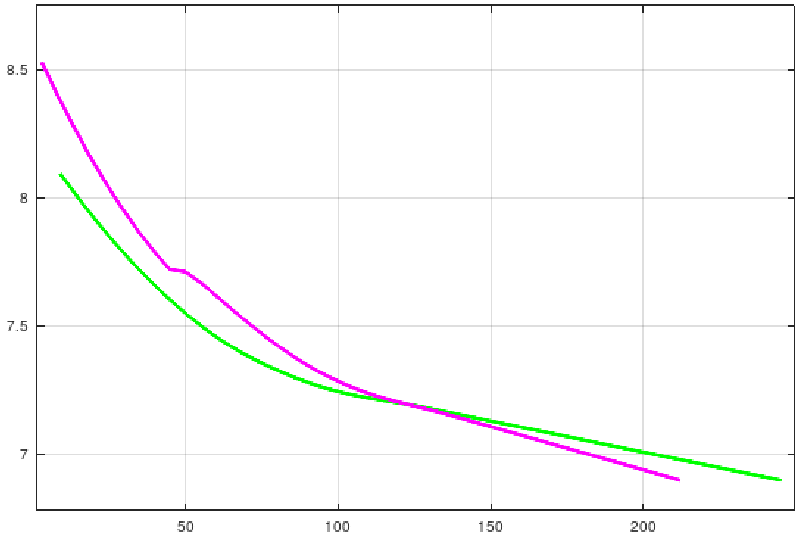

Fig.8

Horizontal axis: Number of earthquakes; Vertical axis: conventional amplitude.
Green line: In 16 years before prohibition; Pink line: In 16 years after prohibition.

From the graphs we see that because of the large number (and greater frequency) of small earthquakes there was a decrease in the number of destructive earthquakes of large magnitude.

To illustrate the nature of flicker-noise we can also refer to a well-known example. Let us imagine a tilted house roof on which snow is falling. The snow is sliding down, but part of it remains and accumulates on rough areas of the roof. If the roof has gathered a lot of snow that slides all at once, we get a large fluctuation. The next large fluctuation will not (on average) appear soon, because the snow has to accumulate first on the roof. But if we force the roof to vibrate with a relatively high frequency, then the snow will slide down more often and will not build up to large quantities. All this, of course, in a statistical sense.

For the processes of transfer and diffusion in matter, that obey the same fluctuation statistics $\sim 1/f$, it means that an increase in the fraction of high frequency fluctuations of small amplitudes, reduces the probability of fluctuations of destructive amplitude. By fluctuations of destructive amplitude, we mean such fluctuations that violate the normal course of the process: errors in (bio)chemical reactions, faults in molecular motors and similar structures in living tissue, the formation of local crystallisation centres and defects in crystalline structures.

The presumed model mechanism of the impact of the generator on matter is shown in Fig.9. The black line is the amplitude of the $1/f$ noise. The red region corresponds to the excitation of additional high frequency phonons under the impact of the generator. The blue region shows the compensating suppression of low frequency phonons. The areas of the red and blue regions are equal. The light blue line shows the maximum amplitude of fluctuations when irradiated by the generator. The green line is the level in the zone of fully suppressed fluctuations, while the purple line is the level of partially suppressed fluctuations.

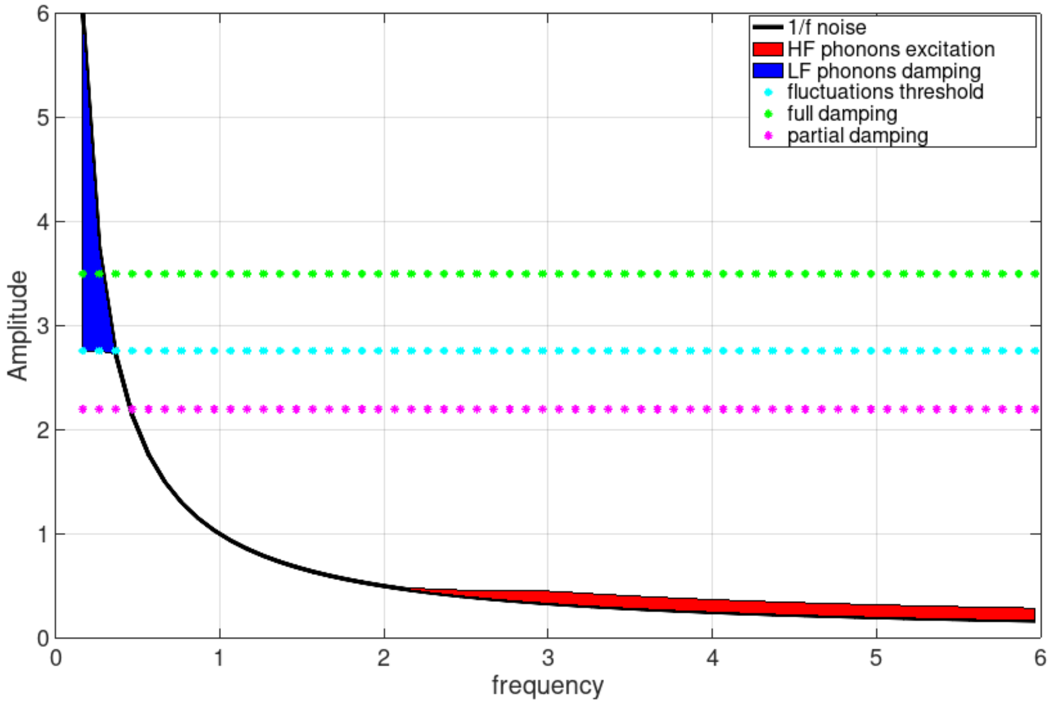

Fig.9

Conditional distribution of the amplitude of fluctuations of physical processes under the influence of the generator.
Horizontal axis: frequency in arbitrary units.
Vertical axis: amplitude of fluctuations in arbitrary units.

