



4

Possible Uniform Approach to the Theory of Catalytic Processes

4.1 Short Review of Chemical Catalysis

It is an awful thing to write text-books On the Chemical Catalysis because everything is going topsy-turvy every year.

J. J. Berzelius.

Let's consider for the sake of simplicity only two types of chemical reactions: decomposition and synthesis, when a complex molecule decomposes under certain conditions into two or more component atoms or molecules, or two atoms or molecules combine with each other and create a new chemical compound. To create a new molecule two different particles should joint each other, but the most complicated role here belongs to interaction potential, which is today unknown even for the simplest chemical reactions. According to Arrhenius' theory (today accepted by everybody), only those collisions are chemically effective, when the participating molecules have an excess of the energy over the average value. The difference between the minimal energy of a molecule, necessary for the reaction and reaction resultant from the bump, is called activation energy E_a . It depends on the temperature of the system. When the number of active molecules N_a is only a small share of the total number of molecules N , their number can be expressed through the Boltzmann-Gibbs activation energy as follows:

$$N_a = N \exp\left(-\frac{E_a}{RT}\right) \quad (4.1.1)$$

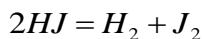
It is known that a temperature increase usually considerably speed up the reaction rate. Van't Hoff discovered that the reaction rate increases by 2-4 times,

when the temperature raises by 10 degrees, and if the temperature raises by 100 degrees, the reaction speed grows approximately by 1000 times. If the temperature raises by 10 degrees, and it is assumed that the activation energy remains constant (which is possible under small temperature intervals), the temperature effect on the number of active molecules can be estimated. Let us assume that the activation energy for a certain reaction under $300^0 K$ is 24000 cal. In this case:

$$\frac{N_a}{N} = \exp\left(-\frac{24000}{2 \cdot 300}\right) \approx 4.1 \cdot 10^{-18}$$

and such a reaction with 4 active molecules at 10^{18} will certainly be very slow. Under $T = 310^0 K$ the same exponent will equal $16 \cdot 10^{-18}$, i.e. the number of active molecules will quadruple. There will be 16 of them per each 10^{18} molecule. The average molecular energy reserve will increase only by 3-4%.

It should not be assumed that everything is so nice and the reaction speed increase is due only to the higher number of collisions between molecules and to the increased number of active molecules. For example, the increase in the number of gas molecule collisions under the growing temperature T will be proportionate to \sqrt{T} . But the change of speed in a homogeneous reaction



cannot always be accounted for only by the Van't Hoff rule. If we calculate the number of molecular collisions HJ using the molecular-kinetic theory equations in 1 cubic cm per second at the pressure of 1 atm., it will be of the order of 10^{28} , and the speed of this reaction with a 100% efficiency of each bump must be gigantic, and everything should be over in 10^{-10} seconds, which never

happens in reality.

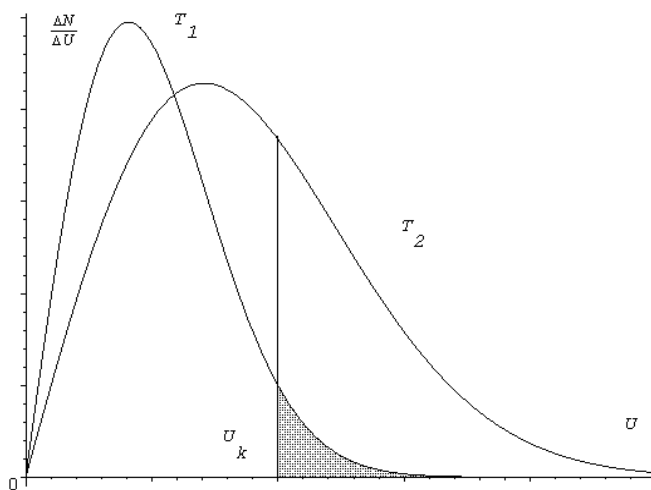


Fig. 4.1.1 Distribution of molecules by kinetic energy ($T_1 < T_2$).

This happens, because not every bump ends with interaction. Thus, a molecular bump for biomolecular reactions is a necessary condition, but not a sufficient one.

By Arrhenius, the constant k of the reaction speed can be expressed by the following equation:

$$k = A \exp\left(-\frac{E_a}{RT}\right)$$

where A is the pre-exponential multiplier, constant for this case. In accordance with Maxwell-Boltzmann ideas, Fig. 4.1.1 contains a sketch of two curves of gas molecule distribution by kinetic energies under two different temperatures $T_1 < T_2$. Along the axis of ordinates the ratio between the number of gas molecules ΔN , the energy of which is between U and $U + \Delta U$, to the energy value interval ΔU , is shown, and along the abscissa axis the energy U . Only such

molecules are capable to enter into the reaction, whose kinetic energy is not less than a certain value U_k , meeting the activation energy. The number of hot molecules able to enter into reaction under T_1 is graphically shown by the crosshatched region. It is evident that this number is greatly increased if $T_2 > T_1$, which happens in accordance with equation (4.1.1), and the average kinetic energy grows much slower, because it is simply proportionate to the absolute temperature. The source of molecular activation may lie not only in heat, but also in radiant or electric energy, the energy of radioactive particles, and... a catalyst. For a reversible reaction, the heat effect equals the difference between the activation energies of the direct and reverse reactions.

Not all chemical processes happen spontaneously. There are reactions that go only in one direction with full consumption of the initial substances (explosive processes). Such reactions, as a rule, cannot spontaneously go in the reverse direction.

The situation is much more interesting with reversible reactions. If we mix, for example, hydrogen and iodine warmed up to $800^0 K$, they will react with forming of hydroiodine. If HJ is not removed from the reaction space, the iodine and hydrogen will never be totally consumed. Under these conditions, the state of dynamic chemical equilibrium will be achieved, which could otherwise be achieved by warming HJ to $800^0 K$, because we are dealing with a reversible reaction (only under these conditions).

Real equilibrium is characterized by the fact that it can be approached from two sides. In a state of equilibrium the concentrations of all the substances in the system remain unchanged under these conditions, since the speed of the direct and reverse reactions is the same.

Real equilibrium in case of a thermodynamically reversible process is shifted under very slight changes in the external conditions, strictly following these changes. It is believed that any transfer to a less stable state is always connected with some work expense from outside. The farther the system is from the balanced state, the more capable it is principally of entering into reactions. But this capability does not always reveal itself under the said conditions. For example, a mixture of H_2 and O_2 is very reactive, but at room temperature their concentrations in mixture do not change. There are a lot of such examples. These systems are in a state of an unstable false equilibrium, and changes are not observed in them simply because the process speeds are infinitely small. There are lots and lots of such false equilibrium systems, and we can even say that we are living in a world of false equilibriums. However, if the process is accelerated by heating or by a catalyst, the false equilibrium will be broken and a reaction will take place. In other words, false equilibrium is almost always caused by kinetic problems (difficulty) during a reaction.

According to the Sadi Carnot theorem, the efficiency equals

$$\eta = \frac{A}{Q} = \frac{T_2 - T_1}{T_2}$$

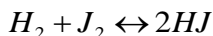
where T_2 and T_1 are the temperatures of the heater and the cooler. Be it quickly or slowly (equilibrium thermodynamics does not deal with this at all), every chemical reaction goes in such a way as to tend to a state of real equilibrium. If the reaction takes place in a system under constant pressure and temperature, the change of enthalpy ΔH (heat content) can be presented as a sum of two terms: the change of the Gibbs free energy ΔG and the change of the bound energy ΔL :

$$\Delta H = \Delta G + \Delta L.$$

The Gibbs free energy G is sometimes called the isobaric-isothermal potential and it is not the free energy under constant volume and temperature, which in theoretical thermodynamics is usually denoted by the letter F . The bound energy ΔL is expressed by the product of absolute temperature T multiplied by the change of the state function (change of entropy) ΔS . In this case:

$$\Delta G = \Delta H - T\Delta S \quad (4.1.2)$$

Fig. 4.1.2 shows the dependence of the free energy on the relative content of HJ in the mixture ($H_2 + J_2$). If, for instance, in the system



being in a state of equilibrium free energy has the value designated by the ordinate at point C (Fig. 4.1.2), any deviation of the composition of the mixture of initial and end substances from the equilibrium to the right or to the left from point C requires certain work, so the free energy must increase both with an increase in the partial pressure of HJ and with an increase of partial pressures (concentrations) of H_2 and J_2 . It follows that under the chemical equilibrium a gas system of H_2 , J_2 and HJ has the minimum value G_{min} . On the way from the mixture of H_2 and J_2 (point A) to the equilibrium mixture composition, loss of free energy must be observed - $\Delta G < 0$. The same $\Delta G < 0$ on the way of the mixture composition change from B to C. With equilibrium mixture composition at point C

$$\Delta G = 0$$

the condition of chemical equilibrium is $\Delta G = 0$, and the criterion of reactivity is the requirement $\Delta G < 0$ under constant pressure and temperature. In other words, the reaction is possible, if G decreases, and once it begins, it will go on spontaneously. The moving force of the whole process is the value of ΔG . Loss

of this free energy in a reaction going on under a constant pressure and temperature does not depend on the route of the process and equals the maximum reaction work, i.e. $-\Delta G = A$.

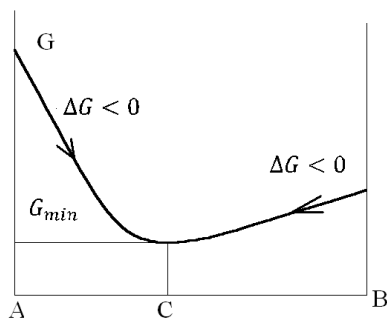
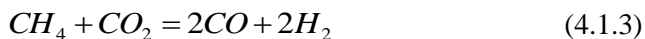


Fig. 4.1.2 The influence ΔG on running processes.

Of course, if for a certain process $\Delta G > 0$, then, from the point of view of the existing science, there is no point in trying to hold it under the said conditions. Let us note that earlier the criterion of chemical affinity was considered to be the value of the positive heat effect Q . Under low temperatures this is almost true, because the product $T\Delta S$ in equation (4.1.2) becomes very small and ΔG nearly coincides with ΔH . Much later it was discovered that there were many reactions with heat absorption, which usually go on under very high temperatures. If $T\Delta S > 0$, the second term of equation (4.1.2) can be more than ΔH , and then ΔG will have a negative value, which makes such reactions possible. Here is an example. Reaction



Which under normal conditions goes on from right to left, can, nevertheless, go on from left to right. For it $\Delta H_{1000} = 62 \text{ kcal}$, $\Delta G_{1000} = -26.1 \text{ kcal}$, i.e. below zero. The Unitary Quantum Theory gives us hope that for reactions of the left-right type the effect of high temperature may be replaced by a relevant catalyst.

Equilibrium chemical thermodynamics only establishes a principal possibility of a reaction and solves the problem of achieving the equilibrium, but it does not answer the question of how quickly this equilibrium can be achieved, because the time is absolutely absent from this theory. In no case it can be assumed that the lower the negative value of ΔG , the quicker the process, because kinetic problems may appear on the way.

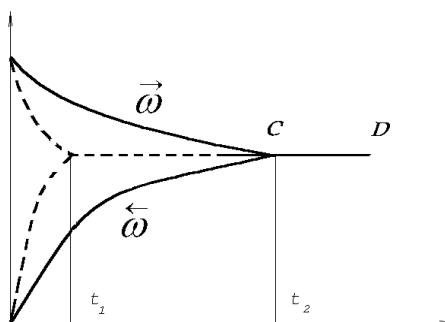
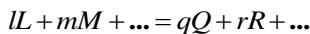


Fig. 4.1.3 Establishment of chemical equilibrium. Along axis x -time, along axis y - reaction speed. Firm line – without catalyst, dotted line – with catalyst. CD – chemical equilibrium line; $t_1 \ll t_2$.

The questions of chemical reaction speed, the effect of different factors on speed, and the reaction mechanism are the subjects of chemical kinetics. Using different methods: changes of temperature, pressure, concentration, introduction of catalysts, light irradiation, it studies the speeds of achieving equilibrium. If the definition of the “energy capacity” of ΔH and the “work capacity” of ΔG in the process requires only the knowledge of enthalpy and the free energy of the formation of the initial and the end substances under given conditions, the process speed depends not only on what substances there are in the right and left parts of the equation; it also always depends on intermediary products and, mainly, on catalytic processes.

Chemical reaction speed $\vec{\omega}$ in straight direction:



where l molecules of substance L react with m molecules of substance M , etc., is expressed by the following equation:

$$\vec{\omega} = \vec{k} C_L^l C_M^m \dots \quad (4.1.4)$$

where C_L, C_M are the concentrations of the substances L and M , i.e. the number of molecules in a volume unit or a proportionate value, and \vec{k} is the reaction speed constant. The reaction speed in the reverse direction is totally similar:

$$\overleftarrow{\omega} = \overleftarrow{k} C_Q^q C_R^r$$

At the equilibrium $\vec{\omega} = \overleftarrow{\omega}$, and, consequently,

$$\frac{C_Q^q C_R^r \dots}{C_L^l C_M^m \dots} = \frac{\overleftarrow{k}}{\vec{k}} = K$$

This is the equation of the active mass law for chemical equilibrium in ideal systems, and K is the equilibrium constant.

The active mass law is intuitively clear: for a reaction to happen the molecules of the initial substances should bump, i.e. the molecules should as a result of chaotic heat movement approach each other to a distance of the atomic dimension order. The probability of finding in a certain small volume at a given moment of time l molecules of substance L , m molecules of substance M , etc. will be proportionate to the probability of compound event $C_L^l C_M^m$. Hence, the number of bumps within a unit of time in a unit of volume is proportionate to this value,

which leads to equation (4.1.4).

This law can have a different interpretation: the reaction speed is proportionate to the derivative of the concentration of the reacting substances in time.

It is clear that the observed speed of a reversible reaction will be as follows:

$$\omega = \overset{\rightarrow}{\omega} - \overset{\leftarrow}{\omega}$$

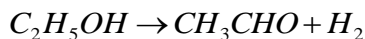
But the seeming simplicity of chemical kinetics is broken by catalytic processes. The speed of catalytic reactions is changed by other substances (catalysts) introduced into the system, the composition and quantity of such catalysts remaining unchanged by the end of the reaction. However, catalysts take part in the process. In biochemical processes a huge role belongs to organic catalysts – ferments (enzymes). In case of homogeneous catalysis, the catalyst is in the same phase with the reacting substances. In case of heterogeneous catalysis, reactions go on the surface of the catalyst, which forms an independent phase.

Today it is believed that all catalytic reactions from the thermodynamic point of view are spontaneous processes, i.e. they are accompanied by reduction of free energy, and the catalysts do not shift the state of chemical equilibrium, but accelerate its achievement. One and the same catalyst accelerates, as a rule, both the direct and the reverse reactions. All catalysts have a selective effect, accelerating not any reaction at all, but one that is thermodynamically possible. Dehydration of ethyl alcohol on different catalysts is a vivid example:

Under 350 degrees C on Al_2O_3 reaction is



Under 350 degrees C on Cu reaction is



On other catalysts and under different temperatures butadiene $CH_2CHCHCH_2$, butyl alcohol C_4H_9OH , diethyl ether $(C_2H_5)_2O$, and other substances are received from ethyl alcohol. It is clear that the type of ethyl-alcohol dehydration is defined exclusively by the catalytic substance.

Acceleration of reaction in homogeneous catalysis is a more or less understandable process and is explained by formation of intermediary compounds (sometimes of a whole chain of them). If a reaction $A+B=AB$ requires a greater activation energy E_a and goes on slowly, introduction of catalyst C allows for holding the process in two stages through an intermediary compound, which process will require smaller activation energies and go on at a much quicker pace, e.g.



The catalyst C remains unchanged in quantity. D. Mendeleev thought, however, that even in homogeneous catalysis another mechanism may exist: the catalyst may sometimes simply reduce the value of E_a in the reacting molecules.

But if the processes in homogeneous catalysis seem fairly clear, in heterogeneous catalysis, which is much more selective than homogeneous and is very widely used, all is in the dark, and the number of heterogeneous catalysis theories is probably only slightly less than the number of heterogeneous catalytic processes themselves. This statement is in no way original. It is enough to read an article by G. Bond [144] with a characteristic title: «Catalysis: Art or Science?». Of course, it is only the opinion of a single researcher, but... here below are the words [145] of the well-known German specialist in chemical catalysis A. Mittasch:

«When a question was raised of the practical use of the ammonia direct synthesis process discovered by F. Haber, K. Bosch, to whom the matter was entrusted, set a task before his team – to replace expensive and rare substances like platinum, osmium and uranium, with more affordable ones, or to improve the known but rarely used catalysts in such a way that they could be used in the industry...We paid principal attention to mixtures of iron with other metals, but in laboratory experiments we, besides iron, mixed every element A from the periodic table with any element B as such, or in the form of compounds with different ratios and by different methods (!!!-authors) [145] ».

A. Mittasch and all his multiple employees from the Baden plants of IG Farbenindustrie solved the problem: the required catalyst was found. They also received patents for hundreds of other catalysts discovered while solving this problem.

Modern chemists can say that the method of primitive and nearly meaningless sorting out remains the main one in the search of the necessary catalyst. Thus, the results of practical work have advanced greatly, but no general catalysis theory has been created for a very long period of the existence of catalytic processes and reactions.

The chemists first faced the catalysis phenomena in 1800's, and today they have a right to expect an understanding of the essence of them. However it did not happen and very serious reasons appeared for being discontent with those theories and hypotheses, which reflected only separate, and not always principal, aspects of the phenomenon. The theories satisfied only their authors, but were not understandable and acceptable for others, and, most importantly, were totally useless as a help to experts in the selection of this or that catalyst.

Let us shortly list the main research results received in heterogeneous catalysis experiments.

1. All solid bodies with all kinds of chemical compositions possess a certain surface activity and can be conducive to initiating and accelerating chemical reactions. But the surface activity of some bodies is so small that these bodies are practically unfit for catalyzing reactions that need even minimum activation energy. The surface activity of some other bodies is sufficient, and they can be widely used as catalysts for a big number of reactions. Such was the conclusion made, for example, by D. Mendeleyev [146], although there are many other researchers who came to the same conclusion independently.
2. Since the catalytic activity, in particular, the orienting actions of catalysts, mainly depends on the chemical composition, the latter is the key factor defining the catalytic qualities of solid bodies. This conclusion was made by D. Mendeleyev, I. Langmuir, A. Mittasch, G. Konovalov and many others.
3. Together with the chemical composition, the physical state of a body is another factor defining the catalytic qualities of solid bodies, first of all, the excess saturation of the body's surface due to an excess of free energy. Such are the conclusions of D. Mendeleyev, G. Konovalov and P. Roginsky, and others.
4. Out of more concrete physical reasons defining the qualities of solid catalysts, porosity and crystallographic state were identified. Nearly all researches came to this conclusion.
5. The catalytic surface of solid bodies represents, as a rule, a largely heterogeneous surface, i.e. the sum of sections differing in their adsorption

and catalytic qualities. The best results are produced by catalytic surfaces of the “spongy” type. It is interesting to note that it was observed by M. Faraday, who devoted much of his time to catalytic processes.

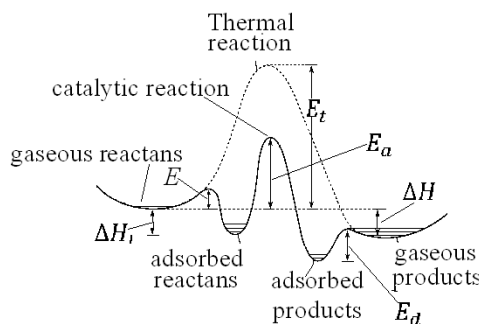


Figure 4.1.4 Energy profiles for catalytic and thermal (noncatalytic) reactions in the gaseous phase. E_a is activation energy for catalytic reaction; E_t is activation energy for thermal reaction; E is activation energy of absorption of gaseous reactants; E_d is activation energy of desorption of gaseous products; ΔH_1 is heat of chemisorption of reactants; ΔH is heat of overall reaction. (Encyclopedia Britannica).

Moreover, D. Mendeleev defines the essence of catalysis through such a form of chemical interaction between catalysts and reagents as provides for continuous chemical interaction and excludes stoichiometric relationships.

Despite the electronic-microscopic research, it is still unclear what serve as active centers of heterogeneous catalysis on a “spongy” surface. The questions of whether they are peaks or wells have long been debated. Are they angles, ribs, or planes? No experimental answers have been found so far.

The accelerating action of a catalyst can be formally explained by the S. Arrhenius equation, if we assume that the molecule activation energy E_a in catalytic reactions is normally less than in non-catalytic ones. It is proved to be true. For example, in case of non-catalytic decomposition of ammonia NH_3 , the value E_a is about 80 kcal/mole, and in case of catalytic decomposition

$E_a \sim 40$ kcal/mole, i.e. twice less! Due to reduction of E_a , acceleration of catalytic reactions is achieved as compared with non-catalytic reactions.

