



## ПРОСПЕКТ СВОБОДНЫЙ-2016

МЕЖДУНАРОДНАЯ КОНФЕРЕНЦИЯ СТУДЕНТОВ,  
АСПИРАНТОВ И МОЛОДЫХ УЧЁНЫХ

ЭЛЕКТРОННЫЙ СБОРНИК МАТЕРИАЛОВ  
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## **«English for Specific Purposes»**



## ENERGY FROM SPACE

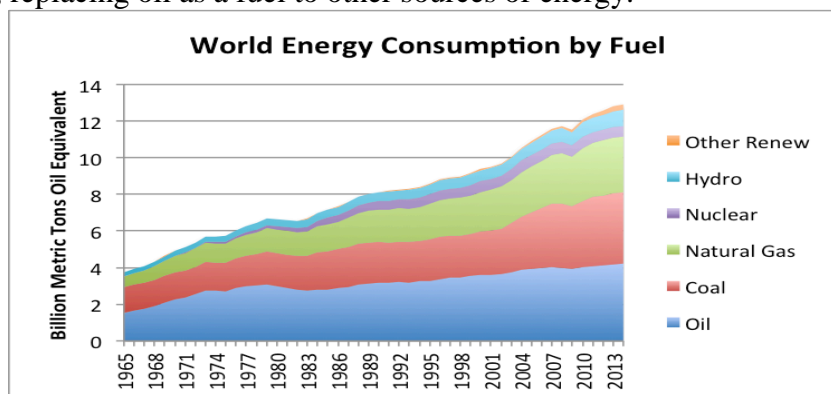
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Mankind uses mainly non-renewable energy. The second half of the 20th century is characterized by mainly using oil, gas - 70%, and the solid fuel about 30%. World reserves of oil and gas are not so large and with extensive development may come to an end soon. Moreover, oil and gas oil are the major raw materials for the chemical industry, which is developing rapidly.

Therefore, you need to save for future oil and gas primarily as a raw material for the chemical industry, replacing oil as a fuel to other sources of energy.



**Figure 1 – the graph of world energy consumption by fuel**

In space there is no atmosphere, there is never going to rain, and in geostationary orbit never comes overnight, this is the perfect place for a solar power plant that will collect energy 24 hours a day, 365 days a year. This idea first appeared in the 1940s, when Isaac Asimov suggested the idea of a robotic space station that would deliver power to the earth by means of microwaves.

Today, this idea is gradually moving from the category of science fiction into scientific reality.

USA, China, India and Japan are already developing their own projects, which will include robotic arrays of solar panels, which will send to Earth a huge amount of clean, renewable energy without wires.

Some variants involve sending up to 1 MW of power using the rays to the Earth, it's enough to power a large city. According to Paul Yaffe, a space engineer of the US Navy Research Laboratory, the concept is absolutely justified scientifically.

NASA and the US Department of Energy carried out this study in the late 70s, which cost \$ 20 million, and made a detailed study of the concept. At that time, the scientists came to the conclusion that there were no problems with physics, but there were questions related to the economy.

The main problem is the cost of launch which requires building of transmitting energy satellite. The cost of the launch is 40 000 dollars per kilo in some cases, the final price of the first space solar power plant may reach 20 billion dollars.

As we enter the era of private space exploration, which significantly reduces the cost of launch, the basic physics suggests that the delivery of cargo into space is extremely expensive.

This topic is reviewed every 10 years, when technology is changed, and so the economic aspect of the issue is changed too. Jaffe claims that the war in the Middle East has given new impetus to the development of space solar plants, as research engineers are faced with the problem of delivering energy to hostile areas. Numerous and hidden receivers could pick up cosmic energy and provide the military complexes, which would not carry dangerous and costly diesel generators by water or air.

If you could produce electricity from space, you probably would solve these problems.

There are two ways to deliver energy to the earth: in the form of laser beams or microwaves.

Option with laser beams involves sending small satellites transmitting lasers in space and has relatively low cost, from 500 million to 1 billion dollars. Self-assembling satellites will reduce costs further, and lasers of small diameter are relatively easy to mount on Earth.

But with the issuance of 1 to 10 MW, a lot of satellites are required to provide sufficient energy. In addition, the satellites will have problems with laser transmission during cloudy or rainy weather. Option with microwaves requires smooth transmission during rain, snow or other weather conditions, and will be able to transmit gigawatts of energy.

Microwave technology, according to Jaffe, exists a lot of decades: in 1964, scientists were able to transfer energy to a helicopter by means of microwaves. Jaffe claims that with a large area of the transmitter, microwaves would be so scattered that it would not be life-threatening. But the main disadvantage is the need for hundreds of launches into space, which will allow to build a space station. As result, cost approximately reaches tens of billions of dollars.

Unfortunately, it should be noted, that companies do not like microwaves and lasers, because microwaves are often associated with the microwaves in the kitchen, and lasers - with space battles in science fiction.

Jaffe's study, which has been already mentioned about, is focused on the so-called sandwich modules, solar cell which converts sunlight into energy. One side of the "sandwich" gets solar energy using photovoltaic panels, electronics in the center converts current into radio waves, and the antenna on the other side sends the beam to the ground.

Jaffe claims that people probably do not know that radio waves can transfer energy. People used to think about radio communication, phones or TVs but they do not think about the fact that radio waves can transfer energy.

Despite the fact that all technologies are available to equip the space solar cell, but the first such station won't be constructed soon. Even despite the fact, that the Japanese made that station as the main idea of their space program.

Without research base, which they have in the US, for example, exploration of nuclear fusion energy, there will hardly be achieved any progress. If the Japanese succeed in the next five years, it will be great mark to all people in the world. Ultimately it is difficult to say that this idea is viable as long as you do not actually try to implement it.

### References

1. Солнечная энергия из космоса. Энергетика будущего? [электронный ресурс]. Режим доступа: <http://hi-news.ru/space/solnechnaya-energiya-iz-kosmosa-energetika-budushhego.html>
2. Тенденции развития мировой электроэнергетики (Ч. 1) [электронный ресурс]. Режим доступа: <http://www.perspektivy.info/print.php?ID=244759>
3. World energy consumption [электронный ресурс]. Режим доступа: <https://gailtheactuary.files.wordpress.com/2015/06/world-energy-consumption-by-fuel-2014.png>

## BIOFORM IN CONTEMPORARY ARCHITECTURE

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Embodied in nature, the principles can be used in modern architecture as well. The co-existence of man and nature cannot be separate.

All biological forms in nature aren't accidental. The form and function of natural elements are inseparable. The builders have been creating buildings similar to the natural objects since old times. They eventually came to the necessity of studying the natural principles for their using in building construction. Initially people had created structures from natural elements (rocks, fallen trees, hills, caves, etc), then they had mastered the handicraft, continuing to copy nature and its proportion (capitals, colonnade) - Antiquity, then Gothic. All the times the aim of architects is to connect man and nature, creating a symbiosis expressed in architecture. But the structure of nature, as a rule, is indescribably difficult. Objects of nature have been optimized during millions of years due to mutation and selection. Any architect is not able to create such a perfect design as nature but just imitate it.

The nature completely expresses itself in the construction of spatial structures. The study of the structure of natural forms (shells, skulls, shell eggs etc.) shows an unusual developmental elaboration of the structure, functional conditioning.

It is a good perception of spreaded loads and covering of cracks in order to prevent destruction of valuable materials for a living organism (e.g., brain), and minimization of consumption of materials. Shells serving as coverings for buildings and constructions are of similar nature. They are architecturally expressive, strong more over it is hard and lightweight construction.

On the basis of the using of natural bionic principles architectural expressive solutions were developed in compressed (columns), bending (beams and slabs), stretched, spatial (the shell membrane structure), cladding (walls) elements. Nowadays, organic architecture has acquired a kind of addition by using of modern materials and technologies.

Bioforms are surprisingly multipurpose (suitable), that is why architects tend to use them in the design of buildings. The decision of many architectural issues has already been found in nature. The only question is to see and to use them as part of the currently available materials and technologies, as well as do it in accordance with the purposes were that given to the architect. In all its technological and scientific achievements humanity does not have the materials and technologies of such level of perfection while the nature has. So we are talking about an attempt to use natural structures in architecture.

Art Museum in Milwaukee (USA, Pic.1) (the architect Santiago Calatrava) is a good example of bionic architecture. The project of a new museum includes Kvadrachchi pavilion, which was built by Santiago Calatrava along with landscaped gardens with hedges, playgrounds and fountains that was designed by a landscape architect Dan Kylie. Calatrava's works are inspired by nature, they are characterized by a combination of organic forms and technological innovation. The location of the museum on the lake played a great importance in the project of the new museum. This "sea" theme can be seen in the moving steel shutters which form was inspired by bird's wings. The support of the hanging footbridge resembles a mast sailing ship. The curved one-storey gallery looks like a wave.

Ironically that Santiago Calatrava is one of the few contemporary architects, whose work can be traced in bionic theme. But he does not consider himself to be a representative of a bio-tech architecture, saying about himself: "But I've never done a bionic architecture! I'm



doing quite classical architecture. I have a classic architectural education and my design philosophy is completely subordinated to the classics. In this sense, what I do is very similar to the Russian architecture in which there is always the flavor of the classics. " <sup>[5]</sup>

This quote only underlines that everything is created on an intuitive level. Following the classical canons, he interprets them so that to create forms that are not only contrary to the principles of nature but on the contrary emphasize their importance in the modern world.



*Pic.1 - Art Museum in Milwaukee*



*Pic.2-The 30 St. Mary Axe*

Another example of a bio-tech architecture is the 30 St. Mary Axe (Pic.2) by architect Norman Foster. Today "Gherkin" is almost standard bionic architecture. The skyscraper has circular plan. The tower is expanding in the middle and tapering upwardly. This form grows up from the specific requirements of the place. The building does not look bulky. Due to the fact that the building is thin, it casts less shadows. The shape increases the penetration of sunlight into the lower floors. The aerodynamic shape naturally makes the wind bends around the building, which minimizes air turbulence and the formation of clouds. Wind tunnel tests have shown that the building considerably improve the air in the surrounding area. In addition, the natural movement of air around the building creates a constant difference in pressure at different facades that allows to ventilate the building by a natural way. <sup>[3]</sup>

In due time, one of the most famous Russian engineers, Shuhov V. G., whose contribution to the global construction is very important, found optimal solutions: he projected hyperboloid constructions and metallic reticular membranes of building constructions (Russian Empire's patents № 1894, № 1895, № 1896; from 12 march 1899 year, by V. G. Shuhov 27.03.1895 – 11.01.1896). Because of this inventions, the projecting of difficult forms has become possible. If you look closely at this constructions, you can understand that their forms were inspired by natural forms. So that rudiments of biomorphic architecture take their beginning from the end of the 19th century.

If we analyze construction elements of bionic architecture, we can understand that principle proposed by V. G. Shuhov underlies many modern buildings. Membrane solution of constructions is one of the general principles of bioforms.

The second important principle of designing is a cable-stayed construction (most of the works by S. Calatrava). Generally, reinforced concrete, metal and glass are the most popular materials in the bionic

German engineer, Frei Otto, who collected a group of like-minded persons ("The biology and construction, 1961 year"), was looking for new solutions to achieve maximum by minimum means. He was infatuated by lightweight structures, and for a long time was learning the process of construction matter and membranes of organisms with biologists and engineers. After, he tried to synthesize received knowledge with existing technologies. Researchers found similarities between their own developments and diatoms and spider's web. Later these developments were applied for projecting and construction of the pavilion of FRG at the Global exposition in Montréal and the Olympic stadium in Munich at "EXPO-67"

(Pic.3). Membrane and elastic constructions were used in this structures and their main advantages were lightness and transparency.



***Pic.3 - Olympic stadium in Munich***

Despite the fact that bionic architecture appeared recently, many architects have already learnt biomorph elements. We can just remember creative works by V. V. Zefeld and U. S. Lebedev, and Konstantin Melnikov's house in Moscow, whose form and location of windows resembles the bee comb (Pic.4). The example of Soviet Union's practice is "shot"(rumka) of Sheremetyevo airport (Pic.5), a covered court at the territory of the sport complex "Moskvich" (Pic.6), (project bureau Mosproekt-1).



***Pic.4- Konstantin Melnikov's house***



***Pic.5- Sheremetyevo airport***

An example of modern biotech architecture in Russia can be Pulkovo Airport in Saint-Petersburg by Nicholas Gremshaw (Pic.7). At the facade the building may resemble umbrellas, trees or even volume leaves of trees. The British architect took into account the location of the airport, needs and habits of citizens. This conditions are inherent part of organic architecture: to create building in bound with nature and human. The elements inspired by natural world, namely by shape of grasshopper that appears to be an insect-pilons which support the roof, were also involved



***Pic.6- Sport complex "Moskvich"***



***Pic.7- Pulkovo Airport***



Nicholas Gremshaw is one of the founders of the movement of high-tech, but he can be called a follower of bionic architecture: "I believe one time buildings will be able to grow organic translucent skin that will resemble wings of dragonflies. Constructions would stay, but skin would be still breathing, transforming, changing its transparency and thickness of isolation. Always adapt to different atmospheric conditions, like living being. In future, buildings will be bigger and resemble organic creations rather than objects of conceptual art."

[5]

All points considered, we can explore advantages and disadvantages of bionic architecture. Bio-tech architecture supposes creation of houses that are an organic extension of nature, without having a conflict with each other. At first, they are energy-efficient and comfortable buildings with autonomous systems of life support. Only ecologically compatible with human materials and building structures are used in constructing. Autonomous self-sustaining system fits in natural landscape, existing with nature in harmony. Human and its comfortable coexistence with environmental come to the fore. Also according to global practice it can be said that these buildings may attract a big tourist flow that can bring fame to the city where it locates. Thus it benefits a city economy and a country in common. The proposed disadvantages may be: impossibility to resemble natural structures and forms completely, complexity of the mathematical calculations, limits of materials, allowing to repeat biological forms, long term of creating, large economic costs.

Why don't architects construct as perfect as nature? Surface imitating does not give a positive result. It is necessary to stay within the limits of possible, understood and studied. When projecting bionic forms, we shouldn't repeat after living beings precisely. We must follow the main task which is to create buildings and cities to be natural and make symbiosis and natural biotope with plants and animals, so that human and its technique will be able to turn into inseparable part of nature.

### References

1. Wikipedia [electronic resource]. Mode of access-<https://ru.wikipedia.org/>
2. A.N. Tetior "architectural and construction environment", Moscow "Academy", 2008
3. Norman Foster. Tower Mary Axe, 30 (Office of the company Swiss Re) X-MMIV - 26.04.2004 [electronic resource]. Mode of access - [http://www.projectclassica.ru/v\\_o/10\\_2004/10\\_2004\\_v\\_01a.htm](http://www.projectclassica.ru/v_o/10_2004/10_2004_v_01a.htm)
4. U. S. Lebedev "Architectural Bionics", Moscow "Stroyizdat", 1990
5. Archi.ru [electronic resource]. Mode of access - <http://archi.ru/russia/>



## TRANSPORT OF COLD ATOMS IN OPTICAL LATTICE

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Interest to this problem arose after realization of the experiments on cold atoms in optical lattice. The reason is that such system is the analogue of a crystal lattice (in terms of its properties of translation invariance): optical lattice is obtained by the interference of laser beams, creating periodic potential such that atoms, cooling to temperatures close to absolute zero, are localized in minimum of periodic potential, and are similar to atoms in a crystal lattice. Advantage of the optical lattice is that it's enough to change parameter of laser radiation for changing the parameters of a lattice (depth of potential, distances between sites).

Let's consider the important case of particle in random potential, i.e. the potential that doesn't have the order. This can be in real things because of periodicity disorders in a location of atoms, the presence of impurities. Hamiltonian of such system can be written as:

$$\hat{H} = \frac{\hat{p}^2}{2m} + V(x), \quad (1)$$

where  $V(x)$  – the potential of the atomic chain in arbitrary form.

In the tight-binding approximation, i.e. when we can assume that the electrons are tightly bound to the nucleus, Hamiltonian of the system can be approximated by the Hamiltonian of an isolated atom  $H_{at}$  in each lattice site. Then the solution of the stationary Schrödinger equation for a single electron can be represented as a linear combination of atomic orbital.

$$\psi(x) = \sum_n c_n \cdot w_n(x), \quad (1)$$

where  $w_n(x) = w_0(x - nd)$  – Wannier functions,  $d$  – lattice period. Substituting the solution in the Schrödinger equation:  $H\psi = E\psi$ , we obtain the equation for the coefficients:

$$-\frac{J}{2}(c_{n+1} + c_{n-1}) + E_n^0 c_n = E c_n, \quad (3)$$

If  $E_n^0 = \text{const}$ , the solution of the equation is the Bloch wave.

$$c_l = \frac{1}{\sqrt{L}} \cdot e^{ikl} \quad (4)$$

The disorder in a location of atoms is counted, if we assume that at each site the energy of the particle is a random quantity

$$|E_n^0| \leq \varepsilon = \text{random}. \quad (5)$$

The model which considers the solution of the equation (3) with (5) was first proposed by Anderson [1]. According to this model, the solution of equation (3) in the limit  $L \rightarrow \infty$  is given by [2]:

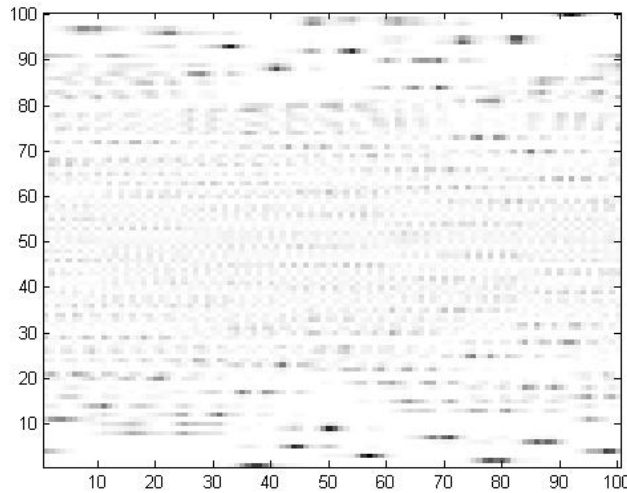
$$c_l \sim e^{-\frac{|l-l_0|}{\varepsilon}}, \quad (6)$$

where  $\varepsilon$  - localization length,  $l$  – number of lattice site.

For the finite system  $L = \text{const}$  can be localized states:

$$\begin{cases} |\psi_{l=l_0}|^2 \approx 1 \\ |\psi_{l \neq l_0}|^2 \approx 0 \end{cases} \quad (7)$$

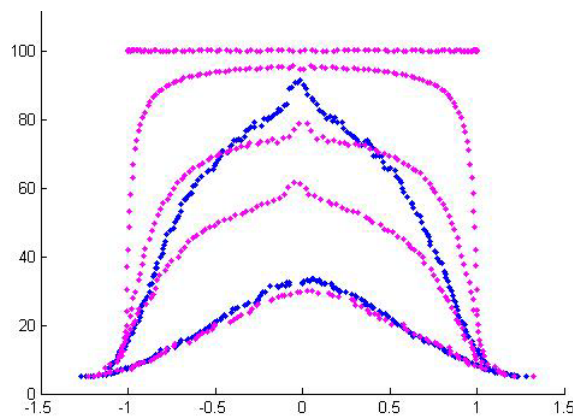
and delocalized states:  $|\psi_l|^2 = \frac{1}{L}$ . It is seen that in the thermodynamic limit, when  $L \rightarrow \infty$ , all states are localized.



