

EVIDENCE FOR DETERMINATION PRINCIPLE IN TERMS OF PHOTOSYNTHESIS

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Here the concept is settled that spontaneous chemical transformations are realized according the determination principle. In particular, at light quantum (γ_{II}) "emission" from the activated photosystem $P680^*$ to pheophytin, a breakdown of γ_{II} into electron-positron pair according to the law of charge parity nonconservation takes place. A passage between two equal spin multiplicity electron states $S_1 \rightsquigarrow T_1$ is in competition with CO_2 assimilation in C_3 - and C_4 - plants.

Key Words: assimilation of C_3 - and C_4 - by plants; indetermination principle; determination principle; charge parity nonconservation; electron-positron pair.

In 1935 Yukava Kh. [1], founding on Heisenberg indetermination principle discovery [2], made a guess about the existence of particles responsible mainly for internuclear forces, which are 300 times as heavy as an electron mass.

In 1947 Powell C.F. with colleges [3] experimentally proved the existence of these particles-pi-mesons with mass numbers 273,3 for π^+ and π^- , 264,3 for π^0 , that served a serious argument in the affirmation of the indetermination principle itself.

Again, in 2006, while working [4] we stated a concept in accordance with which

spontaneous chemical transformations most often are realized on the determination principle. In the same year a new photosynthetic system functioning mechanism, at the heart of which there is the concept of light quantum breakdown (γ) into an electron and a positive ion (e^- and e^+) at γ "emission" activated by $P680^*$ photosystem to pheophetin in accord with the law of charge parity nonconservation [5, 6], was offered.

The offered work contains extra arguments for both determination principle discovery and light quantum breakdown on the law of charge parity nonconservation.

I. A breakdown $\delta\gamma_{II}$ into three electron masses, not four ones, happens

Photosynthesis of green plants is a complex biological process comprising a great number of conjugative oxidation-reduction reactions [7,8]. Cells of higher plants and Cyanobacteriae contain photosystems PII and PI, photosensitive pimentos – chlorophylls (a, b, c, d), carotenoids and phycobilines.

The photosystem $P680$ -683 (b-pigment) absorbs the light quantum within the field of 680-683 nm, transiting into the state of excitement for about 10^{-12} sec [8]. The stay time of the b chlorophyll in the excited state is infinitesimal on account of quick $10^{-15} - 10^{-19}$ sec "emission" of the electron to pheophetin (PHEO) and further on to the centers of primary plastochinon electronic acceptor Q_A and secondary chinon acceptor Q_B . The electron transfer from the PII photosystem onto plastochinons (PQ) happens for 2.0×10^{-6} sec (Figure 1).

The noted above sketchy description of the photosynthesis first stage activation can be written in the form of the following inequation:

$$\sum_{i=1} (\Delta t)_k \leq \Delta t^1, \quad (1)$$

where $\Delta t = 20 \times 10^{-9}$ sec is the time between the activated and inactivated forms of the photosystems PII and PI [9]; Δt^1 - the time of passage of electrons from the photosystem PII to PQ and is equal to 2.0×10^{-6} sec [9].

The inequation (1) allows defining a root-mean-square time interval

$$\Delta t_k'' = \left\{ \left(\frac{2 \times 10^{-6} c}{20 \times 10^{-9} c} \right)^2 \right\}^{1/2} = 0,1 \times 10^3 \quad (2)$$

within which the relation between the energy of the system of the breakdown $\delta\gamma_{II}$ into an electron-positron pair and the time Δt remains constant (3)

$$\Delta E \times \Delta t = \frac{\Delta E'}{\Delta t_k''}, \quad (3)$$

where $\Delta E' = 0,497 \times 10^{-18} \text{ J}$ is the energy of almost all vitally important molecules, which biological structures consist of [10].

