© A U T OM AT I C S & S O F TWARE ENGINERY. 2017, No 4 (22)

The Experiment with a Laser to refute General Relativity

Vasily Yanchilin
translated from Russian

***Abstract*: Four interpretations of the gravitational redshift are discussed. The author proves that the interpretation adopted in general relativity contradicts quantum mechanics and therefore it is not correct. The author revealed numerous other contradictions between general relativity and quantum mechanics. The author proved that when light moves in a gravitational field, its energy changes 2 times faster than energy of an ordinary body, and therefore the gravitational redshift is actually blue shift. The author proposed a scheme of a simple experiment for verifying this statement and refuting general relativity. This experiment can be implemented using modern laser (maser) technology.**

Keywords: Gravity, General Relativity, Redshift, Photon Energy, Wavelength, Atomic Frequency, Laser

I. Introduction

At the beginning of the 21st century, an interesting discussion on various interpretations of the effect of gravitational redshift arose in the pages of leading Russian journals [1-3]. It turned out that two generally accepted interpretations (Newtonian and Einstein's) contradict one another and cannot be used together. Formally, the discussion ended with the victory of supporters of general relativity. But the final decision was not made, because the level of technology of that time did not allow solving this problem experimentally. The current level of laser and maser technologies is quite sufficient for conducting an experiment to refute general relativity. The main goal of this article is to attract specialists in the field of lasers, masers and frequency measurement to conduct this experiment.

II. Gravitational Redshift

Let us have two identical lasers (or maser). Both lasers are at zero altitude and generate the same high-stable frequency f_0. Let us lower one laser to the depth H. How will the frequency of its radiation change? What will be f_H? Let us write the frequency ratio in the form:

$$\frac{f_H}{f_0} - 1 = X \tag{1}$$

If the frequency of atomic radiation does not depend on the gravitational potential, then $X = 0$. If the frequency of atomic radiation depends on the gravitational potential, then $X \neq 0$. X is a very small quantity that depends on the depth H. Let the light propagates from the lower laser upward. How will its frequency change in this case? What will be the frequency of its radiation f_{H0}, when the light from the lower laser reaches zero height? Let us write the frequency ratio in the form:

$$\frac{f_{H0}}{f_H} - 1 = Y \tag{2}$$

If the frequency of photons, when they move upwards, does not decrease, but remains constant, then $Y = 0$. If the photon frequency changes during motion, then $Y \neq 0$. Y is a very small value that depends on the depth H.

What is the ratio f_{H0} and f_0? From equations (1) and (2) it follows that:

$$\frac{f_{H0}}{f_0} = \frac{f_{H0}}{f_H} \cdot \frac{f_H}{f_0} = (1+Y)\cdot(1+X) = 1 + X + Y \tag{3}$$

We neglected XY, because it is the value of the second order of smallness. Thanks to numerous experiments on the measurement of redshift, it is known:

$$\frac{f_{H0} - f_0}{f_0} = X + Y = -\frac{gH}{c^2} \tag{4}$$

Here g is the acceleration of gravity; c is the speed of light.

So, when the laser is lowered to the depth H, its frequency changes by a relative value X. When the light from this laser moves upward, its frequency changes by a relative value Y. As a result, the observer detects that the frequency of the lower laser is lower than the upper one by a relative value: $X + Y = -gH/c^2$. This is the effect of gravitational redshift: the frequency of the lower laser is shifted to the red end of the spectrum.

It should be emphasized that we do not know the X or Y values separately. We still do not know how the laser frequency will change if it is lowered (raised) to the depth (height) H. We can measure the frequency of the lower laser only after the light from it reaches the upper laser. Or vice versa. So we have several interpretations of the redshift, depending on what X or Y we choose.

III. The Newtonian Interpretation

Suppose that the frequency of the laser lowered to a depth H has not changed: $X = 0$. This means that $f_H = f_0$. In this case, the speed of the atomic clock does not depend on the gravitational potential. Such an assertion contradicts the general theory of relativity. Let's see what it will lead to.

Light consists of photons. Each photon has some energy ε and, therefore, has an inert mass ε/c^2, which is equal to its gravitational mass. So having risen to the altitude H, the photon will lose energy $\Delta\varepsilon = -gH\varepsilon/c^2$:

$$\frac{\Delta\varepsilon}{\varepsilon} = -\frac{gH}{c^2} \tag{5}$$

If we assume that Planck's constant does not depend on the gravitational potential, then the frequency of each photon, and, consequently, the frequency of light decreases when it moves upward in proportion to the energy:

$$\frac{f_{H0} - f_H}{f_H} = Y = -\frac{gH}{c^2} \tag{6}$$

Adding X and Y, we get the correct value of the gravitational shift (4). *Fig.* 1 illustrates this interpretation.

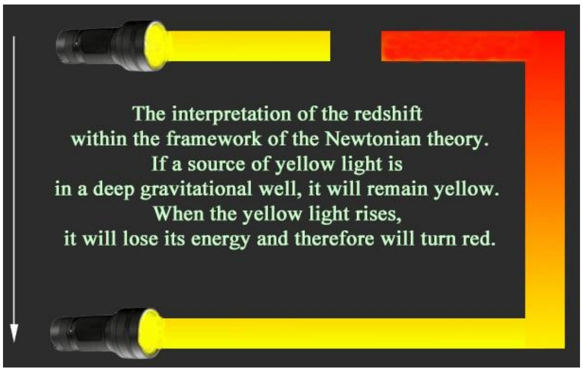

Fig. 1. The Newtonian interpretation

So, within the framework of Newtonian mechanics, we can give the following interpretation to the gravitational redshift. The frequency of the laser lowered to a depth H does not change ($X = 0$). But when the light from it moves upward, its energy decreases and the frequency decreases ($Y = -gH/c^2$). As a result, the sum $X + Y$ leads to the correct redshift value (4).