At first this conclusion was made by S. Arrhenius himself, but he did not suggest any concrete ideas concerning the mechanism of reducing E_a . D. Mendeleyev went further and compared the effect of a catalyst with heat energy! Understanding that there was no source for heat energy, he, nevertheless, reduced the value of E_a with the help of molecule deformation. Today it is absolutely clear that such deformation still needs energy, and it would be naïve to think that D. Mendeleyev did not understand it.

Of course, it could only be a local energy directed specifically to reducing the value of a certain connection, and not heat energy distributed uniformly over the interaction volume, but even such energy in today's science has nowhere to appear from. This is illustrated by Fig. 4.1.14. From this figure it is clear that the reacting particles and particles appearing after the reaction are sort of divided by a potential barrier with the height E_t . An analogy with the tunnel effect suggests itself, but it is very superficial, because the usual quantum tunnel effects do not exist here, and these phenomena are similar only in results.

A natural question arises. If the reaction goes on from left to right, can there be a catalyst that would conduct the reaction from right to left without consumption of energy ΔH ? Both states are divided by a high barrier, and there are lots of reactions, which do not go from left to right without a catalyst at all. The unitary quantum theory gives hope for realization of such phenomena, although within the existing science it is impossible without consumption of energy ΔH .

Next we will give a short statement of the main ideas of Mendeleyev [146]

concerning chemical catalysis.

Chemical interaction of two reagents always takes place when they touch each other, i.e. in contact. The reason of chemical modification E_a of two different substances lies in the emergence of conditions changing the movement peculiar to masses of solitary homogeneous bodies. In a heterogeneous system, at the meeting place of two bodies, in the touching point... real perturbations and deviations of movement will take place, of a different type as compared with a free surface. The difference of movement on the surface is defined by the influence of particles and atoms of one type with the surface ones, and in case of a meeting between two bodies, changes on their surfaces will be defined by the influence of their own and alien atoms and particles.

In a homogeneous system, when “a chemical phenomenon takes place in a homogeneous gas mixture, or in a solution of two bodies, it cannot be regarded as alien to the change taking place on the contact surface, because a particle surrounded by other particles, different from it, must more or less change its state as compared to the one it has when surrounded by similar particles”.

Thus, according to D. Mendeleev [146], a contact of two different substances A and B facilitates modification of their valence state and may lead to redistribution of their “component elements”, i.e. the composition and structure, or otherwise, may cause chemical interaction between them. In this sense, a contact is similar to the effect of temperature; “internal movement changes brought about by a contact with an alien body can quantitatively and qualitatively correspond to such internal movement changes as may happen due to the said physical conditions, e.g. from temperature changes. This brings catalytic or contact phenomena closer to dissociation ones, although does not allow for intermixing thereof”.

It is clear from the above-cited statements that D. Mendeleyev was very brief on the concrete matters of the catalysis mechanism. In his ideas of “perturbations” and “deviations in movement” happening in contact some chemists (A. Balandin, multiple theories [147]) saw signs of an explanation of the catalysis mechanism through molecule deformation, others – through the chemical orientation of reactions. Since every complex molecule has a certain chemical state, any “perturbation” or “deviation in movement” (oscillations) of its atoms can be regarded as a modification of its form and as a more significant modification of its structure, up to a free radical formation.

Of course, there is much room for interpretation. D. Mendeleyev only put the question of the catalysis mechanism and slightly raised the curtain, but he did not solve the problem, and was not even going to do it. He finished his main article on catalysis [146] with only a hint of “finding a method for research, which must... lead to clarification not only of the position of contact reactions in connection with other types of chemical transformations, but of the very mechanism of chemical modifications”.

We have already noted that for molecule deformation in the existing science there is a need for energy, and the main stumbling block lies in the unclear character of the mechanism of reducing the value E_a , because without the Unitary Quantum Theory it is incomprehensible where such energy can come at all. It is this very circumstance that is the main reason of catalysis being so far an art, and not a science!

4.2 Biochemical Reactions with Participation of Enzymes and Their Interpretation Within Modern Science

*Even the brilliant brains were not able
To elucidate the darkness surrounding,
They have just told us few fairy tale
And went to sleep with us.*

Omar Khayyam.

Persian mathematician and poet.

Ferments or enzymes are catalysts for the reactions taking place in living matter, but at some aspects their functioning principally differs from homogeneous and heterogeneous catalysis. Ferments are highly active organic or metal-organic catalysts. Their activity is mostly the activity of total catalytic systems. The most important characteristics of ferments are: highly strong dependence of their reactivity on pH of the medium and relatively narrow temporal area they react. Besides they are characterized by the aggravation effect and extremely complicated “architectonics” of molecules.

The aggravation effect entailed the increase of catalyst reactivity with attaching particles of bigger molecular masses. It is considered that it probably may be caused by arising of “energy trap” helping in keeping the excess of energy, necessary for further passing over the activation barrier. The aggravation effect may also arise as a result of ferment and carrier interaction, i.e. with the basic mass of protein.

The dimensions of ferment molecule may be both noticeably bigger and

smaller than those of the substrate molecule. As a rule, if some connections within the substrate are broken (decomposition) due to special caverns or hollows in the ferment molecules where the substrate molecules get into.

For the time being most part of ferments have been educed in the form of pure crystal substances. It appeared that some of that crystal ferments are pure protein; such are the pepsin, one of proteolytic ferments that catalyses hydrolysis of peptide connection (—CO—NH—) in proteins, and the urease is catalyzing the hydrolysis of urea. Other ferments contain apart of protein prosthetic group important for their catalytic activity; very often prosthetic group is a flavin, like in different ferments able to catalyze oxidation-reduction reactions, or a hematin in the catalysis of peroxidases catalyzing some reactions with hydrogen peroxide. Some other ferments are active in presence of a cofactor besides the substrate. Like ferment, a cofactor takes part in reaction to be catalyzed by the ferment, but it is not destroyed and may have quite simple chemical structure like a non-organic ion, in that case it is called activator. In other case it may be a complicated organic molecule, known as coenzyme.

Apparently, cofactors react like prosthetic groups (or some of such groups) that can be easily separated from ferment. Even the difference between cofactors and prosthetic groups within the limits of ferment is very important from the point of view of biology; it may be quite strained if we speak about mechanism of catalysis. It is considered that ferment by itself or in presence of cofactor creates active zones or active centers where catalysis takes place. Probably each molecule of activated ferment contains only a few active centers (in fact, usually it is only one center) and each active center is polyfunctional. It means that some of its zones (parts) are able to hold substrate in such a position at what its other parts initiate changes of chemical bindings thus activating it for catalysis. The exact knowledge of ferment molecule configuration, including protein

conformation in folds or at molecules coiling as well as chemical structure near active center may become rather important. For example, ferment activity may be upset at heating or chemical reagents acting (acids, alkalines or concentrated salt solutions) able to transform protein conformation by means of denaturation. Besides that, the activity may be reduced in the result of inhibitors influence. The latter work generally in the process of interaction with active centers and are used to determine the number of separate active centers in single ferment molecule and for data about its chemical structure.

For the time being the idea of active center as one with algorithmic steric features gives the most logical explanation of one of the most important characteristics of ferment as catalysts, viz. their high specificity. Ferments are specified for certain types of reactions, for example, for hydrolyze of some bindings, or certain groups transfer, they may be even specified in definite substrates among huge quantity of others with the same bindings.

One of characteristic features of enzymatic catalysis is its extraordinary selectivity lying in the ability of each ferment to turn one definite reaction. Very often that situation is explained by the words “key-lock” (that idea was born in 1899 by German researcher Emil Fischer) it is shown in detail on Fig. 4.2.1. For the explanation of that phenomenon, a hypothesis of tension and deformations is used, based on the principle of structure distortion of parent material under the influence of catalyst active center and their approaching to the structure corresponding with reaction product. At this activation barrier is going down. However, all these obscure ideas and fine pictures are able to explain energy drop with the words: molecules loosening, deformation, conformational transformation of molecules in the form suitable for specific compounds formation and so on, but they do not say even a word where does energy come from, we mean energy necessary for breaking of any “specific” molecular bond. The existing science

stipulates that all these transformations require energy but it is nowhere to be taken from because laws of conservation tie the researchers' hands.

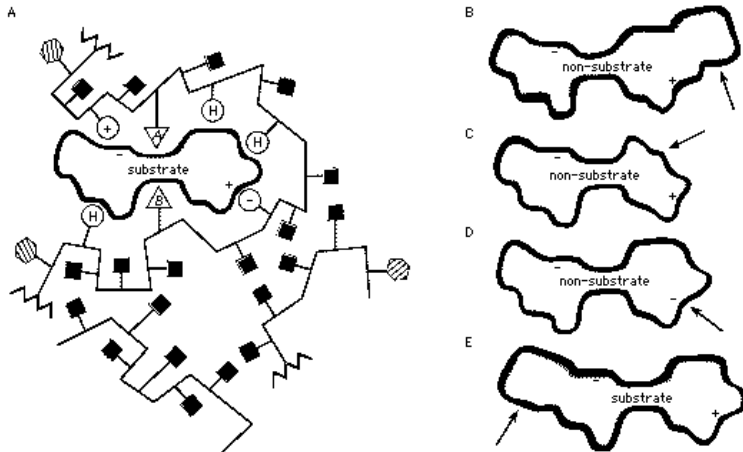


Fig. 4.2.1 System key-lock and its action.

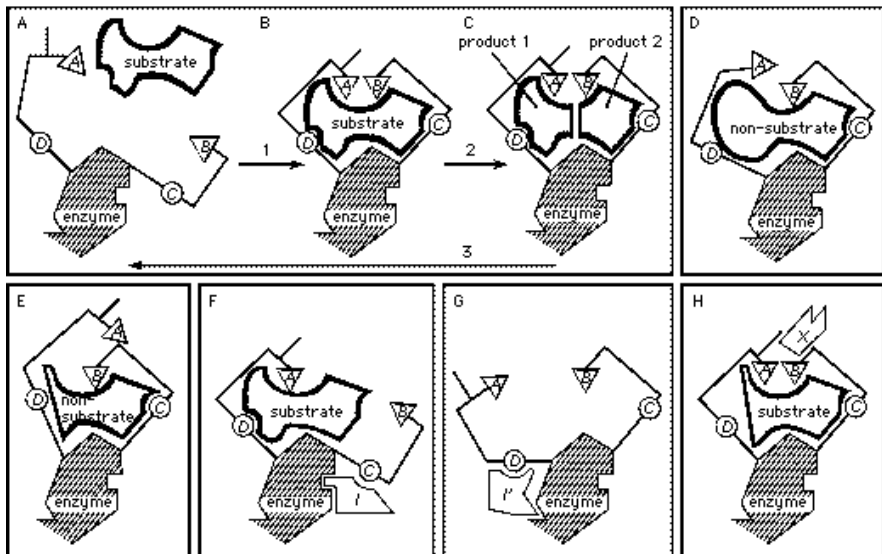


Fig. 4.2.2 System key-lock and allosteric processes.

To redeem the position and explain the energy deficiency a special term “energetic trap” was offered. That trap stores the energy and is able to return it in

an isolated interaction. But after becoming empty it should store energy again. But where does it take energy? Thermal fluctuations may become such source but till now S. Carnot theorem prevents it officially (Second law of thermodynamics). Within the limits of general science that question does not have answer yet.

But generally the single structure of active center is unable to provide the optimal correspondence both for substrates and reaction products. By its structure the active center is mostly close to reaction transient state.

Even if not in all but in most cases ferments catalyze reactions of one of the pair of optical enantiomorphous isomers only. Thus any detailed enzymatic reaction mechanisms should be able to give explanation for both chemical and stereochemical specificity. The troubles dealt with it are usually similar to those we have to run into at interpretation of the mechanism of Ziegler catalyst to be acting in the reaction of obtaining stereoregular polymers.

M. Dixon and E. Webb in their monograph [149] made review of these ferments' characteristics, according to them "*ferment is a protein with catalytic properties resulting from its ability to specific activation*".

The number of known ferments is great. In 1959 M. Dixon and E. Webb had counted more than 650 different ferments and evidently their number will increase with further study of various reactions proceeding within organisms of animals, plants, moulds, bacteria and viruses. For the time being their number reaches few thousands. In absence of more detailed information about individual ferments structure and mechanism of their activity all ferments have been divided into groups by types of reaction they were catalyzing. Ferments have a rather complicated name system; let us dwell on its details shortly. Some of ferments have conventional names, for example, pepsin, trypsin and renin; the others are called after the substrate in the reaction to be catalyzed, e.g. the urease or the

fumarase; there are more complicated names describing in detail the catalyzed reaction, for example, transglucosylase of maltose (catalysis of glucose group transfer from maltose to receptor molecule).

Hydrolyzable ferments form one big group that can be subdivided in accordance with the type of bond to be hydrolyzed. For example, peptidases catalyze the reaction of peptide bond hydrolyze — CO —NH —, glucosidases — glucoside bond within glucosides or polysaccharides, esterases — the ester bond in carboxylic, phosphoric and sulphuric esters and so on. The other big group contains ferments — groups' carriers - able to catalyze the transportation from substrate towards acceptor of definite chemical group like the hydrogen atom, phosphate, glucosile or acyl groups. Reactions with the hydrogen atom transfer as usual concern with the generation of energy in living matter. Ferments are called "oxidase" if such transfer proceeds towards the molecular oxygen or from it, and "dehydrase" if such transfer occurs towards other molecules or from them. Besides these two big groups there are a lot of smaller groups, for example, either for the ferments able to catalyze nonoxidizing decarboxylation, or adjoining to double bond and opposite decomposition, or changes of spatial configuration.

Although kinetic researches of definite type with numerous known ferments have been implemented an extremely small amount of them is known in details. Among them are [149] peptidases: pepsin, trypsin, chymotrypsin and carboxypeptidase; esterases: cholinesterase and adenosinetriphosphatase; urease; fumarase; lactate dehydrogenase; peroxidase and catalase.

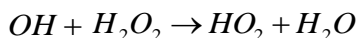
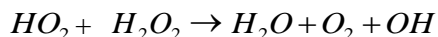
These researches have shown that ferments are extremely active catalysts in comparison with any other ones used for homogeneous non-chain reactions. Comparative research of enzymic processes has been carried out by different ways with the use of two useful criteria — the number of ferment's turnover and reaction constant. In most works, the natural value of the ferment's turnover

number is not used at all, as for the activity of enzyme with one and more active centers per one molecule, it is expressed through the molecular activity, i.e. the number of substrate molecules to be transformed within one minute under the influence of one active center. At any reasonable comparison it appears that ferments are much more active catalysts than, for example, hydrogen or hydroxyl ions as hydrolysis catalysts or metals' ions in oxidation-reduction catalysis. For example, urease is about 10^{14} times (!) more active than hydrogen ions (in convention of reacted molecules number at one ion) in urea hydrolyze, and catalyses is approximately 10^6 time more active than bivalent iron ion in decomposition of hydrogen peroxide.

This extremely high output reminds about photochemical chain reactions and therefore some researchers have assumed that enzymatic reactions are proceeding in accordance with the chain mechanism. From that point of view the high reaction rate can be explained by chains initiated by ferments, as well as the high speed of polymerization reactions that can be obtained in presence of oxidation-reduction or ion catalysts. Inhibitors may react by reducing chain centers, thus shortening chain's length. For example, F. Gaber and E. Wilshtetter [150] assumed that the catalyses was able to initiate the chain decomposition of hydrogen peroxide. The reaction initiation:



leads in chain growth:



Quite similar mechanisms were discovered for dehydrase and oxidase, mutase, glyoxalase and peroxidase catalysis. I. Woters [151] worked out chain

mechanisms for some ferments catalyzing oxidizing processes. But it is rather difficult to explain the specificity of ferments and coferments on the basis of chain mechanisms. The activity of catalysts or chain initiators mostly depends on reaction, corresponding to a long chain, i.e. to the large value of relation between the rate of chain increase and the rate of the breaking of the chain. If that takes place then nearly any substance able to decay with production of free radicals that can initiate chains at temperate rate will result in fast speed of chain reaction. The latter is equal to the product of the rate of initiation by the chain length. It is difficult to adjust that “non-specific” behavior of free-radical chain reactions catalysts with the strictly specific behavior of ferments.

Furthermore, till now no satisfactory proof of free radical presence in enzymatic reactions has been obtained; in fact it was demonstrated that free radicals (to be obtained in the result of radiation treatment) reduce the ferment’s activity. These facts convey that rather evident multi-stage mechanisms of homogeneous catalysis are hardly usable. Moreover some data [152] testifying against the presence of free radicals or free protons in some reactions of proton transfer because that transfer is made without exchange with dissolvent. Apparently, it is unlikely that ferments react in the form of chain initiation with free radicals or with free ion-radicals as chain carriers. On the other hand some of the abovementioned troubles will disappear if we assume that ferments participate at the stage of chain growth; that stage may be extremely specific. In reality all catalytic reactions going by intermediate complexes can be considered as chain reactions. The catalyst disappears at one stage of reaction with the substrate to appear later, as the chain carrier appears again at the stage of the chain growth.

In reality it seems that both substrate and ferment are transformed. Ferment-substrate reaction may be conditioned by hydrogen bonding, electrostatic coupling, and complex forming with charge transfer. The influence

of hydrogen bonding on the process of enzymatic reaction is typical for aqua solutions. If a pair acid-alkaline combined by hydrogen connection exist in the ferment active center, then due to the possibility of an easy proton transfer from one energetic minimum to another that system is able to be highly catalytically active. At the same time the so-called coupled catalysis takes place.

Most part of quantum-chemical models of ferments' activity is based on optimal correspondence of geometrical and energetic parameters of substrate and ferment to be obtained in the appearing intermediate complex.

Besides high rates and specific direction enzymatic reactions have other property principally different from other catalytic reactions. In the overwhelming majority of the cases there is not a purely biological catalyst but a self-controllable catalytic system or a cooperative catalysts system.

As for any natural system with numerous input and output data for enzymatic system internal regulation is typical along with return bond (connection) and the statistical nature of action. And here the significant role of secondary, tertiary and quaternary structures of enzymatic and substrate proteins must be taken into account. Within the process of their transformation the importance of entropy and nega-entropy (the negative entropy of Leon Brillouin) factors, those probably are able to change the process kinetics in principle. Here we are going to mention three aspect of that cooperative origin of enzymatic activity only.

The first deals with the phenomenon of enzymatic activity regulation or allosteric phenomenon, perfectly illustrated by Fig. 4.2.1. and 4.2.2.

The second concerns the ability of enzymatic reaction to process in series or simultaneously in many active centers of one or few ferments. In the case of series reactions cooperative nature of enzymatic system becomes appeared in the process

of charged particles transfer and in electron density move along molecule chains.

The third poorly studied factor is the appearance of negative entropy, apparently able even to upset the balance of chemical process in one or opposite directions as it is evident from equation (4.1.2).

The influence of cooperative phenomena is finely shown at Fig. 4.1.3.

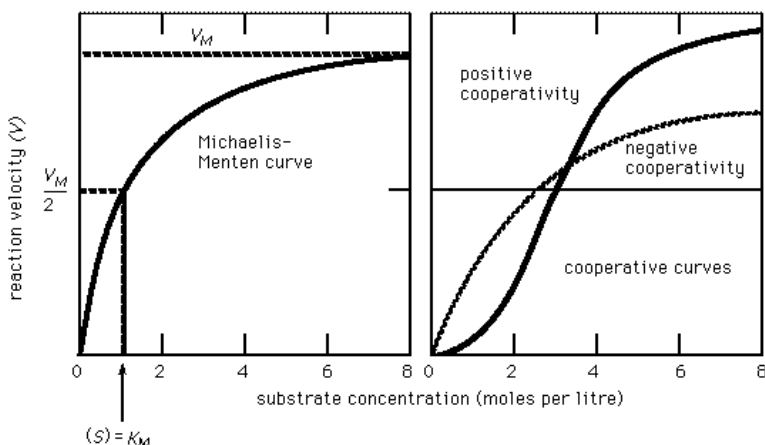


Fig. 4.2.3 Curves representing enzyme action.

Some peculiarities of reactions catalyzed by ferments are similar to those discovered for heterogeneous reactions, for example the type of kinetic equation and inhibitors' activity [150, 151]. V. Beylis suggested [152] mechanism of enzymatic catalysis based on substrate adsorption at ferment surface with further reaction of adsorbed bonding. For the time being there are a lot of similar proofs [150, 151] of the fact that there is a specific chemical reaction between the substrate and the ferment (but not a pure physical adsorption) the same as occurs in the process of heterogeneous catalysis between the substrate and the catalyst surface.