**Fig.1 – Gray-scale image localization eigenstates of the system in random potential. Vertical state number, horizontal number of lattice site. System parameters:  $L=100$ ,  $J=1$ ,  $\varepsilon=0.5$**

The degree of localization is usually considered using the participation ratio  $R = \frac{1}{\sum_{l=1}^L |\psi_l|^4}$ .

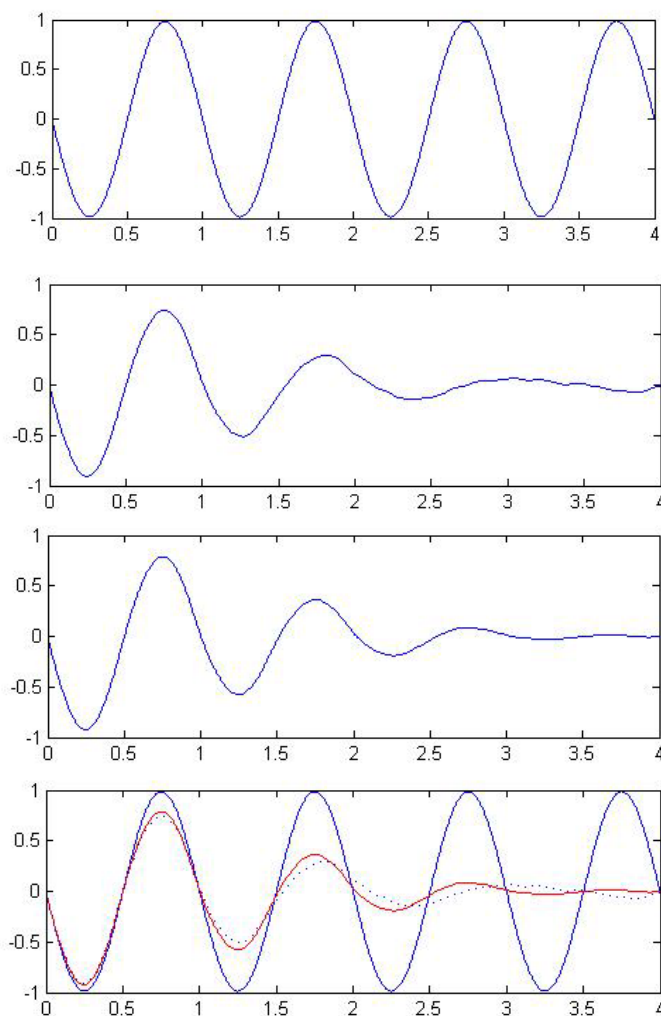
This parameter, as it seen from Eq. (7), tends to zero for the localized states, and in the case of delocalized states is equal to the number of sites in the optical lattice. The dependence of the parameter  $R$  on energy state is shown in figure 2. Most of all localized states are near the minimum and maximum values of the energy, and the states in the middle of the spectrum are delocalized. Localization also depends on the size of the system: the more the size of system is, the more localization is.



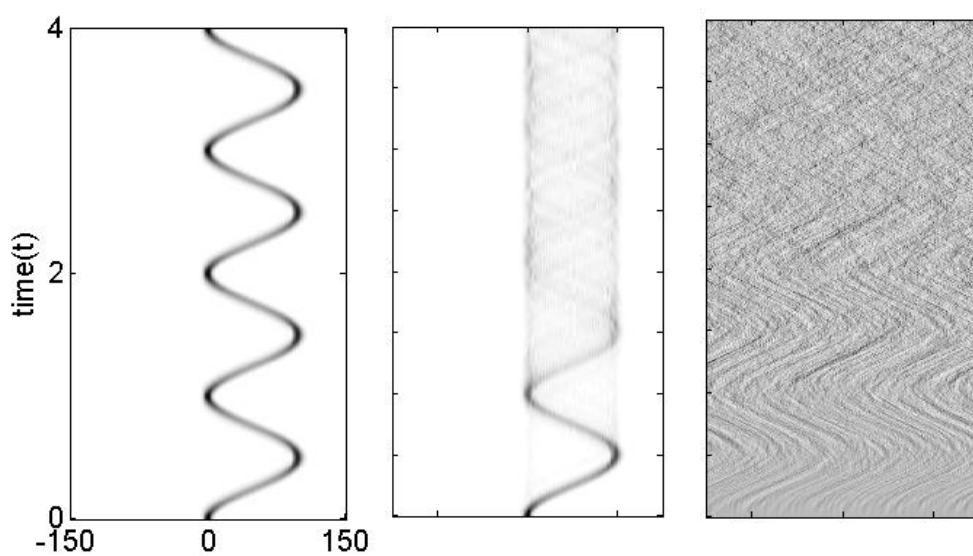
**Fig. 2 – The dependence of the participation ratio on energy state. Parameters of the system:  $L = 100$ ,  $\varepsilon = 1$ ; 0.5; 0.3; 0.1; 0 (pink)  $L=200$ ,  $\varepsilon = 1$ ; 0.5 (blue)**

Transport properties of these systems appear when we apply an external electric field. Firstly, consider the question about a particle in the periodic potential of an ideal optical lattice in electric field. In condition of periodic potential the energy dependence on the wave vector is periodic and consequently the particle velocity is periodic as well (figure 3a) - this phenomenon is known as Bloch oscillations [3].

Thus, by having constant electric field at the entrance, we obtain the alternating field with a frequency of Bloch oscillations at the output. If we add random potential in the system, then for localized states the Bloch oscillations are damped as shown in figure 3b and there is no current. What is also true for the delocalized states (figure 3c).



**Fig. 3 – Bloch oscillations in electric field  $F=0.02$ . (a) Without disorder ( $\varepsilon=0$ ), (b) and (c) localized (solid) and delocalized (dash) states respectively, the quantity disorder  $\varepsilon=0.1$ ,  $L=301$**



**Fig. 4 – Gray-scale image evolution of the probability of detecting a particle in 1D optical lattice site. System parameters the same as in figure 3**

In open system, i.e. at the presence of the inelastic scattering processes, value of the momentum doesn't keep in time. The usual approach in this case isn't applied, and it is necessary to use a density matrix approach. Dynamics of states in open system can be written as:

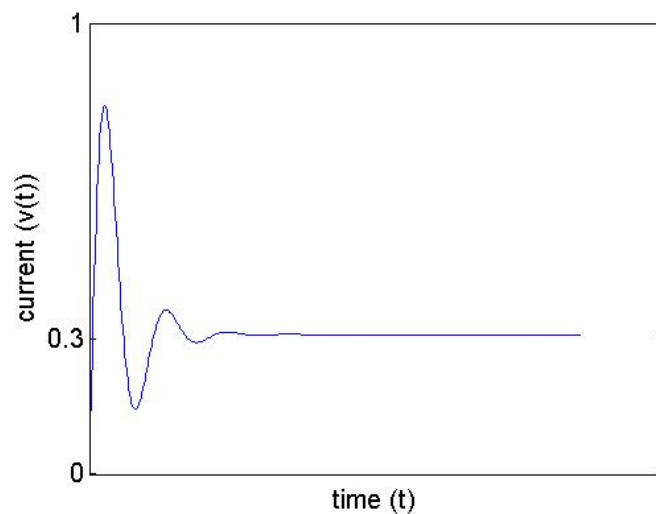
$$\frac{d\hat{\rho}}{dt} = -\frac{i}{\hbar} [\hat{H}, \hat{\rho}] - \gamma(\hat{\rho} - \hat{\rho}_0), \quad (8)$$

$$\text{где } \hat{H} = \hat{H}_0 + Fd \sum_{l=0}^L |l\rangle\langle l|, \quad \hat{H}_0 = \frac{J}{2} \sum_{l=0}^L (|l+1\rangle\langle l| + h.c.), \quad (9)$$

$\gamma - \text{relaxation.}$

The initial state of the system is Bose-condensate: all particles are on the ground state with quasi-momentum zero.

When we apply external electric field the current in the open system is set on some value because of the inelastic processes as shown in figure 5. One can compare with the conductivity of solids, where the conductivity decreases with increasing concentration of impurities in the conductor.



**Fig. 5 – Current in the open system with  $\gamma = 0.05$  in electric field**

### References

1. Anderson P. W. Absence of Diffusion in Certain Random Lattices. Phys. Rev. 109 (5). 1492–1505
2. Штокман Х. Ю. Квантовый хаос. М.: Физматлит, 2004. С.155
3. Ашкрофт Н., Мермин Н. Физика твердого тела. Т.1. М.: Мир, 1979. С.227



**ENGLISH TERMINOLOGY IN THE FIELD OF CONSTRUCTION****A. V. Dimakova****Scientific supervisor E. V. Tankov***Siberian Federal University*

Any branch of science doesn't stand still, but it develops; new branches of knowledge and new concepts are emerging therefore the need for nomination of these concepts is constant. Emergence of new terms and terminological systems is a consequence of this process. Terminology can change in time, both emergence of new terms and rethinking of old ones are results of terminological dynamism. What is "terminology"? Terminology is a complex of terms used in a certain area of knowledge. It takes a long period of time to form and develop a definite terminology. The fact that formation of terminological system is completed means that in a certain area of knowledge or activity there has come the period of bigger or smaller stabilization when certain facts and phenomena are consistently described with a set of terms.

The English terminological system in the field of construction possesses certain originality. A characteristic way of terms formation is the mechanism that allows on the basis of brief and two-word terms to build more difficult terminological phrases demonstrating semantic relations between the main and derivative names. The terms formed in such a way prevail in the studied subject domain. The probability of polysemy of these lexical units decreases with increase in their components. For example, concrete curing – 1) setting of concrete mixture, 2) keeping concrete under a specific condition; concrete curing by ponding – concrete curing by pouring water; air concrete curing – 1) concrete curing in the open air, 2) drying concrete mixture; hot air concrete curing – speeding up the process of concrete setting by means of hot air.

Research of terminological system development in the field of construction and construction technologies shows that it has been formed for a long time and goes back to professional lexicon of builders who lived in early periods of human society. There is a direct relationship between processes of construction terminology formation and development of construction industry.

Construction was only one type of human activities, therefore the lexicon of construction business long time remained undifferentiated, merged with common lexicon. In process of emergence of new materials, new instruments of labor, equipment there was created a need for their nomination, new terms appeared, and already existing terms changed their status. For example, beam; gutter, trough; plaster, gypsum.

When emerging new objects new terms are fixed. They penetrate more and more active into the general use, into informal conversation. There can be observed their "approbation" in other non-terminological conditions. Terms lose their narrow terminological meanings and become objects of rethinking. On the basis of terms in informal conversation there are formed new non-terminological meanings created by associating, comparing objects and phenomena of reality. The whole language thesaurus can be divided into terminological words, common words and words of informal conversation. For example, the term "pen" has a special meaning in construction terminology: vault, joint, corral, and common-literary meanings: nib, ball point pen, felt-tip pen; head – roofing tile (in construction terminology), head – the part of the body containing the brain, ears, eyes, nose, and mouth (common lexicon); flat – the part of the hammer, edge, narrow steel sheets (in construction terminology), flat – apartment (common lexicon).

Such way of forming construction terms is called a terminologization. This process proceeds in the form of transition of common words to a definite terminological system. Transition of common word meanings is carried out by means of metaphorical and metonymical rethinking of semantics. In such a way many terms are created, for example: dead area – zone, that is not involved in work; skeleton – framework (skeleton construction – framework construction); arm – lever; bag – niche; bed – foundation, wall, slab, frame.

We will consider one more way of formation of construction terms: reterminologization. The linguistic lexicon defines this way as transferring the ready term from one discipline in another with full or partial rethinking. For example, calculus – calculation (it comes from mathematics); calcspar – calcareous spar (it comes from mineralogy); calorimeter – an apparatus for measuring quantities of heat (it comes from physics); denudation – erosion (it comes from geology); derivation – water drainage (it comes from hydrology).

Terminology of subject domain is of great importance for implementation of communicative activity in special spheres of scientific communication. Process of term formation is connected with emergence of new concepts, and terms can appear considerably later than these concepts. Verbal fixation often has very conditional or descriptive character and it is gradually transformed to the term. It is necessary to remember that concepts always become terms consciously, and only in this case the real term is made.

Thus, one may say, that English-speaking construction terminology is original. There is a set of ways of term formation. And in this article some of them have been considered. These are creating difficult semantic units on the basis of brief and two-word words; creating a new concept (term) when emerging new materials or technological processes; formation of terms when differentiating word meanings of common lexicon on the basis of their metaphorical and metonymical rethinking; new terms appear as a result of transferring some already existing terms from one discipline in another.

### References

1. Русско – английский глоссарий по теме «Строительство» [электронный ресурс]. Режим доступа: <http://study-english.info/vocabulary-construction.php>
2. Юнусова, И.Р. Проникновение и взаимовлияние терминологической, общеупотребительной и разговорной лексики [электронный ресурс]. Режим доступа: <http://www.elibrary.ru>
3. Хакиева, З. У. Англоязычная терминология строительства и строительных технологий: структура, семантика и динамика развития: автореф. дис. на соиск. учен. степ. канд. филол. наук: 06.06.13 /З.У. Хакиева – Пятигорск. [электронный ресурс]. Режим доступа: <http://cheloveknauka.com/angloyazychnaya-terminologiya-stroitelstva-i-stroitelnyh-tehnologiy>

## **THE PROBLEM OF CORRUPTION (COMMERCIAL CUT) IN BIDDING AIMED AT WINNING A CONSTRUCTION CONTRACT**

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Nowadays the construction industry is one of the most funded and, at the same time, most corrupt sectors of Russia. According to the Accounting Chamber, capital construction has been subsidized with more than one trillion rubles from the federal budget. This enormous sum can't help connecting with such an important issue in our country, such as corruption.

Corruption prevents society and the state from as a whole. In terms of competition between building companies and organizations, often win according to the possibility to give a bribe at the right time but not because their better performance. Corruption seems to be the most obvious in construction industry for state and municipal needs. Large amounts of public investment are always attractive for government employees and officials.

The main document regulating the area of public procurement is the Federal Law of April 5, 2013 № 44-FL named "About contract system in the procurement of goods, works and services for state and municipal needs". This Act replaced the Federal Law № 94-FL. While considering the overall situation, we can say that the new law has improved the procurement process, audit and control of implementation. But despite this, corruption in the public procurement system still holds a leading position.

There is an article "Principles of contract procurement system" in the current Federal Law. One of the principles states: "The contract system in the procurement is aimed at creating equal circumstances for competition between the parties"<sup>[1]</sup>. Therefore, due to this there should be a strong competition in the market in order to win the tender. It is expected that companies and organizations compete with each other, offering the customer the best works. This is quite important, and perhaps the most important principle of Federal law, which provides development and improvement in the economy. But what is the actual situation?

The situation when public procurement authority has one contractor, who doesn't offer the best price for services, is typical for Russia. Why does it happen? Placing municipal or government order is carried out through a bidding process. To win the bid contract, the contractor should at least pay a certain percentage of the contract to the person representing the interests of the state or municipal contract. Such commercial bribery is called the cut - fast and efficient way to win bids.

The cut, in its pure or latent form, can be found everywhere. The existence of cuts in the construction industry seems to be a relevant problem, because the funds go to the "pocket" of officials and greatly reduce the quality of work. The contractor, who won bids by means of bribery, economize everything: on materials, on services. As a result, we get a short-lived and unsafe buildings and structures, and other objects of poor quality.

There is a huge amount of commercial bribery in bidding on the construction contract. Most often the cut follows the scheme - the state or municipal customer, who is interested in the fact that the bids would be won by a certain contractor exposes the terms of reference on the subject in a very concise and short format. The point is that only the preferable contractor knows all the conditions and requirements, and other contractors can't meet the requirements in specified time limits. As a result trades are held according to the law, but they are not fair from the point of view of competition. Due to the fact that in our country there is a unified information procurement system, all state and municipal orders are submitted electronically,

the prospective contractor has an access to all the documents available. If customers consider that the volume of submitted documents is not enough, he should apply to the Federal Antimonopoly Service to make a complaint in order to eliminate the shortcomings.

This cut scheme is a kind of "encryption" documentation. When placing an order on the website of the state purchases the customer presents the documentation in a contracted form with a password. Special features of this approach are that, as a rule, it is used for orders that do not attract the attention of the public.

Let us describe another major problem with tenders referring the construction contract connected with bidding trades object of which has already been built. This scheme is typically used during major events at any level representatives of the construction business. The bottom line is that the contractor does the work in advance and at the final stage the customer announces bids, when to do the work in tight time limits becomes impossible. As a result the same contractor wins the bidding trades.

A lot of innovations have been launched by means of the Federal Law № 44. One of the significant legal improvements of the law was the establishment of additional requirements in tenders with limited participation, two-stage competitions and closed auctions. For example, the requirements for the experience of the organization or the presence of licenses, certificates are available. However the scheme is not perfect as there are still ways to corrupt it. Excessive demands (that are not related to the contract) are imposed to the contractor that causes above mentioned situation when customer wins the bidding trades in case he has already agreed with authorities who are familiar with all of these requirements.

Perhaps the largest and most difficult problem is to define commercial bribery scheme in the same procurement (construction of an object) by the same customer twice. First, the preferable contractor wins the bidding trades, then again the order is placed. The most important thing here is documentation.

Combating corruption in the system of placing state and municipal orders have always been a heated discourse. At the core of any anti-corruption there seems to be an effective regulatory system. In Russia, there is a fairly extensive legal framework to counter corruption. The central part of this system at the moment is the Federal Law of 25.12.2008 №273-FZ named "On Combating Corruption". It establishes a framework for the prevention of corruption and combating it, to minimize and eliminate the consequences of corruption.<sup>[2]</sup>

In addition, a variety of other anti-corruption mechanisms exist. One of the biggest is the project mechanisms named "for fair procurement". Internet platform attracts activists from all over Russia. Recent developments in the electronic public procurement system have also been focused on anti-corruption measures. The changes make the transparent bidding process implementation. Customers used to contact with each other, but nowadays the names of organizations and companies are unknown to the customer, he sees only their numbers. If we talk specifically about the construction, the law prescribes a form of auction, that is, the order will go to those who can fulfill it for less expenditure.

In conclusion we would like to underline that struggle with cuts in the first place should be carried out at the state level. At the moment it is not effective. It is necessary to keep on improving the system of state and municipal orders. This federal law has many gaps, weaknesses and vulnerabilities, which cause further corruption. The improvement of the system depends on fast inheritance of foreign experience. According to research the United States are considered to be a leader among public.

The improvement of public procurement system in the Russian Federation is carried out, but the main focus is aimed at the procedure, not the outcome. In our country sorting out the corruption problems is disadvantageous to some authorities whose personal profitability draws the main attention.