IV. The Interpretation in General Relativity

According to general relativity, if the laser is lowered to a depth H, its frequency decreases:

$$\frac{f_H - f_0}{f_0} = X = -\frac{gH}{c^2} \tag{7}$$

In order to reconcile equation (7) with the experimentally verified equation (4), it is necessary to assume that $Y = 0$. That is, the photon frequency when it moves up (or down) remains constant. If the photon frequency lowered when moving upwards, then we would get the value of the gravitational shift larger than gH/c^2, and this would contradict numerous experiments. *Fig.* 2 illustrates this interpretation.

It is widely believed (hereinafter we will consider examples) that two interpretations of the gravitational redshift (Newtonian and Einstein) are essentially the same, since they lead to the same effect (4). This opinion is erroneous, because in the framework of the Newtonian interpretation $X = 0$, and this clearly contradicts general relativity.

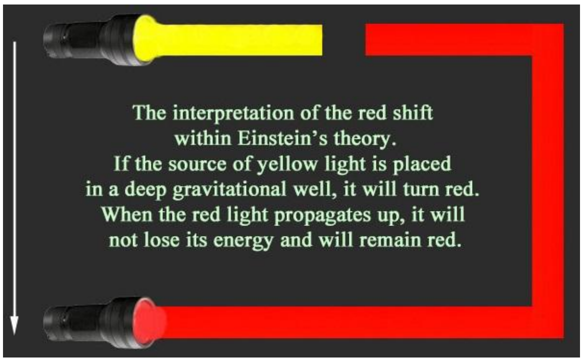

Fig. 2. The interpretation in general relativity

V. Confusion in a Simple Matter

Let us see what gravity specialists write about the gravitational redshift. We open the November issue of the journal "Soviet Physics Uspekhi" for 1964, where a review article "Relativistic astrophysics" is published [4]. Its authors, Zel'dovich and Novikov, are experts on general relativity in the Soviet Union. We read (p. 392): "The signal frequency decreases when it leaves a gravitational field and increases when moving in the opposite direction. Accordingly, the energy of a photon $E = \hbar\omega$ also changes" (the author's translation from the Russian issue).

This is strange. After all, the authors of the article are supporters of general relativity, but they adhere to the Newtonian interpretation, which contradicts general relativity. We read further: "But thanks to the connection of energy and frequency ($E = \hbar\omega$), the change in energy is associated with a change in frequency, and the last one is $\sim 1/\Delta\tau$. Thus, a change in the speed of time in a gravitational field follows from this fact" (the author's translation from the Russian issue).

That is, the authors of the article believe that the frequency of the signal decreases when leaving a gravitational field and this implies the slowing down of time in a gravitational field. But, obviously, this is not true. If the frequency of the signal were not changed ($Y = 0$), then the slowing down of time could be deduced from the redshift ($X = -gH/c^2$). But if the frequency decreases ($Y = -gH/c^2$), then time does not slow down ($X = 0$). The authors of the article use the Newtonian interpretation (*Fig.* 1) to substantiate the Einstein interpretation (*Fig.* 2), not realizing that these interpretations contradict each other.

Let us open the most famous textbook on general relativity "Gravitation" [5], paragraph 7.2 "Gravitational Red Shift Derived from Energy Conservation." Authors, Charles Misner, Kip Thorne and John Wheeler, clearly explain to the reader that a photon's frequency and energy decrease as it rises, because the photon loses its energy: "The energy of the photon must decrease just as that of a particle does when it climbs out of the gravitational field."

But already in the next section the authors "prove" that a slowing down of time is followed from the effect of redshift.

That is, first, using the Newtonian interpretation (*Fig*. 1), the authors prove the effect of redshift, but then, imperceptibly for themselves and the reader, substitute the Newtonian interpretation by Einstein's one (*Fig*. 2) and prove the slowing down of time. Such violence over logic takes place in the most famous textbook on general relativity!

If you look at the extensive literature on general relativity, you can be sure that its authors almost always use the same incorrect method when explaining the redshift.

VI. Professor Revealed the Contradiction

In 2001, the journal "Doklady Physics" published an article: "On a Discrepancy of Experiments Supporting Certain Conclusions of General Relativity" [1]. Its author is Professor of MIPT V.V. Okorokov considered the effect of the gravitational redshift and suggested three logically possible explanations: a) the photon frequency during the rise decreases by a relative value gH/c^2, and the energy levels of atoms when rising do not change; b) the photon frequency does not change when rising, and the energy levels of the atoms increase by a relative value gH/c^2; c) both the photon frequency and the energy levels change.

Analyzing the two interpretations of the redshift, Professor Okorokov comes to the conclusion that the assumption that the photon frequency decreases as it moves upward by the amount gH/c^2 contradicts the assumption that the energy levels of the atoms increase while rising by the amount gH/c^2. So if both assumptions are correct, then the redshift value will be 2 times greater than it is observed in the experiment.

Here is what he writes about the paradoxical situation that has arisen "from nowhere" [1]: "Unfortunately, the numerous long-term discussions I was involved in did not result in any intelligible scientific elucidation of the paradoxical situation. Therefore, I considered it necessary to attract the attention of the scientific community to this issue by writing this paper."