From the equation of the determination principle (3) the value of ΔE within the interval $\Delta t_k''$ is close to the kinetic energy of the electron

$$\Delta E = 0,2475 \times 10^{-12} \text{ J} \quad (4)$$

From the equation $\Delta E = mc^2$ we have the value in mass units $0,0275 \times 10^{-25} \text{ g}$ that is three times as much as an electron mass ($0,91083 \times 10^{-27} \text{ g}$).

By extrapolation on activating the mechanisms of both the first and the second photosynthesis stages we protract the concept

$$\delta\gamma_{II} = 0,826e^- + 2,174e^+ \leq 150\text{ev} \quad (5)$$

It is known [14] that the formation of an electron-positron pair is possible if the kinetic energy of the electron exceeds 10^6 ev . However, its formation energy according (5) doesn't exceed 150 ev (0,015%), that coincides with the green plants absorption photoenergy in standard conditions for one mole glucose synthesis within

verging toward light speed, that is typical of electron tunneling in chemical and biological systems [11-13]

that at the light quantum "emission" from the activated photosystem P680* to pheophetin and further on to PQ a breakdown $\delta\gamma_{II}$ into an electron-positron pair which exceeds an electron mass threefold, not four times, according to the law of charge parity nonconversion (5).

the limits up to 14460 kJ/mol (150 ev) – depending on the absorption wave-length [8].

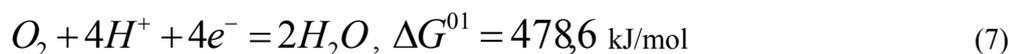
II. The activation mechanism substantiation of both the first and the second photosynthesis stages.

The standard available energy (ΔG^{01}) of an electron stream in the electron transfer chain from NADPH+H to O_2 , which represents an exergonic process, is equal [8]:



In this case for dissolution of two moles of water under the influence of a positronium-ion ($2,174e^+$) from (5) up to $4e^-$ into molecules O_2

it will be required $440,16 \text{ kJ/mol}$, that is $38,4 \text{ kJ}$ lower than the reaction energy (7)



calculated from the equation (8)

$$\Delta G^{01} = -nFE_{298}^0 \quad (8),$$

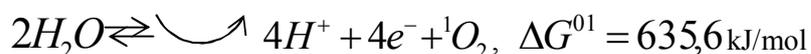
where n is the number of the carried over electrons; F - Faraday number and E_{298}^0 - standard electron potential equal to 1,24v.

The remainder of two water moles (from (6) and (7)) synthesis energy equal to 38,44 kJ is an energy measure of charge parity failure at the

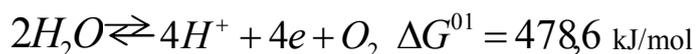
breakdown $4\gamma_{II}$ on pheophetin. Then, at the breakdown $8\gamma_{II}$ this amount will make

$$8\gamma_{II} \approx 154 \text{ kJ/mol} \quad (9).$$

actually, we experimentally affirmed [5, 6] the dependency of four-cycle series of conversion photon flashout from a singlet $^1\Sigma_g^+$ -state of oxygen $2,174e^+$



into a triplet one with a standard emanation energy 154 kJ/mol



that is practically coincides with literature data (157 кДж) [8]. If it is remembered that the flush from $8\gamma_{II}$ makes 1594,1 kJ, the total photosynthesis effectiveness in standard conditions makes 478,6/1594,1 as a minimum, or about 30%, that is also coincides with the literature data [8].

Glucose in plants is synthesized in the dark phase and is a predecessor of the three typical vegetational carbohydrates – saccharose, starch and cellulose, which are not synthesized in an animal body. In C_3 -plants for photosynthesis of dextrogyrate D-(+) –glucose from the equation (7) for 6 moles of O_2 it is necessary



that is practically also comparable with the experimental value

$$\Delta G^{01} = 2870,2 \text{ kJ/mol} [8].$$

III. CO_2 assimilation competition in C_3 - and C_4 - plants with $S_1 \rightsquigarrow T_1$ transitions

The breakdown of ribulose-1,5-diphosphate up to two molecules of 3-phosphoglycerate (A and B) under the action of ribulosediphosphate- carboxylase and the synthesis of D- (+) –glucose and its five

derivatives in C_3 -plants (11) is attended in the dark phase of Calvin cycle. However, this complex process is geometrically close to the spherical electron-positive center of the photosystem PII (Figure 1). Which objective results could serve as the confirmation of this concept?