## References

1. The Federal Law of April 5, 2013 № 44-FL named “About contract system in the procurement of goods, works and services for state and municipal needs. [http://www.consultant.ru/document/cons\\_doc\\_LAW\\_144624/](http://www.consultant.ru/document/cons_doc_LAW_144624/)
2. Legal framework of counter corruption in public procurement [www.gosbook.ru](http://www.gosbook.ru)





## PHOTONIC CRYSTALS

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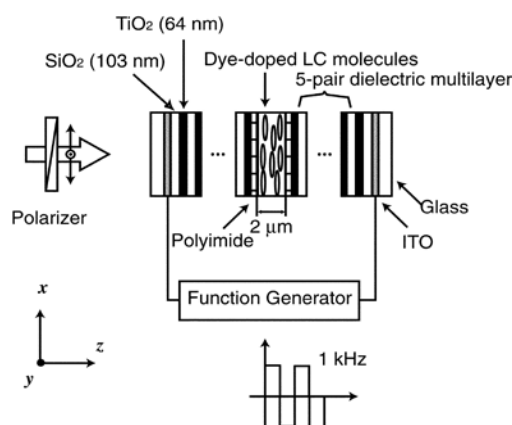
Photonic crystals were advocated by John and Yablonovitch in 1987 [1, 2] and attracted attention as the material for next-generation electronic and optical materials and devices. A photonic crystal is a structure in which the refractive index of a dielectric changes at a period of about the wavelength of the light and has a photonic bandgap where the existence of light is forbidden. In research on photonic crystals, the introduction of the defects that disrupt the periodicity in the periodic structure and the appearance of a localized state are essential. With the appearance of the localized state in the photonic bandgap, light is trapped in the defects and localized. Applications are expected in fine optical waveguides and no-threshold laser materials [3–7].

To produce a complete photonic bandgap, a three-dimensional periodic structure is required, but creating a three-dimensional periodic structure for the visible light wavelengths is not easy. Today, research is being actively pursued on one- or two-dimensional periodic structures. A one-dimensional photonic crystal does not have a complete photonic bandgap, but an advantage is the ease of fabrication and introduction of defects. Since the application to low-threshold lasers or narrowband filters is possible, this research is being energetically pursued [8, 9].

On the other hand, liquid crystals are widely used in current displays and occupy an important position. However, since they have substantial optical anisotropy or dielectric anisotropy and exhibit a high sensitivity to external fields, they are extremely important as optical modulation devices.

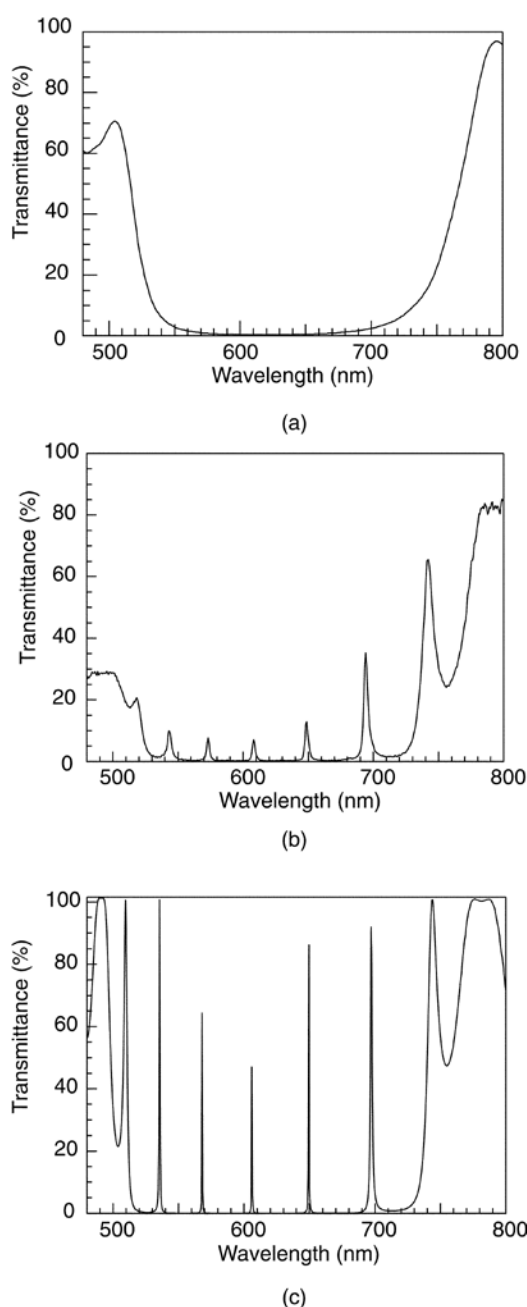
Examples of actively using the optical anisotropy of liquid crystal in photonic crystals are the introduction of liquid crystal into a three-dimensional photonic crystal created by using the self-condensation of colloid particles such as opal and inverse opal and the proposal of tunable photonic crystals that shift the photonic bandgap by using the temperature or an electric field [10–17]. However, the introduction of defects to the periodic structure becomes a major problem.

In this paper, we fabricated a liquid crystal layerdoped with a dye as the defect layer of a one-dimensional photonic crystal and attempted laser emission by optical pumping. We also tried to electrically control the lasing wavelength using the modulation of the localized state by varying the orientation of the liquid crystal layer in the one-dimensional periodic structure.



**Fig. 1. Experimental setup of the one-dimensional photonic crystal having a dye-doped liquid crystal defect layer and control of its localized state**

Figure 1 shows the one-dimensional photonic crystal having a liquid crystal defect layer and the experimental system. The one-dimensional photonic crystal is a dielectric multilayer consisting of five layers of SiO<sub>2</sub> having a refractive index of 1.46 and TiO<sub>2</sub> having a refractive index of 2.35 alternately deposited at thicknesses of 103 and 64 nm, respectively, on In-Sn oxide (ITO) glass. A polyimide (AL1254 from Japan Synthetic Rubber Co., Ltd.) is spin coated as an alignment layer on the surface of the dielectric multilayer film, baked for 1 hour at 150 °C, and then rubbed. A 2- $\mu$ m spacer is inserted between two rubbed dielectric multilayers to provide a gap and form a sandwich cell. Nematic liquid crystal (E47 from Merck) doped by 0.5 wt% with [2-[2-[4-(dimethylamino)phenyl]ethenyl]-6-methyl-4H-pyran-4-ylidene] propanedinitrile (DCM) dye is inserted in this gap to form the liquid crystal defect layer.

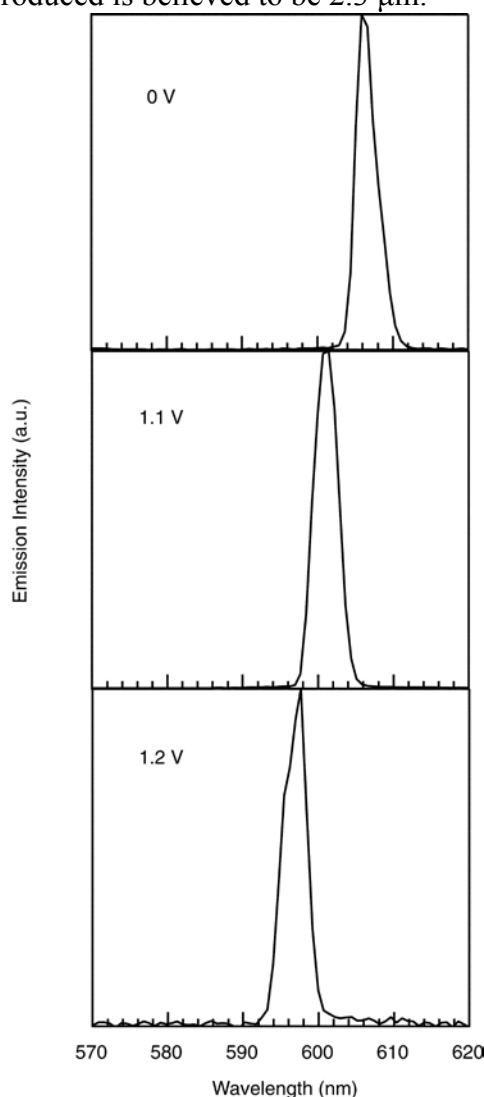


**Fig. 2. (a) Transmission spectrum of a dielectric multilayer. (b) Transmission spectrum of a dielectric multilayer with a liquid crystal defect layer. (c) Calculated transmission spectrum of a dielectric multilayer with a liquid crystal defect layer**

Figure 2(a) shows the transmission spectrum of dielectric multilayer (10 periods) without a defect layer. A stopband was formed in the range from 500 to 800 nm.

Figure 2(b) shows the transmission spectrum of dielectric multilayer (10 periods) with a liquid crystal defect layer doped with DCM. A stopband was also formed in the range from 500 to 800 nm when there is a liquid crystal defect layer. Both bands appear in the range from 500 to 800 nm, and the bandwidth is not affected by the presence or absence of the defect layer. A total of seven peaks appeared at intervals of about 45 nm in the stopband in the dielectric multilayer film with a liquid crystal defect layer. These peaks are in the localized states which appeared by introducing the liquid crystal defect layer. A decrease in the transmittance of the shorter wavelengths in Fig. 2(b) depends on the absorbance of DCM.

Figure 2(c) shows the transmission spectrum obtained by the  $4 \times 4$  matrix method. This is the result under the condition of a refractive index of 1.7 for the liquid crystal defect layer having a 2.3- $\mu\text{m}$  thickness. That is, the ne of the liquid crystal having the planar orientation was adopted. We clearly see from the figure excellent agreement with the wavelengths of the seven localized states obtained in the simulation. Based on this result, a practical thickness for the cell produced is believed to be 2.3  $\mu\text{m}$ .



**Fig. 3. Emission spectra of 1-D photonic crystal with DCM doped liquid crystal defect layer**

Up to an applied voltage of 0.9 V, the peaks did not shift. When the applied voltage exceeded 1.0 V, we observed the simultaneous shift of all of the peaks to the shorter wavelengths. This threshold voltage is believed to correspond to the threshold of the Fredricks transition of liquid crystal [20]. The localized state wavelength varied greatly from 1.0 V to 1.5 V and varied smoothly above 2.0 V. Even if a higher voltage (above 2.5 V) was applied, the localized state wavelength did not change. In other words, above 2.5 V, the liquid crystal molecules are oriented in the direction of the electric field, that is, the direction of cell thickness ( $z$  direction), and do not have orientation variations at higher values. As is clearly seen from the figure, the orientation of the liquid crystal defect layer changes depending on the applied voltage and the localized state wavelength can be controlled. Up to 1.0 V, a localized state is observed at seven peaks, but only six peaks were observed above 1.1 V. This occurs for the following reason. The incident light in the initial orientation coincides with the rubbing direction, and the light experiences the extraordinary refractive index  $n_e$ . However, as the orientation is varied by the applied voltage, the refractive index experienced by the light gradually decreases to the ordinary refractive index  $n_o$  from the  $n_e$ , the optical length of the liquid crystal defect layer shortens, and the number of states that can exist in the defect layer decreases. The 532-nm second harmonics of the Nd:YAG laser irradiated the one-dimensional periodic structure with a liquid crystal defect layer for the excitation. Laser emission was observed when the pump light intensity exceeded the threshold. Figure 3 shows the laser emission spectrum. Before the voltage was applied, the laser emission wavelength was 606 nm. By applying the voltage, the laser emission wavelength shifted to the shorter wavelengths. The shift to the shorter wavelengths by applying the voltage matches the shift direction of the localized state wavelength.

1. The localized state in the one-dimensional photonic crystal with a liquid crystal defect layer was successfully controlled by applying a voltage.

2. By doping a dye in the liquid crystal of the defect layer, the laser emission was observed upon irradiation of the pump laser beam above the threshold energy. Lasing wavelength was widely tuned with a low voltage.

3. We verified the laser emission from the localized state when the voltage dependencies of the localized state wavelength and the laser emission wavelength agree.

## References

1. Yablonovitch E. Inhibited spontaneous emission in solid-state physics and electronics. *Phys Rev Lett* 1987;58:2059–2062.
2. John S. Strong localization of photons in certain disordered dielectric superlattices. *Phys Rev Lett* 1987;58:2486–2489.
3. Dowling JP, Scalora M, Bloemer MJ, Bowden CM. The photonic band edge laser: A new approach to gain enhancement. *J Appl Phys* 1994;75:1896–1899.
4. Tocci MD, Bloemer MJ, Scalora M, Dowling JP, Bowden CM. Thin-film nonlinear optical diode. *Appl Phys Lett* 1995;66:2324–2326.
5. Vlasov YA, Luterova K, Pelant I, Honerlage B, Astratov VN. Enhancement of optical gain of semiconductors embedded in three-dimensional photonic crystals. *Appl Phys Lett* 1997;71:1616–1618.
6. Foresi JS, Villeneuve PR, Ferrera J, Thoen ER, Steinmeyer G, Fan S, Joannopoulos JD, Kimerling LC, Smith HI, Ippen EP. Photonic-bandgap microcavities in optical waveguides. *Nature* 1997;390:143–145.
7. Noda S, Tomoda K, Yamamoto N, Chutinan A. Full three-dimensional photonic bandgap crystals at near-infrared wavelengths. *Science* 2000;289:604–606.



8. Hattori T, Tsurumachi N, Nakatsuka H. Analysis of optical nonlinearity by defect states in one-dimensional photonic crystals. *J Opt Soc Am* 1997;14:348–355.
9. Dumeige Y, Vidakovic P, Sauvage S, Sgnes I, Levenson JA. Enhancement of second-harmonic generation in a one-dimensional semiconductor photonic band gap. *Appl Phys Lett* 2001;78:3021–3023.
10. Yoshino K, Tada K, Ozaki M, Zakhidov AA, Baughman RH. The optical properties of porous opal crystals infiltrated with organic molecules. *Jpn J App Phys* 1997;36:L714–717.
11. Yoshino K, Lee SB, Tatsuhara S, Kawagishi Y, Ozaki M, Zakhidov AA. Observation of inhibited spontaneous emission and stimulated emission of rhodamine6G in polymer replica of synthetic opal. *Appl Phys Lett* 1998;73:3506–3508.
12. Yoshino K. Photonic crystal engineering. *Manuf Technol* 1998;50:26–33.
13. Yoshino K, Shimoda Y, Kawagishi Y, Nakayama K, Ozaki M. Temperature tuning of the stop band in transmission spectra of liquid-crystal infiltrated synthetic opal as tunable photonic crystal. *Appl Phys Lett* 1999;75:932–934.
14. Leonard SW, Mondia JP, van Driel HM, Toader O, John S. Tunable two-dimensional photonic crystals using liquid-crystal infiltration. *Phys Rev B* 2000;61:2389–2392.
15. Kang D, MacLennan JE, Clark NA, Zakhidov AA, Baughman RH. Electro-optic behavior of liquid-crystal-filled silica opal photonic crystals: Effect of liquid-crystal alignment. *Phys Rev Lett* 2001;86:4052–4055.
16. Shimoda Y, Ozaki M, Yoshino K. Electric field tuning of a stop band in a reflection spectrum of synthetic opal infiltrated with nematic liquid crystal. *Appl Phys Lett* 2001;79:3627–3629.
17. Ozaki M, Shimoda Y, Kasano M, Yoshino K. Electric field tuning of the stop band in a liquid-crystal-infiltrated polymer inverse opal. *Adv Mater* 2002;14:514–518.





## FLUORESCENCE RESONANCE ENERGY TRANSFER BETWEEN QUANTUM DOTS DONOR AND XANTHENE DYE ACCEPTOR

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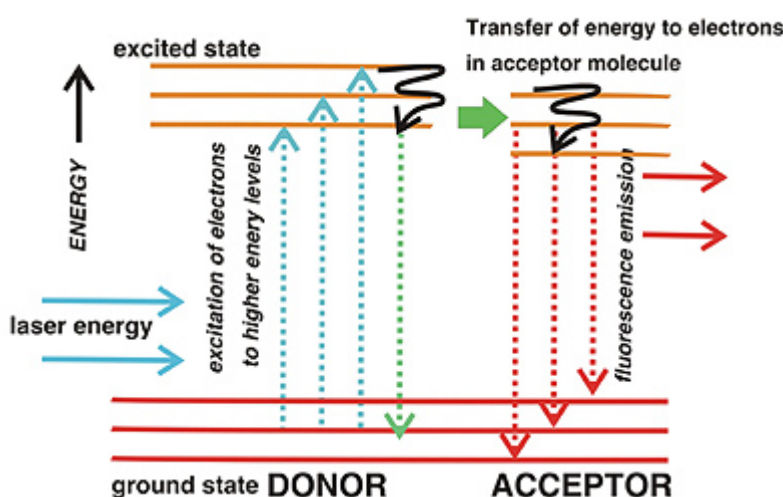
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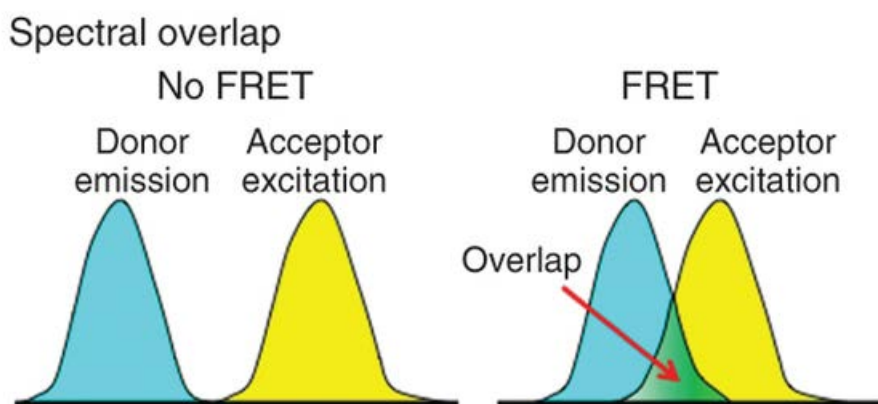
Fluorescence resonance energy transfer (FRET) has become widely used in all applications of fluorescence, including medical diagnostics, DNA analysis, and optical imaging. FRET has been used to determine submicroscopic distances in organic molecules, and a wide variety of macromolecular assemblies such as biological membranes and proteins.