When we will get more information about the structure of active centers of

ferment molecule, then the real necessity to examine “surface geometry” of ferment molecule will appear (Fig. 4.2.1. and 4.2.2.). At present it is often quite enough to examine the composition of the substrate S and the enzyme E as a single whole.

In most cases the mechanism of enzymatic reactions is a strong modification of a quite simple transient formations or complexes, shortly touched upon in section 4.1.

As we will see later, there is a related coupling between the heterogeneous catalysis and the mechanism of enzymes action, because in both cases the mechanisms of activation energy drop are similar.

So let us return to the question of heterogeneous catalysts. The most significant heterogeneous catalysts for industrial and laboratory processes are metals, oxides, sulphides or combinations of those substances. Molecular crystals are rarely suitable for catalysis' purposes. Among metals, the transition metals and platinoid metals are usually used. As it will be shown later they react similarly in all reactions enumerated. Thus, for example, for oxidation catalysts one can often see oxidation and its reduction to metal back or pair of oxides creation easily turning from one into another.

There are no doubts that the hydrogen is chemisorbed by hydrogenation agents with further dissociation. More active metals have free l-orbits able to couple Hydrogen atoms. In Fisher-Tropsch synthesis the ability of Carbon oxide for chemisorption (without dissociation) is very important because similar agents are used in Ammonia synthesis to split nitrogen molecules into atoms. Oxides can be divided into two separate groups.

Oxide-insulators are used for cracking, isomerization and dehumidification

reactions, its activity can be concerned with acidity of their surfaces and ability to carbonize (to form carbonium ions) from carbohydrates. Oxides-transistors are suitable for the hydrogenation, exchange, oxidation and some decomposition reactions. Apparently, they are adsorbing reagents in the form of ions because quite interesting relations between catalytic reactivity and surface conductivity of these transistorized oxides have been discovered. The surface itself does not react and plays an utterly mysterious role.

An ideal catalyst for industrial production of any chemical substance must be extremely reactive, firm and stable as well as reproducible. To our regret we have to notice that highly reactive surfaces as a rule do not have a long life-time and the expenses for renewal or re-activation of spent catalyst were so high, that usually that resulted in use of a less active but more stable agent.

The capacity of specified catalyst quantity can be increased by extension of activity of the surface area unit and catalyst surface area. Due to the difficulties of surface structure determination we know less about factors controlling the activity of the surface area unit than about the influence of various preparation procedures on the specific surface area value. It has been fixed that the specific activity is highly preparation procedure-sensitive. The only way to guarantee the repeatability and the satisfactory work is a tried formula.

Generally it is considered that in accordance with the standard preparation technique a catalyst with activity proportional to its surface area is to be produced from certain raw materials. But this proportionality may be exact only when the surface is strictly homogeneous or is characterized by homogeneous activity in all range and when it is equally available for reagents.

The necessity to save world resources of oil and at the same time more and more growing use as feedstock resulted in series catalysis reactions applied in

oil-refining industry. From decade to decade the tendencies in that sector changed radically. The first oil refinery was necessary, especially Sulfur stripping, then automotive and aviation fuel of higher quality became required, that resulted in researches of possibility of low-boiling fractions use obtained from crude oil stripping and refining. Later monomer production like styrene and butadiene for caoutchouc and other polymers production took on special significance. Either it is considered as a rule that most part of these reactions includes an intermediate stage of carbonyl ions forming, their further isomerization, adjunction and exchange reactions, the details of these mechanisms are not studied well enough. Thanks to intensified researches the best conditions for catalyst work have been empirically determined. And quite satisfactory rules for products distribution prediction became known. But much more work is necessary to elucidate the kinetics and mechanisms of different catalysis reactions.

The main reactions are nowadays classified as: a) cracking, where carbohydrates with lower boiling temperatures are produces from “heavier” oil fractions, b) catalytic reforming including hydrogenation – dehydrogenation, isomerization reactions, rings’ opening and closing; c) hydro fining, i.e. catalytic hydrogenation of unsaturated compounds and decomposition containing Sulfur and Nitrogen with forming and removal of Hydrogen sulphide and Ammonia; and d) scaling and polymerization reactions that usually are cracking counter reactions.

The economy of developed counties is in particular based on the catalytic cracking of mineral oil. The idea of cracking is in the destruction of long hydrocarbon molecules with mainly long chain $C_{12} - C_{16}$ into smaller molecules $C_4 - C_8$. Thus mainly paraffin, olefinic and aromatic hydrocarbons are destructed. At that so-called “breakdown” of oil take place and light and heavy motor fuels are produced. Enzyme application in similar processes as oil treatment may lead to

fundamental changes in future. It is quite enough to mention enzymatic processes of paraffin treatment in the result of which we get both diesel fuel and artificial protein as fodder addition. That is why we would like to study the processes of cracking shortly later. We could do it even before in section 4.1.

First cracking performed in 1920-1930 was non-catalytic thermal reactions. In these reactions big paraffin molecules or side chains of substituted aromatics were splitted to smaller molecules of hydrocarbons and olefins. It is considered that as intermediate compounds of these reactions uncharged free radicals are obtained. The main final products obtained from paraffin and olefin and side chains of aromatic compound were hydrocarbons from C_1 to C_3 . But in the shortest time it was determined that fuel of better quality can be produced by catalytic decomposition. Thus the non-catalytic thermal cracking was mainly replaced by the charcoal or platinum catalytic cracking or by different acid catalyses as, for example, at acid-treated clays or mixtures of silica gel and aluminum oxide or at “double effect catalyst” composed of Platinum, Nickel or molybdenum over Aluminum Oxide.

It is considered that acid catalysts react like Fridel – Krafft catalysts transforming olefins into ions of carbonium, participating in various transformations, resulting in series of products absolutely different from those to be obtained in thermal cracking, with a better output of hydrocarbons C_3 and C_4 , branched olefins, iso-paraffin and aromatic hydrocarbon, that are in particular used in the compounds of petrol or in the case of source material for other chemical products’ synthesis.

Apparently these reactions over metal catalysts belong by their character to free-radical ones, but nevertheless their products are more useful than the

products of the thermal cracking, because here isomerization in branched chains, $C_5 - C_6$ naphthene dehydrogenation into aromatic hydrocarbons and paraffin cyclization are proceeding to a greater extent. These reactions are often classified separately from cracking as reactions of “reformation” or “reforming”.

Without catalytic decomposition (cracking) it would be impossible to produce that quantity of petrol and no natural sources would be enough, because in the process of general simple distillation only a small part of petroleum is transformed into petrol and the other 95 % would remain in the form of bitumen. It is quite difficult to split strong molecular bonds thanks to thermal motion only without any catalyst. Catalytic cracking saves the situation at level of oil stock conversion of 75-80% and usually proceeds at 470-550 °C. It includes not only endoergic reactions (splitting of C-C bond), but also a series of secondary exothermic reactions: dealkylation and alkylation, isomerization and hydrogen redistribution, dramatization, dehydrocyclization, polymerization.

In other words the whole series of complicated catalytic processes takes place. As raw materials for catalytic cracking atmospheric and vacuum distillates of primary oil refining within temporal interval 250-500 °C are used, in addition to heavy distillates of secondary oil refining processes – coking, deasphalting, oil paraffin production.

As catalysts natural and synthetic aluminosilicates, porous platinum and zeolites are used. Great number of internal channels and cavities of porous platinum, zeolites and aluminosilicates guarantee the active diffusion exchange between vapors of raw material and products. For effective cracking, the pore size should be about 1-10 NM.

We are not going to review theories of catalytic processes with enzymes; they

are too many of them. We should note only that both heterogeneous catalysis and reaction with ferment show effective process of molecular bond splitting. Energy strength of these bonds exceeds by dozens of times the energy of thermal motion. However exactly this fundamental phenomenon is explained by different theories in different ways, though, as we will be able to see later, a suitable simple mechanism exists for these processes [185, 197].

4.3 General Approach to Catalysis Phenomena Connected with Energy Generation

The man with a new idea is a crank, until the new idea succeeds.

Mark Twain

As a rule atoms but not molecules participate in primitive reactions. In the case of gas mixtures, for example, the latter should be in atomic state. If examined for example the reaction between the nitrogen and either the oxygen or the hydrogen, these gases do not react in general conditions, and moreover the nitrogen, due to its chemically passive behavior, resembles rare gases, because it either does not react at all, or reacts at extremely high temperatures. The Nitrogen reacts with the Oxygen and forms the Nitric oxide only at the temperature of 4000°C and with the Hydrogen it forms Ammonia and not only at terms of high temperature and pressures but in the obligatory presence of a catalyst. That happens due to the extremely high energy of the Nitrogen dissociation, about ~ 170.22 kcal /mole that is essentially more than energy of the thermal motion at usual temperatures. At 3000°K and normal pressure Nitrogen is dissociated at 0.001 portion, in the

same conditions Hydrogen and even Oxygen are dissociated more than at one tenth. However so huge temperatures are not used in the large-scale production of Ammonia and Nitric Acid, but a special catalyst is required (as a rule it is a heterogeneous one).

It is known that both plants and animals assimilate Nitrogen, of course first having transferred it into the atomic state. The mechanism of atomic Nitrogen assimilation by animals is connected with the activity of the nitrogenase ferment. The attempts to reproduce that reaction in artificial conditions without ferment or catalyst failed.

During the last years it was shown for the first time that the molecular Nitrogen is able to form complexes with some transition metals, and then conditions were found for the reduction of Nitrogen molecule combined within the complex to hydrazine. Such binuclear complexes correspond to the idea of model catalytic system with two active centers that work simultaneously.

The conventional today point of view [153] is that this process consists of the following ones: for the Nitrogen molecules activation it is necessary to spend some energy for the first π -bond, at the further stage of Nitrogen regeneration it requires essentially less energy. It was possible to overcome the high activation barrier at the first stage due to the electron redistribution within the complex. At this stage, electrons populate the antibonding π -orbits of Nitrogen molecules and reduction of electron density at bracing σ and π -orbits takes place. Electron re-distribution on the Nitrogen molecule's orbits happens due to the participation in that act of some d-electrons of transition metals that promote the N-N connection slackening.

To realize the described electron transmission within the complex transition metal – Nitrogen molecule a correspondence between definite geometrical and

energetic factors is required.

In fact, the scheme presented is a quantum-chemical picture of cooperative action model, typical for ferments. We should note that influence of ligands' and protonic solvents on the Nitrogen molecule activation and further reduction has not been shown in that scheme. Meanwhile such an influence on the catalysis exists, that has been confirmed by experiments, and that fact brings the model even closer to enzymatic reactions. Quantum-chemical models of the process of activation and molecular Nitrogen reduction in living organisms with the participation of iron protein ferredoxin – supplier of electrons for the purpose of N-N bond splitting have been developed.

But the above mentioned explanation of the Nitrogen splitting into the atomic state (recall that it requires an enormous energy and it remains unknown where to take it from) is not free of criticism above because any bond's loosening should be paid off by a tremendous quantity of energy.

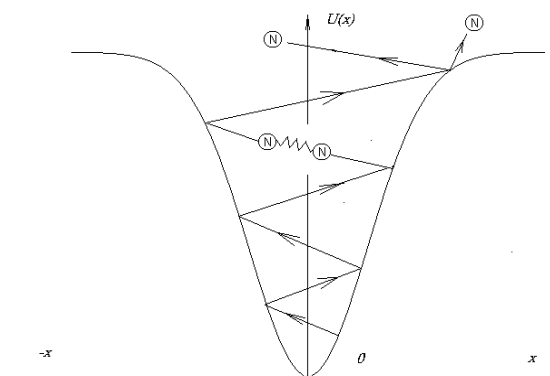


Fig. 4.3.1 Oscillation of Nitrogen molecule in potential well of catalyst.

That process seems more natural in accordance with the UQT [185, 197, 200, 201]. For this we should return to section 3.3. The bottom of nearly any potential well may be fully approximated by a parabola. Then the use of results obtained in

3.3. is possible. Let a Nitrogen molecule to get into a cavern or some cavity on the catalyst surface during the adsorption. Then the natural oscillation of that molecule starts. During the oscillation, its energy starts growing and becomes more than the energy of the Nitrogen dissociation, in the result two Nitrogen atoms will fly out of the cavity and they will have enough time to react without any energy problem (with an Oxygen atom, for example). That is sketched on Fig. 4.3.1.

After that the cavern is ready for next “free of charge” repetitions. Of course a satisfactory initial phase of Nitrogen molecule getting inside is required to realize exactly the “Maternity home” solution, because at other phases the molecule flying in starts to deliver to the vacuum its kinetic energy thus realizing the “Crematorium” solution. Probability of that or other solution strongly depends on the catalyst geometry and material by potential equation and on the value of the most probable material molecule velocity and structure. The cavern itself can be compared with the catalyst active center. If such well were changing its form for whatever reason or an alien object were sticking in then the divergent oscillations would stop, that equivalents to the “poisoning” of active center.

The material of well’ walls should fulfill the only task – to reflect in a proper way the object getting into it. That is the general requirement for all ferments and catalysts. And of course the type of the wall potential plays a very significant role, but the most important are its dimensions and form, that from the most general considerations should be about nanometers (an upper estimate). Exactly that explains the widest universality of some catalysts like the platinum black, clays, and aluminosilicates. As it is known these catalysts work perfectly in different reactions.

In the case of enzymes the form of cavities have dimensions and potential specific for each type of ferment (molecule architectonics, key-lock system) and sometimes the molecules of definite form only may take places and oscillate.

That apparently explains the high specificity of enzymes reactivity.

The idea of molecule decomposition mentioned above looks quite simple. But ferments and heterogeneous catalysts are able to synthesize in spite of repulsive forces that associating atoms have to overcome. We shall assume the existence of simultaneous orthogonal oscillations of atoms-respondents within one general well or in few next one to another wells. Then the energy of these oscillations at “Maternity Home” solution implementation will be spent for overcoming of repulsive forces hampering reaction.

We should specially note that the energy during that process is liberated locally within the area of some concrete molecular or atomic bond and meanwhile the energy destroys that bond but does not disperse over the surrounding medium, so the process hardly can be detected by temperature increase. In that simple variant of heterogeneous catalysis the constant of chemical equilibrium will not shift.

In the framework of proposed mechanism the positive influence of effect of aggravation becomes clearer: the catalyst activity is considerably increasing due to the assembling of big molecular masses that is probably necessary because the solution “Maternity home” is more likely for big masses. Coenzymes may play a similar role. In addition, the influence of pH at enzymic processes is explained, because a Hydrogen free atom or bare proton can easily “connect” to nearly any chemical object and so it may radically change the character of oscillations within the well. Temperature also strongly influences these processes because enzyme form is strongly connected with it (as a rule an enzyme is a protein).

To shift equilibrium constant (equation 4.1.2.) of a chemical reaction requires changes of the system entropy, that cannot be excluded for enzymatic processes, because ferments can deliver negative entropy, as we have mentioned already in section 4.2. Today it is considered impossible, but who is able to foresee the future?

We cannot exclude the idea of energy generation within a potential well is just waiting for the creation of general theory of catalysis. Here we should recall brilliant words of a famous Russian specialist on physical chemistry Professor A. N. Kharin (Taganrog, 1954) who always said at his lectures [148]:

“The problem of chemical catalysis is the most incomprehensible in the modern physical chemistry and it won’t be solved until physicists discover some new mechanism able to explain the liberation of the energy that lowers the reaction barrier.”

Our UQT allows, as we hope, to make the first shy steps in right direction [1-9, 55, 72, 81-86, 200, 201].

4.4 Possible Perspectives

Se non e vero, e bene trovato.

It is known that the human society nowadays faces the problem of a new steady energy source, as far as the reserves of burned (in the literal sense of a word) natural fuel – oil, gas, coal and so on rapidly run out.

Over the last decade it became evident that further intensive development of modern power engineering and transport leads the humanity into a large-scale ecological crisis. Rash decrease of fossil fuel resources against the background of the natural annual growth of power consumption forces industrially developed countries to expand their net of nuclear energy installation. That in more and more increases the risk of their exploitation.

The problem of nuclear wastes utilization becomes more actual. Taking that alarming tendency into account a lot of scientists and experts definitely express

their opinion in favor of speeding up the search for new alternative energy sources and new energy carriers' application in power engineering and transport. In particular they fix their eyes on Hydrogen, as its sources in the World Ocean waters are inexhaustible.

Additional irrefutable advantages of that fuel are the relative environmental safety of its use, eligibility for heat-engines without any noticeable changes of their construction, high-calorie capacity, possibility of permanent storing, transportability by existing transport network, nontoxic character and etc. However an essential problem, that has not been overcome till nowadays, is the diseconomy of its industrial production.

More than 600 companies, concerns, university laboratories and social scientific and technical societies in Western Europe, USA, Australia, Canada and Japan toil at reduction of prices of the process of Hydrogen generation (see magazine "Motor transport", № 4, 1992, and page 38). Successful solution of that important problem will revolutionary change World economy and will be able to sanitize the environment by reducing carbon-dioxide wastes.

There is a whole range of well-known water decomposition techniques: chemical, thermo-chemical, electrolysis and others, but all of them have the same imperfection, the using of expensive high-grade energy in engineering process of hydrogen generation. More over this high-grade energy liberation requires the scarce fossil fuel (coal, natural gas, oil products) or power energy produced at electric power stations. It suffices to say that the conventional industrial electrolysis requires for one cubic meter of Hydrogen generation of 18-21, 6 mega-watt-seconds, and taking into consideration the generation of electric power itself general power consumption exceeds 50 mega-watt-seconds, that makes the Hydrogen extremely expensive (about US \$2 per cubic meter).

At the same time our Earth is literally bathing in the heat energy flow, received from the Sun. And the task comes “to insert” that inexhaustible source of free-of-charge low-potential heat into the industrial procedure of Hydrogen generation. Hydrogen exceeds natural gas by its calorific value in 2.6 times, oil in 3.3 times. In addition, the cleanness of the process of Hydrogen burning, transportability, possibility of direct transformation of the chemical energy into the electric one should be added. Moreover, the sources of Hydrogen are practically inexhaustible. But we will have to develop inexpensive, technologically applicable, large-scale method of Hydrogen generation requiring low energy consumption. Due to that reason the electrolysis cannot be used for this purpose.

From that point of view the bio-photolysis of water with the use of non-organic catalysts or enzymes and solar energy attracts our attention. Of the most interest was the hydrogenase application. The process of water bio-photolysis consists of two stages. At the first stage the flow of solar energy acts upon the mediator-carrier. As carrier compounds with strong electron-seeking characteristics, for example, viologenic dye (γ, γ' -dipyridine derivative) or nicotinamideadenine dinucleotide (NAD⁺) are used. Mediator with a high oxidative-reduction potential being excited by radiation takes electrons away from the water molecule and passes into the reset state. Molecular Oxygen is liberated; it does not oxidize the mediator in the reset stage.

At the second stage there is the electron transfer with the help of bacterial ferment of hydrogenase from the mediator in the reset form to protons with combining of molecular Hydrogen. Till now the efficiency of the process of water bio-photolysis under this scheme is too low, and the system itself is not stable enough, but researches in that field are successfully continuing. That classical direction appeared not far ago and promised to be interesting being quite close to

equilibrium with environment.

However sometimes ago there was a report on practically spontaneous water decomposition by Oxygen and Hydrogen under the influence of catalyst. That partially confirms the accuracy of ideas described above. For example there was a private communication about a Japanese Kamuro Dozi, who used for this purpose catalyst of cupric oxide. The other two groups (one in Philippines and the other - in USA) are already testing a vehicle powered by mixture of Oxygen and Hydrogen to be generated by catalytic decomposition (with low energy consumption) of common water. The authors have even attached a plate with the inscription: “They said it couldn’t be done!” to the reactor where water decomposition takes place. The vehicle itself is provided with a label: “Powered by ordinary water”. There is a widely known opinion of most chemists: “If any reaction does not precede that means that an appropriate catalyst has not been developed yet”.

Of course if it were created a source of electric power similar to working in Switzerland device of Paul Baumann of “perpetuum mobile” type, there would not be necessity in using of water electrolysis or even its catalytic decomposition for the purposes of motor transport because that would decide all existing principal energy questions. But never the less solar energy should be used as utter as possible because that approach will not move general heat equilibrium of the Earth.

There is no necessity to add anything about further perspectives for professional researcher and advanced thinking reader.

4.4.1 Modern Trend in Quantum Picture of the World

(I) Introduction

It seems that the majority of researches have absolutely forgotten the fact that

one of the master spirits of contemporary world, A. Einstein, till the end of his life had not adopted the standard quantum mechanics at all. Better to cite his well-known words: *“Great initial success of the quantum theory could not make me believe in a dice game being the basis of it. I do not believe this principal conception being an appropriate foundation for physics as a whole... Physicists think me an old fool, but I am convinced that the future development of physics will go in another direction than heretofore I reject the main idea of modern statistical quantum theory... I’m quite sure that the existing statistical character of modern quantum theory should be ascribed to the fact that that theory operates with incomplete descriptions of physical systems only.”* A. Einstein (back translation).