It can be noted that in the beginning of 2001 a monograph [6] was published in Novosibirsk, in which the option c) was proposed to explain the redshift: both the atomic energy levels ($X \neq 0$) and the photon frequency during the motion ($Y \neq 0$) changed.

VII. International Group of Experts on General Relativity

In the October issue, 1999, of the journal Physics Uspekhi a methodological article was published devoted exclusively to the interpretation of the redshift [2]. The authors of the article (one of them is an academician of the Russian Academy of Sciences and the other is a head of the CERN scientific policy committee) intelligently explain to the readers that the idea about a photon losing energy when leaving the gravitational field is fundamentally mistaken in the framework of general relativity: "the photon frequency in a static gravitational field is independent of the altitude and so the photon only reddens relative to the clocks."

The authors explain why the Newtonian interpretation is wrong: "If the explanation in terms of the gravitational attraction of a photon to the Earth were correct, one should expect red-shift doubling (summation of the effects of the clock and photon) in an experiment of Pound – Rebka type."

Here is a quote from an article that criticizes specialists in general relativity who do not understand that there is no place for Newtonian interpretation in general relativity: "Their authors proceed from the implicit supposition that a massless photon is similar to a conventional massive nonrelativistic particle, call the photon energy E divided by the speed of light squared c^2 the photon mass, and consider the "photon potential energy" in the gravitational field. Only exceptional popular-science texts do not contain this incorrect picture and emphasize that the energy and frequency of a photon do not change as it moves higher and higher."

Thus, the list of scientists who misunderstand general relativity: academician Ya.B. Zeldovich, Corresponding Member of the Russian Academy of Sciences I.D. Novikov, Nobel laureate Kip Thorne and many other well-known specialists in general relativity.

The article in a journal "Physics Uspekhi", according to the intention of its authors, was to remove the accusation of inconsistency of general relativity advanced by Okorokov (the preprint of his article was published in 1998).

VIII. Experimental Determination of the Value *X*

The magnitude of the redshift (4) is equal to the sum of two effects: $X + Y$. To correctly interpret the redshift, we need to know magnitudes of X and Y separately. The value of X shows how gravity affects the atomic frequency. To determine X, we need to find out how the gravitational potential affects a rate of an atomic clock.

It is widely believed that such experiments were carried out repeatedly. For example, on the Internet you can find articles with the title: "Physicists measured the gravitational time dilation" with reference to some scientific journal. As a rule, similar experiments were conducted as follows: one clock (frequency generator) was raised relative to other clock, and it began to "tick" faster.

But it is not known why the upper clock began to tick faster. Perhaps the atomic frequency rises with altitude. But perhaps the frequency of the signal from the upper clock increased after this signal reached the lower clock.

All these experiments are experiments on measuring the gravitational redshift. In them, the sum of two effects ($X + Y$) is measured at once. Then the Einstein interpretation (*Fig.* 2) is used and a conclusion is made about the time delay in a gravitational field.

This also applies to the operation of global navigation systems. Each navigation satellite forms its on-board time scale using a stable maser frequency. When the signal from the satellite reaches the Earth its frequency increases. To neutralize this effect the frequency of the generator on the satellite is somewhat reduced. According to general relativity the frequency of a signal, while it is moving toward the Earth, remains constant (*Fig*. 2), and only therefore it is concluded that the frequency of the generator on the satellite is higher than on the Earth. But an electromagnetic signal consists of photons. When photons approach the Earth their energy increases, and the signal frequency rises. This statement can be confirmed or refuted in a simple experiment (the next paragraph).

It should be emphasized that the international group of experts on general relativity (the previous paragraph) believes that experiments that directly measured the influence of gravity on the rate of atomic clock were not conducted. Here is a quote from their article [2]: “Unlike the original papers by Pound and colleagues, most of the reviews covering gravitational experiments [18–24] consider their result as a test of clock behavior in a gravitational field. Actually, the experiments themselves do not provide the choice between the two interpretations, unless GR is taken as the basis in making that choice. The reason is that they measure the relative shift of photon and nuclear frequencies, and each of the frequencies is not measured separately. The same remark also concerns the shift of the photon (radio wave) frequency with respect to the frequency of the atomic standard (a hydrogen maser) measured with a rocket that was launched to altitude 10,000 km and then fell into the ocean [12].”

Reference [12] is the article. But [18–24] are seven reviews, the numerous gravitational experiments described in them do not allow us to conclude that the atomic frequency decreases near the Earth. I would like to note the review [23]: “The Global Positioning System: Theory and Applications” Vol. 1 (American Institute of Aeronautics and Astronautics Inc., 1995). That is, even navigation system operation, contrary to widespread belief, does not support the prediction of general relativity about the lowering of the atomic frequency near the Earth.

The only experiment in which an attempt was made to determine the value of X is the airplane experiment of Hafele and Keating. However, the accuracy of an atomic clock at that time was clearly insufficient for such experiments. The experiment was conducted rather for propaganda purposes.

In the autumn of 2002, I wrote a letter to one of the authors of the article [2] – Russian academician L.B. Okun and asked if he knew the experiments that reliably confirm time dilation in a gravitational field. The academician replied that he did not know such experiments and gave me a link to his article: “A Thought Experiment with Clocks in Static Gravity”, published in 2000 in the journal “Modern Physics Letters A”. The article was written as a dialogue between two physicists. The first person proves that the photon frequency when it moves in a static gravitational field does not change. The second man believes that current experiments are not enough to confirm this. At the conclusion of the dispute, both physicists agree that it is necessary to conduct a direct experiment to measure the effect of gravity on the rate of atomic clocks. Therefore, we can conclude from the article that such experiment was not conducted.