FRET is an electrodynamic phenomenon that can be explained using classical physics. FRET occurs between a donor (D) molecule in the excited state and an acceptor (A) molecule in the ground state. (Fig.1)



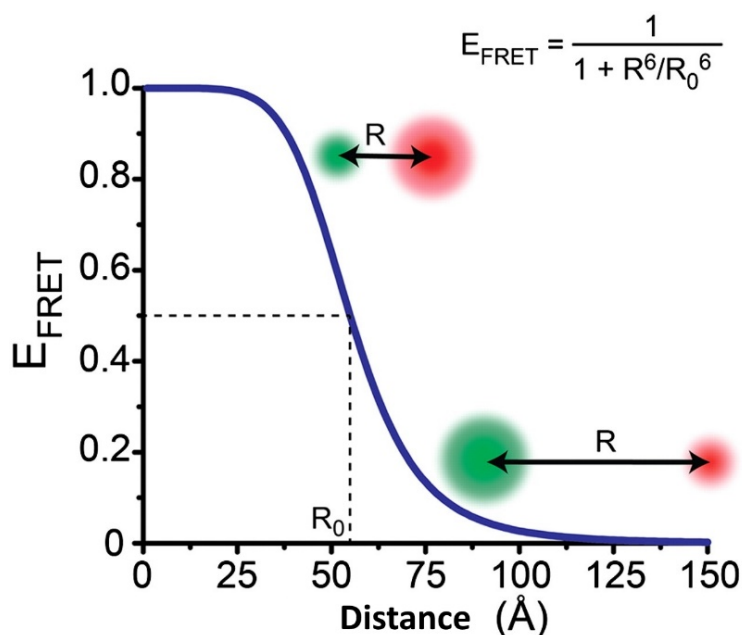
**Fig. 1 – Jablonski diagram for Förster resonance energy transfer**

The donor molecules typically emit at shorter wavelengths that overlap with the absorption spectrum of the acceptor. (Fig. 2)



**Fig. 2 – Spectral overlap for fluorescence resonance energy transfer**

Energy transfer occurs without the appearance of a photon and is the result of long range dipole–dipole interactions between the donor and acceptor. The rate of energy transfer depends upon the extent of spectral overlap of the emission spectrum of the donor with the absorption spectrum of the acceptor, the quantum yield of the donor, the relative orientation of the donor and acceptor transition dipoles, and the distance between the donor and acceptor molecules. The distance dependence of FRET allows measurement of the distances between donors and acceptors [1]. It is possible by the fact that the efficiency of transfer energy depends strongly on D-to-A distance ( $r$ ), and is proportional to  $r^{-6}$ . (Fig. 3)



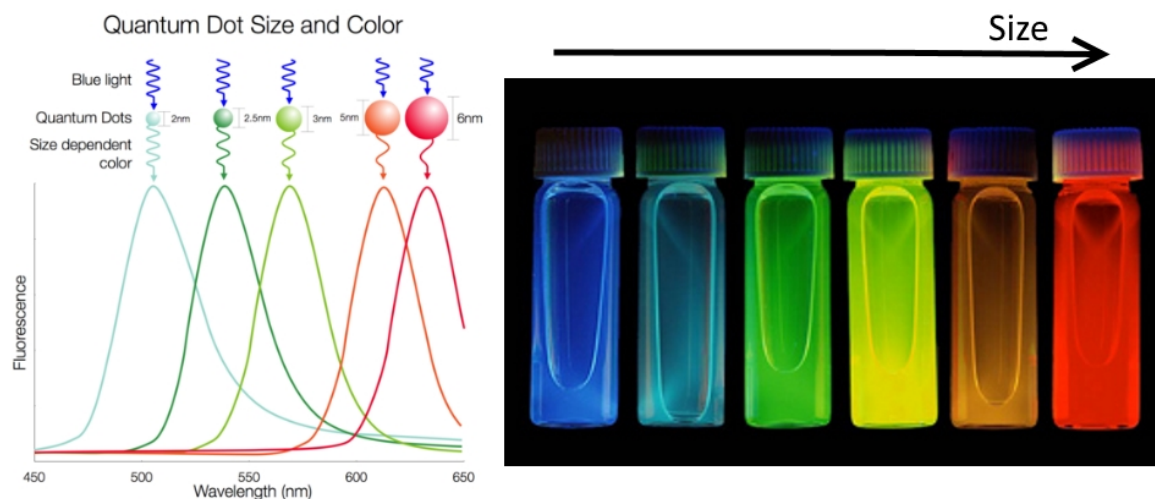
**Fig. 3 – Dependence of the energy transfer efficiency ( $E$ ) on distance.**  
 $R_0$  is the Förster distance

The distance at which FRET is 50% efficient is called the Förster distance, which is typically in the range of 20 to 60 Å. At this distance ( $r = R_0$ ) the donor emission would be decreased to half its intensity in the absence of acceptors.

The transfer efficiency is typically measured using the relative fluorescence intensity of the donor, in the absence and presence of acceptor and can also be calculated from the lifetimes under these respective conditions. These methods relate to various types of measurements: steady-state and time-resolved, respectively. Steady-state measurements, the most common type, are those performed with constant illumination and observation. The sample is illuminated with a continuous beam of light, and the intensity or emission spectrum is recorded.

The second type of measurement is time-resolved, which is used for measuring intensity decays. For these measurements the sample is exposed to a pulse of light, where the pulse width is typically shorter than the decay time of the sample. This intensity decay is recorded with a high-speed detection system that permits the intensity to be measured on the ns timescale.

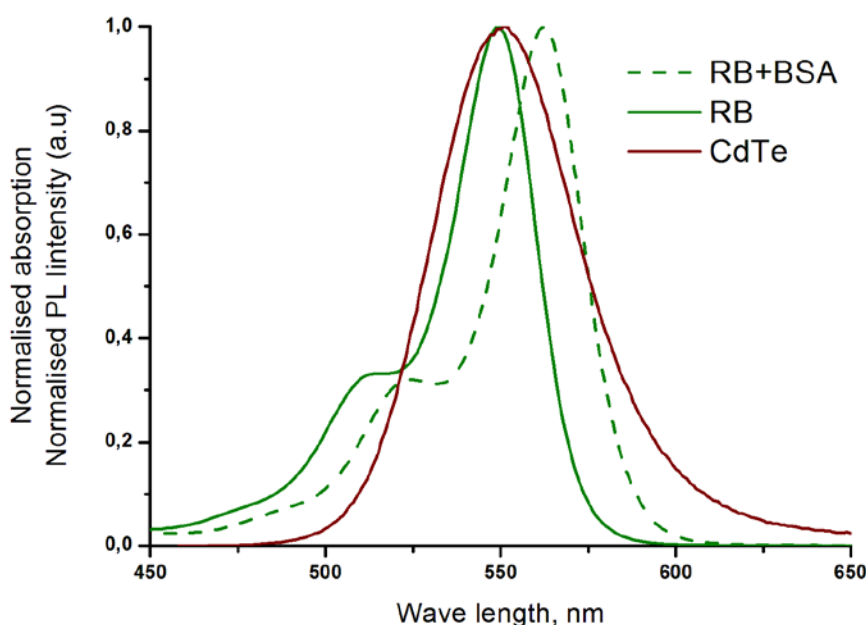
In this paper we have tried to detect the transfer of energy by both the above methods. Organic fluorophores, namely xanthene dyes, was used as an acceptor, semiconductor nanocrystals or quantum dots (QDs) – a donor. QDs are widely known for its unique properties and it is now well established that QDs are ideal for fluorescence resonance energy transfer based devices due to their size dependent emission wavelength, narrow emission, broad excitation spectra and high photochemical stability [2-4]. (Fig. 4)



**Fig. 4 – Quantum dots, depending on their size, emit light at different frequencies**

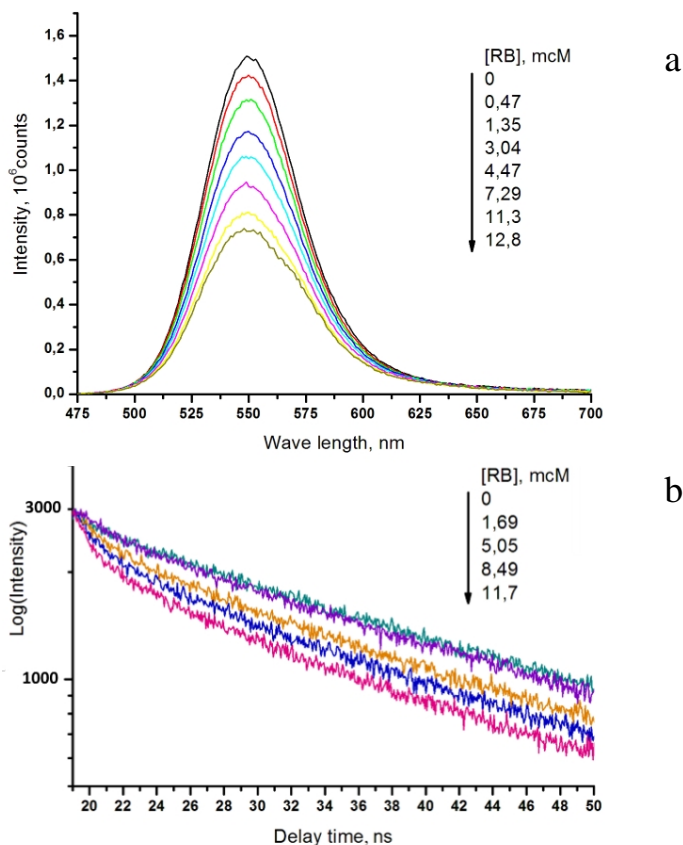
In order to satisfy the conditions required for the transfer of energy we have chosen aqueous colloidal quantum dot of type CdTe that has emission peak at 550 nm and Rose Bengal dye.

Formulas for calculating of FRET's parameters are correct only at a fixed D-to-A distance. There are not physically caused reasons for binding in the system QD-dye. For this reason, we added biopolymer - bovine serum albumin (BSA) in our solvent. We assume that binding the donor and acceptor to BSA will allow observing the FRET. Addition of BSA has no effect on the spectral characteristics of the donor, but upon binding to acceptor shifts its spectra to longer wavelengths [5]. (Fig. 5)



**Fig. 5 – Absorption spectra of Rose Bengal in presence and in absence of BSA; emission spectra of CdTe QD**

After processing the data obtained during the experiment the decrease of donor's intensity and of decay time were recorded, these results are presented in Figure 5.



**Fig. 2 – Quenching of photoluminescence emission of CdTe QD (a); time-resolved fluorescence decay curves of CdTe QD (b)**

As is shown in the figure quenching of donor by acceptor occurs. Furthermore, our data doesn't show sensitization or flare-up of the acceptor, that is possible in case of FRET, but chosen by us dye has a low quantum yield. It explains the lack of it on the figure.

We come to the conclusion that resonance energy transfer in system QD-dye-BSA was observed. As for QD-dye system a test experiment was performed, in which energy transfer has not been found.

### References

1. Lakowicz, J. R. Principles of Fluorescence Spectroscopy / J. R. Lakowicz. – New York: Springer Science+Business Media, 2006. – 960 p.
2. FRET from CdSe/ZnS core-shell quantum dots to Fluorescein 27 dye / Math A. Shivkumar [et al.] // Phys. Chem. – 2013. – Vol. 3. – P. 40-48.
3. Sadhu, S. Donor–Acceptor Systems: Energy Transfer from CdS Quantum Dots/Rods to Nile Red Dye / S. Sadhu, A. Patra // ChemPhysChem. – 2008. – Vol. 9. – P. 2052-2058.
4. Förster Resonance Energy Transfer Investigations Using Quantum-Dot Fluorophores / Clapp A. R. [et al.] // ChemPhysChem. – 2006. – Vol. 7. – P. 47-57.
5. Spectroscopic investigations on the mechanism of interaction of bioactive dye with bovine serum albumin / Shaikh S.M.T. [et al.] // Dyes and Pigments. – 2007. – V. 74. – P. 665-671.

## COLLOIDAL QUANTUM DOTS

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Quantum dots are semiconductor particles with the size of several tens or hundreds atoms. Matter particle of such small size retains some properties of atoms, particularly it keeps discrete energy levels system. Movement of an electron between energy levels of the particle leads to the emission of the light. This effect is called luminescence and familiar to everyone from daylight lamps.

The main applications of quantum dots are field-effect transistors, quantum dot lasers, a new generation luminophores for white LEDs. It also makes possible to use quantum dots as the luminescent marking additives, particularly intended for protection of documents and security papers from falsification. The use of quantum dots as biomarkers for medical imaging is also possible [1].

The unique properties of quantum dots make possible to use them in almost every biological tagging and imaging systems.

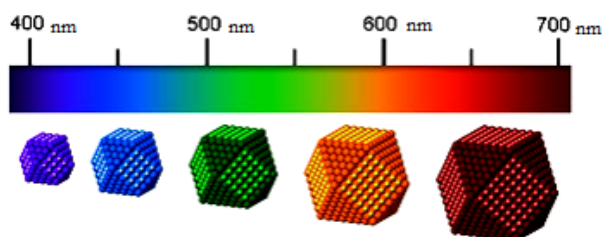
Colloidal quantum dots are semiconductor nanocrystals with the size range of 2 – 10 nm, consisting of  $10^3 - 10^5$  atoms and based on non-organic semiconductor materials like Si, InP, CdSe and others covered with a monolayer of organic molecules.

Quantum size effects play a key role in the optoelectronic properties of quantum dots. The energy spectrum of the quantum dot is fundamentally different from the bulk semiconductor. An electron in a nanocrystal behaves like a three-dimensional potential pit. So, the energy spectrum of the quantum dot depends on its size. The transition frequency (light absorption or luminescence wavelength) can be easily controlled by varying the size of the quantum dot.

The fundamental property distinguishing colloidal quantum dots from semiconductor materials is their possible existence in the form of solutions (sols). This property will provide great manipulation capabilities of such objects.

The unique properties of quantum dots are:

- Narrow symmetrical peak of fluorescence, whose position is adjusted by changing the nanocrystal size and composition;
- A broad excitation band, which allows to excite the nanocrystals of different color with a single emission source. This advantage is important in the process of creating multi-color coding system;
- A high brightness of the fluorescence, which is determined by a high value of extinction and a high quantum yield (for CdSe / ZnS nanocrystals— up to 70%).
- Uniquely high photostability that allows the use of high-power excitation sources.



**Fig. 1 - The quantum dots fluorescence depending on their size**



Colloidal method of the quantum dots synthesis is based on the process of nucleation (formation of new phase nucleation centers from metastable state) [2]. The desired chemical composition of the reagents is injected into the heated dispersion medium. As the result, a rapid chemical reaction comes with the formation of solid phase nucleation centers from locally supersaturated solution. Solid phase particle growth is carried out according to the Ostwald ripening mechanism. It means that the larger particles, which have reached a certain size grow from particles of smaller size. There is a specific critical size. Small particles dissolve and the larger ones grow. The critical sizes (in this case, the critical radius) are unstable and getting lower with increasing of supersaturated solution.



*No lightening at the top of the image, ultraviolet light at the bottom*

**Fig. 2 – Luminescence of the CdSe quantum dot samples with size from 2.0 to 5.5 nm in the form of soles**

Let us consider the question of colloidal system stabilization [3]. To stabilize free energy, it is necessary to reduce the surface tension at the phase boundary. An additional component – stabilizer can be injected into the dispersion medium for these purposes. The stabilizer has to prevent the growth of large particles, as well as to cover the surface of the particles and therefore localize charge carriers within the quantum dot.

The quantum dots are used as materials for lasers and LEDs [4]. Possibility of varying the wavelength of the luminescence and simplicity of creation thin layers based on quantum dots represents a great opportunity to create light-emitting devices with electrical diode stimulation and new laser media. The quantum dots are also used as materials for solar cells and biomarkers because fluorescence markers can be based on the quantum dots.

### References

1. Medintz I. L., Uyeda H. T., Goldman E. R., Mattuosi H. Quantum dot bioconjugates for imaging, labelling and sensing. *Nature Materials*, 2005, Vol. 4, 435 – 446.
2. Murray C. B., Norris D. J., Bawendi M. G. Synthesis and characterization of nearly monodisperse CdE semiconductor nanocrystallites. *J. Am. Chem. Soc.*, 1993, V. 115, p. 8706.
3. Overbeek J. T. G. Strong and weak points in the interpretation of colloid stability. *Adv. Coll. Interf. Sc.* №16, 1982 p. 17.
4. Coe S, Woo W – K, Bawendi M, Bulovic. Electroluminescence from single monolayers of nanocrystals in molecular organic devices. *Nature* 2002, 420: 800 – 803.

## **ZERO CONSUMPTION BUILDINGS**

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Activity of a man inevitably leads to climate changes, as some scientists consider. Such climatic changes periodically happened in the history of our planet, however, it is for the first time caused by activity of a man, and the speed of the current changes is unprecedented. CO<sub>2</sub> produced by controllable use of fossil energy leads to strong exhaustion of world reserves of fossil fuel. The slightest economy of energy, especially in cities, results in decrease emissions of the polluting substances and, therefore, helps to protect environment.

The only area, where it is possible to reduce sharply volumes of consumed fuel, and as a result power consumption and volumes of emissions are found. They are in the field of house heating. New smart buildings have already been built. For this purpose it is necessary to improve thermal insulation and to install more effective heating systems. In order to decrease emissions of CO<sub>2</sub> and for environment protection in the future we should use much less amount of energy for heating, than we use today. So the main characteristic of buildings architecture in future is ultralow, zero consumption of energy and even its generation.

### **Zero-energy building**

A zero-energy building, also known as a zero net energy (ZNE) building is a building with zero energy consumption. The total amount of energy used by the building is approximately equal on the sum of the renewable energy created in the territory and also renewables in other places. Therefore these buildings don't increase amount of greenhouse gases in the atmosphere or it periodically spends non-renewable energy and makes greenhouse gases, but in other cases reduces consumption of energy and compensates release of gases.

The majority of zero buildings of useful energy at first receives part of the energy from a grid, and then returns back the same amount of energy. It is possible to call energy buildings which make surplus of energy in a year "-plus buildings" and buildings which spend a little more energy, than they make, are called "almost zero power buildings" or "ultralow power buildings".

One of the main reasons for production of greenhouse gases is traditional buildings which consume 40% of a total energy of fossil fuel in the USA and the European Union. The zero principle of consumption of useful energy is considered as means to reduce emissions of carbon and to reduce dependence on fossil fuel and though buildings of zero energy remain unusual even in the developed countries, they become more and more important and popular.

The majority of buildings of zero energy use an electric grid for energy accumulation, but some are independent of a grid. Energy is usually developed through the power generating technologies as solar and wind, reducing full use of energy with very effective HVAC (heating, airing and air conditioning) and covering of modern technologies. So we will reduce power expenses and costs of traditional increase in fossil fuel production.

Buildings of zero energy can be part of an intellectual network. Some advantages of these buildings are:

- integration of renewable energy resources;
- integration of electric vehicles;
- distribution of zero-energy concepts.

### **Design and construction**

Buildings of zero energy use considerable energy saving features. Effective heating and cooling is made by means of highly effective equipment, added isolation, highly effective

windows, natural ventilation and other methods. Features vary depending on climate zones. The warming loads of water are lowered by means of the highly effective equipment of water devices of preservation, thermal units of restoration on sewage, and by means of solar water heating. Besides, day lighting with windows in a roof or solar tubes can provide 100% of lighting in the house for all day. The night-time lighting, as a rule, becomes possible with fluorescent and LED lighting which use 1/3 or less power, than glow lamps.

Zero-energy buildings are often designed to make dual use of energy including white goods; for example, ventilation air and shower drain heat exchangers, using refrigerator exhaust to heat domestic water, office machines and computer servers, and body heat to heat the building. These buildings make use of heat energy that conventional buildings may lose. They may use hot water heat recycling, combined heat and power generation, heat recovery ventilation, and absorption chiller units.