At the first stage of quantum mechanics evolution in the frame of classical physics theory the mechanism of corpuscular-wave dualism was not discovered at all, as it was done later in the UQT [1-9, 165-172, 186]. It is worth a surprise that the super abstract quantum ideology ad hoc designed by Niels Bohr was suitable in general for the description of quantum reality. An explorer contradicted anything by strictly using new frequently paradoxical quantum rules, and any paradox could be removed by the simple prohibition of its analysis. Although many researches tried to solve these problems they were not successful. The outspoken interpretation of quantum theory had become out of any criticism. More over the determination of simulators describing one of the sides of quantum reality had been announced as the main target of quantum science, while the picture in figures and a-going had become simply an optional target.

Nevertheless one general philosophic problem had to be remaining: the dual principles of the fundamental physics. There were particles as some points being the source of a field that could not be reduced to the field itself; the researchers did not do their utmost, though. Introduction of this micro-particle resulted in a wide range of different divergences - anybody knows now that electric power of a

point charge equals infinity. A lot of ideas has appeared, absolutely brilliant ideas from mathematical point of view, suitable for these appearing infinities abolishing. We can use as a cover the words of P. A. Dirac: *“most physicists are completely satisfied with the existing situation. They consider relativistic quantum field theory and electrodynamics to be quite perfect theories and it is not necessary to be anxious about the situation. I should say that I do not like that at all, because according to such perfect theory we have to neglect, without any reason, infinities that appear in the equations. It is just mathematical nonsense. Usually in mathematics the value can be rejected only in the case it were too small, but not because it is infinitely big and someone would like to get rid of it”*. Direction in Physics, New York, 1978 (back translation).

The substantial success of the quantum mechanics (particularly in the stationary cases) was based on the simple correlation of de Broglie wave length and geometric properties of potential. Formally the particle was considered as a point; in other case it was difficult to add probability amplitude character to the wave function. But the point-character of a charge as well as the principle of Complementarity did not allow going ahead in the elementary particles structure and thus the further development of the quantum theory of the field in the frames of the assumed paradigm had resulted in total fiasco of the field quantum theory itself.

There is another concept in physics; it comes from W. Clifford, A. Einstein, E. Schrodinger and Louis de Broglie in which the particle is considered as a bunch (wave packet) of a certain unified field. The position of associated concept would be expressed the most clearly by the following words of A. Einstein: *“We could therefore regard matter as being constituted by the regions of space in which the field is extremely strong. A thrown stone is, from this point of view, a changing field in which the states of the greatest field intensity travel through space with the velocity of the stone. There is no place in this new kind of physics*

both for the field and the matter, for the Field is the only reality... and the laws of motion would automatically follow from the laws of field". (back translation). By (M. Jemmer, [179]) definition of the particle as a wave packet is the item for some unitary theory.

The first articles concerning this matter were published in [1-9]. The entire term "unitary" belongs to who has classified quantum wave's theories, and it is correlated with the theories that represent particle as a wave packet. In Unitary Quantum Theory a particle is described as a wave packet that in its movement is periodically spreading along the Metagalaxy and is gathering again. For such moving wave packet both the relativistic and the classical mechanics follow from these unitary quantum equations, probably the Maxwell equations and the gravitation follow from exact UQT equations [200], but this has not been proved yet being the problem of the future. Nevertheless the UQT scalar equation (a telegraph type) in general makes it possible to obtain not only Schrodinger but also Maxwell equations [165, 166, 200, 201].

The field of investigations of the Unified Unitary Quantum Theory (UUQT) is the most profound level of substance: the level of elementary particles and quantum effects.

As well known all particles have besides corpuscular properties wave properties too (particles can interfere with each other or with themselves), and their behavior is described by means of the wave function. In the case of a particle moving in the free space, the wave function is described as de Broglie plane wave which wavelength is inverse to the momentum of the particle. If the particle is slowing down or accelerating by applied fields then its wavelength is increasing or decreasing, respectively. The wave itself has no physical interpretation, but the squared value of its amplitude is proportional to the probability to find the particle in a defined place. That is why these waves are also called "waves of

probability” or “waves of knowledge”, etc.

There is another problem: the particle has no exact value for coordinate and for momentum at the same time, although either value could be measured arbitrarily closely (uncertainty relation). That is why the definition of trajectory of a quantum particle has no sense.

As opposed to the laws of the classical physics with its determinism where one can predict results of the motion of separate particles, in the quantum theory one can only predict the probability of the behavior of separate particles. Even the nature does not know the way a particle goes by in the case of diffraction by two slits. But not this is the most depressing. The Quantum Physics has wave-corpuscule dualism as well as field dualism and matter dualism. All particles act as sources of field, but it appears that they are only points which have no relation to these fields, and one can't tell anything in concrete about them.

Let us continue to confuse the reader. We shall consider an extremely simple experiment with single particles in the terms of the modern quantum theory. It will allow us to understand what is going on and will be useful for us in the future.

Let single photons fall on a semitransparent mirror directed at the angle of 45 degrees to their stream. Semitransparent means that a half of the falling light is reflected and another one passes by. Photon counters are installed on the paths of reflected and passed rays (Fig. 4.4.1).

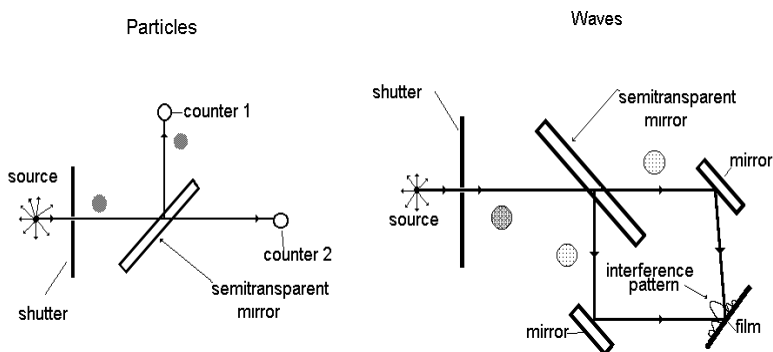


Fig. 4.4.1 Experiments with individual photons on semitransparent mirror.

In the terms of the wave theory everything is simple: an incident wave will be reflected and will be passed partially.

But particles as they are indivisible have to be reflected or be passed by. If a counter of reflected beam's particles registers an event it is evidently to suppose that the second counter will register nothing. It is easy to see that if one will re-unite passed and reflected beams and sends them to the screen then... it's all about the way how we are going to argue.

From the wave theory there will be an interference pattern, but from the corpuscular theory it will not occur. In fact, an interference pattern is observed in experiments even for single photons, and our suppositions are wrong to say the least. In order to spare the doubts about how is it possible, it is better to forbid one to think about it. And the principle of Complementarity in modern physics does it in any case. It allows to ask only the questions for which it's possible to give an answer by experimentally only. When one tries to find a particle it means that one rejects to observe the interference pattern and vice versa. As though we could know from experiment either a particle has passed by or has been reflected, we would realize the real particle behavior. But it's impossible to do by the means of macro-instruments.

The principle of Complementary makes the quantum physics descriptively inaccessible. *“There are many experiments, that we just cannot explain without considering the wave function as a wave that influences on the whole region and not as particles appearing may be here, may be there, as it is possible in the terms of the clearly probabilistic point of view”* (E. Schrodinger). In other words a wave acts in the whole area simultaneously, not “may be here, may be there”, otherwise there wouldn’t be any diffraction or interference.

Eventually we have to admit that the prohibitions of the principle of Complementarity respond to the weakness philosophy, and the role of this principle is obviously analogous to the role of a calorie, a phlogiston and other obsolete concepts.

(II) Unified Field Theory Approach

Let us ask the questions that are forbidden by the principle of Complementarity. What is the wave of an electron? What is the behavior of an electron indeed, when nobody looks at it? (it’s natural behavior?) How does it manage to go through a potential barrier when its energy is less than the barrier height (tunneling effect)? How does it, as it is indivisible, go simultaneously by two slits which are divided by a great distance in comparison with its own size? What kind of structure has an atom of hydrogen constructed at the lowest energy state (s-state)? How can the probabilistic consideration of a wave function to result from the mathematical formalism of the theory? Why is the actual Quantum Mechanics reversible? This is a primary law, and the irreversibility has to follow from it for dispose the paradoxes in the statistical mechanics. Last but not least: what structure has the electron itself described in the terms of probability?

This is a huge complex of mysteries. All (or almost all) physicists resigned and even prefer not to speak about it. But there is also someone who does speak. Paul

Langevin even called the formalism of Quantum Mechanics with its principle of Complementarity the “intellectual debauch”.

E. Schrodinger wrote that he “was happy for three months” when he had got the idea to consider the particle as the packet (bunch) of de Broglie waves until the English mathematician Darwin proved that the packet would spread and vanish. But the trouble of all of these attempts (E. Schrodinger, Louis de Broglie, etc) was the fact they always tried to construct it by means of de Broglie waves with such dispersion that any wave packet has to spread. The including of nonlinearity (Louis de Broglie) just extremely complicated the problem but didn't solve it.

(III) Unified Unitary Quantum Theory Interpretation

The critical feature of the Unified Unitary Quantum Theory (UUQT) is the fact that it describes the particle as a bunch (packet) of certain unified field, but not as a questionable structure of the de Broglie waves of probability.

For spying upon the particles which we consider as very small bunches of the real field, let us consider a Hypothetic Observer (HO) which is able to measure the parameters of these bunches with the hypothetic microprobe. Dimensions of microprobe are much less than the dimensions of the particles. The result of these measurements will be certain structure function that describes bunch of the real field. Obviously, this hypothetic HO and microprobe couldn't exist, but our thought experiments will be as simple as possible.

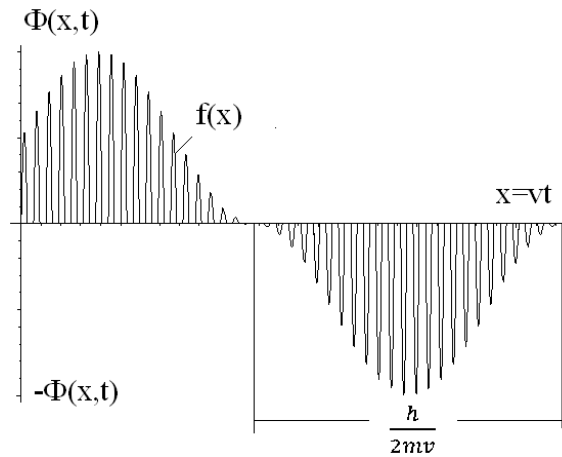


Fig. 4.4.2. Behavior of wave packet in linear dispersion medium (i.e., rather like a series of stroboscopic photographs).

If we choose the dispersion of these partial waves equal to linear, we could have an extremely curious process, which mathematical formulation hasn't been used ever before. If we have dispersion, then harmonic components of partial waves propagated with different velocities will result in spreading of the wave packet over all space or over all Metagalaxy. Mathematical investigations show that the spreading goes on without any changes of the form of the wave packet; but at the end, there is a moment when a wave packet vanishes at all. Where does its energy disappear to? It remains in the form of harmonic components that set up a certain background in any point in the space. As these waves are not damped and continue to propagate with velocity of their own, then after a while the wave packet begins to revive in another point, but its sign will be changed at that. During the motion, the packet will appear and disappear periodically (Fig. 2).

The envelope of this process is locus of points, locus of points of its maximum, it is a sinusoidal quantity and it rests in all reference frames; in other words, its phase velocity is equal zero in any reference frame, i.e. it's relativistically invariant (only by means of it the results of the relativistic dynamics are absolutely correct). If we

change a reference frame, we will receive a different value of wavelength of the envelope, but it will be motionless as well. As the computing shows the wavelength of the envelope is exactly equal to de Broglie wavelength, and the dependence of this wavelength on packet velocity is the same! As you see, all the Unified Unitary Quantum Theory is occupied with the resolute exploiting of this basic idea. It should be stressed that this periodical appearing and disappearing of particles doesn't refer to the Quantum Mechanics, as an immovable packet doesn't oscillate. The requirement of the relativistic invariance, that would be the main requirement for any theory, specifies the idea further. It states the following: when Lord has excited in space continuum wave packet with his finger and then he has taken it away, then the packet will go on oscillating as a membrane or a string after impact. The frequency ω_S of these free oscillations is very high: it is proportional to the rest energy of the particle and it is equal to the frequency of the so called Schrodinger's trembling ("zitter-bewegung").

$$\omega_S = \frac{mc^2}{\hbar\gamma}, \quad \gamma = \sqrt{1 - v^2/c^2}$$

Within the motion there arise de Broglie vibrations with frequency $\omega_B = mv^2/\hbar\gamma$ due to dispersion. At small energies $\omega_S \gg \omega_B$ and in the presence of quick own oscillations has no influence on experiment. So, all quantum phenomena result from de Broglie oscillations.

The value of frequency ω_B tends to ω_S with growth of energy and resonance phenomenon appears that results in oscillating amplitude increase and in mass growth. Thus the well-known graph of particle mass dependence on the velocity (Fig. 4.4.3) approaching to light's velocity constitutes actually a half of usual resonance curve for forced oscillation of harmonic oscillator if energy

dissipation is absent. In the case when $v \rightarrow c$, frequency $\omega_B \rightarrow \omega_s$ (frequency resonance), $\gamma \rightarrow 0$ and the beats appear with difference frequency

$$\omega_d = \omega_s - \omega_B \approx mc^2 \gamma / \hbar$$

and particle will obtain absolutely new low-frequency envelop with wave length

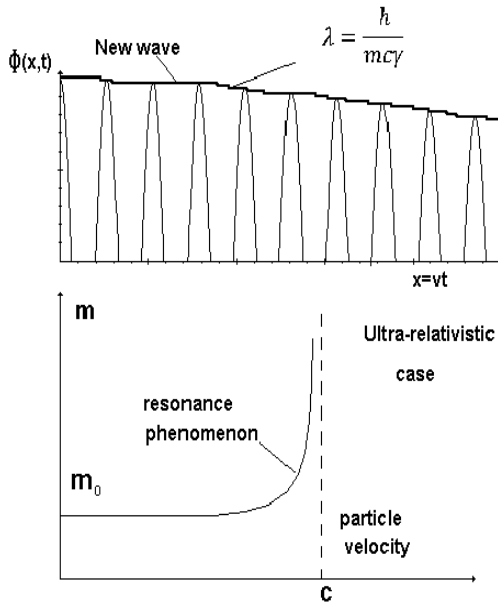
$$\Lambda = \frac{h}{mc\gamma}$$

This is a new wave. This can be checked experimentally in CERN. In ultra-relativistic limit case the value of Λ becomes much greater as typical dimension of quantum system it (new wave) interacts with. Now the length of new wave grows with energy contrary to de Broglie wave length slowly decreasing, and particle requires the form of quasi-stationary wave packet moving in accordance with classical laws. That explains the success of hydrodynamics fluid theory concerning with numerous particle birth when the packet having extremely big amplitude is able to split into series of packets with smaller amplitudes.

But such splitting processes characterize not only high-energy particles. Something like this takes place at small energies also, but overwhelming majority of arising wave packets are under the barrier and so will not be detected. It would be perfect to examine by experiments at future accelerators the appearance of such new wave with the length growing together with energy [165, 166, 200, 201].

If our HO places at the way of motion of the wave packet a number of his microprobes, then due to the dispersion spreading and rebuilding he can observe the envelope of this process, and it will not be at variance to the general Quantum Mechanics, as this envelope corresponds to the wave function. This figure, i.e. a sinusoidal envelope with a regular shape, can be seen by the HO in the only case:

if the only single particle would exist in the world.



Within the ultra-relativistic Limit the wave length λ be Comes much greater than the characteristic dimension of the quantum system with it interacts. Therefore, the particle represented as a quasi-stationary wave packet moving in accordance with the classical laws.

Fig. 4.4.3 *Appear of the New Wave in the ultra-relativistic limit.*

But the real world consists of an enormous number of particles moving each other with different velocities. The partial waves (harmonic components) of those particles which have vanished at this moment can be summarized and emerge real fluctuations of the field or in other words the vacuum fluctuations that will act in a random manner. These fluctuations could destroy all idyllic character of measurements of our HO (Hypothetic Observer) for single particle in Universe because the sinusoidal envelope will be distorted by vacuum fluctuations and it will be difficult to separate it clearly.

Any wave packet that is described in the terms of the becoming structural function could be decomposed by means of Fourier transforming into plane sinusoidal (partial) waves. These waves are infinitely numerous, and their amplitude is infinitesimal. If we summarize them it will emerge zero everywhere

except of the area occupied by the structure function. Thus the structure function could be represented either as a function of time (time representation) or as a function of an amplitude of harmonic components related to frequency (spectral representation). It is absolutely equivalent to mathematical representations.

Now there is no necessity in the principle Complementary that was a very convenient view ad hoc. It is easy and clear how the synthesis of corpuscular and wave properties is realized. Corpuscular properties occur due to the localization of a wave packet in a small spatial region. The wave properties of the de Broglie waves can be explained in the following way: when the wave packet approaches to the diffraction system (for example Young's experiment with two slits) then we have an ordinary diffraction of partial waves by splites, and the diffraction pattern of partial waves appears at the screen. HO could observe it with his microprobes.

As these packets are not overlapped then everything is linear and the superposition of the partial waves creates a total diffraction pattern modulated by the de Broglie wave, although the plain de Broglie wave doesn't exist at all. It should be stressed that de Broglie wave is a packets locus of points of maximum in his motion, and it is a superposition of partial waves, that is why it appears in any diffraction and interference experiment.

(IV) Quantum Measurements

Let us try to consider real instruments, which are always macroscopic. Atomic nuclei and electron shells are situated very near to each other and form a very numerous, but discrete series. A transition from the one such a state to another is a quantum jump. That is why the absorption and emitting of energy between the atomic systems is carried out by means of the quanta. However, it doesn't mean that in the motion process the quantum or the particle propagates as something constant and indivisible. The energy of the particle can be divided or changed by

vacuum fluctuations. The wave packet of a photon, for example, can, in the issue of the overlapping of vacuum fluctuation, turn into meson at short time, and photon can disguise oneself as a proton or as a neutron. It is assumed in the ordinary quantum field theory that a proton has an atmosphere of mesons; it follows from the interpretation of the results of its collisions with other particles. There is no meson atmosphere indeed. A proton appears and disappears during its motion constantly at the de Broglie wavelength, and its mass changes periodically from the double value of a proton's mass to zero, taken on the intermediate values of meson masses.

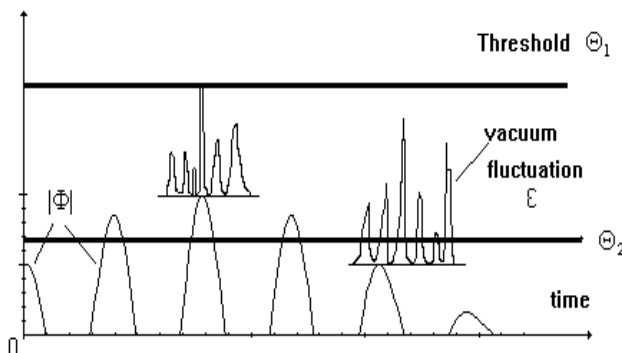


Fig. 4.4.4 Quantum measurements.

Eventually, all of the quantum measurements are based on energy absorption and present irreversible processes [4, 5, 165, 166, 200, 201]. For every instrument founded a particle will operate, a quantum of energy is needed at least, thus it is a threshold energy of instrument defining its responsiveness. By the way, we would like to notice that our HO (Hypothetic Observer) uses the instruments with zero threshold energy that is why it can register even vacuum fluctuations.

Let us consider the process of interaction of a particle with a macro-instrument [5, 6]. As soon as the particle is a wave packet, its energy is proportional to the intensity of the packet, but it can be changed because of periodic spreading's and

appearances. Besides the packet itself can be divided during the interactions. The macro-instrument to register a particle has to wait for a moment when the total energy of the particle and of the fluctuation of the atom would be more or equal to threshold energy. It is clear that the probability of the operation of the apparatus will be proportional to the amplitude of the wave packet, or more exactly, to the value of intensity of the envelope of the wave function.

If the wave packet with a too low intensity in comparison with threshold energy of the macro-instrument approaches to the macro-instrument, the great fluctuation of vacuum is required, but the probability of such an event is too small, and it means that the probability to detect the particle is small too (Fig. 4.4.4). The theory of the quantum measurements is developed in the Unified Unitary Quantum Theory (UUQT), and the statistical interpretation follows now from the theory, but not just postulated, as it was before in the conventional quantum theory. This point of view requires automatically that the value of the dispersion of vacuum fluctuations is finite that, in another turn, requires the finiteness of the Universe.