After that, I asked Lev Okun about the possibility of conducting an experiment on the effect of gravity on the atomic frequency in Russia, for example, in VNIIFTRI (Mendeleevo). The academician replied that he would think. On 14 January, 2003, he invited me to the Institute of Time and Space Metrology, a seminar: “Possible experiments with clocks in a static gravitational field.” Then a “round table” was held with about forty leading experts in metrology. They concluded: the experiment with atomic clocks is quite complicated, but feasible. Unfortunately, this experiment was not conducted.

IX. The Experiment to Refute General Relativity

As far as I know, nobody measured the value of Y experimentally, and even the matter of measurement has not been discussed in the scientific literature. But this value can be measured and, as a result, either to confirm or to refute general relativity.

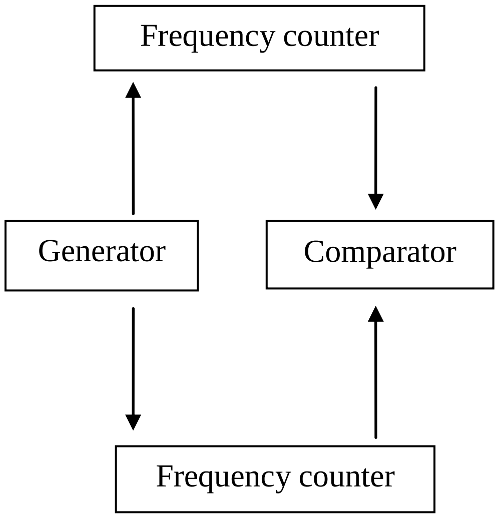

Fig. 3. Scheme of the experiment to refute general relativity

So I propose to conduct an experiment to measure the change in the frequency of an electromagnetic wave as it moves up or down. This experiment is simple (*Fig*. 3).

The frequency generator is located on the middle floor of a high-rise building. It generates a continuous periodic signal. The signal splits into two parts. One goes up, the other goes down. Frequency counters (top and bottom) count oscillations. The signals from the counters are transmitted to the comparator located on the middle floor.

The purpose of the experiment is to find out whether the frequency of an electromagnetic wave changes or not when it moves up or down.

According to general relativity (*Fig.* 2), the counting rate of both counters will be the same. If the Newtonian interpretation is correct (*Fig.* 1), the lower counter will count faster according to equation (6).

The height difference between the counters is about 100 meters. The generator frequency is several gigahertz. The time of an experiment is 2-3 days. The expected difference is about 10 pulses per day at a generator frequency of 10 GHz. We should to conduct a series of experiments for 2-3 months.

As a generator, a laser, a maser, a femtosecond laser, a meander generator, etc. are suitable. The shape of the pulses can be any (optimal for the count), but should be a coherent sum of sinusoidal oscillations. The generator should preferably be chosen so that its impulses (oscillations) are easier to count.

Some scientists [5,7,8] believe that the frequency of the signal cannot change. They even try to prove this by using a comparison of the light wave with the sound wave, which is incorrect [5,p.188].

Imagine a monochromatic light wave that moves vertically upward. The vectors of electric and magnetic fields, which rotate in a plane perpendicular to the direction of motion, are connected with this wave. As the wave rises, its energy decreases, and the rotation speed of the vectors decreases. We take a femtosecond laser. The sequence of its pulses is the sum of monochromatic waves (equidistant comb of optical frequencies). If the frequency of each wave changes, then the frequency of the laser pulses will change in the same proportion. This also applies to a periodic signal of a rectangular shape (meander), which is the sum of sinusoidal oscillations.

Thus, if the photon energy decreases as it moves up (down), then the proposed experiment will allow it to be detected. In this case, general relativity will be refuted.

X. The Simple Argument Against General Relativity

When Einstein constructed general relativity, he made a prediction that the light beam must deviate near the Sun. Subsequently, this prediction was confirmed by observations. It is this effect that is considered a decisive confirmation of general relativity. However, this is a misunderstanding. The deviation of the light beam in the field of the Sun does not confirm, but, on the contrary, refutes general relativity. Let's take a look at this.

The trajectory of the light beam is determined by the principle of the shortest optical path:

$$\int \frac{dl}{\lambda(l)} = \min \tag{8}$$

If the length of the light wave λ does not change along the trajectory of the ray l, then the light moves along a straight line. If the light is deflected toward the Sun it means that its wavelength decreases near the Sun. The photon energy ε is equal to:

$$\varepsilon = \hbar\omega = \frac{2\pi\, c}{\lambda}\hbar = \frac{2\pi}{\lambda}\frac{e^2}{\alpha} \tag{9}$$

According to general relativity, the fine structure constant α and the electron charge e do not change near the Sun [5,p.888]. Therefore, the photon energy has to increase in the vicinity of the Sun inversely proportional to its wavelength. This contradicts general relativity (paragraph VII).

XI. The Third Interpretation of the Redshift

The gravitational redshift is a trivial effect, which follows from the law of energy conservation [9]. The main thing is interpretation of the redshift. In general relativity, it is assumed that $Y = 0$. In the Newtonian interpretation, it is assumed that $X = 0$. To correctly interpret the redshift, we should use another gravitational effect.