The net zero concepts are applicable to a wide range of resources due to generating energy, water heating, waste recycling and etc.

In conclusion it is important to tell about prospects of the passive house technology use in Russia. Today the majority of buildings in Russia considerably lag behind on efficiency of energy use the European standards. In Germany buildings reckon with a certain annual expense of high temperature of about 300 kW of h/sq.m a year as usual buildings, and we spend 400-600 kW power per h/sq.m year by data from the magazine "Zero Energy Buildings: A Critical Look at the Definition". Thus it is obvious that passive buildings are much more actual in our severe conditions, than in quite soft climate of the majority of the Western European countries. But until recently the power effective buildings have been apprehended in Russia as something fantastic; only in the last years there are some signs of future changes.

Relative high cost in their construction becomes a certain limiting factor in construction of new type buildings as the cost of construction per square meter of the power the effective house in our country is about 8-10% more, than average values for the usual building. Nevertheless, only in Moscow some experimental buildings with use of passive house technology are already built (in particular the house in Nikulino-2) and the demonstration project of such house is developed near St. Petersburg in 2013. It is necessary to tell that additional costs of construction are paid off within 7-10 years. Meanwhile universal use of the power effective buildings could reduce considerably consumption of energy in the Russian Federation, to rescue air from pollution, and millions tons of usual fuel from burning.

### References

1. «Zero Energy Buildings: A Critical Look at the Definition»
2. P. Torcellini, S. Pless, and M. Deru National Renewable Energy Laboratory D. Crawley U.S. Department of Energy
3. Journal «Energy Efficiency»
4. S. Seebauer, A. Wolf
5. «A Common Definition for Zero Energy Buildings»
6. NREL Research Support Facility, photo credit: Bill Gillies, NREL
7. Web-site Wikipedia, the free encyclopedia
8. <https://en.wikipedia.org/>
9. «Massachusetts Zero Net Energy Buildings Task Force», 2009

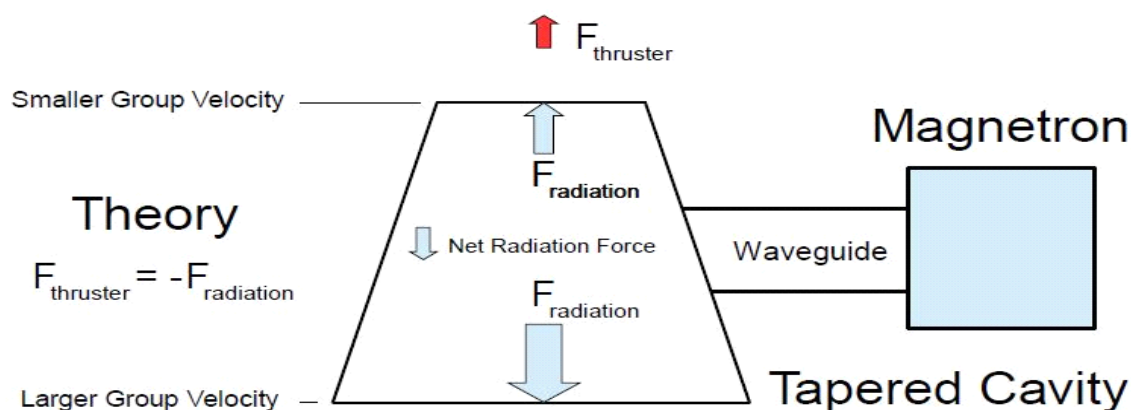
## EM DRIVE TECHNOLOGY FOR SPACECRAFT TRAVELLING

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A new principle of electric propulsion to spacecraft was introduced. The principle of operation of a new engine was introduced by Roger J.Shawyer in 2001. It uses microwave technology to achieve direct conversion of d.c. power to thrust without the need for propellant. In 2001, a small UK company, Satellite Propulsion Research Ltd (SPR), was set up to carry out a programme into a revolutionary electrical propulsion concept. The proposed technology would provide direct conversion from electrical energy to thrust, without the need to expel any form of propellant. At first sight, the idea of propulsion without propellant seems impossible. However, the technology is firmly anchored in the basic laws of physics and following an extensive review process. No transgressions of these laws have been identified.

The principle of operation is based on the well-known phenomenon of radiation pressure. This relies on Newton's Second Law where force is defined as the rate of change of momentum. Thus an electromagnetic (EM) wave, travelling at the speed of light has a certain momentum which it will transfer to a reflector, resulting in a tiny force.

Thus, if the EM wave travelling in a tapered waveguide is bounced between two reflectors, with a large velocity difference at the reflector surfaces, the force difference will give a resultant thrust to the waveguide linking the two reflectors. If the reflectors are separated by a multiple of half the effective wavelength of the EM wave, this thrust will be multiplied by the Q of the resulting resonant cavity, as illustrated in fig. 1.



**Fig. 1 - Engine concept.**

This force is supported by inspection of the classical Lorentz force equation:

$$F=q(E+vB)$$

The concept of an EM Drive is that electromagnetic microwave cavities might provide the direct conversion of electrical energy to thrust without the need to expel any propellant. The lack of expulsion of propellant from the drive was met with initial skepticism within the scientific community, because they consider that this lack of propellant expulsion would leave nothing to balance the change in the spacecraft's momentum if it were able to accelerate.

However, in 2010, Prof. Juan Yang in China began publishing about her research into EM Drive technology, culminating in her 2012 paper reporting higher input power (2.5kW) and tested thrust (720mN) levels of an EM Drive. After consistent reports of thrust

measurements from EM Drive experiments in the US, UK, and China - the question of where the thrust is coming from deserves serious inquiry.

Table 1 - Tests of EM Drive

Force, newton	Year	Research company	Country
0.02	2002	Satellite Propulsion Research	GB
0.1	2006	Satellite Propulsion Research	GB
0.72	2008	Northwestern polytechnical university	China
0.01	2013	NASA Eagleworks	US

The laboratory installation is a vacuum box that contains the prototype of EM Drive, lasers, lens and other equipment with different systems of protection from parasitic effects like external electromagnetic fields or thermal phenomena.

At the end of 2015 NASA conducted a number of tests of various engines of this type and finally confirmed the viability of the technology. Testing was conducted with reference to the previous errors and, nevertheless, the results were positive - EmDrive engine produces the thrust. At the same time, the researchers admit that the newly discovered unaccounted factors, one of which may be thermal expansion, significantly affecting the device in a vacuum. Research results of a 2015 year are planned to be published soon.

By the results of researchers, the scientists concluded that the electromagnetic engine will take a rocket to Pluto in just 4 years. In contrast, the step drives that are used in designing rocket nowadays will take same rocket to Pluto in about 10 years due to the fact that that the rocket with step drive accelerates repeatedly, about 3-5 times. The rocket with EM Drive accelerates all the time while it keeps flying. Thus, a rocket with the electromagnetic engine will develop higher speed for distant flights, than a rocket with the step drive.

For a typical geostationary communications satellite, which capacity is 6kW of solar power, the conventional apogee engine, attitude thrusters, and propellant volume with an EM Drive would result in a reduction of the launch mass from 3 tons to 1.3 tons.

The applications of such a propulsion drive are multi-fold, ranging from the low Earth orbit operations, to transit missions to the Moon, Mars, and the outer solar system, to multi-generation spaceships for interstellar travel.

### References

1. Nasa spaceflight [Internet resource] <http://www.nasaspacesflight.com>
2. EmDrive's official site [Internet resource] <http://emdrive.com/>



## COMPUTER GAMES AS A NEW FORM OF ART

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The word "art" has many meanings. Someone perceives art as any creative activity, and someone as a synonym for the words "skill", "perfection". Art tends to bear the imprint of the period to which it applies at a given time. For this reason, contemporary art reflects modern life.

Therefore, the aim and inspiration for writing this article was the desire to talk about what constitutes contemporary art, why is it so controversial and what unexpected forms it may take.

Our century is a century of rapid development, large-scale studies in different areas of freedom of thought. We build and then demolish to introduce and promote new products, which it is necessary as they become obsolete and we start all over again. We are attracted by the process of continuous improvement of technology and scared of the opportunity to stay; stagnation for us means death, and development is life and freedom.

The rapid pace leads to rapid saturation. The artists of the 21st century are fed up with the usual way, they began to experiment implementing new concepts into art and inspiring further generation of researches to think that has led to the emergence of new styles of art such as cubism, expressionism, surrealism, massurrealism, etc, which have not been unanimously recognized. However, it does not prevent artists from searching of new ideas, so the number of different trends in art grows. This led to the fact that contemporary art is sometimes controversial and scandalous. Some even argue that in today's world of art as something sublime, beautiful and harmonious, characteristic of antiquity and the Renaissance was gone. But in my opinion it has become versatile. Contemporary art possesses inherent individuality which is not for everyone.

Now the artists are trying to surprise the audience trying to combine everything, even uncombined. The use of unexpected materials, surfaces, transformation or distortion of familiar images. For example, a physicist Arie van't Riet uses X-ray cameras to take pictures of flowers, plants and small animals (figure 1). Riet takes photos of objects, and then digitizes, inverts, and then paints the parts of the image getting interesting results<sup>1</sup>.



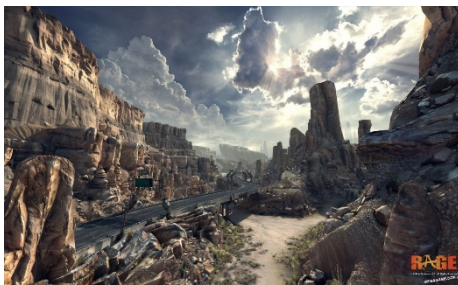
**Figure 1- Arie van't Riet**

These days a fundamentally new phenomenon that unites not only almost all kinds of arts but also techniques were born. I am talking about video games. Are you surprised? But those who are familiar with products of the gaming computer industry are not. Now a computer game is the integration of more narrowly focused usual forms of art, and not only:

<sup>1</sup>The picture is taken from the electronic resource: [cameralabs.org](http://cameralabs.org)



1. Of course, the primary are the idea, the story itself and the gameplay. There are a lot of games with a boring and hackneyed plot, but there are also many ones that are much



**Figure 2-Rage**

more interesting than books. Technical progress and development in the literature of the 20th century of a fantasy genre led to the emergence of new genres, such as science and space science fiction, horror, dystopia, etc, themes of which form the basis of books, films, theaters, and game today. As a result, we see that one of the components of a computer game is literature.

2. Graphic arts. An attractive picture plays the main part here. In general, the quality of performance in this environment is a detailed and realistic portrayal of people, objects and landscapes (The Elder Scrolls V: Skyrim, Rage<sup>2</sup> (figure 2), Xrebirth, Thief<sup>3</sup> (figure 3). As in painting, realistic and interesting technique and style of depiction may be of high value. Though sometimes something primitively drawn touching in its simplicity and sincerity (Botanica, Rayman).

3. Music. This affects the atmosphere of the game. It is not enough to see the darkness and know it is the night. You can experience the tranquility of the starry night, or feel lurking in the dark alley the danger through the sound. It is nice to stroll through the city market listening to relaxing music and the voices of people from all sides, and scaring to wade through the cellars of the old crypt. Exactly music is a regulator of emotions, because of which going total immersion to the game.



**Figure 3-Thief 2014**



**Figure 4-Mass Effect**

4. Interactivity. This is a new stage of development for the works of art familiar to us from a performance where the audience is fundamentally important. But here the player chooses the development of the plot. Now these games are the most popular and interesting. An example of such a game is a series of Mass Effect<sup>4</sup> (figure 4), where it is possible to carry the progress of the game to the next part, thus affecting the pre-game ramifications. The choice can change a lot, from the abilities of the character to the story endings. Thus the game becomes more and more similar to the real life, where, making a choice, you gain or lose something.

<sup>2</sup>The picture is taken from the electronic resource: [www.descarga2.me](http://www.descarga2.me)

<sup>3</sup>The picture is taken from the electronic resource: [m.ruliweb.daum.net](http://m.ruliweb.daum.net)

<sup>4</sup>The picture is taken from the electronic resource: [www.xgn.nl](http://www.xgn.nl)

5. Development of a software code. The most important part of the development of computer games is creation a software code. Location of interface elements, behavior of artificial intelligence, the impact of the gaming environment on the player character –that is all of a mathematics code. For example: for the behavior of a character, a deformation of an object, dynamics of liquids and gases in the gamea physics engine is responsible. Visualization of objects, movement of light and color are tasksfor a graphics engine. And engines(gaming enginesin this case)neither more nor less than a means to an embodiment of writers, artists and sound engineers' plans through the code.

As a result, the complex of these parts produces a masterpiece. In 2011 computer games have been officially recognized separate art by the US government and American National Foundation. Officially recognized as works of art such games as Video Games Flower and Halo 2600 became a part of one of the world famous collections of contemporary art.

Thus, it is obvious that contemporary art has many faces, often unpredictable. It is growing rapidly, loves mixing different styles, contamination with various technologies, and can be expressed in the most unexpected manner.

### References

1. Cameralabs [electronic resource]. Access mode: <http://cameralabs.org/4756-rentgenovskie-snimki-kak-iskusstvo-ot-are-vant-rita-arie-van-t-riet>
2. GamesIsArt.ru [electronic resource]. Access mode: <http://gamesisart.ru/>
3. Wikipedia [electronic resource]. Access mode: [https://ru.wikipedia.org/wiki/Произведение\\_искусства](https://ru.wikipedia.org/wiki/Произведение_искусства)



## **THE IMPOTRANCE OF SOLAR ENERGY AND ITS APPLICATION ON THE EXAMPLE OF «AUTONOMOUS CHARGER FOR LAPTOP»**

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To imagine our life without energy is impossible. Energy includes all spheres of human activity: industry, agriculture, science, space, our life. In industry energy is used for actuating the various mechanisms, and directly in industrial processes. The modern communication is based on the use of energy. Energy in the home is a key of comfortable life. Energy is an important part of human life.

At the same time, energy is one of the sources of adverse impacts on the environment and humans. It affects the atmosphere (oxygen consumption, emissions of gases, moisture and particulates), the hydrosphere (water consumption, the creation of artificial reservoirs and discharges of contaminated and heated water, liquid waste), the biosphere (emissions of toxic substances) and the lithosphere (the consumption of fossil fuels, changing the landscape). Moreover, our world is undergoing one of the main global problems, namely the problem of using exhaustible sources of energy. In my opinion, the solution of this problem is obvious - you must use inexhaustible sources of energy.

### **Solar power**

The Sun is the biggest source of energy in our lives. The Sun gives off enormous amounts of heat and light in all directions. Scientists say it will continue to shine for billions of years in the future. The Sun's heat and light have many uses. To help plants grow, some people build greenhouses, which collect solar heat. Some people rely on the Sun to dry their clothes after washing. Some people boil water or cook food using the heat of the Sun's rays.

Sunlight is also used to produce one of our most important forms of energy: electricity. There are a couple of different methods to do this. Each method can be used in power stations, or power plants. These are large facilities that supply electricity to the public power system, which is also known as the grid. Each method of producing electricity can also be used in smaller power-supply systems. Such smaller systems can meet some or all of the electricity needs of a machine, a small house, or another kind of building. The systems can be used by people who do not want to rely on the grid. They can also be used in places where the grid is so far away that connecting to it would cost too much or would be impossible.

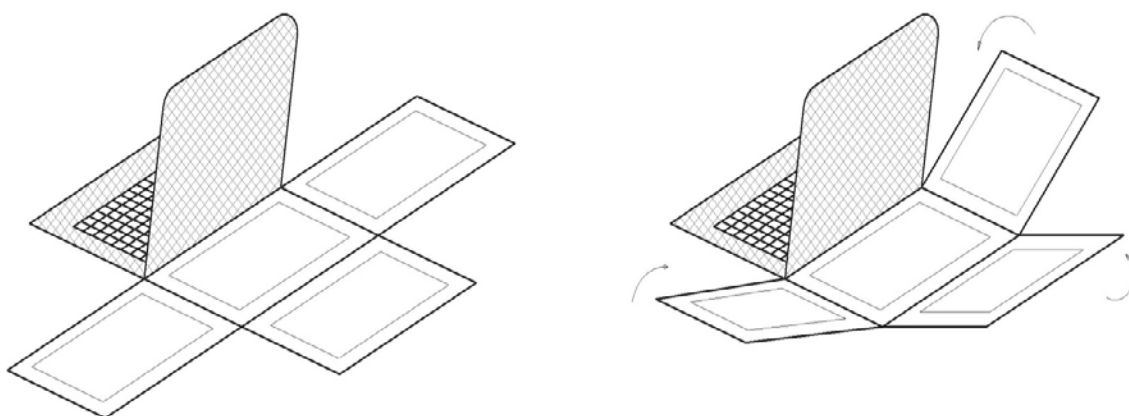
In addition, the systems can come in handy when it is simply not convenient to connect to the grid. One of the methods of using sunlight to produce electricity uses the Sun's heat to run a machine that generates electricity. The other method of using sunlight is particularly versatile. It relies on small devices called solar cells. Solar cells make electricity directly from sunlight. These cells are good power sources for small things like outdoor lights, highway signs. They are often used to power small electronic devices.

### **Autonomous Charger for Laptop**

Using these solar cells, we created a project «Autonomous Charger for Laptop». In this work we propose to create a battery for low-power portable electronic devices, namely laptops, using solar energy as a source.

The problem of easy access to mobile communications and the Internet is now very relevant for business people (business travelers, or else on vacation on the nature and not only), tourists, and just any modern person walking in step with the times and respecting

such. This problem came because of the need to be connected at any time. As the main battery sources are not always at hand, there arises the need for alternative charging technology.



*Figure 1 - Sketch of solar panel.*

Solar panels will convert solar energy into electrical current. The controller charging power, DC-DC converters will convert electrical energy from the solar panels to the battery charger parameters. Battery will stabilize voltage fluctuations, and provide additional power notebook in poor lighting conditions.

#### **Technical aspects**

All components of the concept chosen for reasons of price-quality goods.

Controller. It is necessary for protection against short-short-circuit, discharge lightning arrester, etc. This controller is the cheapest of the proposed controllers on the Internet, moreover, it is the current limit of 20 A. The controller will be used with a voltage of 12V.

DC/DC converter. Need for constant voltage output circuit. Two regulated voltage converter with input and output in the optimal range is optimal for the output voltage 5 and 19, as they can convert a power of 100 watts.

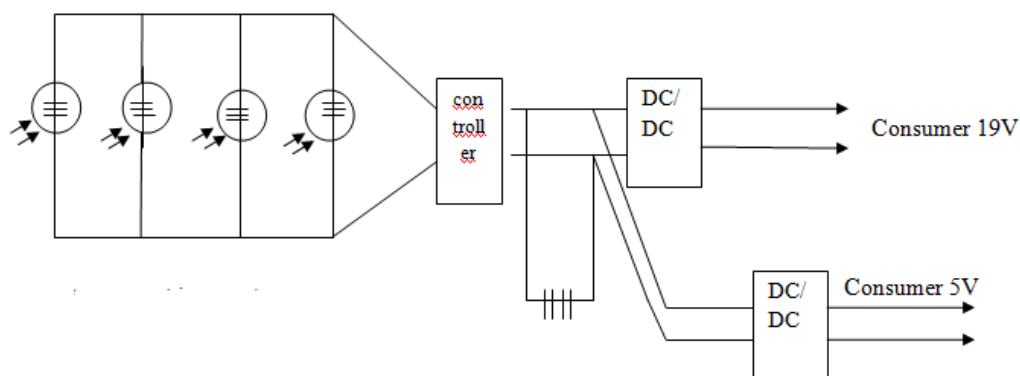
Solar battery. Four solar panels, each 10 watts, though are much more expensive than the cheapest counterparts, but are thin and flexible, ideal for portable battery.