The picture is simplified with numerous physical details omitted for the sake of clarity. Definitely the low frequency fluctuations cannot be fully suppressed, nevertheless the concept of the effect of the generator becomes clear.

LOW FREQUENCY MODULATION

We are left with understanding the role of the low frequency modulation of the generator signal, in which the frequency distribution of fluctuations is rhythmically being changed.

The modulated flicker-noise can affect the behaviour of oscillators by several mechanisms. For example, for bistable non-linear oscillators it is possible to stimulate interstate transitions under a regular change of the fluctuation levels[26]. For non-linear biological oscillators (molecular motors) the periodic modulation of fluctuations can have a decisive effect on their parameters[27]. For linear oscillators the change in amplitude of fluctuations near the oscillator frequency is equivalent to a change of its Q-factor, which can trigger (and in experiments indeed it does) the phenomenon of parametric resonance.

A definite (but almost improbable, due to low amplitude) cause for the appearance of parametric resonance could be the direct modulation of the speed of sound as a gravitational wave propagates through matter, due to distortion of its structure.

Mechanisms in which simple resonance occurs are also possible. For example, for processes of thermally activated delayed fluorescence (TADF) the rhythmic change of the fluctuation distribution at frequency f_s corresponding to Fig.5 leads to a rhythmic change of the afterglow constant at the same frequency f_s. This effect has been repeatedly observed in our experiments and forms the foundation of our “Hertz experiment” for gravitational waves[28,29]. Probably this result may be extended onto other processes as well if they exhibit an Arrhenius temperature relationship.

Overall, the hypothesis concerning the impact of the Gertsenshtein generator on matter may be formulated in the following manner:
The source of electromagnetic wave in the Gertsenshtein generator emits several closely located modes $f(i)$, for $i = 1..N$. The electromagnetic radiation is transformed inside the generator into coherent gravitational radiation. Modes of the gravitational radiation, by the mechanism of three-wave mixing, stimulate a resonant excitation in the irradiated matter of additional phonons with frequencies $f(k) = |f(i) - f(j)|$. This is further facilitated by the fact that phonons possess (negative) mass and therefore participate in gravitational interaction. The excited phonons under normal conditions correspond to a high-frequency phonon spectrum. Since in this process there is no significant transfer of energy to the matter, the increase in the fraction of high-frequency phonons should be compensated by a decrease in the fraction of low-frequency phonons. As a result, the form of the spectral distribution density of phonons changes, while the integral of the distribution function (total power) remains constant. The physical and chemical processes in matter (based on transfer and diffusion) that are studied under the impact of the generator are subject to flicker-noise ($1/f$ noise). In this case the lowest frequency phonons correspond to the highest amplitudes of fluctuations and the impact of the generator is expressed in the suppression of the highest amplitude fluctuations. As a result, under the impact of the generator, in processes proceeding in matter, fluctuations with amplitude greater or equal to the critical are fully or partially suppressed (depending on the threshold amplitude of the specific process). By critical here we mean the amplitude of fluctuations that is sufficient for violating the normal course of the process resulting in errors in (bio)chemical reactions, the formation of crystallisation and dislocation centres etc. As a result, under the influence of the generator there is an increase in the performance of reactions due to a decrease in the influence of random energy fluctuations on the course of the process, since there is a decrease in the probability of errors, mutations etc. The generator, at the same time, has an impact only on processes that are already ongoing, with their own characteristic fluctuation spectrum being, fully or partially, above the critical level.

Under the low-frequency modulation of the Gertsenshtein generator there is a modulation of the fluctuation spectrum of processes proceeding in matter that leads to a regular change of the process parameters, which can cause an excitation of oscillations of the process parameters and also resonant excitation of oscillators in matter (for example in living tissue) by the mechanism of parametric and simple resonance.

CONCLUSION

Gertsenshtein generators are devices that in theory emit gravitational waves. Despite their power being too low to trigger processes in matter, experiments have shown that they can affect on-going processes. The hypothesis presented here is an attempt to describe possible mechanisms that would explain the experimental results obtained with the Gertsenshtein generator. The parametric three-wave mixing mechanism may be responsible for the excitation of phonons and the change in the phonon distribution density of the characteristic $\sim 1/f$ flicker-noise background. The generator suppresses the highest amplitude fluctuations (above threshold) of physical and chemical processes. The suppressed fluctuations in real processes are responsible for their anomalous course, the occurrence of errors, dislocations and defects. As a result, we get an increase in the efficiency of reactions and a decrease in the spread of parameters of processes and the probability of appearance of errors and defects, as observed in our experiments with the Gertsenshtein generator.

The low-frequency modulation causes oscillations of the process parameters at the frequency f_s and can lead to resonance of oscillators at the frequency $f_s/2$ (parametric resonance), and at frequencies $f_s = N \cdot f_s$, for $N = 1, 2, \ldots$ (parametric and simple resonances).

The presented hypothesis of the mechanism of impact of the Gertsenshtein generator on processes in matter enables not only to explain results, observed in experiments with the Gertsenshtein generator, but also propose methods of detection of the Gertsenshtein generator radiation and natural gravitational waves. Concerning the detection of radiation of the Gertsenshtein generator and gravitational waves refer to our article “Methods of detection of the Gertsenshtein generator radiation”.

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