In the previous section we found out that the photon energy varies inversely with its wavelength (9). On the other hand, it is known that a ray of light deviates near the Sun by an angle β:

$$\beta = \frac{4GM}{\rho c^2} \tag{10}$$

Here, G is the gravitational constant, M is the mass of the Sun, and ρ is the impact parameter. Knowing the deflection angle (10), we can calculate the effective refractive index $n(r)$ as a function of the distance r to the center of the Sun [10]:

$$n(r) = 1 + \frac{2GM}{rc^2} \tag{11}$$

As seen from equation (8), the effective refractive index is inversely proportional to the wavelength. Taking into account that $GM \ll rc^2$, we get:

$$\frac{\lambda(r)}{\lambda_0} = 1 - \frac{2GM}{rc^2} \tag{12}$$

Here λ_0 is the wavelength of the photon at a large distance from the Sun, $\lambda(r)$ is the wavelength of the photon at a distance r from the Sun. The photon energy ε is inversely proportional to the wavelength:

$$\frac{\varepsilon(r)}{\varepsilon_0} = 1 + \frac{2GM}{rc^2} = 1 - \frac{2\varphi}{c^2} \tag{13}$$

Here ε_0 is the photon energy at a large distance from the Sun, $\varepsilon(r)$ is the photon energy at a distance r from the Sun, $\varphi = -GM/r$ is the gravitational potential of the Sun. Pay attention that the energy of the photon increases as if it moves in the field of a double potential. The physical meaning of this interesting phenomenon is discussed in detail in [11]. If we assume that Planck's constant does not change in a gravitational field, then the photon frequency ω increases in proportion to its energy ε:

$$\frac{\omega}{\omega_0} = 1 - \frac{2\varphi}{c^2} \quad (14)$$

We came to the conclusion that the frequency of a photon (like its energy) when moving in a gravitational field changes 2 times faster than in the Newtonian interpretation (6). This means that the value of *Y* is also 2 times greater than in the Newtonian interpretation:

$$Y = -\frac{2gH}{c^2} \quad (15)$$

Using equation (4) for the redshift, we find the value of *X*:

$$X = \frac{gH}{c^2} \quad (16)$$

We have obtained a nontrivial result. The frequency of radiation of an atom (a laser or a maser) does not decrease, but increases in a gravitational field! This effect is the opposite of the effect in general relativity.

When I studied at school and university and read scientific and popular science books, in all these books time dilation in a gravitational field was presented as a firmly established experimental fact. But on closer examination it turned out that all the experiments on measuring time dilation are actually experiments on measurement of gravitational redshift. Thus, time dilation is a myth. A simple experiment depicted in *Fig*. 3, will expose this myth.

XII. Logical Confuse of General Relativity

We have proved that the radiation frequency of an atom does not decrease, but, on the contrary, it increases in a gravitational field (near the Sun and the Earth), contrary to general relativity. In doing so, we relied on equation (12), which follows from equation (10). But equation (10) is the pride of general relativity: the main experimental confirmation of the theory. Let's figure it out.

If the laser is away from the Sun and its beam is directed toward the Sun, then the wavelength of the beam will decrease along the trajectory according to equation (12). If another similar laser (we denote its wavelength λ_r) is at the distance *r* from the Sun then the ratio of the wavelengths of two lasers will be:

$$\frac{\lambda(r)}{\lambda_r} = 1 - \frac{GM}{rc^2} \quad (17)$$

This is the usual gravitational shift. That is, an observer at a distance *r* from the Sun will detect the shift of the wavelength of the remote laser to the blue end of the spectrum by 2 times than it follows from equation (12). This means that the wavelength of the observer's laser has decreased. We divide (12) into (17):

$$\frac{\lambda_r}{\lambda_0} = 1 - \frac{GM}{rc^2} \quad (18)$$

The essence of the approach used is illustrated in *Fig*. 4

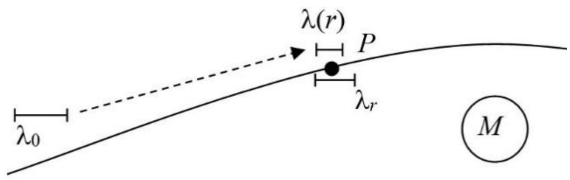

Fig. 4. The remote observer, knowing the angle of light deflection near the mass *M*, calculates how the wavelength of his laser $\lambda(r)$ varies along the ray trajectory and finds the ratio $\lambda(r)/\lambda_0$ at point *P*. His partner at point *P* measures the gravitational shift, that is, the ratio $\lambda(r)/\lambda_r$. As a result, the ratio λ_0/λ_r becomes known. As a result, we determine the shift of the wavelength of the laser at *P* relative to the distant observer. The shift occurs to the blue end.

It's time to ask specialists on general relativity to comment on our conclusion. We open the book of M. Bowler "Gravitation and Relativity" [12]. In the annotation you can read that this is an educational monograph on general relativity, which is distinguished by rigor and consistency. The book is written on the basis of a course of lectures delivered by Professor Bowler to students at Oxford University. You can learn from it that the speed of light decreases near the Sun [12, p.71]:

$$c(r) = c_0\left(1 - \frac{2GM}{rc^2}\right) \quad (19)$$

According to general relativity, the frequency of an electromagnetic wave remains constant, so the wavelength varies along the ray path in proportion to the speed of light (19), that is, in full agreement with equation (12). And this is not surprising, since otherwise the angle of deflection of the light beam would not be described by equation (10). But the blue shift of the spectrum near the Sun (18) follows from equation (12) and the gravitational shift (17). It turns out that specialists in general relativity do not understand this?