Battery. Two batteries at 6V, connected in series. The total capacity of the two batteries is 5.6 Ah, so the recommended charging current is 0.56 amperes. These batteries are very compact for its capacity. As the batteries are the same, and the internal resistance will be equal, and hence the voltage on them, 6 A.

Cable. Price cables vary slightly compared with the price of the entire system.

Cloth. It is water-resistant to solar panels that are not afraid of the water.

Pins are required for fixing solar panels on the laptop screen.



**Figure 2 - Electrical scheme.**

Solar devices keep improving. Today's devices and systems are better than the ones that were in use a few years ago. PV cells get cheaper and cheaper, and batteries and other storage devices get better. Meanwhile, scientists keep finding new ways to use solar energy. At the same time, people are getting more and more worried about fossil fuels and their probable effects on Earth's climate. As a result of these trends, sunshine will probably provide a larger share of the energy we use in the future. It is hard to say how fast this will happen. It is also hard to know how big this share will be. Both depend on how quickly solar technology improves. They also depend on what happens with other renewable energy sources. Their cost might go down, too. Still, solar energy seems to have a bright future.

As for our project, we have only to investigate the effect of incidence of sunlight on the solar panel and reduce its impact. We will also take care of aesthetic perception of our project, discuss the implementation in production, examine its relevance and demand in the market.

### References

1. Kodis, Michelle. Turn Me On: 100 Easy Ways to Use Solar Energy. Layton, Utah: Gibbs Smith, 2009.
2. Povey, Karen D. Energy Alternatives. San Diego: Lucent, 2007.
3. Tabak, John. Solar and Geothermal Energy. New York: Facts On File, 2009.
4. Thomas, Isabel. The Pros and Cons of Solar Power. New York: Rosen, 2007.
5. Richard Hantula. Solar power, 2010.



## GEMS THROUGH THE PRISM OF THE PAST

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From its' very beginning the mankind has been interested in exploration of the planet it lives in. In ancient times, knowledge of the word around based on conjectures or religious superstitions due to incapability of explaining some natural phenomena. But modern science is capable. Nevertheless, it is still interesting to cast a look at science past, see how our predecessors had explained the appearance of different minerals and analyze differences between past perception and recent scientific methods.

The first mineral that comes into mind while talking about gems is, of cause, *diamond*. Diamond is famous for its incredible toughness, high refraction index and extraterrestrial beauty and because of these reasons many of legends attribute celestial etiology to diamonds. There is a Persian legend which describes so-called "Empyrean" – the divine cover made up by God to protect his children and new-born harmonious world. Later, sinister forces had destroyed the Empyrean and it had fallen on Earth turned into the rain of sparkling diamonds [2].

Next mineral heats people's imagination all through the ages by its extraordinary qualities such as the most accomplished hexagonal crystals, hardness, extremely ideal transparence and low temperature at a touch. It is *clear quartz*. In Aristotle's writings we can find the saying: "*Ex aqua generatur crystallus remoto totaliter calido*" which means that when water loses its' warmth in full it turns into clear quartz. In other words, ancient Romans thought that clear quartz was the ice which had forgotten how to melt down.

Interestingly enough, in ancient Egypt there also was a legend about transparent mineral but this time it was about *tourmaline*. According to the legend, one colorless stone was walking in the skies and saw a rainbow. The stone was so impressed by the beauty of rainbow colours that he incorporated rainbow them and became the same multicolored [3].

Actually, rainbow phenomenon haunted minds of people all over the world. For example, let's take a look at *opal* formation legend. There is an Indian story about goddess of rainbow, who was really beautiful and for whose love lots of men had been fighting. One day the goddess was followed by group of men and when she realized that she couldn't shake off the pursuers she dapped and turned into millions of marvelous opal stones [3].

In The Bible legends about stones have found their place too. The thing is, The Bible called *jasper* the progenitor of all minerals on Earth and also it is said that jasper is one of the twelve stones which were used to build New Jerusalem foundation. As a matter of fact, there is a probability that jasper mentioned in The Bible was actually a *nephrite*. Such confusion might be caused by similarity in colour of green jasper and nephrite coloration. Linguistic similarity brings in even more confusion. For instance, in Chinese and Japanese languages both jasper and nephrite are written by character "玉". Although, nephrite was considered as much more valuable stone than jasper at all times, so that is why the majority of geologists are sure that it is referred to nephrite in these legends [2].

It begs the question, if nephrite was a progenitor of all minerals, who was the progenitor of nephrite? The answer could be found in Chinese tale about The Creation. The legend tells about a giant called Pangu, the first human on Earth who created the Universe and who was born from an egg. Pangu divided skies and earth and held skies on his shoulders until own death. And when his breath converted into wind, his hair became stars, grass and trees, while blood became rivers and his marrow turned into nephrite and pearls.



Talking about *pearl*, Pliny the Elder in his book “Natural History” narrated another way of pearl’s appearance. He supposed that the oyster producing pearls is actually a stone, which opens at dawn and takes in the rays of stars, the moon and sun rays and drinks dew, and pearls are made of this mixture [4]. What is more, in legends pearls are frequently associated with tears of gods or beauties. The only stone mentioned in legends as petrified tears oftenly than pearl is *amber*. In order to prove the point, let’s glance at Baltic legend about sea nymph’s empress called Jurata. She lived in water depth but loved to look at sunsets on the sea surface and one day she saw a young fisherman and felt in love with him. Unfortunately, her father did not approve her choice and killed the fisherman. Ever since, Jurata bewails her lover and her tears, turned into magic pieces of amber, are washing ashore by sea waves.

On the contrary, next stones are usually associated with fire. Charming *cinnabar*, with a reference to Arabian legends, is nothing else but blood of fire-breathing dragon who lives under the ground and crops up only once in fifty years. When the fire-drake is angry he snorts fire and blood from the mouth and this is how the cinnabar appears. By the same token, medieval alchemists believed that cinnabar is great fodder for phoenixes [4].

Second fire-associated mineral is *asbestos* which is popular with its exceptional characteristic – it cannot be exposed to combustion. Such unusual quality is embodied in legends about magic beasts all over the world, e.g. a salamander rat, which lives in fire. As salamander rat’s fur does not burn in fire, asbestos is sometimes called “salamander fur” [5]. In the same way, some of Ural tales confirm that Mistress of the Copper Mountain wears asbestos-woven clothes.

Speaking of the Mistress of the Copper Mountain, we could not bypass *malachite*. Russian writer and folklorist Pavel Bazhov noted down a series of fairytales about the Mistress. In accordance to his writings, the Mistress, who lives inside a cliff, where everything is made from malachite, is proud-spirited and steadfast, sometimes even ruthless, however only few people of good character can avoid her anger and pick up generous award.

One more beast which is consistently mentioned in the same breath with salamander, dragon, phoenix and the Mistress of the Copper Mountain is the Great Snake, the guardian of gold. Once a year the Great Snake sloughs off his old skin and when it hardens it becomes a *serpentine* [1]. Apart from this, not only in Ural tales serpentine is associated with snakes, even serpentine’s name recalls to snakes - in Latin it sounds like “*serpens*” which means “a snake”. And, to some degree, it’s not that surprising because serpentine indeed looks like a snake skin. In contrast to, there is a Christian version of serpentine’s appearance. Pursuant to this version, when Adam forced by Devil ate a forbidden fruit he choked and spited it out. The leftover bit had turned into a serpentine.

Though, not only Adam suffered from Devil’s intrigues. Once Devil saw how Eva was admiring Eden flowers and wished her admiring some devilish creation as well, so he created *moonstone*, which entranced Eva with its inexplicable magical shining. And this Devil’s action led off the greediness in people’s hearts [3].

To conclude everything that has been said, it is noticeable that people ascribed divine or devilish origin to the most of stones. Depending on a country with its national identity, mentality and religious commitments different versions were created. In Europe, Egypt, Russia and in other west countries stones were usually created or given as a present or as a punishment to the mortals by gods. Alternately, in such countries of East as Japan or China legends about stone’s appearance from god’s guts or body parts were quite widespread. It could be a link between special focus of eastern people at human’s inward and such legends.

It must not escape our attention that tales about pearl and amber are tend to be almost the same. Besides that modern science does not qualify pearl and amber as minerals, also in

all legends they're described as petrified god's or demigod's tears. It is fair to assume that even our predecessors had noticed the exceptionality of amber and pearl.

Obviously, in this article not all the gem legends were mentioned, but the research still goes on, so in the foreseeable future the continuation will be definitely written.

### **References**

1. Bazhov P.P. The Malachite Casket. – Saint-Petersburg: Rech, 2016. – 592 p.
2. Krendelev F.P. Legends and facts about stones. – Krasnoyarsk: Krasnoyarsk book publisher, 1985. – 143 p.
3. Mella D.L. Stone Power II: The Legendary & Practical Use of Gems and Stones. – Albuquerque: Brotherhood of Life, Inc., 1986. – 164 p.
4. Pliny the Elder. The Natural history. Book nine. – London: Bloomsbury Academic, 2015. – 368 p.
5. Vinycomb J. Fictitious and Symbolic Creatures in Art. – London: Chapman and Hall, limited, 1906. – 276 p.



## **THE FOREIGN EXPERIENCE OF DESIGNING CYCLING PATH INFRASTRUCTURE**

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Nowadays, considering congestions of city roads and highways networks, cycling becomes one of the most rapidly developing infrastructures in the cities. The present article analyzes the cycling infrastructure development principles in a number of European cities. The paper highlights the main economic aspects of using a bicycle in the city and points out the advantages of cycle paths networks. It also focuses on different problems of designing, exploitation, and maintaining of cycle paths. The study showed that nowadays the chief task of architects is to find a new approach to the city building.

Traffic structure in many cities does not function properly due to the large number of vehicles, which directly destroy the environment and quality of life. Every day megalopolis inhabitants are faced with the 21st century disaster - overcharged highways, traffic jams. Traffic congestions are usually accumulated in the central part of the city and in the direction to the dormitory areas. Consequently, people bear physical and moral discomfort that leads to different pathologies, diseases, depression and decreases ability to work. As a result, the level of sickness and criminality increases, changes the emotional background of the city. Moreover, nowadays a car apart from being the necessary means of transport is a symbol of luxury and wealth and everyone strives to get that status object.

Europe has reached a high level in the organization and implementation of transport infrastructure, developing cycle paths. That is why in this article we analyze the European cities experience, which can also be applied to Russian cities. In Russia we face the same problems therefore we can successfully use experience of foreign projects with benefit for the city and without unjustified expenses.

Development and introduction of the bicycle as the main type of vehicle can have a significant impact on the ecological state of the city, as well as to reduce the load on the highways with heavy traffic.

The most important economic indicators that make the bike "urban jungle paramedic" are:

- fuel saving
- pollution abatement: emissions of CO<sub>2</sub>, CO, NO<sub>x</sub>, solid particles and etc.
- inhabitants' health improvement
- reducing highways congestions during peak time and many other aspects.

It seems that the main advantages of a bicycle are fuel economy and relatively low cost and maintenance of a bicycle. However, the main benefit for people is health. Owning to cycling people avoid following diseases and ailments: locomotors apparatus diseases; spinal curvature; depression; varicose diseases; osteochondrosis; heart and blood vessels diseases.

According to one American research, if 50% of short trips were made by bikes in the Middle West (33 million people), the mortality rate would lower by 1100 per annum. Benefits from the air quality improvement as well as health benefits amount to 7 billion dollars per annum. At the same time, a shift from car to bicycle trips in Europe (for a distance up to 5 km) would amount to 1300 euro annually in the context of health benefits.

Let us first analyze the cycling infrastructure in Hamburg. In 2008 some 12 percent of all trips made by Hamburg's inhabitants were done by bicycle, a 3 percent rise on 2002. In

order to further increase the share of cyclists, the city authorities rely on a comprehensive «Cycling Action Plan».

The 2008 Cycling Action Plan is the basis for developing the city's cycling strategy and makes bicycles part of the general transportation system. This means that bicycles are accepted as a fully-valued means of transport. The Action Plan's most important objectives include doubling the modal-share of bicycle traffic to 20 percent (from the 2002 level), increasing traffic safety, expanding the main bicycle route network, improving the bicycle-climate and public relations and securing a stable system of funding in the long term.

To implement the Plan's ambitious objectives the city authorities are focusing on priority areas, such as infrastructure for riding bicycles, bicycle parking, integration of bicycles into the public transportation system and improving traffic safety. These measures are accompanied by a public relations strategy for improving the image of cycling, bicycle tourism, service points for bicycles and a system of quality management and monitoring.

Copenhagen also shows active progress in cycling development. One of the unique things about Copenhagen is the cycle tracks. Copenhagen is also about to develop intelligent streets: in 2025, the streets will be able to handle rush hour, peak shopping hours, evening life and night activities. By using ITS (Intelligent Traffic System), the street will be transformed from static to dynamic. LED lights in the asphalt signal which transport form has priority and when. Certain stretches, for example, can be made one-way for cars for some periods of the day, just as cycle tracks can be widened during the morning rush hour by taking over space from the sidewalk. The sidewalks can then be widened during the middle of the day when there are more pedestrians and fewer cyclists.<sup>[1]</sup>

To sum up, foreign experience of the design and maintenance of bike paths is quite high and developed. Bike path infrastructure is essential for modern, comfortable operation of city traffic as well as for economic development. In our country a bicycle is considered as a means for walking and recreation. That is why even if we have cycle paths, the authorities dispose them in recreation areas, parks, without implementing into a common road network. Thereby such considerations deprive the city basic beneficial advantages that this type of transportation gives us. It is important correctly identify the function of a bicycle. We shouldn't treat it only as the way of recreation. First of all we should understand that it as mode of transport that allows us to get from point A to point B relatively fast. In order to create bicycle path infrastructure it is important to have precise strategy of actions which includes all fundamental ground works, requirements and methods that are essential for the formation of a new road network. Various arguments, for example, bad climate as we have seen are just an excuse. The same question concerns the bicycles stealing, bicycle interaction with other road traffic participants and other pointless assumptions.

Cycling is the strongest means of diseases prevention and good muscles training. Cycling gives autonomy. It is pleasant and enjoyable and it protects our environment. Cycling is interesting in the context of unloading roads. Modern civilized city can not exist without this vehicle for numerous reasons described above in this article. «Hundreds of thousands people, of all ages, races and backgrounds, will discover that the bike has changed their lives» (Boris Johnson, Mayor of London, bicycle activist).<sup>[2]</sup>

## References

1. Marcel Roethig, Darya Efimenko. Changing urban traffic and the role of bicycles. Moscow, Friedrich-Ebert-Stiftung, 2014. 96 p.
2. The mayor's vision for cycling in London – An Olympic Legacy for all Londoners. London, March 2013.

## THE TREE IMAGE IN THE COMPOSITIONAL AND ARTISTIC SOLUTION OF BEARING AND ENCLOSING BUILDING STRUCTURES

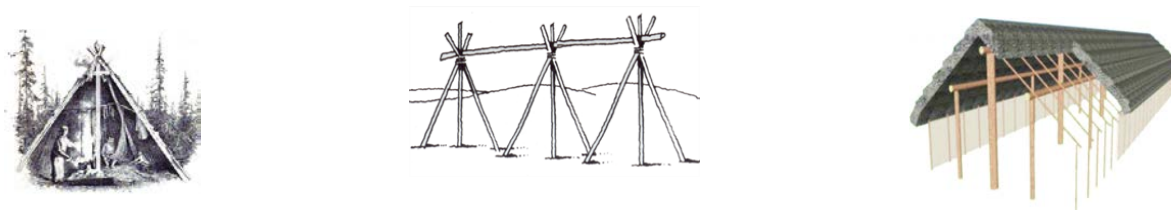
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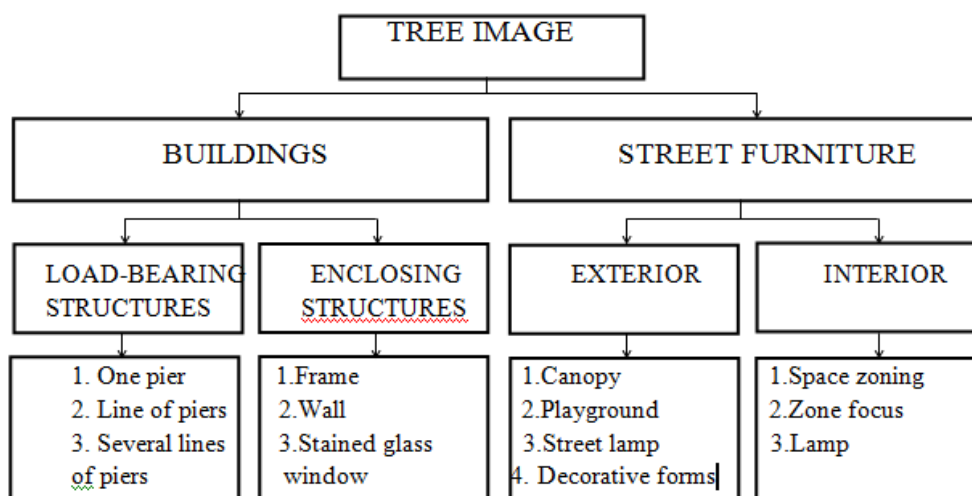
Currently, in our modern technocratic world more and more attention is being paid to the revival of human relationships with nature. The aim of the present paper is to investigate the characteristics of tree images in bearing and enclosing building structures as well as to reveal the specifics of such forms in contemporary architecture. Tree is an important part of natural world. Trees inspire art, design and architecture with their elegance, strength and sense of history.

Wood is the most ancient structural material. It was most commonly used by ancient people to construct their shelters. In simple structures tree trunks were used to form a circle. Such construction had to separate interior from exterior. Sometimes there was a pier in the middle of a shelter which supported the sloping elements. For more spacious constructions piers were set in a line (fig.1).



*Fig.1 – Piers position in ancient constructions*

It is important to mention, that a pier is a vertical support of a structure which was associated with a tree trunk in ancient stone buildings. In modern architecture the pier is similar to a tree trunk too and a roof looks like a tree crown. Creative architects find ways to use the image of tree in their architecture. Structures which look like trees are used in *buildings* and in *street furniture* (fig.2).