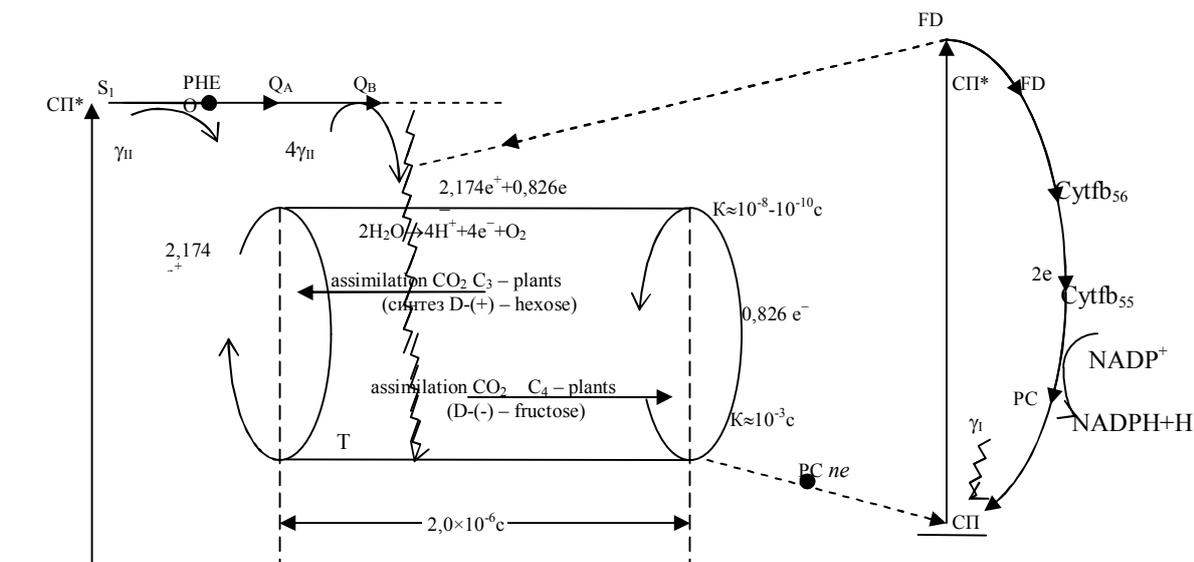


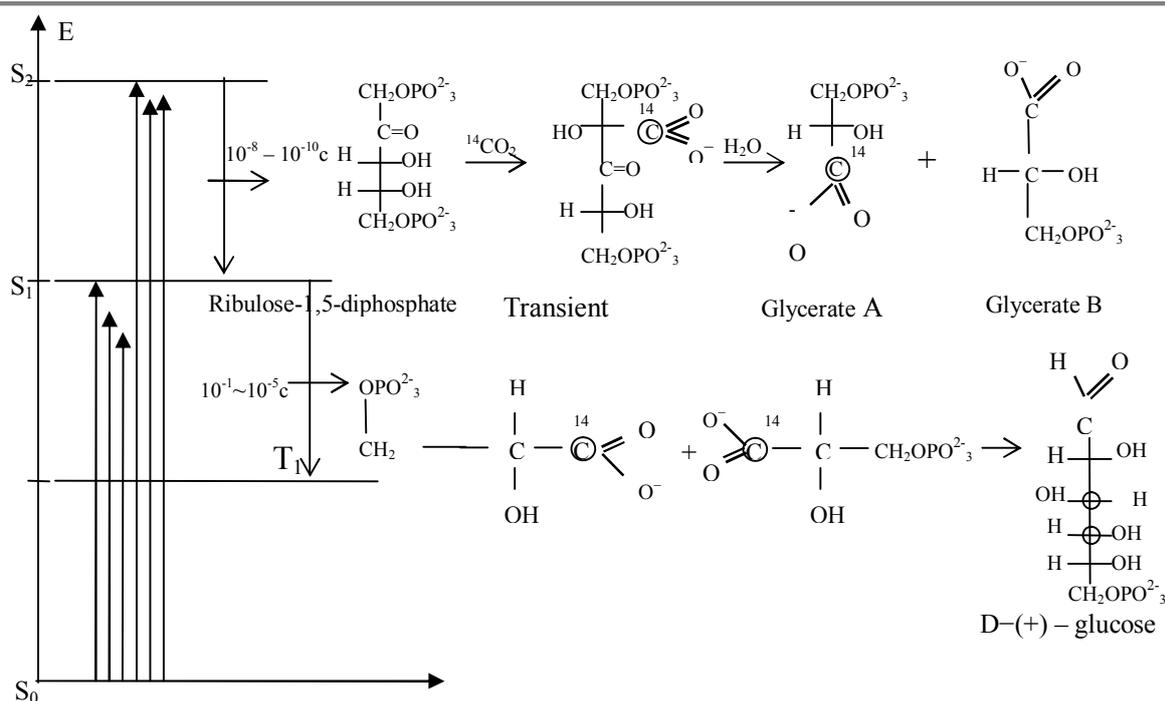
Figure 1. electron flow diagram in the model of two photosystems PII and PI: LP - light-harvesting pigments; PHEO – pheophetin; Q_A – primary plastochinon; Q_B – secondary plastochinon; S_0 – the system energy in its main state; S_1 – singlet low energy; $S_1 \rightsquigarrow T_1$ - transition from a singlet into a triplet state; PC – plastocyanin; FD – ferredoxins (hinded) and FD – soluble ferredoxins

First, the transient composed by carboxy group joining to ribulose-1,5-diphosphate corresponds to ($10^{-7} - 10^{-10}$ sec) lowest singlet state (S_1) by life time. The molecule in the lowest singlet state is very quickly hydrolyzed with formation of two molecules of 3-phosphoglycerate, one of which – glycerate A, contains the mark $^{14}CO_2$ in the form of carboxy group [8, 15].

Second, the singlet-excited transition molecule (11) suffers an intercombination conversion in the form of hydrolyse up to two glycerate molecules, that is attended by the transition into a more stable state (T_1). The life time of the lowest T_1 -state is rather long to form D-(+)-glucose from two glycerate A molecules. In another situation the interaction of glycerates A and B would lead to levogyrate D – (–) -glucose formation, that according to

stereoselectivity is unauthorized close to the electron-positive center of PII (Figure 1).

And third, one of structure fragments of many oligosaccharides (for example, saccharose and raffinose), polysaccharides (for example, innulin) is D – (–) -fructose. In temperate zone plants but which hail from the tropics (corn, sugar cane or amercane) the CO_2 assimilation happens in the way of C_4 -metabolism (Hatch-Slack reaction). The C_4 -plants include CO_2 into a C_4 -compound and only after two preliminary migration stages fix CO_2 the same way that the C_3 -plants do. This assimilation way leads to a sufficient removal from the center PII in the cycle of Calvin, and thus, a long enough time (about 10^{-3} sec) is needed for the synthesis of D – (–) -fructose (Figure. 1).



Hence, physical processes conditioned by the intersystem crossing – the transition between the two electron states of equal spin multiplicities $S_1 \rightsquigarrow T_1$ compete with chemical reactions of CO₂ assimilation in C₃- and C₄-plants.

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