(V) Unitary Quantum Illustrations

The uncertainty relation arises because energy and momentum are not constants, but they periodically change because of the dispersion owing to disappearance and appearance of the particle [2-4]. Besides because of statistical laws of measurements with macroinstruments, there is no any way to measure anything accurately owing to the unpredictable fluctuations of the vacuum. HO (Hypothetic Observer) could predict the coordinate, the momentum or the energy of the packet, if he would be the only one in the Universe, i.e. in the case of absence of the vacuum fluctuations.

The presence of unpredictable vacuum fluctuations makes all of the laws of the micro-world principally statistical for any observer. An accurate prediction of

expected events requires an accurate knowledge of the vacuum fluctuation in any moment of time, what is impossible, because it is necessary to have the information on the structure and the behavior of any packet (particle) in the universe and to control their motion. The mechanical determinism of Laplace went absolutely lost in the modern physics as well as in the future one. Maxwell was right when he told; “the true logic of the universe is calculation of the probabilities” (back translation). The envelope of partial waves, occurring due to linear transformations at the wave packet and being in the ruins of splitting of the packet corresponds to Huygens principle. It explains how the relating of a moving particle with a monochromatic de Broglie wave is formally possible, propagating in the direction of the motion, and with all wave properties. There are partial waves that we consider as participants of diffraction and interference, but due to the principle of superposition we get the same result as if it a de Broglie wave would participate at the process.

The new linear equations of the UUQT allow the time inversion with simultaneous replacing of the wave function with a conjugated one, with the formal reversibility. Actually this reversibility takes place just in the case if the Universe consisted of the only one particle, as in the real world the recovering of the previous vacuum fluctuation is also needed for the total reversibility of the process. But there is a simultaneous reversibility of all processes in the Universe required for it that is impossible. It doesn't mean that quantum processes are inconvertible, just the reversibility has a statistical character, but now direction of the current of time defines entropy only.

The envelope, introduced before, is accurately monochromatic, but it does not exist as a traveling plane wave with such properties in the reality. Though it is related to the energy of the particle, the following definitions, such as “waves of the probability”, “waves of the knowledge”, could be related with it too. In

contrast to the general quantum theory, now a very important phase is coming. It is the most easy to show it as the tunneling effect.

We would like to mention these established quantum phenomena to the reader. If we have a sufficiently narrow barrier with the height that is larger than the energy of an incident particle, according to the classical mechanics it will never go through the barrier. In the general quantum theory, the incident wave reflects and passes by partially, and we have a finite quantity of the probability that the particle will be behind the barrier. In these cases the general Quantum Mechanics states that the particle makes a tunnel in the barrier for itself, hiding the method of creation of this tunnel.

Let us listen to what HO says of this process? If a particle is approaching closely to a potential barrier in the phase of an absolute collapse, then it easily goes through the barrier, not interacting with it because of linear of all of equations for the small amplitude of the field. It just appears behind the barrier, without interacting with it, if its width is much less than de Broglie wavelength. And there is no necessity for it to make a tunnel. However, if it approaches in the phase with the maximal value of the packet, then the particle would be reflected because of the nonlinear interaction of the waves with the field of the barrier.

Now let us return to the experiment with the semitransparent mirror, discussed above. In terms of the described point of view, the wave packet (particle) will be divided at the mirror and enter in every beam, that depends on the packet phase near the mirror and on the structure of the mirror in this place. We have, in general, two not equal wave packets fragments with less values of the amplitude that can interfere. The changing of the parts of the fragments does not follow by because all processes are linear, i.e. they are not dependants on amplitude. Besides the probability of detecting of the fragments is reduced, because an appreciable fluctuation of the vacuum is necessary for arising of threshold of

detection of the counter. Consequently, in the results of the measurements the particles have to be lost or be observed as single particles in both of the beams simultaneously. The creation of two particles from a single is not a confusing fact, because the energy of the fragments will be reconstructed to the necessary level by means of the vacuum fluctuation. Note, the statement of Standard Quantum Mechanics that the particle may be presented simultaneously in many points of quantum world sounds strange from the common sense and remained for decades without any understanding of principal things. Within bounds of UQT scientific explanations are correct in principle.

At present time we have an ambiguous situation when high-tech experiments with fantastic results have been carried out, for example the classical experiments of Brown and Twiss and the variations of them (Fig. 1). It was found out that frequently both of the counters detect particles simultaneously, that is confirmed by the proposed mechanism. Furthermore, most of such experiments (including experiments with entangled photons) confirm directly this interpretation. The results of experiments with entangled particles are quite simple and understandable within bounds of UQT, and the idea to seek some over light mystic relations between particles is fully meaningless.

In consequence, an increasing number of photon pairs are always observed in the beam of light. However, it was found out that it is possible to carry out experiments whose effect remains also in the situation when there is no any way for any induced radiation. If we collide particles of any kind, and if in the colliding point one or two particles are vanished, then they have to go against another without any interaction. Indeed, in the proton-proton interactions 6% of the particles don't interact, but go through the others. An analogous effect takes place in the atom of hydrogen in the state of minimum of energy. It is well known that this s-state is not rotational, and Bohr-Sommerfeld's atom model describes

the spectrum strictly in the relativistic case. If we apply this model to the s-state of the electron, we will obtain that the paths of the electron pass through the nuclear, and they were early excepted as absolutely absurd. Today it is clear that an electron just oscillates along a straight, going through the proton. All this allowed one of the authors to consider the problem of deuteron-deuteron interaction in other aspect and to predict the cold fusion [7, 11].

Quantum object is getting classical one with a simultaneous increasing of its mass, i.e. in the case of superposition of a large number of wave packets. The case when all packets creating a body are consolidated and spreading simultaneously is impossible in physics, as they have different velocities and masses. That is why such a combination seems as a stable and permanent object, moving according to the classical mechanics laws, though every packet is described in terms of the Quantum Mechanics. It looks like all particles in the Universe owe their existence to each other, and the Universe itself is just a mathematical illusion, a trick.

In justice to the adherents of the Complementary we have to say the following. They do not retract it, though they have to wriggle, they have to tell that particles always go to the mirror as correlated pairs, and one of them goes through, but the second is reflected. Of course we need to consider the induced radiation effect, when the one atom's radiation is increasing the probability of emitting from another excited atom of the same source, but it does not always happen. Let us return to the principle of Complementary. It is clear, that if we would not be interested in the nature of the particle and consider it just as an indivisible point then the principle of Complementary is correct. It is a very curious principle and it is amazing how N. Bohr could invent it.

In recent years a numerous of experiments was carried out, which found out superluminal speeds. Not debating if the special theory of relativity is right or not, let us show that in the Unified Unitary Quantum Theory (UUQT) any velocity is

possible and the velocity of light is not maximum possible.

Let us consider Euclidean plain space, in which the photon propagates along the X-axis. According to the UUQT it is a wave packet and it can be presented as an infinite sum of harmonic components, that exist on the X-axis, figuratively speaking, and are placed at a distance of a million light years ahead and backwards. Now if we place on the X-axis arbitrarily far some special device, creating an anomalistic high dispersion, then the photon can occur at the exit of the device, because the harmonic components shift each other. The most interesting in this process is that nothing has moved between incident and reconstructed photons at this velocity! With other words, the conventional definition of the velocity is getting obsolete [165, 166].

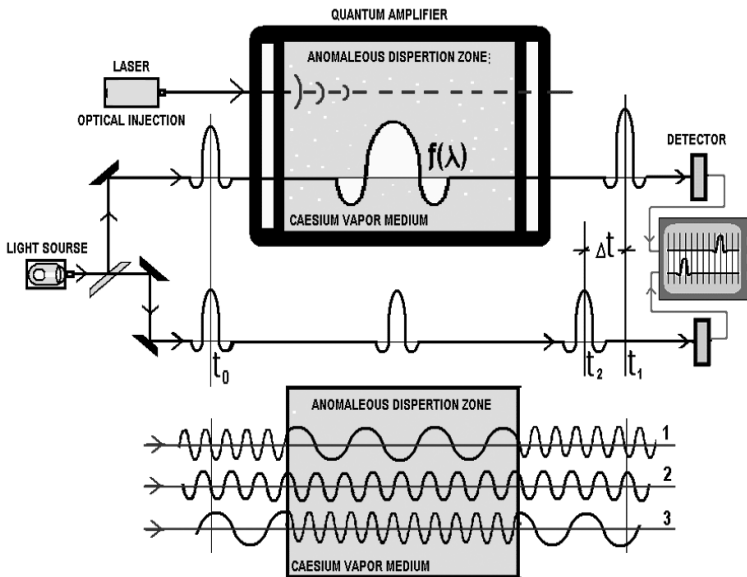


Fig. 4.4.5 Experiments of L. Wang - superluminal light propagation.

Such experiments were carried out by several teams (in Berkeley, Vienna, Cologne, Florence, etc.) and they emerged the superluminal speeds. The most

interesting were Lijun Wang's investigations [27] in which the velocity 310 times higher than the speed of the light (Fig. 4.4.5) was found. Wang gives the same interpretation as ours, but only for an impulse of light. In this case it was a wrong interpretation, because in the experiment the envelope of the light pulse was not distorted absolutely, but it had to be obligatory, and Wang noticed that it was amazed. He supposed that the special theory of relativity was absolutely destroyed. But it is not quite true.

Our idea that particles are wave packets is an absolutely original idea for the world wide science. The waves at the Fig. 4.4.5 have to be realized as separated partial waves of the spectral decomposition of the wave packets of the separated photons, but not as a spectral decomposition of the light pulse. Then the form of the momentum envelope will not be distorted.

The aspects of the Unitary Quantum Theory are confirmed by results of their practical applications to traditional tasks of physics. The UUQT allows for the first time in the international science, not either to compute the electron charge and the fine structure constant ($1/137$) with the great precision (0.3%) [6, 7, 165, 166] but even to compute masses of many elementary particles [162, 164, 200, 201] (with the accuracy of 0.1-0.003%)! It is amazing that in the calculated spectrum of masses there is a particle mass about 131.7 GeV ($L=2$, $m=2$) that can be called Higgs boson [202].

The Modern Standard Model and quantum theories of field couldn't even raise these problems mathematically. It should be stressed that when we will find the spectrum of masses and charge of electron, time won't be a part of the ultimate equations and it will stay Newtonian. In the Unified Unitary Quantum Theory all interactions and particle production (packet split) are considered as an effect of diffraction of the packets by each other because of the nonlinearity. An analytical solution of these tasks will require new mathematical methods, and it is not even

clear how to start with it at presence.

(VI) Approximated Equation with the Oscillating Charge

There are strong hard rules in the modern theoretical physics. Any new theory has to include classical results. This is strictly satisfied because the Hamilton-Jacobi relativistic equation and Dirac equation follow from the UUQT, i.e. all modern basics of the fundamental quantum science. In the linear equations of the UUQT the mass is replaced by the rest energy divided to square speed of light, and then the system of 32 nonlinear integro-differential equations appears as a consequence. They were firstly found out by L. Sapogin and V. Boichenko [8] in 1984, and only in 1988 they solved the dimensionless scalar version of this equation that allowed to get the fine structure constant $1/137$ and electron charge with accuracy 0.3% [6, 7, 165, 166].

In this approximation of the UUQT, the wave packet is realized as a spatial divided electric charge that oscillates, its equation depends on time, coordinate and velocity and it could work in the rough model of the particle as oscillated charge, so we can exploit the Newton equations. It is becoming easy to see the tunneling effect: while the moving particle is approaching to the potential barrier, in the phase when the charge is extremely small, it is easy for it to go through the barrier, and when the quantity of the charge is large, the repulsion force is increasing, and the particle will be reflected. The numerical solution of these equations [172, 183, 200, 201], for the most common quantum tasks emerges approximately the same results as the calculation of the general Quantum Mechanics (QM). By the way, by means of the UUQT it is possible to get this equation from the Schrodinger's one with very low energies [172, 183, 200, 201]. But there are though some interesting differences. The equations of motion of the oscillated charge were not treated in physics before and they have an important

difference from the classical laws of motion - the invariance of the motion in the relation to invariance translations. It means the absence of the great classical momentum and energy conservation laws. They appear in the UUQT and then in the classical mechanics only with an averaging for all particles.

Now we obtain Uncertainty relations [200, 201]. As far as the particle (wave packet) is periodically appearing and vanishing at de Broglie wave length (more precisely, the packet disappears twice, and the probability of its detecting is sufficiently big in maximum region only) the position of such a packet may be detected with error

$$\Delta x \geq \frac{\lambda}{2} \text{ and then } \Delta x \cdot P \geq \frac{h}{2}$$

As at measuring of momentum module is inevitable the error $P = 2P$, then we have following inequality: $\Delta x \cdot \Delta P \geq h$. The statements of standard quantum mechanics that particles do not have a trajectory become more understandable. Of course, there is a lot of truth in these words. First, it is possible to say so about intermittent (dotted) motion of the particle with oscillating charge. Second, any packet (particle) is able during its motion to split into few parts. Each of these parts being summed with vacuum fluctuation may product, in principle, some new particles. Or visa versa the broken particle may vanish at all and contribute to general fluctuating chaos of the vacuum. But in any case it is better to have more clear idea of particle concrete motion than operate with generally accepted nowadays-obscure sentence about lack of trajectory.

The consideration of the problems concerning oscillations of particles with an oscillating charge in a parabolic well (harmonic oscillator) besides the common results of QM for stationary states results in two different solutions that are shown on Fig. 4.4.6. New amazing solutions appeared, one of them was called

“Maternity Home” and another was called “Crematorium”. In the first case the energy of the particle can increase indefinitely, furthermore if we proceed from a very low initial quantity in the equation, it results in the increasing of the energy of the particle in the production of the matter, indeed. The second solution could due to collapse (disappear) of the matter-particle. These solutions are logically independent directly, and their appearance depends on initial phase. With other words, one solution describes the matter (energy) production, and another one its collapse; and it may be said that the Unified Unitary Quantum Theory (UUQT) allows to describe the creation of the matter and the Universe, but not as a result of the Big Bang. The Universe wouldn’t be given to us in the static form, it arose in some way and it continues to develop, and we could see that one of the basic features is the filling of space by matter.

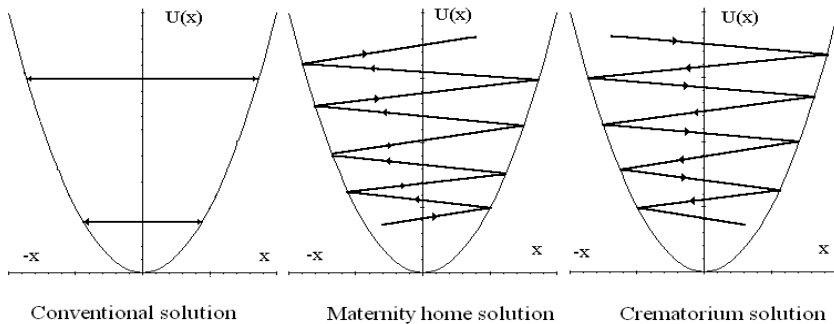


Fig. 4.4.6 Possible solutions for the harmonic oscillator.

(VII) New Sources of Energy

As well known, in all experiments the local law of energy conservation (LEC) and the law of conservation of momentum in individual quantum process are correct only for high-energy states. For low energies we can’t claim that, because of the uncertainty relation and the stochastic nature of QM’s predictions. That is why the idea of the global, but not of local LEC exists invisibly in the QM and it

is not a new one.

For the physics it only means that for the stationary solution with fixed discrete energy levels (the general QM) of the velocity of the particle reflected by a wall is equal to incident one. The UUQT allows to consider another ways too. Thus if the velocity of the particle for every reflection is decreasing, then it corresponds the “Crematorium” solution, but if it is increasing, then it corresponds the “Maternity home”. What scenario will turn to the reality depends on the initial phase of the wave function and on the energy of the particle. Besides the UUQT is fundamentally inapplicable for closed systems, because such systems are idealizations, which are very useful, but not according to the base of consideration used in the UUQT.

Anyway, the whole modern science, including the Quantum Mechanics (QM), is still based on the great LEC. However, there is a difficult situation in the Quantum Mechanics. It deals with the fact that the LEC follows only from the Newton mechanics. QM generalizes the facts of the classical mechanics including all of its laws, but its results have a sufficiently statistical nature, they are correct only for large amounts of particles. But how do we have to consider single particles, with their individual processes? It appears that for the single particles LEC does not follow from QM (!), thus individual events are absolutely incidental and do not follow this law. To evade this question it was announced that Quantum Mechanics does not describe individual events (!?)

Let us discuss a thought experiment. To make our reasons more simple let operate a certain quantum ball-particle. If the ball is approaching to the wall, then its velocity after reflection will always be equal to the incident velocity (here we neglect a quantity of the friction force and consider that the ball and the wall are perfectly elastic). In the case of the quantum ball the velocity after the reflection would possess the whole arrange of the values, in different experiments under

equal conditions. There would be some balls that would be reflected with velocities that are higher and some that are lower than the initial velocity, and some of them with velocities equal to the incident one, and every case would be considered statistically in the terms of the Quantum Mechanics.

Let us answer the following question: what would happen if we placed another wall opposite the first, and tried to increase the velocity of the ball after every reflection? Then we would get increasing of energy of the ball without action of any external force. The energetic of the systems in the XXI century will treat the question of constructing of initial conditions for a numerous quantity of particles to realize only the “Maternity Home” solution so that the “Crematorium” solution would be damped as far as possible. But it depends on the selection of initial phases and the geometry of the system.

Thus, if we use the ideas of the Unified Unitary Quantum Theory appropriately then a general prohibition for creating of a quantum perpetuum mobile does not exist. Formally there is no such a prohibition even in the general Quantum Mechanics, because there are no conservation laws for a single process under the low energy conditions, but it treats with probabilities instead of this. In other words, the Quantum Mechanics (QM) also offers opportunities for getting energy by collecting of random process somehow. It seems that UUQT affords today such an opportunity and suggests the ways how to regulate the values of probabilities.

Together with theoretical investigations plentiful of numerical solutions of equations with oscillating charge were performed, momentum of particles falling with different velocities were summarized and the result was compared to momentum of reflected particles. It was found out that for different repulsive potentials, the total momentum of reflected particles was equal to momentum of the falling particles with a high accuracy, but for a single scattering particle the value of momentum could be either less or more than the momentum of the falling

particle. This problem is very complicated and it requires subsequent researches as all this depends on initial conditions (velocity, phase, distance) complexly as well.

The prospects following from the UUQT are not even the most significant. Any flat bans as the impossibility of perpetuum mobile creation and any other confirmation of the immovability of conservation laws are unacceptable in philosophy. No, these laws will never be neglected; but there will be such areas in science and technology, very limited in the beginning, so that these laws will be not enough.

The problem of existing of the global conservation laws (we have proved that they are not local laws) is left in abeyance. Nothing but the idleness and atavism of the human thinking lead to it. But this idleness of thinking - concerning the physics - manifests itself in the intuitive atavism for the Newton laws.

Yes, the conservation laws are incontestable in the classical mechanics and in terms of this theory a continuously operating machine is theoretically impossible. It should be stressed that the conservation laws were transferred to the Quantum Mechanics as an object of worship of the classical mechanics. But the Quantum Mechanics is more fundamental, Newton laws follow from it as a particular case. And if in the terms of the Unitary Quantum Mechanics a possibility to get energy from nothing is theoretically possible, thus a quantum perpetuum mobile can be constructed.

It is made possible by means of the equation with oscillating charge. It describes single particles; the difference in their behavior depends on the initial phase of the wave function, but there are no conservation laws for an individual particle at all, they appear only after an ensemble averaging. The equation with an oscillating charge is absolutely new type of motion equation [200, 201, 172, 183]. For such equation energy and impulse conversation laws do not exist. It appears

after the ensemble averaging. By the way Schrodinger mechanics also does not propose energy conversation laws for small energies (it can offer only a probability of this or that event happening) but it cannot advise how to combine processes and energy liberation while UQT can. A theorem on the circulation does not work in the equation with oscillating charge that allows using different way to move charge from the point A to the point B, but different ways operations will be diverse and this difference should be used.

The authors are trying to design new power plant working at these principles. We think that such a plant will be able to produce energy with extremely small spending of energy. If such power program was fulfilled on our Planet then it would be no doubt result in overheating of the environment. But UQT suggests the solution again: we can construct refrigerating plants which realize the “Crematorium” solution and promote the cooling. Extra heat will disappear. Numerous experiments with the cold nuclear fusion (including the latest of Andrea Rossi - Italy) have shown that nuclear reactions do exist but the nuclear reactions products by themselves are not enough for the explanation of huge amount of heat being produced. It is the responsibility of the UQT solutions “Maternity Home” [200, 201, 172, 183]. So it looks like catalysis mechanism [200, 201, 185, 197]. Besides all the equation with oscillating charge is quite good in describing the wave properties of the particle. We predict that experiments on the diffraction reflection of electrons from the lattice (classical experiments of Davisson Germer) can be simulated by supercomputer, but authors do not have such possibility.