*Fig.2 – Tree image in buildings and street furniture*

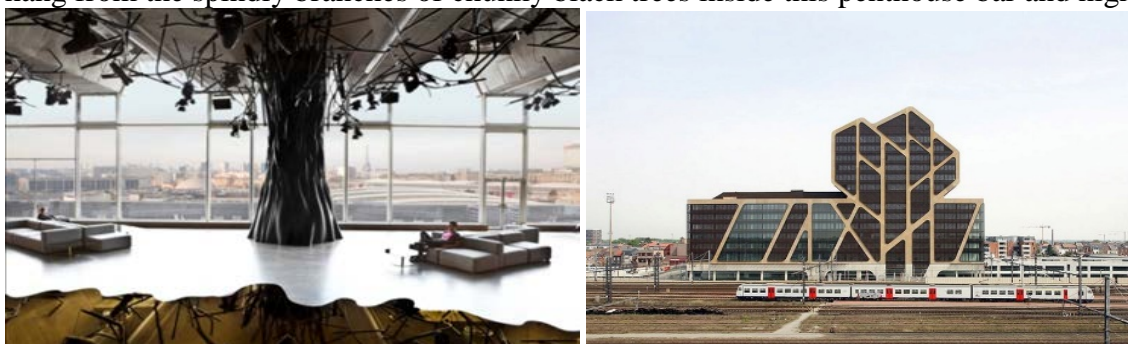


Analyzing buildings that use the tree image in their constructions we made our own classification of images and determined several compositional methods of their location in a building.

1. The main element of the first compositional method is a pier which looks like a tree trunk.

a) The new Court of Justice building in Hasselt was designed by the team of Berlin architects using this method. The former railway station site has been restructured with a park, public buildings, offices and hotels, as well as urban residential blocks. Architects have realized one of the two high-rise buildings, "the new court of justice", a structure that stands as a contemporary urban landmark of the new district. References in the design process refer to both the image of the "tree", the hazelnut trees in the City of Hasselt's coat of arms, and steel structures in the once industrial and Art Nouveau influenced area.

b) Another example is the Electric club by Mathieu Lehanneur (fig.3b). Electric, the new cultural platform in Paris, is already an event in itself: a 1,000 m<sup>2</sup> penthouse in which the designer has devised a canopy of sound suspended between heaven and earth, monumental electrical braids emerging like pitch black trees. Lighting projectors and cables hang from the spindly branches of chunky black trees inside this penthouse bar and nightclub.



*Fig.3 a) – Court of Justice Hasselt; b) - Electric club in Paris.*

2. The second compositional method presents the tree image by a line of piers.

a) Herbst Architects created a house among the Pohutucawa trees using this method. The public space connects the two towers and attempts to engage with the surrounding pohutukawa forest by defining a crossover space between the powerful natural environment and the built form. The primary structure holding up the roof is a series of tree elements (fig.4) which allude to the trunks and branches of trees but are detailed in a rigorous geometric arrangement which suggests an ordering of nature as it enters and forms the building.

b) The architects from Czech Republic decided to develop a kindergarten for 30 children in the village. The basic vision was to situate the kindergarten in the vicinity, in symbiosis with the country and village. The formal concept was developed complying with the historical concept of vernacular architecture. Colour and material design builds on the local genius loci reflected in the 'earthy' character of the building. The architects used piers in form of tree which supported gable roof.





**Fig.4 a) - A house among the Pohutucawa trees; b) - Kindergarten in Dobrin**

3. The third compositional method shows the chaotic location of piers in a building.

a) The architects from Romania developed the office center in Bucharest. They made trees on a façade using laser cut metal (fig.5a).

b) UK architects Chris Lee and Kapil Gupta have designed a banquet hall, restaurant and bar using this method. Their briefs was to incorporate a series of disused buildings from the city's colonial past set within the Mumbai race course and convert them to form a series of restaurant and bars. The open spaces covered by mature rain trees (fig.5b). Their proposal attempted to continue the idea of a continuously differentiated space, with no clear boundary.

c) Israel studio by Ron Shenkin is a canopy over cemetery pavilion. Characterized as an exposed concrete slab, this is supported by a series of tree-shaped metal pillars formed in homage to the trees that were cut down for the urban reconstruction of the area (fig.5c). A single oak tree remains, incorporated within the structure where an opening has been cut to allow the foliage to emerge through the roof.



**Fig.5a) - Victoria Center, b) - Banquet hall, c) - Canopy over cemetery pavilion**

Structures of street furniture sometimes look like trees too (fig.6). The basket tree was installed in a playground in Nantes by French architecture firm Agency/LTA. Basket Tree is a sculptural piece of playground equipment with five basketball hoops. The unique design allows children of different ages (and heights) to play basketball.



**Fig.6 - Basket Tree**

The projects of Siberian federal university students confirm that a tree image is a topical technique in modern architecture. They often use constructions which look like a tree in their projects. Students use the tree image even in their initial projects which are usually devoted to street furniture.

We also applied the tree image in our own project. Our exhibition hall consists of five blocks with gable roof. Eaves are supported by construction which looks like a tree. Green roof is a tree crown (fig.7).



**Fig.7 – “Exhibition hall” by Stramilova Anastasiya**

To sum up, introduction of tree image technique allows architects to use shapes of nature in their projects and to connect buildings with environment. Scientists from Australia, the USA and Israel design building projects which are made from natural trees. Scientists are going to change tree roots in such a way that they can become foundation, walls and other parts of building. Sometimes natural trees are used in interior design. This method adds originality to interior and saves nature.

### **References:**

1. J. Mayer H. Court of Justice Hasselt [Electronic resource]. Access mode: <http://bustler.net/news/3028/j-mayer-h-completes-court-of-justice-hasselt>
2. Electric by Mathieu Lehanneur [Electronic resource]. Access mode: <http://www.dezeen.com/2013/03/06/electric-by-mathieu-lehanneur/>
3. A house among the Pohutucawa trees [Electronic resource]. Access mode: <http://www.designhunter.net/house-among-pohutukawa-trees/>
4. Kindergarten in Dobrin / ATELIER 8000 [Electronic resource]. Access mode: <http://www.archdaily.com/778130/kindergarten-in-dobrin-atelier-8000>
5. Victoria Center / PZP Arhitectura [Electronic resource]. Access mode: <http://www.archdaily.com/100933/victoria-center-pzp-arhitectura>
6. Series architects / Chris Lee and Kapil Gupta: the tote, Mumbai [Electronic resource]. Access mode: <http://www.designboom.com/architecture/serie-architects-chris-lee-and-kapil-gupta-the-tote-mumbai/>
7. Ron Shenkin, Concrete folded canopy over cemetery pavilion in Israel [Electronic resource]. Access mode: [http://www.designboom.com/architecture/ron-shenkin-open-sided-shelter-pardesia-israel-09-03-2015/?utm\\_campaign=daily&utm\\_medium=e-mail&utm\\_source=subscribers](http://www.designboom.com/architecture/ron-shenkin-open-sided-shelter-pardesia-israel-09-03-2015/?utm_campaign=daily&utm_medium=e-mail&utm_source=subscribers)
8. Basket Tree, A Five Basketball Hoop Playground Sculpture [Electronic resource]. Access mode: <http://laughingsquid.com/basket-tree-a-five-basketball-hoop-playground-sculpture/>

## DISCOVERY OF GRAVITATIONAL WAVES

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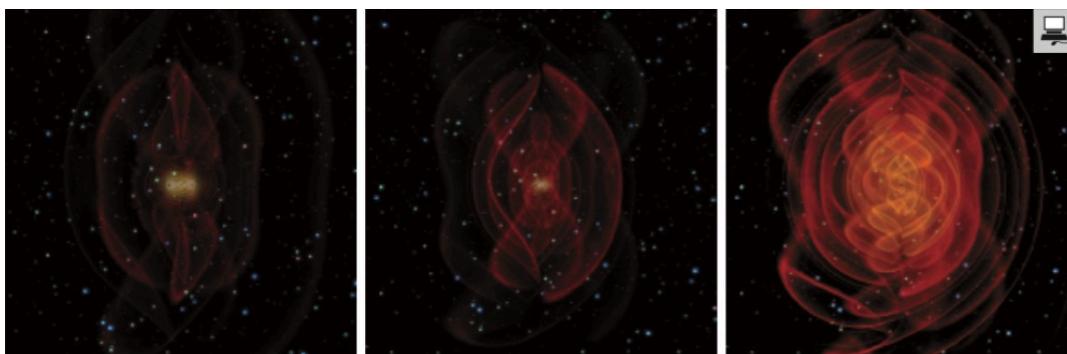
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Over 100 years ago, Albert Einstein predicted the existence of gravitational waves as a consequence of the theory of general relativity. This theory tells us that space and time are closely connected and represented as a four-dimensional spacetime. The structure of spacetime is shaped by the gravity of the objects within it and can vary from place to place like a rubber sheet. If the objects undergo certain types of movement or change, they can cause distortions in spacetime fabric. According to Albert Einstein's theory of general relativity, these distortions create spacetime ripples, which propagate through the universe at the speed of lightlike waves. So we call these spacetime ripples gravitational waves.

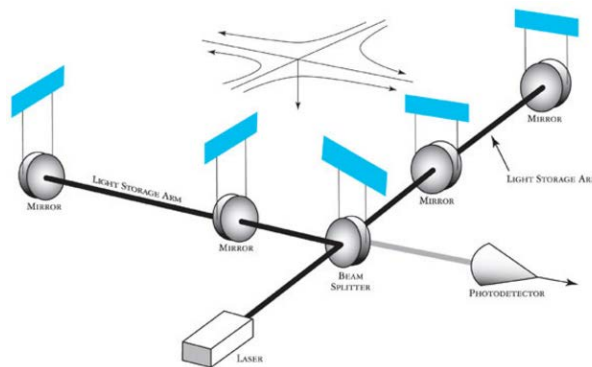
All objects whose motion involves acceleration that is not spherically or cylindrically symmetric can generate gravitational waves in spacetime. If we wanted to make gravitational waves on the Earth, they would be too small to detect. According to this, the only way to study them is to look for the places in the universe where they can be generated. Actually, the universe is filled with incredibly massive objects with rapid acceleration that emits strong gravitational waves. Most common sources of gravitational waves are spinning neutron stars, supermassive black hole pairs and supernovas.

In addition, by orbiting around each other close enough, a pair of black holes lose energy through the emission of gravitational waves. This emission is the reason to the gradually approaching process of two black holes for over billion of years. In the final minutes process gets quickly and two black holes form a single more massive black hole, which produce a portion of the combined black holes' energy (Fig.1).



***Fig.1 - Simulation of the final moments before a pair of black holes merge***

In order to detect the gravitational waves, scientists create Laser Interferometer Gravitational-wave Observatory (LIGO) (Fig.2). It consists of two L-shaped vacuum detectors, located in Livingston and Hanford. Calibrated laser beam is split at the corner of the L, so laser light shines down each of the two arms, which both four kilometres long. To measure a change in arm length 10.000 times smaller than a proton meant that arms must be long enough to detect such tiny change. After passing through the beam splitter the light passes through the mirror closest to the corner and goes to the end of the arm, where it is reflected back to the first mirror. The light is reflected back and forth in the arm, effectively increasing the arm's length. The light eventually passes through the mirror close to the corner and is combined with the light from the other arm.



**Fig.2 -Schematic of LIGO's interferometers**

If the two arm lengths are identical, the light waves cancel each other out and no light is detected. If the arms have different lengths, we will have a result of gravitational waves, and the light is gathered by the detector. Due to the interference, researchers can compare the relative lengths of the two arms to within  $1/10,000$  the width of a proton - with enough sensitivity to see a passing gravitational wave as it stretches the arms by different amounts.

A century after Einstein's prediction, on September 14, 2015 scientists have made the first detection of gravitational waves by both of the LIGO's interferometers, located in Livingston and Hanford. Based on the observed signals, LIGO's scientists figure out that the black holes for this event were about 29 and 36 times the mass of the sun. Their merger created a new black hole about 62 times the mass of the sun. Energy from this massive black hole is emitted as a final burst of gravitational waves with a peak power 50 times the power output of all the stars in the universe combined. This event took place 1.3 billion years ago about 400 megaparsecs from Earth in Southern Hemisphere skies.

From the point of stellar evolution, the direct detection of gravitational waves opens up an entirely new way of studying the universe – gravitational astronomy. According to the fact, that gravitational waves interact only weakly with matter and are not absorbed or scattered like electromagnetic radiation, this new branch of astronomy gives us an information about nature of black holes, supernovas, very compact massive objects like neutron stars and exotic events like Big Bang, that can tell us more about the way the universe was formed.

As we know, the theory of general relativity had been created only by one man, the detection of gravitational waves is a completely triumph of a teamwork. Scientists and engineers from many nations and cultures were working together to make a major discovery for science and humanity. It is hard to predict how gravitational waves can be used in our life, but this discovery has already given us the understanding that science goes in a right way.

### References

1. Gravitational waves: history of study and the opening of LIGO [web resource]: <http://postnauka.ru/faq/59492>
2. Point of view: what discovery of gravitational waves will change [web resource]: <http://postnauka.ru/talks/59808>
3. What are gravitational waves [web resource]: [http://www.huffingtonpost.com/jeffrey-bennett/what-are-gravitational-waves\\_b\\_9253680.html](http://www.huffingtonpost.com/jeffrey-bennett/what-are-gravitational-waves_b_9253680.html)
4. Wikipedia [web resource]: [https://en.wikipedia.org/wiki/Gravitational\\_wave](https://en.wikipedia.org/wiki/Gravitational_wave)
5. LIGO's interferometer: [web resource]: <https://www.ligo.caltech.edu/page/ligos-ifo>
6. Gravitational waves detected 100 years after Einstein's prediction [web resource]: <https://www.ligo.caltech.edu/news/ligo20160211>



**THE RUSSIAN CITIES CYCLING INFRASTRUCTURE****Tihonova K.I****Language supervisor Filonchik O. A***Siberian Federal University*

This article presents the results of a study in the field of cycling infrastructure in a number of Russian cities such as Moscow, Perm, Voronezh, Yekaterinburg and St. Petersburg. The comparative analysis of cycling infrastructure in these cities has shown that there are some factors which stop the development of cycling movement in big cities. Nevertheless, during the last 20 years there is a tendency of promoting and advertising of bicycle as a healthy means of life. Cycle transport influences the ecological situation in the cities, it rescues urban environment from exhausted gases. Nowadays people more often begin to think of the healthy life style, ecology, that's why the introduction of this type of transport becomes an integral part of city transformation.

Streets are a blood system of our cities in general and all urban economy. They represent the safe environment for the movement of pedestrians, bicycles, cars and public transport. The cities which have chosen the way of sustainable development care for ecological benefits of society by reduction of exhausted gases and unjustified fuel consumption. One of the solutions of ecological, transport, medical problems is connected with the projects which try to change the transport system and replace cars with bicycles. The infrastructure of the bicycle movement has to be operated, safe, intuitively clear and continuous.

The bicycle is a very effective mode of the city transport. Cycling has many advantages. But why don't we exploit these advantages in all possible ways? So let's consider several situations faced by the Russian cities at designing of cycle infrastructure.

The Russian Federation's busy and cosmopolitan capital is the largest urban conglomeration in Europe. Moscow is a major political, economic and cultural centre and it has huge potential for also becoming a centre of cycling infrastructure. Shifting some of the city's commuting activity from the use of cars and other motorized vehicles to individual traffic would help to address two of Moscow's major challenges: reducing pressure on its chronically congested streets and improving air quality. Adapting the vast urban landscape of Moscow to the need of cyclists may seem like a lifetime worth of work.

Moscow is not starting from scratch in introducing a cycling system of its own, but there are significant challenges. Currently, there are almost 150 km of bicycle paths, while 340 more routes have been proposed by city districts and 50 routes by cycling activists. However, the different routes are not yet integrated into an integral system and there is no systematic procedure in place concerning the order in which suggestions for new routes are being handled. For that reason, the city has decided to focus on priority areas for 2015. In these pilot areas, full-scale cycling systems will be implemented and they allow for a system of prioritization. The full list of the streets is now being developed.

Introducing bicycle lanes is not enough to make a city attuned to cyclists' needs. Essential infrastructure in a city with the size and traffic volume of Moscow includes a strategy for secure parking lots and allowing for alternative ownership structures through a bike share system. Moscow decided to introduce various parking facilities appropriate for short-term and long-term parking and to introduce a bike sharing system similar to schemes in London, Barcelona and Paris. In 2013, there were 79 stations with 550 bicycles and in 2013 a total of roughly 20,000 individual users had registered for the system. Experience with the bike share system has been positive thus far as only 16 out of the 550 bikes (or 3.4 percent)

were reported stolen in the first year of its introduction. Most of the trips still serve recreational purposes and only 35 percent of the trips were made simply to get from A to B, according to a user survey. With the planned expansion of the system this share is set to increase.

Cycling in an industrial city with a continental climate is a challenge. For Perm this means a relatively short cycling season, with dusty streets in summer. In winter, however, maintenance of streets is low and therefore makes cycling even more difficult. At the moment, there is little investment in infrastructure and road traffic continues to be dangerous. Last year there were over 30 accidents involving cyclists. The city spreads across a large area and cyclists need to cover a lot of ground in order to make it to the next Centre. In addition, bicycles need space for secure locking in order to avoid theft. All these factors together lead to more of a leisure-oriented use of bicycles. But Perm has set out to increase its share of cycling commuters.

Responsible planning is an important element in Perm's quest to increase cycling activity. Several municipal departments have integrated cycling into their list of duties, such as the departments for Road Traffic, City Development, Consumer Market, Sports, Youth Politics and Road Traffic Safety. However, there is no bicycle sharing system planned for the near future. Instead, privately owned rental stations cater to the need of citizens who do not wish to use a bicycle of their own.

The city of Voronezh is located 500 km south of Russia's capital. Now Voronezh is striving to become a capital in its own right by becoming Russia's capital of the bicycle. Cycling enthusiasts all over the city have joined forces in "VeloVoronezh", an association aiming to making cycling in the city safer, faster, and more enjoyable by upgrading infrastructure and involving local officials and businesses. Voronezh features a lively community of over 800 cycling activists. They come together in the association "VeloVoronezh" to discuss future changes to the cycling network and to raise awareness for their cause among citizens. Events organized by VeloVoronezh sometimes attract up to 2,000 participants and they operate inside and outside the city's area.

In addition, they forge close ties with the city's government in order to promote a transformation of the city towards a more bicycle-friendly future. In a joint effort, VeloVoronezh and the mayor's office installed about 150 bicycle parking lots for 2 to 10 individual bicycles and larger scale parking spaces for 14 and 50 bicycles, respectively. They also consulted with an array of organizations on how to build further bicycle parking lots, design bike tracks, and other elements of cycling infrastructure and landscape.

Ekaterinburg is Russia's fourth largest city with a population of approximately 1.4 million (as of 2010). Located on the border between Europe and Asia, it features a fairly flat geography and winters are long.

Unleashing the bicycle revolution: if policymakers, civil society and the city's planning staff and engineers pull in the same direction they can make change happen and ensure an appropriate funding base.

A good plan changes the game: Planning authorities should elaborate a network plan for all private and public projects in the city. On this basis, a primary network bicycle plan will be developed and made available for dedicated funding.

Involving urban planners and engineers in the cycling community: staff responsible for developing and approving cycling infrastructure need to be aware of cyclists' daily deeds. In this way, the city could make sure it obtains a fully functional network of cycling tracks.