The most amusing in this situation is that the specialists in general relativity conclude exactly the same: the wavelength of atomic radiation shifts near the Sun to the blue end. But they do not realize this. Indeed, already on the next page Professor Bowler comes to the conclusion that all the standards of length are shortened near the Sun: "Therefore, it is necessary to understand the physics of atomic processes in the presence of a gravitational potential. We assume that the atomic frequencies and atomic dimensions will vary according to the factor $1 + \varphi$" (the author's translation from the Russian issue). Bowler uses the notation $\varphi = -GM/rc^2$.

Professor Bowler proposes to understand what will happen to the atom if it is placed in a gravitational pit. At the same time, he assumes that atomic frequencies and atomic sizes will change identically. According to general relativity, all dimensions must change in the same proportion. If the size of an atom decreases, then the wavelength of its radiation will also decrease. Thus, it follows from the quote that the frequency of the radiation and the wavelength of the radiation will change in the same proportion.

Is this possible? If the wavelength of the atomic radiation decreases, then obviously the radiation spectrum shifts to the blue end. But if the frequency decreases, then the radiation spectrum shifts to the red end. Specialists in gravitation need somehow to decide on this issue.

The merit of Professor Bowler is that he wrote two clearly contradictory statements in one simple and understandable sentence. His book is recognized as an authoritative educational monograph. We can conclude from this that the specialists in gravitation are in a deep illogical hole, from which they cannot independently escape. And this is only the tip of the iceberg.

XIII. Hydrogen Atom Against General Relativity

Specialists in general relativity may object about the writing in the previous paragraph. It does not matter which way the wavelength is shifted. It is important where the frequency is shifted. The frequency of atomic emission near the Sun decreases, and the energy of radiation also decreases.

This is not true. The energy of radiation is determined only by a size of an atom. If the size of the atom decreases near the Sun, the energy of the photon emitted by it will increase. Let's look at this simple example.

The formula for the Bohr radius a of the hydrogen atom in the SGS system:

$$a = \frac{\hbar^2}{me^2} \tag{20}$$

m is the electron mass, $\hbar$ is Planck's constant. The energy levels E_n in the hydrogen atom have a discrete spectrum of values and are determined by the Bohr formula:

$$E_n = -\frac{1}{n^2}\frac{me^4}{2\hbar^2(1+m/m_P)} \tag{21}$$

m_P is the proton mass. When an electron moves from the level E_n to the level E_k ($k < n$), a photon with energy $\varepsilon = \hbar\omega = E_n - E_k$ and frequency $\omega = (E_n - E_k)/\hbar$ is emitted. We introduce quantity Z:

$$Z = \frac{e^4}{2(1+m/m_P)}\cdot\left(\frac{1}{n^2}-\frac{1}{k^2}\right) \tag{22}$$

The value of Z depends only on the electron charge and the dimensionless constants. So it does not depend on the gravitational potential. Photon energy:

$$\varepsilon = Zm/\hbar^2 \tag{23}$$

We multiply equation (23) by equation (20):

$$\varepsilon\, a = Z/e^2 = \text{const} \tag{24}$$

We got a simple but interesting result. The energy of processes in the atom, including the emission of photons, is uniquely related to its size. The smaller the size of atom a the greater the energy ε of the photon emitted by it. And vice versa. This is understandable even from the most general considerations. If the system of charges is squeezed in 2 times, then the field will increase 4 times, the energy density of the field will increase, respectively, 16 times. The volume will decrease 8 times. Therefore, the total energy will increase by 2 times, that is, inversely proportional to the size.

According to general relativity, a size of an atom decreases in a gravitational field, and the energy of radiation also decreases. This fundamentally contradicts the simple equations of quantum mechanics for a hydrogen atom.

XIV. Planck's Constant and the Electron Charge

According to general relativity, the laws of nature do not depend on the absolute magnitude of the gravitational potential. Therefore, if we, together with the laboratory, approach the Sun and begin to measure different physical constants there, we obtain the same values as far from it.

On the other hand, according to general relativity, the standards of length and time vary near the Sun. Measuring different physical constants by these changed standards we will get the same values as far away from the Sun. Otherwise, we will be able to detect a change in the gravitational potential.

This means that all physical constants had to change near the Sun in proportion to their dimensionality. For example, the speed of light has the dimension m/s; therefore, its value should change in proportion to a length standard and inversely proportional to a time standard. According to general relativity, a standard of length decreases near the Sun, and the duration of a second increases (7). So the speed of light greatly decreases (19). Planck's constant has the dimension kg·m^2/s. So in the framework of general relativity, its magnitude has to decrease very strongly in a gravitational field. But in this case the energy of the photon emitted by the atom will obviously increase (21). And its frequency will increase even more. But experts in general relativity "completely forgot" about Planck's constant. They argue that when a photon leaves a gravitational field, its energy and frequency do not change. But this is impossible because Planck's constant changes.

The energy has the dimension kg·m^2/s^2, therefore within the framework of general relativity any energy must decrease very strongly in a gravitational field: it is proportional to the square of the speed of light (19). That is, 4 times stronger than it follows from the magnitude of the redshift (18). We again come to a contradiction.

The square of the electron charge has a dimensionality (CGS system) kg·m^3/s^2. According to general relativity, the magnitude of the charge does not change in a gravitational field. But a standard of length decreases, and a duration of a second increases. It turns out that within the framework of general relativity the electron charge must decrease in a gravitational field. We again come to a contradiction.