Interestingly enough, there are devices called Testatik Machine M/L Converter from religious group Methernitha. They belong to a religious Christian commune, situated in Linden near Bern. They were created by Swiss physicist Paul Baumann living in the commune. These fantastic devices run as direct current

generators, are made as a four dimensions (sizes) type with power value of 0.1, 0.3, 3 and 10 kW. In outward appearance this device resembles an electrostatic machine with Leyden jars, so familiar from school physics laboratory. There are two acrylic discs with 36 narrow sectors of thin aluminium stuck to it. The discs rotate in different directions and their mechanical energy is hundreds times lower than produced energy it accounts for about 100 mW in measurements. The largest device with the power value of 10 kW has disc diameters more than 2 m, and the smallest has 20 cm; the device with the power value of 3 kW has 20 kg in weight. There is no cooling or heating of the air during the long operation of the device, it just smells of ozone there. It was found out that the inventor doesn't clearly understand the principle of operation of the device.

Professor S. Marinov (Austria), whom the commune had given as a present the device with the power value of 100 W wrote in his book called "Difficult way to the truth - documents on the violation of conservation laws", issued in 1989 by International Publishers East-West: *"I can confirm without any doubt that this device is a classical perpetuum mobile. Without any initial impact, it could rotate an unlimited long period of time and generate electrical energy equal to 100 W... In that device, the motor and generator are connected... However, it is not clear how it is possible"*.

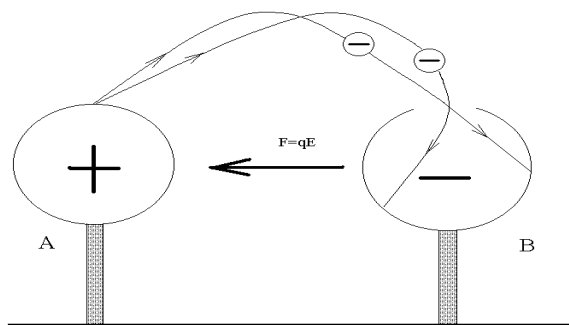


Fig. 4.4.7 Work for transferring the charge depends on the mode of transferring and on the path.

The authors of the Unified Unitary Quantum Theory know approximately how this device is constructed, but in this article we are going to do only what is absolutely clear: we are going to show that the operation of this device completely corresponds with the UUQT. Evidently, it operates due to the charge separation concept.

Let us consider two metallic spherical surfaces with a hole isolated from the Earth and from each other. If we carry a first electron from sphere A to the inner surface of sphere B through the hole by means of an isolated stick, then there appears a potential difference. Further, if we carry the second one and the subsequent electrons, sphere A will attract the carried charge, and B -will repeal it. It is clear that to move the charge we will have to spend energy. (Fig. 4.4.7).

In the Technical University MADI (Moscow) professor V. I. Uchastkin gives lectures on the Unified Unitary Quantum Theory (UUQT) and new energy sources. In his explanations, he uses the figurative analogy: Let us consider a sack of potatoes which mass is m . If we carried it to the fourth floor (the height is h), then we spend the quantity of work opposite to the gravitational field which is equal to mgh . And if we threw it down we would get kinetic energy $mv^2/2$, and these quantities would be equal to each other. But we could also carry not the whole sack, but every potato one by one. The work of one quantum of a potato s transfer depends on time, velocity and coordinate, and it must be carried in such way that the spent work would be minimal. If you carry the whole sack in this way, you can get the quantity $mv^2/2 > mgh$. So, there are no changes in the system, but the energy has appeared.

(VIII) Conservation Laws and Unitary Quantum Theory

Inventors and swindlers of every stripe and range many years tried to construct or even to design perpetuum mobile, i.e. imaginary mechanism able to work without outside energy supply. Peter the First (Russian Emperor Peter Great) had even established Russian Academy of Science for such researches (see. V. L. Keerpechev, “Talks about mechanics”, Gostechisdat, 1951, page 289), but today persons from modern Russian Academy of Science do not like to recollect that circumstance. At the other side French Immortals have decided in 1775 to consider no projects of perpetuum mobile, and it seems they have not been mistaken yet. However one mistake is known: Daniel Bernoulli was awarded a prize by French Academy for mathematical proof that a boat with engine and screw propeller would never have faster speed than sailing ship!

Magnificent successes of classical thermodynamics have strengthened Humanity confidence in Divine Infallibility of Conservation Laws. Today it is considered nearly indecent to call in question these laws.

First of all let us clarify the origin of conservation laws in classical mechanics [165, 166, 200, 201]. Nearly each textbook contains a statement that Energy Conservation Law (ECL) results from homogeneity of time, Momentum Conservation Law results from homogeneity of space, and Angular Momentum Conservation Law – from isotropy of space. And so many people are impressed that Laws themselves result from space-time properties that nowadays they are no doubt relativistic conception. But for example angular momentum is not a relativistic conception already. Therefore such restricted approach is not totally correct; Newton's second law of motion or relativistic dynamics equation and concept of system closeness should be attracted. More over the requested space-time properties themselves are usually wrongly being interpreted. For

example, it is assumed that time homogeneity means simple equivalence among all moments of time and homogeneity and isotropy of space means equivalence of all its points and absence of preferential direction in space (all directions are equal) correspondingly.

But these statements are *sensu stricto* wrong. For example, within many mechanical systems the Earth center direction and horizontal direction differ in principle (for example, pendulum clock located in horizontal plane will not work at all). We can say the same about the body being at the top of the hill, it is able to roll down independently, but according to classical mechanics it never climbs by itself. And for a person, being young or old, these moments of time are not equal at all. Hereinafter we would like to explain in what way all that should be understood.

Time homogeneity implies that, if at any two moments of time in two similar closed systems somebody runs two similar experiments, their results would not differ.

Space homogeneity and isotropy means that if closed system is moved from one part of the space to another or oriented in other way, nothing would be changed.

Derivation of energy and momentum conservation laws from Newton equation is quite simple in idea. Viz., let us write down the main equation of dynamics in form of

$$\mathbf{F} = \frac{d\mathbf{P}}{dt}$$

For closed system $\mathbf{F}=0$ (there are no external forces) and the equation possess the integral

$$\mathbf{P} = \text{Const}$$

expressing the momentum conservation law.

Now let's write the main equation of dynamics in the form:

$$\mathbf{F} = m\mathbf{a} = m \frac{d\mathbf{v}}{dt}$$

and scalar-wise multiply it by \mathbf{v}

$$\mathbf{F} \cdot \mathbf{v} = m \frac{d\mathbf{v}}{dt} \cdot \mathbf{v} = \sum_{i=1}^3 m \frac{dv_i}{dt} v_i = \sum_{i=1}^3 m \frac{d}{dt} \left(\frac{v_i^2}{2} \right) = \frac{d}{dt} \left(\frac{m\mathbf{v}^2}{2} \right),$$

where v is a modulus of velocity vector \mathbf{v} . For the closed system $\mathbf{F}=0$ it exists the integral

$$\frac{m\mathbf{v}^2}{2} = \text{Const}$$

expressing one of the forms of energy conservation law.

Using the definition of the angular momentum for the particle, i.e.

$$\mathbf{L} = [\mathbf{r} \times \mathbf{P}]$$

and differentiating it both parts by t , we obtain

$$\frac{d\mathbf{L}}{dt} = \left[\frac{d\mathbf{r}}{dt} \times \mathbf{P} \right] + \left[\mathbf{r} \times \frac{d\mathbf{P}}{dt} \right]$$

As the momentum vector is parallel to velocity vector, the first bracket is equal to zero. And basing on the equation and on definition of central force, as one not creating a momentum, we get

$$\left[\mathbf{r} \times \frac{d\mathbf{P}}{dt} \right] = 0$$

and

$$\mathbf{L} = \text{Const.}$$

In the case of central force within unclosed system angular momentum remains constant in value and direction.

The energy and momentum conservation laws can be easily obtained within relativistic dynamics from relativistic relation between energy and momentum

$$E^2 = P^2 c^2 + m^2 c^4$$

The term $m^2 c^4$ is an invariant, i.e. it is similar within all reference frames. In other words it is a kind of constant. This relation can be written in rather different form

$$E^2 - P^2 c^2 = \text{Const}$$

To satisfy that relation one should admit that

$$E = \text{Const} \quad \text{and} \quad P = \text{Const}$$

And that is nothing else than energy and momentum conservation laws.

But strictly speaking in relativistic mechanics there is a law of conservation of four-momentum vector P^μ , but we are not going to stop at these details.

In accordance with the classical mechanics, the energy conservation law signifies that energy of closed system remains constant, hence, if at the moment $t=0$ the energy of such system is denoted by E_0 , and at the moment t is denoted

by E_t , then

$$E_0 = E_t.$$

In accordance with standard quantum theory, the energy conservation law is laid down in the same way. Within that theory we have the same integrals of motion as in classical mechanics. Some value L is an integral of motion if

$$\frac{d\hat{L}}{dt} = \frac{\partial \hat{L}}{\partial t} + \left[\hat{H}, \hat{L} \right] = 0 \quad (4.7.1)$$

As $\left[\hat{H}, \hat{L} \right]$ is determined by commutator of operator \hat{L} and of Hamilton's operator \hat{H} , so any quantity L , being not evidently dependent on time will be an integral of motion if its operator commutes with \hat{H} . When quantity L is not evidently dependent of time, then the first terms in (4.7.1) vanishes. As remainder we have

$$\frac{d\hat{L}}{dt} = \left[\hat{H}, \hat{L} \right],$$

and, as we know, the quantum Poisson bracket vanishes for the integrals of motion being not evidently dependent on time. Thus,

$$\frac{d}{dt}(L) = 0.$$

In any good work dealing with quantum theory it is shown that probability w to observe at any moment t any value of such motion integral L , does not

depend on time at all. We will denote below such integrals of motion L_n . As far operators \hat{L} and \hat{H} commuted they had common eigen-functions that were functions of stationary states. We should note that the last were obtained from solution of Schroedinger equation without time (not containing t) which is derived from full Schroedinger equation if

$$\Psi(\mathbf{r}, t) = \Psi_0(\mathbf{r}) \exp\left(i \frac{E}{t}\right),$$

i.e. if this equation has the periodic solutions. The solutions of Schroedinger equation not containing t satisfy conservation laws, which are, in fact, dictated by condition of total time-independence. The expansions of such solutions in eigen-functions' have the form

$$\hat{L} \Psi_n = L_n \Psi_n,$$

$$\hat{H} \Psi_n = E_n \Psi_n,$$

where

$$\Psi(x, t) = \sum_n c_n \Psi_n(x) \exp\left(-i \frac{E_n}{\hbar} t\right) = \sum_n c_n(t) \Psi_n(x),$$

$$c_n(t) = c_n \exp\left(-i \frac{E_n}{\hbar} t\right) = c_n(0) \exp\left(-i \frac{E_n}{\hbar} t\right).$$

As $c_n(t)$ is eigen-functions' expansion of the operator L_n , the probability does not depend on time, i.e.

$$w(L_n, t) = |c_n(t)|^2 = |c_n(0)|^2 = \text{Const}$$

We should note once more that it is the probability to observe some given value that is time-independent, while the value itself is occasional in each individual case. As far the energy is an integral of motion and probability $w(E, t)$ to find out at the moment t energy value to be equal to E is time-independent, then:

$$\frac{dw(E, t)}{dt} = 0$$

Quantum energy conservation law in the above mentioned form assuming the possibility not to take into account energy determination at the current moment of time and its uncontrolled changes due to influence of the process of measurement itself. That situation does not raise any doubts within classical mechanics. But according to quantum theory (as we have written already in [13-15]), the energy can be measured without disturbance of its value only up to

$$\Delta E \geq \frac{\hbar}{\tau},$$

where τ - is the duration of measuring process. Formally, there are no troubles for energy conservation law, as the energy is the integral of motion and we have arbitrary large time interval to accomplish long measuring. For example, let measure within time τ , then leave the system alone for the time T , and then measure the energy once again. The energy conservation law in standard quantum mechanics states that the result of the second measuring will coincide to

$$\Delta E \approx \frac{\hbar}{\tau} \text{ with the results of the first measurement. But even according to}$$

standard quantum theory all this is not totally logical, because really existing vacuum fluctuations may meddle and they are able to change the result. Here we have evident violation of conservation law due to vacuum fluctuations, although the integrals of motion exist (contrary to UQT). The standard quantum theory

carefully avoids the question of conservation laws for single events at small energies.

Usually that question either does not being discussed at all, or there some words that quantum theory does not describe single events at all. But these words are wrong, because the standard quantum theory describes, in fact, single events, but is able to foreseen only the probability of that or other result can be added. It is evident that at that case there are no conservation laws for single events at all. These laws appear only after averaging over a large ensemble of events. As the matter of fact it can be easily shown that classical mechanics is obtained from quantum one after summation over a large number of particles. And for a quite large mass the length of de Broglie wave becomes many times less than body dimensions, and then we cannot talk about any quantum-wave characteristics any more.

It is well known that local laws of energy and momentum conservation for the individual quantum processes are valid within all experiments at high energies only. We cannot say so in the cases of low energies at least due to uncertainty relation and stochastic nature of all predictions in quantum theory. The idea of global but not local energy conservation law is invisibly presenting in quantum mechanics and in any case is not new. From the physical viewpoint it just means that in stationary solutions with fixed discrete energies (standard quantum mechanics) the velocity of a particle reflected from the wall is equal to the velocity of an incident particle. If the particle energy decreases at each reflection, then that case corresponds to solution type “Crematorium” and if increases – to “Maternity Home” solution. The scenarios under which events will be developed depend on the initial phase of the wave function and particle energy.

In the strict Unitary Quantum Theory and in the theory of quantum measuring

(chapter 1.6) un-removable vacuum fluctuations have a great role. It is quite clear that these fluctuations are totally unforeseen and non-invariant with respect to space and time translations. In other words, within UQT there are no habitual space-time properties. Now space-time is heterogeneous and non-isotropic. For example, if the experiment is replaced in any other point of the space or repeated at other time, then in the point where the particle's parameters were examining and particle was interacting with macro-device, another value of vacuum fluctuations would appear (differing from the previous one) that would give another result. Of course that is true for small energies and individual events (particles) only.

The Unitary Quantum Theory is much more destructive with regards to the notion of Closed System. For single events at small energies that notion is inapplicable at all because at any moment of time and in any place where the particle is located (for example, within potential hole) vacuum fluctuation may be abruptly changed. It may occur thanks to various causes; either due to the nature of vacuum fluctuations, or due to the tunneling effect of other random particle.

Sometimes it is stated that energy conservation laws follow from E. Noether theorem, although those results have been contained in the works of D. Gilbert and F. Klein. For any physical system, the motion equations of which can be obtained from variation principle, every one-parameter continuous transformation, that is keeping the variation functional invariant, corresponds only one differential law of conservation and then there exists explicitly conserved quantity. However, it can be easily seen that vacuum fluctuations being imposed on varying functional (Lagrangian) does not remain constant (in any case it seems so today) under parametrical transformations. That consideration does not work too without ensemble averaging either.

In other words, all requirements that lead to classical laws of conservation are

absent now. It is hard to expect that the entire laws of conservation will remain valid in that situation for the single particles at small energies. But nowadays it seems that classical laws of energy, momentum and angular momentum conservation for the single quantum objects do not work at small energies due to the periodic appearance and disappearance of particles. All direct experimental checks of the conservation laws were carried out in the cases of great energies but in the cases of small energies for single particles probability results can be obtained only. In that case it is indecently even to recollect the idea of conservation law.

And now a bit of Philosophy for reader. Local Energy Conservation Law (LECL) for individual processes results from the Newton equations for closed systems. It is naive to think that its local formulation will remain constant forever. And it would be a gross error to transfer ECL without alterations from Newton mechanics to quantum processes inside microcosm. Definitely speaking references to the first law of thermodynamics are baseless because it is a postulate. For example, in his letter to one inventor the famous Russian mathematician N. N. Lousin wrote: “first law of thermodynamics was a product of unsuccessful attempts of the humanity to create perpetuum mobile and frankly speaking did not follow from anything”. Today we can say with more belief that no resourceful machines within the network of Newton mechanics are able to realize perpetuum mobile, and the decree of French Academy, accepted in 1755 to consider no projects of perpetuum mobile is still valid. We should add that is apparently true for all projects based on Newton mechanics only.

It is characteristic of the understanding the position ECL in modern physics that this law is bringing down, especially in theory, to the rank of second-order conclusion from the equations of motion. Some physicists reduce ECL to the statement of the first law of thermodynamics, others as for example D. I. Blochintsev [79] consider that “it is quite possible with further development

of new theory ECL form will be transformed”. As F. Engels wrote in his “Natural dialectics”: *“...no one of physicists does not, in particular, consider ECL as everlasting and absolute law of the nature, as a law of spontaneous transformation of substance motion forms and quantitative permanency of that motion at its transformations.”* Many of them are thinking in another manner as, for example, M. P. Bronshtein. He wrote in his work “Substance structure” ECL is one of the basic laws of Newton mechanics. And nevertheless Newton had not attributed to that law rather general character that law had in reality. The reason of that Newton mistaken point of view at ECL was quite interesting... Now it is understandable that in the light of the above mentioned such point of view was not wrong at all. And we should remind that Newton had foreseen in his “theory of bout” many things even quantum mechanics.

At the other side, the founders of quantum mechanics perfectly understood that the conservation law for the single quantum processes at small energies did not exist at all. So, the first thought that understanding of ECL on a par with the second law of thermodynamics, as statistical law, being correct on average and not applicable to the individual processes with small energies, appeared as despair and went back to Erwin Schroedinger first and then to N. Bohr, Kramers, Sleter and G. Gamov. In 1923 Bohr, Kramers and Sleter in despair tried to construct the theory according to which in the process of dispersion energy and momentum conservation laws were satisfied statistically on the average during long time intervals but were inapplicable to the elementary acts. Leo Landau even called that as “Bohr perfect idea”.

According to that theory, the process of dispersion should be continuous, but Compton electrons are emitted in a random way. The authors assumed both processes of wave dispersion and Compton electrons dispersion were not connected with each other (?). The main idea was to lay a bridge between

quantum theory of the atom and classical emission theory. There were introduced specially so called “virtual” oscillators which generate in accordance with classical theory waves (non quantum one) enable to induce the transition from the state with lower energy to the state with higher energy. These waves did not carry the energy, but power necessary for atom transition from lower to the higher state was generated within the atom itself. Along with that the inverse process of the atom transition from excited state to the lower one could take place, but the energy was not taken away by waves but should disappear inside the atom. In other words, the increase of one atom energy was not connected with energy decrease in another one. Authors considered that these processes compensated each other on average only and that compensation was the better the more events are participated. Energy conservation law has statistical character according to that interpretation, and there is no law of conservation for single events, but they appear in processes involving large number of particles, i.e. at transition to Newton mechanics. But then it should be acknowledged that in the case of Compton effect the changes of motion direction of the light quantum and its energy to be appeared in the result of collision were happening apart from the changes of electron’s state. The unfoundedness of such an approach was lately experimentally proved by Bote and Geiger. To say the truth, the authors abandoned that point of view later; moreover at that time this idea did not follow from quantum theory equations. And to get out of the tight spot it was declared that quantum mechanics did not describe single events at all. Thus the most striking paradox was removed by a simple prohibition just to think about it! But genius idea that laws of conservation are not valid for individual processes and appear in quantum mechanics after statistical averaging does not become less genius even if those for whom it “has come to mind” rejected it. May be, this idea was a little premature and should have a somewhat different shape. Contrary to that Unitary Quantum Theory describes single particles. And the alteration of

their behavior is determined not only by initial values of its position and velocity but also by initial phase of the wave function (of the wave packet). Then for the single particle local conservation laws do not exist at all. And that is quite another question how to measure the initial phase or any other parameters of a single particle.

Let us examine the following virtual experiment. For more simplicity let use in our reasoning some quantum ball-particle. If classical ball is running to the wall (for simplicity assume it as perpendicular), the velocity of the reflected ball would be equal to its initial velocity (we neglect friction and consider the ball and the walls as totally resilient). In the case of quantum ball the velocity of the reflected ball in various experiments with similar initial circumstances will have the whole spectrum of values: there will be balls reflected with the velocity higher than initial, equal to it and lower than initial. And all these will be described by means of quantum mechanics within uncertainty relation.

Let us ask what would be if we placed a second wall parallel to the first one in such a way the ball at each reflection increased its velocity? Then we would get the growth of the ball energy without any efforts from our side. The aim of future constructors of such systems of XXI century would be the necessity to create such initial conditions for the great number of particles forming the object, that is realized the sole solution “Maternity Home” and is suppressed as far as possible the other solution.