Developing the cycling infrastructure in St Petersburg, as in many other cities in the world, is a completely new, challenging, long-time and large-scale project that could totally change the look of the city and seriously influence its future.

When cities start bicycle projects, the critical points should be:



- Consulting with bicycle activists to obtain an understanding of modern approaches to bicycle planning, to select best practices and obtain general knowledge;
- Drawing on international experience and best practices, especially in the initial stages of planning and design;
- Consulting with international experts, especially during pilot projects;
- Doing pilot planning and construction before introducing large-scale projects.

If we consider the cities in which such work has already started, it is also necessary to note several factors that will help to involve more and more people in the process of replacing their vehicles. Such factors include different promo-companies, competitions and championships, cycling trips, discounts in sport shops. Companies may provide their employees with corporative bicycles. In fact, today the Krasnoyarsk JSC “Krastsvetmet” is examining the question of using the bicycles in their company work. The factory has a big territory and movement across it is tiresome for employees. The CEO made the decision to change the system of movement and introduce bicycles for better productivity of the work. Near each workshop it is planned to establish bicycle parking and make traffic markings across the territory. According to the carried-out work, we came to a conclusion that the city authorities should pay maximum attention to the further development of cycling infrastructure in the cities. Following the simple algorithms of this system, we will be able to move freely around the city by bicycle in the near future.

### References

1. Marcel Roethig, Darya Efimenko (Ed.): Changing Urban Traffic and the Role of Bicycles - Russian and International Experiences Moscow: Friedrich-Ebert-Stiftung 2014 Translated by: Anastasiya Shamotko © Friedrich-Ebert-Stiftung in the Russian Federation, 2014. 96p.
2. Public project "Cycling in St. Petersburg" Dirk Dufour "Legtermoet & Partners", Netherlands, February 2010 PRESTO
3. Design of city streets / Group of authors of NACTO; Lane P79 with English – M of a.:alpin non-fiction, 2015. – 192 pp.



## NEAR FIELD COMMUNICATIONS ANTENNAS

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So Near Field Communications Antenna (NFC) is just a method of communication between two devices at short distance. What makes the NFC antenna design simple or easy? If you know much about antennas, the first question you might ask is what is the operating frequency of NFC. It turns out that these devices operate around 13.56 MHz. The corresponding wavelength is 22 meters long - this means to get a nice half-wave dipole antenna (that radiates well) we would need a device about 11 meters in length.

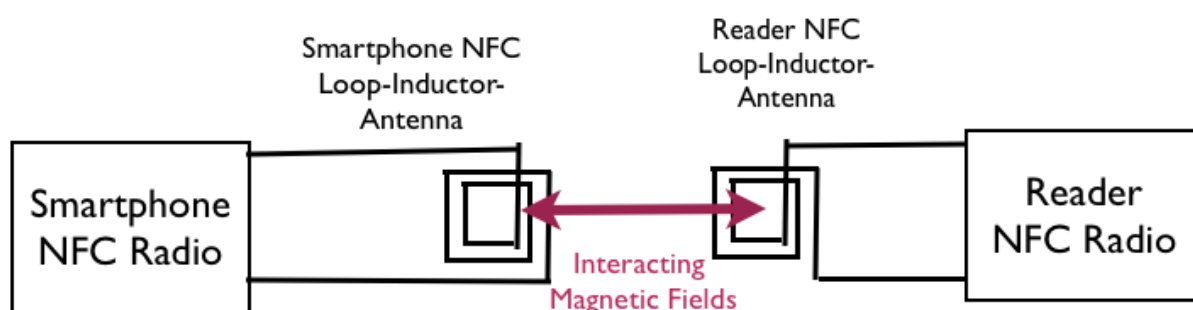
Now, clearly we have NFC antennas on smartphones, for instance. So the challenge in NFC antenna design is to obtain a "radiating" structure when the NFC antenna area may be limited to 7 cm \* 2.5 cm. Consequently, the result is in fitting an antenna into a volume where the maximum linear dimension is about 0.5% or less of a wavelength. And from antenna theory, we know that you won't get any radiation out of such a small device.

To sum up the discussion so far: NFC antennas operate at low frequency (large wavelengths) on small devices. A consequence of this is that the radiation efficiency of an NFC antenna will be about 0.

Therefore, NFC antennas are not really antennas, in that no one cares about typical antenna parameters, such as the radiation pattern or the antenna gain. So, in what way they work?

You may recall from your electric circuits classes that inductors can be made to couple together - that is, there exists mutual coupling. If the magnetic fields from one inductor pass near another inductor, an induced current will exist within the second inductor. This is contactless energy transfer - exactly what NFC requires.

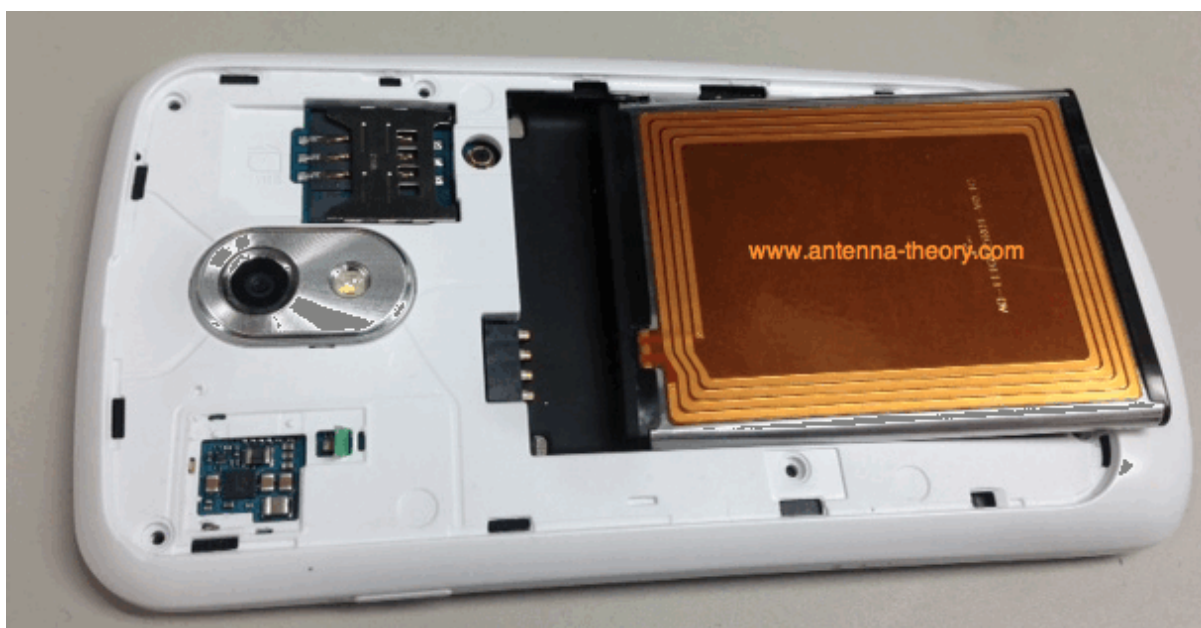
Thus, an NFC antenna isn't an antenna at all - it is really just a big inductor. In general, the larger the inductance of the antenna can be made, the better it will perform. Note that this doesn't mean you can place a very small chip inductor as your NFC antenna - the magnetic fields on these inductors are tightly wound and don't extend much beyond the chips themselves. Rather, a good NFC antenna is as large of a wrapped coil of wire as possible. Recall that a loop of wire around a material gives a strong magnetic field within the loop (and generally the more turns you have the more inductance you create). Hence, NFC antennas are often simply loops of wire, occupying as much surface area as the device allows.



**Fig. 1. Circuit diagram for NFC Loop antenna interacting between receiver and smartphone.**

In fig. 1, the NFC reader excites current at 13.56 MHz through the reader NFC antenna (which is really an inductor). This induces a magnetic field, which further (via mutual coupling) induces an electric current in the smartphone's NFC antenna when they are closely placed. This induced electric current can be read, and we have communication. This is exactly what is happening when it comes to NFC communication in practice, with the focus on the antennas.

One final note related to NFC antenna design. We've already stated that the larger the surface area, the better performing your NFC antenna will be. We haven't mentioned anything about volume. Can the NFC antenna be infinitely thin? The answer is yes - if there is no metal or conductive material around the NFC antenna. However, the NFC antenna illustrated in fig.2 is on the back of a smartphone, which is metallic.



***Fig. 2. Loop NFC antenna on cellphone battery.***

If you know much about electromagnetics, you will know that a ground plane directly beneath magnetic or electric fields will very much degrade them. Consequently, performance degrades for the NFC inductor style antenna when placed near a metallic surface. As a result, for the performance the height of the NFC loop will need to be maximized. If the space is near zero, the performance will suffer.

One small trick to get around this is to use high permeability sheets of ferrite or iron based materials between the NFC antenna and the metallic ground plane. This serves to concentrate the magnetic fields, effectively making them to behave as the distance is larger between the NFC antenna and the ground plane. This helps to alleviate the height problem, but does not eliminate it.

### **Bibliography**

1. NFCAntennas [web-page]. <http://www.antenna-theory.com/definitions/nfc-antenna.php>

## PROBLEMS OF EDUCATION IN THE FIELD OF CULTURE AND ARTS

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The concept of the system of education is aimed at modernization of the current situation in the this field. But is this upgrade going to benefit the younger generation of students? And how perfect the current situation is, and what drawbacks can overshadow the overall picture of the current situation?

The current system of education has been criticized by people of creative professions. Its position is so that changes that have been made through reforms led to ambiguous consequences, which are now reaping the younger generation of students. Since there is always the one who makes changes and who is reaping them. It is noticeable that in this article we will talk about the components of the problem only on behalf of the students to make the reasoning honest in relation to these changes.

Education is a part of life which has a wide range impact on its pace and quality. The relevance of education in the sphere of culture is rightfully one of the most important in General educational space. And the fact that the quality of the process of obtaining a certain amount of knowledge to date is based on shaky ground is undeniable.

Current trends are so that the contact between teachers and pupils/ students goes to the maximum possible low, limited to the provision of the tasks facing the student.

Despite this, the profession of a teacher remains a priority, since it is a necessary intermediary between the source of knowledge (books, scientific articles and other types of media) and a student. The role of the teacher is, as many would say today, in the explanation of information and its submission the student/disciple. Though, by calling a teacher a mediator, we set aside some important aspects of this profession. For example, they not only deliver information but also control the process of obtaining this information. This is one of the important tasks of a teacher to control and organize the quality of knowledge given to a student. Add to this the fact that a teacher sets a pattern of behavior for the student as the bearer of the future of the profession during practical and lecture sessions, which is also important and impossible in the absence of the contact with a teacher. In other words, the process of pedagogical communication transforms into a dialogic collaboration. Simply saying, by replacing the live communication, students may lose up to 30% of what they might get.

Without doubt, the question arises to student's independent work. As the matter of fact the chief task of educational process is training of cultural thinking. Just at that spot one can notice the importance of independent work exceeds the limits of a course of studies and becomes the foundation of working skills formation in future. Acquisition of such skills at the stage of an educational institution at the least favors more intensive work, facile adaptation to dynamic labor market changing, and ability to react to alterations that emerge from outside.

The time of studying in institutions is shortened due to reduction of some disciplines. It is one more aspect that one can fairly consider as a problem. Unfortunately, we do not know whether lack of some disciplines is connected with obtaining two-tier educational system, however, due to exclusion of some disciplines (or mixing them with others, for example, modeling and designing), the current system of education educational fails.

To compare we had a contact with a student of Nihon University in Japan. The curriculum in Japan differs from that one in Russia, but on the example of Japanese university

we can see what kind of advantages a student, who has the chance to take whole class of modeling, can get.

The biggest advantage is that by giving enough time for modeling a student learns to think thoroughly, work with hands, develop skills of making models, and ability to transform these models according to the original idea. As a result, students who do modeling as a separate course gain more creative imagination. On the contrary, students who faced shortened curriculum and studied fewer materials achieve results much later.

Next distinguishing feature of «japanese» modeling is in materials and representing the form and construction, which also enlarges the frames of imagination.

Another calamity issue of education is considered to be its cost. A great number of students dispute about high costs of education. That is why we decided to treat this question to understand whether the cost of education is a calamity issue nowadays.

According to the website <http://krasnoyarsk.ucheba.ru/> the cost of education at art specialties is currently not the last in the line. Thus, for example, a bachelor's degree in architecture or design or architectural design costs 118.910 rubles per year. Within the limits of the city Krasnoyarsk such a price is one of the highest, assuming the fact that the cost has a tendency to rise regularly.

So, «The youth is a direct marker of sociocultural changings and the transformation of mentality of the whole Russian ethnogeny», said Konstantin Yancen, a candidate of psychological science in his dissertation devoted to the mentality the Russian society and, in particular, the present generation of students. As far as mentality is mainly education and experience, we can agree with the author's quotation and state that the generation of young students and future specialists quickly responds to all educational system changes. This very generation absorbs everything that the state can give them and immediately reacts. That is why the accessibility of education and quality of information supplying should become an important mission of education in the field of culture and art.

### References

1. Electronic Journal of education "Accreditation in Education" [http://www.akvobr.ru/reformy obrazovania v sfere kultury i iskusstva.html](http://www.akvobr.ru/reformy_obrazovania_v_sfere_kultury_i_iskusstva.html)
2. The article entitled "Organization of independent work of students" [http://teoria-practica.ru/rus/files/arhiv\\_zhurnala/2012/8/pedagogika/sukhanov.pdf](http://teoria-practica.ru/rus/files/arhiv_zhurnala/2012/8/pedagogika/sukhanov.pdf)
3. Information portal about education: <https://www.youtube.com/user/IizumiChyanChannel>
4. Information portal about education: <http://www.ucheba.ru/>



## CONCENTRATION AND RATIONING OF RADON IN THE DRINKING WATER

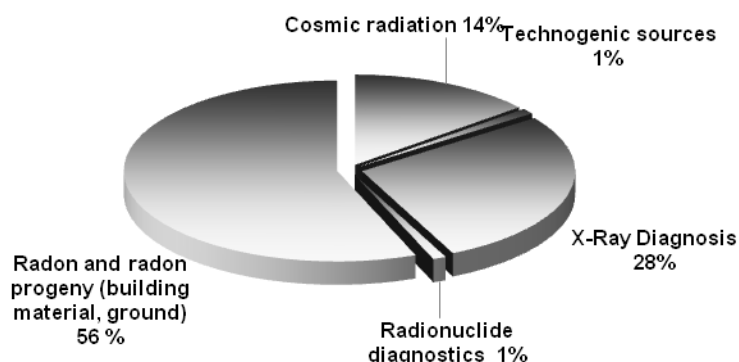
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Natural ionizing radiation is about 2/3 of the whole radiation dose that human gets exposed during his life. The half of this exposure are daughter products of isotopes of radon, which can be found in indoor air and water.

Radon is a natural radioactive gas that has no taste, smell or colour. Radon-222 heavier than air 7.5 times and it is one of the heaviest elements in the zero groups of inert gases. There are three isotopes of radon—actinon, toron and radon. All isotopes of Radon-222 are  $\alpha$ -emitters and the half-life of radon is almost 3.8 days. The products of radon decay are also radioactive elements: alpha-, beta- and gamma-radiation.



**Figure 1 – The relative impact of different components of natural background radiation to the population.**

An increase of the number of terminal cancer cases is the one of the main effects of radiation on humans. According to the United States Public Health Service, there were 20000 cases of terminal lung cancer caused by radon among the US population. They also estimate that the damage caused by the radon radiation is “..10 times more than by outdoor air pollution” [4].

The research conducted by the Eastern European countries illustrates that depending on the dose of the radiation caused by radon exposure of the population (average effective dose) over 70 years varies from 0.2 to 1.5 Sv (20-150 Ber), i.e. the level of exposure of the population of the radon dangerous areas (0.07 Sv) is ten times higher than normal level. Radiation Standards do not define an effective dose of radiation by the natural sources. The reduction of the level of exposure is defined by limiting the radiation level of each sources separately. [1]

The danger of high concentration of radon in the water is due to, firstly, the risk of exposure by drinking water, secondly, the use of this water with high concentration of radon for the household purposes. Radon's main part passes to the air that can cause serious hazards indoors.

According to the NRB, for the drinkable water there has to be done a quality check based on the radiation safety indices. In the cases when the acceptable level is exceeded the radionuclide analysis is conducted. The critical way of exposure by radon from drinking water



is a transition of radon to the indoor air and further inhalation of the daughters of radon. accordance with NRB, the radon level of intervention to the drinking water is 60 Bq/kg, and defining the massic activity of radon of the drinking water from underground sources is compulsory. For the comparison, there are allowed concentration of radon in the water for different cities, which are measured in the wide range. [1] The collected data is illustrated in the Table:

Table 1 - Maximum allowable concentration of radon in water for public watersupplies Country [3].

Country	Concentration of radon, Bq/l
Finland	300
Sweden	100
Czech Republic	50
Ireland	100
Russia	60

There are some areas with low, heightened a high concentration of radon in the water in Russia. For example, in the particular areas of Leningrad Region the concentration of the radon in the water is 550-1700 Bq/l, in Karelia – more than 550 Bq/l, in Caucasus – 109-1480 Bq/l, in Transbaikal - 1480-7400 Bq/l. The regions of West Siberia, such as Belokurikha and Novosibirsk, are also potentially dangerous [2].

The radon level in the drinking water and its acceptable concentration significantly vary for the different countries and depend on many factors. As an example, in centralized water supply systems the concentration of the radon tends to be lower than in private water supplies. As a whole, the researchers from Russia point that there are some level of radon in the tap water; however, this topic has not been studied well enough. The studies in this area are conducted as requirements for water quality control and only point at the fact of existence or not existence of some level of radon in the water source. There are, practically, no studies of the reasons and sources of the radon in the centralized water supply systems in Russia [5].

The wide range of standards for the concentration of radon in the water demonstrates the necessity of the further studies of this problem. It is worth noting that the analysis of the radon concentration is not systematic in Russia, but has been conducted within the ecological safety. Based on a small amount of data, which have no connection to the particular experimental conditions, we can only acquire crude data.

### References

1. НРБ – 99/2009 Нормы радиационной безопасности: Гигиенические нормативы. – М.: Центр санитар.-эпидемиолог. нормирования, гигиен. сертификации и экспертизы Минздрава России, 2009
2. Воронов А.Н. Радон в подземных водах: экологические аспекты / Воронов А.Н. // Экологические проблемы гидрогеологии: Восьмые Толстихинские чтения. – СПб., 1999. – С. 148-151.
3. Voronov: 2004, AUSTRALIAN DRINKING, New Jersey Drinking, Radon Legislation, НРБ 99, The Unfamiliar Killer, New Zealand, Radon presence and remedial measures in Europe and the USA, [www.hc-sc.gc.ca](http://www.hc-sc.gc.ca)
4. Региональная целевая программа "Радон" на 1996 - 2000 гг., 30 сентября 1996 года N 601-П
5. Synnott, Fenton, An Evaluation of Radon Reference Levels and Radon Measurement Techniques and Protocols in European Countries, 2005