The constancy of the electron charge imposes a restriction on any theory of gravity: different standards must change in a gravitational field so that the electron charge remains the same. That is, the following condition must be satisfied:

$$\text{kg}\cdot\text{m}^3/\text{s}^2 = \text{const} \qquad (25)$$

XV. Author's Interpretation of the Redshift

We obtained equation (14) from equation (13), assuming that Planck's constant does not change in a gravitational field. But in the previous paragraph we found out that the magnitude of Planck's constant is likely to change. In [11], it is argued that Planck's constant $\hbar$ decreases with depth H:

$$\hbar(H) = \hbar(1+\frac{\varphi}{c^2}) = \hbar(1-\frac{gH}{c^2}) \qquad (26)$$

If this is the case, then the photon frequency when moving in a gravitational field will change faster than its energy. We divide equation (13) into equation (26):

$$\omega = \omega_0(1-\frac{3\varphi}{c^2}) \qquad (27)$$

The photon frequency when moving up (or down) changes 3 times faster than in the Newtonian interpretation. Consequently:

$$Y = -\frac{3gH}{c^2} \qquad (28)$$

Using equation (4) for the redshift we determine the value of X:

$$X = \frac{2gH}{c^2} \qquad (29)$$

Thus, if a laser is lowered into a potential well, its frequency will not decrease, but increase. The magnitude of the effect will be 2 times greater than in general relativity (7). It turns out that Einstein made two errors in interpreting the redshift: he did not write the multiplier "two" and wrote the wrong sign.

When the light from the laser moves up, its frequency drops very much: 3 times stronger than in the Newtonian interpretation. The double effect will be because the energy of light decreases 2 times faster than the energy of the ordinary body. And since Planck's constant increases with height, then instead of the multiplier 2 will appear the multiplier 3 (28). *Fig*. 5 illustrates this interpretation.

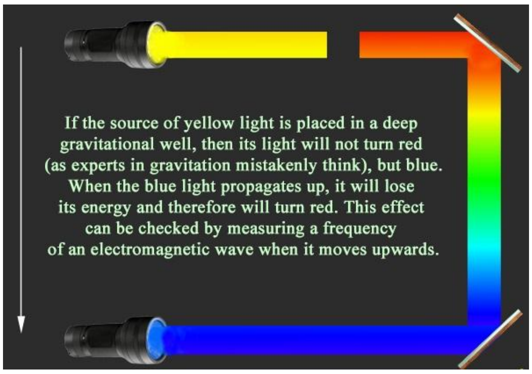

Fig. 5. The fourth (author's) interpretation of the redshift.

It is known that if a light source is placed in a potential well (closer to a massive object), it will redden (*Fig*. 6).

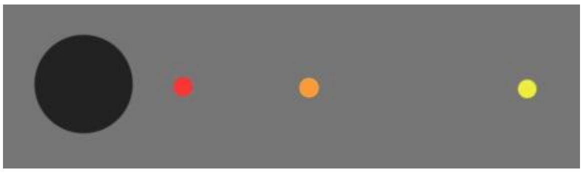

Fig. 6. The closer the source of light to a massive object, the redder it becomes.

We see that the wavelength of the atom has become larger. But after all, we see light from the atom after it overcomes gravitational attraction. Hence, the light at the time of its emission was not red. When light leaves a gravitational field, its wavelength increases very fast (12): the wavelength increases 2 times larger than in the gravitational shift effect (17). Hence, the light at the time of its emission was not yellow, but had a shorter wavelength. It was green or blue. According to the third interpretation (16), the light was green, according to the fourth (author's) interpretation (29), the light was blue (*Fig*. 7).

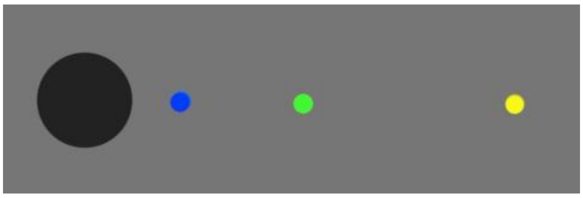

Fig. 7. The closer the source of light to a massive object, the bluer it becomes. But when the blue light leave the gravitational well, it reddens, and we see a phenomenon depicted in *Fig*. 6.

The most important thing in this matter is experiment. A simple experiment (the scheme is in *Fig*. 3) will help to determine whether the frequency of an electromagnetic wave changes as it moves up or down. If the author's interpretation is correct (*Fig*. 5 and *Fig*. 7), then taking into account (28) we get:

$$\Delta = \frac{3gH}{c^2} f \cdot T \qquad (30)$$

Here Δ is the difference between the lower and upper counters, f is the generator frequency, and T is the time of the experiment. If the height difference between the counters H = 100 meters, f = 10 GHz, T = 10 days, then Δ = 282.

If the third interpretation is true, then Δ = 188. If the Newtonian interpretation is true, then Δ = 94. If Einstein's interpretation is true, then Δ = 0. In the latter case, counters count at the same speed within the measurement error.

The experiment will refute all interpretations except one. Possibly, all four interpretations will be refuted, and the fifth, still unknown, will be realized. The author is confident that the fourth (30) most radical interpretation of the redshift will be confirmed.