It is evident from the above-mentioned that at competent exploitation of the Unitary Quantum Theory ideas the principle prohibition for perpetuum mobile does not exist. Formally as it was shown above that prohibition does not exist even in standard quantum mechanics (there is no laws of conservation for single processes with small energies), and to get energy the particles should be selected in some way (grouping together all random processes with excess energy). But

the standard quantum mechanics refuses to describe single events and is not able to advise the way for grouping. As it seems today, the Unitary Quantum Theory gives us such an opportunity.

However, by efforts of scientific groups, interested in their own stability because of simple instinct of self-preservation the great idea of free energy generation was distorted to such a degree everybody who started to talk about it was taken for mad.

The modern experimental physics has examined the correctness of conservation laws for huge energies in single cases and for large macro-object when ensemble averaging is used, but the area of small energies is terra incognita.

(IX) Prospects

Let us remember the problem of the maintenance of long-term flights to the outer space with electricity. The Prof. Uchastkin's describes precisely a theoretical approach for solving this problem. Of course, there is a great deal to do though, to understand what phenomenon will play the role of those quantum potatoes and how to construct an instrument that would be able to support a minimal energy to bring them to the fourth floor. How can a spaceship be supplied with energy during many months of flight? Near the Earth, photovoltaic cells can be used but the more the distance from the Sun is increasing, the more needless they will; and the use of a nuclear energy source will be problematical for different reasons.

Today we can neither improve this situation considerably nor do we have even any theoretical conditions which could let us approach it. On the base of such a situation there are common ideas of the construction of matter and its properties. Now then, a new conception of physics is being proposed. Like many others as

well. If we stay by the space technology, it is over constructing of engines based on new principles of energy production, maintaining of real-time telecommunication on the distances in outer space, free of limits which are proper to the diffusion of electromagnetic waves. It follows from the foregoing that UUQT opens up a perspective of a solution for the communication problem on extremely wide distances in outer space, excluding the limits of information exchange between Earth and spaceship. The theory also predicts the approaches of creation of the new energy sources and of the new types of engines that would be almost ideal for creating of spaceships of the future.

Conventional jet propulsions transform the conducted energy in the kinetic energy of the beam of a working body flowing from the engine, and the reaction force of this beam the pulling force accelerate the spaceship. Therefore space flights to extremely wide distances will require huge stocks of working body. A classical progression curve reflects the velocity increasing of a thrown-off mass of the working body. Though there is a possibility for creating of a very weak constant pulling but (!) without throwing off of mass.

Let us use the method of analogy again. Regard a classical trick problem in physics for universities admission tests: there is a boat in motionless water and a man with a sandbag in this boat. Can he move the boat by performing any manipulations with the sandbag, for an endless time?

Correct answer: throw the sandbag from the front part of the boat to its back, then carry it back slowly, throw it again and so on. As the viscous friction force by Stocks is proportional to the velocity, the boat will perform swinging motions, over which some linear movement will be applied. Based on this idea, marsch buggies were constructed in Germany - there is heavy mass moving in there, in one direction quickly and back slowly. Many decades ago, the same effect (Dean's engine) was wide-ragingly discussed in the USSR in popular science

magazines and on TV.

There is a similar phenomenon in the classical electrodynamics as well as in the quantum electrodynamics and it is related to the Lorentz radiative friction force. The appearance of Lorentz force becomes evident by considering the interaction of the charge and the field caused by it. For a motionless charge the force of such an interaction or self-action is equal to zero, otherwise the free charge would experience a self-acceleration. The charge begins to move, but the electromagnetic field, as its spread velocity is finite, can't reschedule immediately. The accelerated charge practically flies onto its own field; with other words, this effect can be described as appearance of energy flow which is directed upstream to the flow and slowing it down. It generates electromagnetic viscosity which value is related to the acceleration.

How can this phenomenon be used? If there is a charge cloud in flat capacitor, it is possible to make it swing between sheets with different values of acceleration forwards and backwards by applying a sawing motion to the sheets. Because of different forces of radiation friction in the alternate and opposite direction, pulling force appears along the lines of electric field. The radiation of such accelerated charges is always perpendicular to their movement and can be screened, but the most important thing on it is the fact that it doesn't change its impulse in relation to the direction of the capacitor's field. It may be paradoxical, but it seems that we get a pulling force by spending energy for this process without throwing-off of any mass in the direction, which is opposite to the motion's one. The authors even published in the US-magazine *Journal of New Energy* vol.5, #1, 2000 an article, containing an exact analytical solution of this problem: the pulling of some micrograms appears in a flat capacitor, containing a cloud of 10^{19} electrons in which the distance between the sheets is many meters long, by applying of sawing potential of millions of volts. Of course, it is an

insignificant result in relation to such a huge (hypothetical) instrument employment, and the using of electron cloud in a flat capacitor has practically no prospects. But if stabile charged particles exist which mass is at least one billion of electron mass, then this idea becomes very interesting from the technical point of view. Do such stabile charged leptons exist at all and how is it possible to generate them in a sufficiently large number? Today nobody can give an answer...

To generate pulling it is still possible to throw off the mass/matter, created potential hole, accelerating in it in the same moment. Generally, UUQT allows such solutions that are evident from the “Maternity home” solution.

Let us consider the results. UUQT will in future let us solve several basic problems of the worldwide energy supply and all problems in outer space: immediate information changing, the problem of energy supply and constructing of new engine types. It is absolutely precipitant to make technical plans for those solutions, but the foregoing should be considered not as a wanton imagination, but as a possible future program of fundamental researches to transpose our civilization to new physical principles.

The UQT ideas are presented in instinctively absolutely clear picture of quantum events in terms of figures and movements. And philosophical principal of Complementarity can be now retired with well-deserved honors. In spite of mathematical complexity, the UQT delivers the physics from ordinary Quantum Mechanics paradoxes and consequently frank words of Richard Feynman: “*I can easily say that nobody understands quantum mechanics*” will become the property of history.

Moreover, it became possible:

1. to obtain after solving some QUT equations an electron charge with the

high precision;

2. to obtain after solving the scalar telegraph equation the mass spectrum of numerous elementary particles with appropriate precision the mass spectrums of numerous elementary particles[14-16, 18]. The same spectrum was followed from the solutions of the Schrodinger equation and Klein–Gordon integro-differential equations. The risk of computed mass spectrum being random is less than 10^{-60} . Of course such results cannot be obtained without sacrifice. What would be offered in sacrifice if Ordinary Quantum Mechanics is replaced by the Unitary Unified Quantum Field Theory (UUQFT):

- There are no in UUQFT strict principles of superposition. It is violated if wave packets are colliding.
- There are no strict close systems in UUQF and the Conservation Laws work for big energies only. Note that the Conservation Laws forbid beginnings of the Universe.
- The classical relativistic relation between energy and impulses is valid in UUQFT only after averaging of observed phenomena and Relativistic Invariance itself is not “the sacred cow”.
- The Space in UUQFT is not homogenous and not isotropic.
- The particles and their interaction are not local.
- The existing Standard Model Quantum Theory of Elementary Particles requires much alteration.
- The velocity concept as quotient from division of the traversed path to sometime interval is not quite appropriate in UQT.

If a wave packet (particle) is spreading along the Metagalaxy and then appearing somewhere else, what should we do with the rate, if nothing moves between the points of disappearance and arrival, does it mean that particle has just simply disappeared and then appeared in a new place? There was observed resembling crushing defeat of physics 50 years ago as “weak interaction” burst, so to say, into physics. As soon UQT is nonlinear, it automatically combines all four interactions that can pass from one into another distance. Below we analyze the most important fields of science from UUQFT general physics positions.

(X) Lorentz Transformations

It’s quite complicated [200, 201, 182, 196, 198]. The special relativity is in fact of Lorentz transformations (1904) derived by V. Vogt (1887) in the century before last. These transformations followed from the properties of Maxwell equations which were also proposed in the nineteenth century (1873). One of these equations connecting electrostatic field divergence and electric charge (Gauss' law of flux), in fact is just another mathematical notation of Coulomb's law for point charges.

But today anybody knows that Coulomb’s law is valid for fixed point charges only. It doesn’t work for the frequently moving charges. Besides anybody knows that lasers beams are scattered in vacuum one over another, which is absolutely impossible in Maxwell equations. That means that Maxwell equations are approximate - and for the moving point charges experimental results essentially differs from the estimated ones in the case charges areas are overlapping.

Few people think about the shocking nonsense of presenting in any course of physics of point charge electric field in the form of a certain sun with field lines symmetrically coming from the point. But electric field is a vector, and what for is it directed? The total sum of such vectors is null, isn’t it?

There are no attempts to talk about, but such idealization is not correct. We should note that Sir Isaak Newton did not use term of a point charge at all, but it is ridiculous to think that such simple idea had not come to him! As for Einstein, he considered “electron is a stranger in electrodynamics”. Maxwell equations are not ultimate truth and so we should forget, disavow the common statement about relativist invariance requirement being obligatory permission for any future theory.

To reassure severe critics we should note that UQT is relativistic invariant, it allows to obtain correct correlation between an energy and impulse, mass increases with a rate, as for relativistic invariance just follow of the fact that the envelope of moving packet is quiet in any (including non-inertial) reference systems. To be honest we should note that subwaves the particles consist of are relativistic abnormal, at the same time envelope of our wave packet being immovable in all coordinate-systems corresponds to of Lorentz transformations.

The success of Maxwell equations in description of the prior-quantum view of world was very impressing. Its correlation of the classical mechanics in forms of requirement to correspond Lorentz transformations was perfectly confirmed by the experiments that all these had resulted in unreasoned statement of Maxwell equations being an ultimate truth.

Other reasons for this were later very carefully investigated by a disciple of one of the authors (L. S.), Professor Yu. L. Ratis. (S. Korolev Samara State Aero-Space University), who has formulated the modern spinor quantum electrodynamics from the UQT point of view:

1. Maxwell equations contain constant c , which is interpreted as phase velocity of a plane electromagnetic wave in the vacuum.

2. Michelson and Morley have never measured the dependence of the velocity of a plane electromagnetic wave in the vacuum on the reference system velocity as soon plane waves were mathematical abstraction and it was impossible to analyze their properties in the laboratory experiment in principle.
3. Electromagnetic waves cannot exist in vacuum by definition. A spatial domain where an electromagnetic wave is spreading is no longer a vacuum. Once electromagnetic field arises in some spatial region at the same moment, such domain acquires new characteristic, because it became a material media. And such media possesses special material attributes including power and impulse.
4. Since electromagnetic wave while coming through the abstract vacuum (the mathematical vacuum) transforms it in a material media (physical vacuum) it will interact with this media.
5. The result of the electromagnetic wave and physical vacuum interaction are compact wave packets, called photons.
6. The group velocity of the wave packet (photon) spreading in the media with the normal dispersion is always less its phase velocity.

All abovementioned allows making unambiguous conclusion: the main difficulties of the modern relativistic quantum theory of the field arose from deeply fallacious presuppositions in its base. The reason for this tragic global error was a tripe substitution of ideas - velocity of electromagnetic wave packets 'c' being obtained in numerous experiments physics was adopted as constant 'c' appearing in Maxwell equations and Lorentz transformations. Such blind admiration of Maxwell and Einstein geniuses (authors in no case do not doubt in the genius of

these persons) had led XX century physics up a blind alley. The way out was in the necessity of revision of the entire fundamental postulates underlying the modern physics. Exactly that was done by UUQFT [165, 166, 200, 201].

Some time ago CERN has conducted repeated experiments of the neutrino velocity measurement that appeared to be higher than velocity of the light. For UUQFT they were like a balm into the wounds. The administration of CERN renounced after sometimes these results considering them as the consequence of experimental errors. As far as the authors know, not all participants of this experiment have agreed to such renouncing. Besides, many astronomers detect superluminal velocities during observations of stars and galaxies [169, 189]. In fact the movements in excess of the light velocity were discovered earlier by numerous groups of researches. Nearly everybody disbelieved it [169, 189]. The importance of these experiments for UUQFT is settled in the article [166] where at the page 69 it is written that this should be considered as direct experimental proof of UUQFT principle.

Other ideas also exist [190, 191]. For example, at «New Relativistic Paradoxes and Open Questions», Florentin Smarandache shows several paradoxes, inconsistencies, contradictions, and anomalies in the Theory of Relativity. According to the author, not all physical laws are the same in all inertial reference frames, and he gives several counter-examples. He also supports superluminal speeds, and he considers that the speed of light in vacuum is variable depending on the moving reference frame.

The author explains that the red shift and blue shift are not entirely due to the Doppler Effect, but also to the medium composition (i.e. its physical elements, fields, density, heterogeneity, properties, etc.) Professor Smarandache considers that the space is not curved and the light near massive cosmic bodies bends not because of the gravity only as the General Theory of Relativity asserts

(Gravitational Lensing), but because of the Medium Lensing.

In order to make the distinction between “clock” and “time”, he suggests a first experiment with a different clock type for the GPS clocks, for proving that the resulted dilation and contraction factors are different from those obtained with the cesium atomic clock; and a second experiment with different medium compositions for proving that different degrees of red /blue shifts would result. To our regret, the authors today have no decisive position to these complicate questions.

Note, this question is terribly complicate and probably is to be leaved to next generations. From one side, the time in UQT exists, so to say, in our head only. From other side, the Lorenz Transformations describe correctly some experimental facts, for example, the mass growing with velocity. Otherwise, all atomic accelerators would be out of order. Thereafter, it is a big mistake to consider all Special Relativity Theory as erroneous. The attitude to the Special Relativity Theory is today highly vague and may be compared in full with the discussion among painters about significance of the Malevitch picture “The black square”.

Curiosity from the another side the Special Relativity Theory declares that the spreading velocity of the information and of the signals cannot exceed the light velocity. At the same time today it is well known that the gravity interaction spreads with the velocity exceeding many times the light velocity. Laplace has obtained corresponding estimates long ago. But this problem is not discussed in any way in Special Relativity.

There is a statement in Special Theory of Relativity that affects the mankind like a sleep-inducing mantra-paradox: suppose there are two observers with rules and watches sitting in two objects and moving straight-line and with constant speed in direction to each other. Then from the 1st observer point of view the

watch of the 2nd observer is slow because he is moving. But the 2nd observer can (?) stipulate that he is at rest and the 1st observer's watch is slow. To find out which watch is slow indeed the observers should meet, but that will infringe the terms of inertia – constant and steady motion. The experiment shows the returning watch is slow and this time lag relates to the changes of the gravity potential. But if we return the rules their lengths will not be changed, and that is quite strange because both effects are closely associated.

We would like to show this mantra is absolutely false. Imagine the 1st observer is sitting of the rain drop falling with the constant speed in the terrestrial gravitational field, while the 2nd observer is on the Earth. By this doubtful statement of Special Theory of Relativity the 1st observer can say that his drop is at rest and that the 2nd observer together with the Earth is flying towards him. If observers are not absolute idiots the first observer should ask the second about the source of such a great amount of kinetic energy. This statement can have a little sense only if the masses of the 1st and 2nd objects are equal. The main problem is misunderstanding that any motion is absolute, this idea is thoroughly discusses by the authors in the recent works [205, 206].

(XI) Standard Model

As soon relativistic invariance underlies every of the numerous quantum theories of the field, it leaves a devilish imprint at everything. Nevertheless relativistic ratio between energy and impulse although being absolutely correct in fact are not obligatory follows from relativistic invariance only and can result from another mathematical reasons that will be discovered in future. Nowadays Standard Model (SM) contains the most elegant mathematical miracles of researches which hands were tied with relativistic strait-jacket and it not so bad describes these experimental data. Amazing that it was possible to think it out at all.

Nowadays to confirm SM one should find a Higgs boson and for this purpose the governments of some countries assigned essential sums for the construction of Large Hadrons Collider (LHC). For entire SM the interaction with Higgs field is extremely important, as soon without such a field other particles just will not have mass at all, and that will lead into the theory destruction.

To start with we should note that the Higgs field is material and can be identified with media (aether) as it was in former centuries. But SM authors as well as modern physics have carefully forgotten about it. We would not like to raise here once again the old discussion about it. It is a quite complicated problem and let us leave it to the next generation.

But another problem of SM has never been mentioned before: in the interaction with Higgs field any particle obtains mass. As for Higgs boson itself, it is totally falling out of this universal for every particle mechanism of mass generation! And that is not a mere trifle, such mismatching being fundamental fraught with certain consequences for SM.

After Higgs boson discovery nothing valuable for the world will happen except an immense banquet. Of course boson will justify the waste of tens billions of Euros. But even now some opinions in CERN are expressed that probably boson non-disclosure will reveal a series of new breath-taking prospects and where were these voices before construction, we wonder? But that's not the point! If this elusive particle were the only weakness of SM!

To our regret today this theory cannot compute correctly the masses of elementary particles including the mass of Higgs boson. More badly, that SM contains from 20 to 60 adjusting arbitrary! parameters (there are different versions of SM). SM does not have theoretically proved algorithm for spectrum mass computation and no ideas how to do it!

All these bear strong resemblance to the situation with Ptolemaic models of Solar system before appearance of Kepler's laws and Newton's mechanics. These earth-centered models of the planets movement in Solar system had required at first introduction of so called epicycles specially selected for the coordination of theoretical forecasts and observations. Its description of planets positions was quite good; but later to increase the forecasts accuracy it had required another bunch of additional epicycles. Good mathematicians know that epicycles are in fact analogues of Fourier coefficients in moment decomposition in accordance with Kepler's laws; so by adding epicycles the accuracy of the Ptolemaic model can be increased too. However that does not mean that the Ptolemaic model is adequately describing the reality. Quite the contrary.

The Unitary Quantum Theory allowed computing the mass spectrum of elementary particles without any adjusting parameters. By the way computed spectrum [162, 164, 200, 201] has particle with mass 131.51711 GeV ($L=2$, $m=2$). Once desired it can be called Higgs boson, it lies within declared by the CERN+Tevatron mass interval 125-140 GeV expected to contain Higgs boson. CERN promises to obtain more precise mass value by December 2012.

Note the following remarkable fact: the standard theory allowed to detect spectra by using always the quantum equations with outer potential and as corollaries to geometric relations between de Broglie wave's length and characteristic dimension of potential function. The quantum equation of our theory does not contain the outer potential and describe a particle in empty free space; the mass quantization arises owing to the delicate balance of dispersion and non-linearity which provides the stability of some wave packets number. It is the first case when spectra are detected by using the quantum equations without outer potential.

(XII) Nuclear Physics

Nuclear physics as a part of quantum theory is very luckless. Thus the potential of the strong interactions is so complicated that no one even very bulky and intricate mathematical expression is able to describe with more or less veracity the experiments of two nucleons interaction. This interaction depends in very complicated manner from all parameters of the nucleons movement and their orientation towards vectors of velocity, acceleration, spin, magnetic movement, etc. Scarcely one can find a parameter which practice interaction does not depend on. From UQT point of view the strong interactions appear in the result of nucleons represented by the wave packets overlapping. Today the way of mathematical notation of the overlapping wave packets interaction is absolutely vague as soon nonlinear interaction in any space-time point of the waves is different due to different amplitudes.

It's a really complicated problem as soon there is only one nonlinear mathematical problem existing for each space-time point and even with the intuitive clearance of situation we do not expects its soon solution. The complete understanding of the nuclear structure hardly can be expected in the soonest time without exact expression for the potential of the strong interaction.

In general it should be noted that quantum world looks more clear and simple in UQT than in the general quantum mechanics, but we cannot repeat it while speaking about the mathematics used. The appearance of the exact analytical solution of the scalar problem of elementary particles mass spectrum can be considered as Fate gift (or God's help) for UQT. By the way the standard Schrodinger quantum mechanics has the same gift -- the exact analytical solution of the Hydrogen atoms equation.

The nuclear process at small energies should be reviewed. Today the strict

nuclear physics does not assume nuclear reactions at small energies and that contradict experimental data. Here we should also note our skepticism towards the idea of nuclear fusion in Tokamaks, we consider this way as hopeless. To justify these experiments we have to mention that the solution was obtained in the lack of other ideas and under the great pressure of the future power problems. But the use of the reactions of classical cold fusion for the power output is also difficult due to the complexity of colliding nuclei phasing. This phenomenon is well described by the equation with oscillating charge, while the cold nuclear fusion had been predicted in UQT 6 years before its real discovery [72].

(XIII) Solid-state Physics

The band theory of solid is based at the point on the solution of the problem of an electron movement in the field of two or more charges. But this problem does not have analytical solution yet, in practice a speculative quality solution is used only. The results are that electrons in the solid have quite specific allowed power bands. This field of the science is very successful and hardly will be revised. Any solution of the equations with the oscillating charge for the electron moving in the field of few nuclei also result in appearance of allowed and forbidden bands [200, 201].

Somewhat apart is classical tunneling effect. In UQT the probability of tunneling effect appearance depends on the phase of the wave function (in contrast to the ordinary quantum theory, where at the squaring of the wave function module its dependence on the wave phase totally disappears). It could be interesting to prove such dependence by the experiments. It can be easily done if creating a new transistor on the basis of absolutely new principle of the electron current control [172, 184, 200, 201].

We are not going to analyze the modern theory of superconductivity, but we are sure that the equation with oscillating charge will deepen on both understanding

of superconductivity as well as mysterious properties of quantum liquids.

(XIV) Astrophysics and Cosmology

The authors regret not being in sympathy with the ideas of the Universe origin from one singular point. The most amazing in this theory is a detailed computation of events occurred in the fractions of the first second just after the Big Bang. Today when the fundamental physics is making only first shy steps towards the real understanding of the quantum processes we still do not have clear model of the particles, or understanding of a spin appearance, of a charge and magnetic moments. At the same time, in Internet there are sensational results obtained in well-known Lawrence Livermore National Laboratory USA were newly announced. In this Laboratory the space model of our Universe was constructed after many years of astronomical observations and their analysis with Supercomputers. It was turned out that our Universe has the flat structure and all Galaxies have dimensions near a half of million light-years being six milliard light-years apart and all Galaxies lie on the same plane (!). Obviously, such picture of our Universe has no relation with the Big Bang model.

According to UQT the processes of the multiple particle production at collision is a common result of the waves packets of big amplitudes diffraction in periodic structures one another, as for the multiple outgoing in different directions particles they correspond to the general diffraction maximums. But we do not assume the responsibility of the mechanism of the multiple particles production for the Universe appearance. To our opinion the complete understanding of the quantum world will arise only after solving of 32 nonlinear integro-differential equations of UQT [196, 198, 200, 201]. To their regret the authors are not able to solve these equations.

And many cosmologists would like to use theories assuming existence of

Universe localities where the energy is coming into being and also other localities where the energy annihilates. For example, British astronomer Fred Hoyle has developed the theory of Universe where it takes the place the continuous creation of matter. He wrote: *“Different atoms constituting the matter do not exist at some given moment of time and then after instant they exist already. I must admit this idea may look as strange. But all our ideas about creation are strange. According to previous theories the whole quantity of matter in Universe was coming into being just as whole and all process of creation looks as super-gigantic instant explosion. As for me, such idea seems much stranger, than idea of continuous creation”*. (F. Hoyle, La nature de l Universe, 1952.)

The official astronomical science does not accept the ideas of F. Hoyle and of some other astronomers (H. Bondi, T. Gold, and P. Jordan) about continuous creation of matter in Universe because the Conservation Laws are considered as infallible. But from the viewpoint of our UQT these ideas are quite not strange.

Our real world continuum consists of enormous quantity of particles moving with different velocities. Partial waves of the postulated vanishing particles create real vacuum fluctuations that change in a very random way. Certain particles randomly appear in such a system, owing to the harmonic component energy of other vanished particles. The number of such dependant particles changes, though; they suddenly appear and vanish forever, as the probability of their reappearance is negligibly small, and so we do expect that all particles are indebted to each other for their existence. Yet, if some particles are disappearing within an object, other particles are arising at the same moment in that object due to the contribution of those vanishing particles harmonic components and vice versa.

The simultaneous presence of all particles within one discrete macroscopic object is unreal. Some constituent particles vanish within the object while others appear. In general, a mass object is extant overall, but is not instantaneously

substantive and merely a false image. It is clear that the number of particles according to such theory is inconstant and all their ongoing processes are random, and their probability analysis will remain always on the agenda of future research.

In accordance with UQT there are other solutions for the quantum harmonic oscillator besides stationary, where the given tiny incipient fluctuation is growing, gaining power and finally becoming a particle. It is so called “Maternity Home” solution. There are also other solutions where substance (power) is disappearing. Such solutions have been called “Crematorium”. May be Metagalaxy is simply entangled in searching the balance, isn’t it?

All this allows expecting that space continuum in the centers of Galaxies produces different particles, electrons, protons, neutrons, which are the sources of light atoms. Later thanks to the gravitation light atoms are transformed into gas nebulae where under gravity compression the stars are lighting. It is quite possible that the current theory of Stars evolution is correct in general while describing (via Supernova) the production of other atoms apart Hydrogen and Carbon the planets consist of. We do not think nuclear process at small energies (which are possible in UQT, but impossible in standard quantum theory) will essentially modify evolutionary view of the Galaxies development.

It is interesting that the state with the minimum quantum values $L=0$, $m=0$ belongs to the very heavy neutral scalar particle (WIMP) with our name Dzhan and mass about 69.6 TeV, which in principle should purely interact with the others [162, 164, 200, 201]. With the growth of the quantum numbers the mass of the particle is diminishing. So there should be a lot of Dzhan-particles due to the small quantum numbers. And probably their existence is responsible for the dark matter in general, in accordance with some evaluations Metagalaxy consist of up to 80-90% of the dark matter.

(XV) Gravitational Theory

It seems Gravitational theory should follow from 32 nonlinear integro-differential equations of UQT and the authors are expecting that it can be done in future [6, 200, 201]. Nevertheless we will make now some conservative assertions. The current data regarding the Universe expansion can be interpreted as the change of the gravitational potential sign (gravity is replacing by repulsion) at great distances for the great masses. Probably the difference between absolute the values of electric charge of a proton and an electron, say in 15-20 signs, is responsible for his phenomena, but for us this idea is extremely unsympathetic.

Gravitational interaction remains an extraordinary mysterious appearance in UQT as actually it has a very high speed of interactions distribution and approximately is in times weaker than electro-magnetic interactions. The origin of such an enormously big number remains the greatest riddle.

On the other hand if any particle is a package of partial waves of some uniform field, probably is possible a following curious phenomenon which has been observed and described by the authors more than once earlier [186, 187]. If to put a ditch with the substance having abnormal dispersion on a way of the wave package moving in flat Euclidean space, the package after ditches can appear even if it is situated at distance of many light years from a package as formally mathematically harmonious components exist on all infinite rectilinear coordinate of package movement as ahead of it, and behind. Thus the package can disappear in that place where it was, and to appear at huge distances ahead of a package, or behind. Thus the package did not move at all between points of disappearance and new appearance, and the normal idea of speed in the unitary quantum theory loses its initial meaning.

Similar teleportation was observed of ten times. Probably, it is actually a

long-range action, (else à longue distance) observed in gravitation. A curious though appears that the waves building a package, could be connected with gravitation and all particles consists of a gravitational field. Then this field can be a stage or a scene where all other processes with final speeds of interaction transfer are played. It will allow connecting the quantum theory and the gravitation theory which while aren't connected yet today in the future. But it is a task for the future generations.

At the same time according to the processed information (Hlistunov at all [188]) from Russian Command-and-Measuring Complex for the monitoring and control of the space objects at the entire moment of collision geodesic satellites Tope-Poseidon and GEO IK began swaying at their orbits. Normally the orbit of a geodesic satellite lies inside the tube with about 1 km diameter and the orbit can be control with the high accuracy not more than one meter precision for the position data and centimeters per second for velocity.

During the collision the sensors registered 5-8 times increase of the trajectory tube diameter. In the same article Hlistunov [188] on the basis of correlation analysis of the position data measurements and information obtained from earthquake-detection station showed that the waves of gravitational potential variation were the trigger for earthquakes. To the authors regret they do not have the similar information from NASA. With other hand official science in Russia did not know about it [204].

(XVI) Chemical Catalysis

The process of chemical catalysis and the catalysts are the great mystery of the modern science. The number of chemical catalysis theories equals the number of chemical catalytic processes. A specialist in chemical catalysis used to think that this or that reaction is not going because of the needed catalyst has not been found.

Even Michael Faraday studied these problems. He seemed to say about platinum as being the universal catalyst. Only this (while platinum practically does not react with anything) immediately suggests an idea that chemical processes are not enabled at all and we should look for the physical universal mechanism of reactions.

The UQT has such a process. The details are listed in the articles [172, 183, 185, 197, 200, 201]. The universal mechanism of heterogeneous catalysis, for example in Ammonia Synthesis, consists of the following: Nitrogen molecule falls into a cavity (hole a few tens of Angstroms unit size), then at some initial moment the molecule starts oscillating with an energy augmentation implementing solution of “Maternity Home” like in a normal potential well - Fig. 4.4.6. If the augmented energy exceeds the binding energy of molecule Nitrogen then atomic Nitrogen at the exit from the cavity will be caught by protons (Hydrogen), form Ammonia and then quit the game and free cavity for the new deeds.

We cannot exclude that idea of energy generation within a potential well and are just waiting for the creation of general theory of catalysis. Here we should recall brilliant words of a famous Russian specialist on physical chemistry Professor A. N. Kharin (Russia, Taganrog, 1954) [148, 200, 201] who always said at his lectures:

“The problem of chemical catalysis is the most incomprehensible in the modern physical chemistry and it won’t be solved until physicists discover some new mechanism able to explain the liberation of the energy that lowers the reaction barrier.”

Our UQT allows, as we hope, to make the first shy steps in right direction.

We are sure that in such a way water can be decomposed for Oxygen and

Hydrogen. At normal conditions the mixture of Oxygen and Hydrogen is stable. In other words two stable substances (water and gas mixture) are simply divided by a high energy barrier, that can be overcome (tunneling effect analogue) by using the exact catalyst and the UQT ideas. For today a lot of experiments of water decompositions are known, the energy evolved in the process of hydrogen combustion is ten times higher than necessary for decomposition. It makes possible to construct a water-engine for autos.

(XVII) Conclusion

In essence, our theory discovered new world properties and new theoretical possibility of the radical transformation of the civilization.

Let us to remind of the prophetic words of the famous US science-fiction author Arthur Clarke: Something that is theoretically possible will be achieved practically independent of technical difficulties. It's enough to desire it. (back translation)- Profiles of the Future, 1963.

In conclusion we would like to quote extremely acute words of Louis de Broglie: *“Those who say that new interpretation is not necessary I would like to note that new interpretation may have more deep roots and such theory in the long run will be able to explain wave-particle dualism, but that explanation will not be received either from abstract formalism, modern nowadays, or from vague notion of supplementary. But I think that the highest aim of the science is always to understand. The history of the science shows if any time somebody succeeded in deeper understanding of physical phenomena class, new phenomena and applications appeared. Hope that many researchers will study that enthralling question casting aside preconceived opinions and not overestimating the importance of mathematical formalism, whatever beautiful and essential it was, because that may result in loss of deep physical sense of phenomena”* (Louis de

Broglie, Compt. Rend, 258, 6345, 1964 back translation).

We would like to add the amazing phrase of A. de Saint-Exupéry: “The truth is not something that could be proved, but something that makes all things easy and clear” (back translation).

Supplement.

4.4.2 Seven Matrices 32x32

Matrix λ^0

```

u1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, u2, 0, 0, 0, 0, 0, 0, 0, 0, u3, 0, 0, 0, 1, 0, 0, 0
0, u1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, u2, 0, 0, 0, 0, 0, 0, 0, 0, u3, 0, 0, 0, 1, 0, 0
0, 0, u1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, u2, 0, 0, 0, 0, 0, 0, 0, 0, u3, 0, 0, 0, -1, 0
0, 0, 0, u1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, u2, 0, 0, 0, 0, 0, 0, 0, 0, u3, 0, 0, 0, -1
0, 0, 0, 0, u1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, u2, 0, 0, 0, 1, 0, 0, 0, -u3, 0, 0, 0, 0
0, 0, 0, 0, 0, u1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, u2, 0, 0, 0, 1, 0, 0, 0, -u3, 0, 0
0, 0, 0, 0, 0, 0, u1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, u2, 0, 0, 0, -1, 0, 0, 0, -u3, 0
0, 0, 0, 0, 0, 0, 0, u1, 0, 0, 0, 0, 0, 0, 0, 0, 0, u2, 0, 0, 0, -1, 0, 0, 0, -u3
0, 0, 0, 0, 0, 0, 0, 0, u1, 0, 0, 0, 0, 0, 0, 0, 0, u3, 0, 0, 0, 1, 0, 0, 0, -u2, 0, 0, 0, 0, 0
0, 0, 0, 0, 0, 0, 0, 0, 0, u1, 0, 0, 0, 0, 0, 0, 0, u3, 0, 0, 0, 1, 0, 0, 0, -u2, 0, 0, 0, 0, 0
0, 0, 0, 0, 0, 0, 0, 0, 0, 0, u1, 0, 0, 0, 0, 0, 0, u3, 0, 0, 0, -1, 0, 0, 0, -u2, 0, 0, 0, 0, 0
0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, u1, 0, 0, 0, 0, 0, 0, u3, 0, 0, 0, -1, 0, 0, 0, -u2, 0, 0, 0, 0
0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, u1, 0, 0, 0, 1, 0, 0, 0, -u3, 0, 0, 0, 0, 0, 0, 0, -u2, 0, 0
0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, u1, 0, 0, 0, 1, 0, 0, 0, -u3, 0, 0, 0, 0, 0, 0, 0, -u2, 0
0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, u1, 0, 0, 0, -1, 0, 0, 0, -u3, 0, 0, 0, 0, 0, 0, 0, -u2, 0
0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, u1, 0, 0, 0, -1, 0, 0, 0, -u3, 0, 0, 0, 0, 0, 0, 0, -u2
u2, 0, 0, 0, 0, 0, 0, 0, 0, u3, 0, 0, 0, 1, 0, 0, 0, -u1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0
0, u2, 0, 0, 0, 0, 0, 0, 0, u3, 0, 0, 0, 1, 0, 0, 0, -u1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0
0, 0, u2, 0, 0, 0, 0, 0, 0, 0, u3, 0, 0, 0, -1, 0, 0, 0, -u1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0
0, 0, 0, u2, 0, 0, 0, 0, 0, 0, 0, u3, 0, 0, 0, -1, 0, 0, 0, -u1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0
0, 0, 0, 0, u2, 0, 0, 0, 1, 0, 0, 0, -u3, 0, 0, 0, 0, 0, 0, -u1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0
0, 0, 0, 0, 0, u2, 0, 0, 0, 1, 0, 0, 0, -u3, 0, 0, 0, 0, 0, 0, -u1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0
0, 0, 0, 0, 0, 0, u2, 0, 0, 0, -1, 0, 0, 0, -u3, 0, 0, 0, 0, 0, 0, -u1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0
u3, 0, 0, 0, 1, 0, 0, 0, -u2, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, -u1, 0, 0, 0, 0
0, u3, 0, 0, 0, 1, 0, 0, 0, -u2, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, -u1, 0, 0, 0, 0
0, 0, u3, 0, 0, 0, -1, 0, 0, 0, -u2, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, -u1, 0, 0, 0, 0
0, 0, 0, u3, 0, 0, 0, -1, 0, 0, 0, -u2, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, -u1, 0, 0, 0, 0
1, 0, 0, 0, -u3, 0, 0, 0, 0, 0, 0, 0, 0, -u2, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, -u1, 0, 0, 0
0, 1, 0, 0, 0, -u3, 0, 0, 0, 0, 0, 0, 0, 0, -u2, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, -u1, 0, 0, 0
0, 0, -1, 0, 0, 0, -u3, 0, 0, 0, 0, 0, 0, 0, 0, -u2, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, -u1, 0
0, 0, 0, -1, 0, 0, 0, -u3, 0, 0, 0, 0, 0, 0, 0, 0, -u2, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, -u1

```

Matrix λ^1

[illegible]

Matrix λ^2

```
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,-1,0,0,0,-u3,0,0,u1
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,u0,0,0,0,0,0,0,-1,0,0,0,-u3,u1,0
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,u0,0,0,0,0,0,0,-1,0,0,-u1,-u3,0
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,u0,0,0,0,0,0,0,-1,-u1,0,0,-u3
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,u0,0,0,0,u3,0,0,u1,-1,0,0,0
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,u0,0,0,0,u3,u1,0,0,-1,0,0
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,u0,0,0,-u1,u3,0,0,0,-1,0
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,u0,-u1,0,0,u3,0,0,0,-1
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,0,0,0,-u3,0,0,u1,-u0,0,0,0,0,0
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,0,0,0,-u3,u1,0,0,-u0,0,0,0,0,0
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,0,0,-u1,-u3,0,0,0,-u0,0,0,0,0,0
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,-u1,0,0,-u3,0,0,0,-u0,0,0,0,0,0
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,u3,0,0,u1,1,0,0,0,0,0,0,-u0,0,0,0
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,u3,u1,0,0,1,0,0,0,0,0,0,-u0,0,0
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,-u1,u3,0,0,0,1,0,0,0,0,0,0,-u0,0
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,-u1,0,0,u3,0,0,0,1,0,0,0,0,0,0,-u0
u0,0,0,0,0,0,0,0,0,-1,0,0,0,-u3,0,0,u1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
0,u0,0,0,0,0,0,0,0,-1,0,0,0,-u3,u1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
0,0,u0,0,0,0,0,0,0,0,-1,0,0,-u1,-u3,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
0,0,0,u0,0,0,0,0,0,0,0,-1,-u1,0,0,-u3,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
0,0,0,0,u0,0,0,0,0,u3,0,0,u1,-1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
0,0,0,0,0,u0,0,0,0,u3,u1,0,0,-1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
0,0,0,0,0,0,u0,0,0,-u1,u3,0,0,0,-1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
0,0,0,0,0,0,0,u0,-u1,0,0,u3,0,0,0,-1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
1,0,0,0,-u3,0,0,u1,-u0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
0,1,0,0,0,-u3,u1,0,0,-u0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
0,0,1,0,0,-u1,-u3,0,0,0,-u0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
0,0,0,1,-u1,0,0,-u3,0,0,0,-u0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
u3,0,0,u1,1,0,0,0,0,0,0,-u0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
0,u3,u1,0,0,1,0,0,0,0,0,0,-u0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
0,-u1,u3,0,0,0,1,0,0,0,0,0,0,0,-u0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
-u1,0,0,u3,0,0,0,1,0,0,0,0,0,0,-u0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
```

Matrix λ^3

0,-u2,0,0,-Iu1
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,-1,0,0,0,0,0,0,u0,0,0,0,-u2,u1,0
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,-1,0,0,0,0,0,0,u0,0,0,u1I,-u2,0
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,-1,0,0,0,0,0,0,u0,-Iu1,0,0,-u2
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,-1,0,0,0,u2,0,0,-Iu1,-u0,0,0,0
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,-1,0,0,0,u2,u1I,0,0,-u0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,-1,0,0,u1I,u2,0,0,0,-u0,0
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,-1,-Iu1,0,0,u2,0,0,0,-u0
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,u0,0,0,0,-u2,0,0,-Iu1,-1,0,0,0,0,0,0
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,u0,0,0,0,-u2,u1I,0,0,-1,0,0,0,0,0,0
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,u0,0,0,u1I,-u2,0,0,0,-1,0,0,0,0,0
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,u0,-Iu1,0,0,-u2,0,0,0,-1,0,0,0,0
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,u2,0,0,-Iu1,-u0,0,0,0,0,0,0,-1,0,0,0
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,u2,u1I,0,0,-u0,0,0,0,0,0,0,-1,0,0
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,u1I,u2,0,0,0,-u0,0,0,0,0,0,0,-1,0
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,-Iu1,0,0,u2,0,0,0,-u0,0,0,0,0,0,0,-1
1,0,0,0,0,0,0,0,0,0,u0,0,0,0,-u2,0,0,-Iu1,0,0,0,0,0,0,0,0,0,0,0,0,0,0
0,1,0,0,0,0,0,0,0,0,u0,0,0,0,-u2,u1I,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
0,0,1,0,0,0,0,0,0,0,u0,0,0,u1I,-u2,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
0,0,0,1,0,0,0,0,0,0,u0,-Iu1,0,0,-u2,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
0,0,0,0,1,0,0,0,u2,0,0,-Iu1,-u0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
0,0,0,0,0,1,0,0,0,u2,u1I,0,0,-u0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
0,0,0,0,0,0,1,0,0,u1I,u2,0,0,0,-u0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
0,0,0,0,0,0,0,1,-Iu1,0,0,u2,0,0,0,-u0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
u0,0,0,0,-u2,0,0,-Iu1,1,0
0,u0,0,0,0,-u2,u1I,0,0,1,0
0,0,u0,0,0,u1I,-u2,0,0,0,1,0
0,0,0,u0,-Iu1,0,0,-u2,0,0,0,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
u2,0,0,-Iu1,-u0,0,0,0,0,0,0,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
0,u2,u1I,0,0,-u0,0,0,0,0,0,0,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
0,u1I,u2,0,0,0,-u0,0,0,0,0,0,0,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
-Iu1,0,0,u2,0,0,0,-u0,0,0,0,0,0,0,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0

Matrix Λ

[illegible]

Matrix Λ_2

[illegible]