XVI. Conclusion

The foundation of general relativity contains many elementary contradictions with quantum mechanics. They are hidden behind the cumbersome tensor apparatus of the theory. The most radical contradiction is the description of a photon's motion in a gravitational field. According to general relativity, when a photon approaches the Sun (Earth), its velocity does not increase, but, on the contrary, decreases (19), and the wavelength also decreases (12). This is a completely absurd statement, because, on the one hand, the photon energy is equal to its inert mass multiplied by the square of the speed of light and must decrease, and on the other hand, the photon energy is inversely proportional to its wavelength (9) and must increase. According to general relativity, the photon energy remains constant, which is no less strange. It is even stranger that this doubtful statement of general relativity was not tested experimentally, and general relativity supporters did not even try to verify it.

The application of general relativity to astrophysical observations has led to numerous contradictions. To overcome them, general relativity proponents have put forward many hypothetical dark substances: black holes, dark matter, dark energy, inflation, etc.

As for experiments that seem to confirm the general relativity, it should not be forgotten that they were all interpreted by the supporters of general relativity. But even recognized authorities in general relativity (Zeldovich, Novikov, Thorn, etc.) used various and contradictory interpretations to describe the same simple redshift effect, without realizing it.

A simple experiment (*Fig*, 3) will allow us to rigorously prove that physical processes do not slow down near massive objects, but accelerate (29). As a result, it becomes clear to everyone that black holes do not exist and general relativity is incorrect. Astrophysics will come out of the impasse and begin to explore not hypothetical substances, but real objects.

This article is a response to the discussion initiated by publications [13–17].

References

[1] Okorokov V.V. On a Discrepancy of Experiments Supporting Certain Conclusions of General Relativity. Doklady Physics, Vol. 46, No. 6, 2001, pp. 400–402

[2] Okun L., Selivanov K., Telegdi V. Gravitation, photons, clocks Phys. Usp., **42**:10(1999), 1045-1050

[3] Okun L.B., Selivanov K.G., On the Consistency of Experiments Supporting General Relativity. Doklady Physics, Vol. 47, No. 6, 2002, p. 461

[4] Zel'dovich Ya.B., Novikov I.D. Relativistic Astrophysics. I. Soviet Physics Uspekhi, Vol. **7**, Number 6 (1965)

[5] Misner Ch.W., Thorne K.S., Wheeler J.A. Gravitation, W.H. Freeman and Company, San Francisco 1973

[6] Yanchilin V.L. Gravitation and Quantum Mechanics, Novosibirsk, Editorial and Publishing Center NSU, 2001 (Russian)

[7] Einstein A. Uber den Einfluss der Schwerkraft auf die Ausbreitung des Lichtes. Ann. Phys., 1911, **35**, 898-908

[8] Will C.M. Theory and Experiment in Gravitational Physics, Cambridge University Press, 1993

[9] Dicke R.H. Gravitation and Universe, American Philosophical Society, Philadelphia, 1979

[10] Fock V. The Theory of Space, Time and Gravitation, Pergamon Press, 1964, p. 222

[11] Yanchilin V. The Quantum Theory of Gravitation, Moscow, Editorial URSS, 2003

[12] Bowler M.G. Gravitation and Relativity, Pergamon Press, 1976, p. 71,72

[13] V.A. Zhmud. O printsipial'nom otlichii metodov dokazatel'stv ot metodov ubezhdeniy. Avtomatika i programmnaya inzheneriya 2013. №3 (5). S. 87–104. FGBOU VPO NGTU (Novosibirsk, Rossiya). http://jurnal.nips.ru/sites/default/files/%D0%90%D0%98%D0%9F%D0%98-3-2013-15_2.pdf

[14] V.A. Zhmud. K novym gipotezam v oblasti traktovki ponyatiy elektrodinamiki, gravidinamiki i fizicheskogo vakuuma. Avtomatika i programmnaya inzheneriya 2013. №4 (6). S. 82–89. FGBOU VPO NGTU (Novosibirsk, Rossiya). http://jurnal.nips.ru/sites/default/files/%D0%90%D0%98%D0%9F%D0%98-4-2013-08.pdf

[15] V.A. Zhmud. Teorema Kotel'nikova-Nayvista-Shennona, printsip neopredelennosti i skorost' sveta. Avtomatika i programmnaya inzheneriya 2014. №1 (7). S. 127–136. FGBOU VPO NGTU (Novosibirsk, Rossiya). http://jurnal.nips.ru/sites/default/files/%D0%90%D0%98%D0%9F%D0%98-1-2014-16.pdf

[16] V.A. Zhmud. Protiv antinauchnykh kontseptsiy v forme nauchnykh izdaniy. (FGBOU VPO NGTU, Novosibirsk, Rossiya) Avtomatika i programmnaya inzheneriya 2014. №2 (8). S. 125–137. http://jurnal.nips.ru/sites/default/files/%D0%90%D0%98%D0%9F%D0%98-2-2014-12_0.pdf

[17] V.A.Zhmud. O prirode relyativistskoy kontseptsii popravki k dannym ot global'nykh sistem GPS i GLONASS: vzglyad s pozitsii teorii zamknutykh sistem (avtomatiki). Avtomatika i programmnaya inzheneriya. 2014. № 4(10). S.87-141. http://jurnal.nips.ru/sites/default/files/%D0%90%D0%98%D0%9F%D0%98-4-2014-11_0.pdf

Vasily Yanchilin – correspondent of the science department of the newspaper of the scientific community "Poisk", Moscow.

http://www.poisknews.ru/about/team/46/

E-mail: yanchilin@yandex.ru