

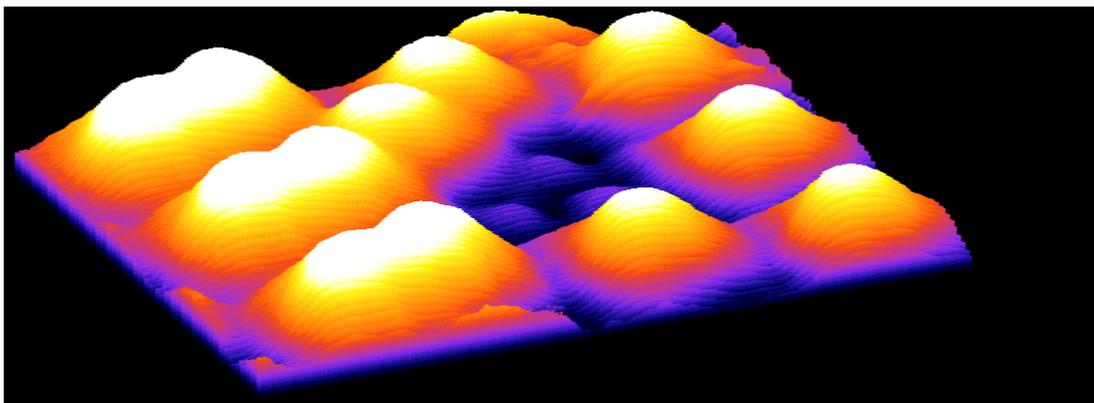
Entangling Catalysis

Cross-fertilisation of biochemical reactivity through
“non- local” coherent operations in Q.communication

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[<Quantum path>](#)



<http://www.liv.ac.uk/Chemistry/ArtGallery.htm>

The catalytic processes has a central role in all chemical and biochemical transformation so that catalyst and enzymatic processes has a paramount importance in the industrial production of chemical materials and it is extremely necessary to obtain a coordination of reactivity processes of bio-chemistry of life.

In spite of this importance the “*theory of catalysis*” is very approximate and it is conceived in terms of the “*Transition State Theory*” , (1) especially in order to interpret the enzyme specific activity in biological reactions. This theory remains limited to an old thermodynamic conceptions of transformations based on a continuous series of shifting equilibria, but evidently the catalysis is not an equilibrium phenomenon. In this way of thinking , the catalysis theory, lack for defining a clear interpretation of the relationships between the equilibrium and the out of equilibrium dynamics of transformation, where the catalysis show its proper activity. As a matter of facts the “*Transition State*” is an hybrid form of binding energy , that has not chances for an effective physical existence. Experimentally catalysis correspond to an acceleration or deceleration of the rate of a reaction, brought through a catalyst (*heterogeneous catalysis*) (2) , or via an “*auto-catalyst*” activity (*homogeneous catalysis*). Both are evidenced in out of side of equilibrium conditions, and during the two types of catalytic actions the catalysator remains unaffected at the end of the reaction. (3),(4)

The acceleration/deceleration of the rate of the reaction can be seen in two different modes :

I°) by means of an activity able to lower the hill of energy, that impede the transformation from a reagent to a product , II°) by means of an growth of intensity of “*chemical affinity*” (3) able to select the path through the potential energy surface, in order to find a “quantum walk” in correspondence to a less consuming energy.

The (I°) mode of understanding catalysis, is normally utilized as an explanation associated to the “*molecular collisions*”, preferred by the mechanical interpretation of chemical reactivity (5).

The (II^o) mode of understanding renews the old concept of *Jöns Jacob Berzelius* (1779-1848) about the “*chemical affinity*” changes, during a reaction, and now it is revised in terms of “*Quantum Entanglement*” as a process where happens the mutual exchange of information as it is necessary to comprehend the quantum effects in the catalytic activity as an energy-saving process.

It is useful to remember that “*Chemical Affinity*”, means; the selected tendency that elementary bodies have to combine and remain in combination. As a matter of fact it is well known that experimentally a compound can show a greater or a lower tendency to combine or not with another body. Following this ancient concept, J.J. Berzelius, described the catalysis as an “*at distance effect*” that change, the speed of a reaction, by means of the variation of the chemical affinity of the system with time.

Differently the “*Collision Theory*” (5) forgets the concept of “*Chemical Affinity*” to maintain the classic mechanical character of science in explaining how chemical reactions take place. The supposition is that for a reaction to occur, it is necessary that the reactant particles must collide; but only a probable fraction of the total collisions, causes an effective chemical change, these are called “*successful collisions*”; in fact they need to have sufficient energy (*activation energy*) at the moment of impact, in order to break the existing bonds and form new bonds, resulting in the products of the reaction. Therefore both, the increasing the concentration of the reactants and the raising the temperature, bring about more collisions, and therefore also more successful collisions, increasing the rate of reaction. When a catalyst undergoes collision with the reactant molecules, less *activation energy* is required for the chemical bonding changes, to take place, and hence more collisions have sufficient energy for reaction to occur. In this context of thinking about the “*collision theory*” of the chemical reactivity, the catalysis influences the reaction rate, this because increases or decreases the speed of the reaction, approaching a “*Transition State*”, in which original bonds are weakened and new bonds are partially formed. This behaviour is considered approximately valid also nearest to the stable condition of temperature and concentration of reactants.

In the other conceptual approach (II^o mode), based on “*Chemical Affinity*” (*Natural Attraction*), the development of the understanding of catalytic reactions can be made approaching the problem in “*quantum physics*”, especially starting from the photochemical reactions, so important for the “*green-chemistry*”. In this case the mechanical model of “*collision among billiard balls*”, need to be deeply changed this because all quantum particles, before to get a collision, changes their single status in an “*entanglement*” mixed state. In fact the recent experimental evidence for “*entangled mixed states*” can be an useful method to understand the catalysis as a self organization, driven by the exchange of information in a way that, the original intuition of J.J. Berzelius can be better understood.

The entanglement is generated by a cross-coupling of quantum Wave/Particles (*W/P*), that, just before the collision, permits us to re-model the mechanic conceptualization of the catalytic activity. In fact the discovery that transmission of information encoded into single quantum systems enables new forms of communication, let us to consider the emergence of the “*information energy*” domain in quantum communication. In a general approach of this quantum field, we remember that “*entanglement*” manifest itself by producing *non-local correlation*, between interactive events, .i.e. this correlations can't be described by theories based solely on localised space/time variables. As far out as through “*entanglement-pairs*” of *W/P*, *Information Energy (I)* can be seen as a new kind of energy in a sense that (**I**) belongs to a more basic energy than those known as free vibrational Energy (**E**), and Energy encoded like matter (**M**). (6)

Now we try to follow through the imagination the process of the “*entangling Quantum Path of two photons*”. They never collide, but approaching the “*Heisenberg Horizon*”, the waves associated with *Q*.particles enter into simultaneous oscillation through a mutual action of

confinement. Continuing on the cone of approaching path to one to the another, the mixed photon's pair, lower its energy, this decrease of energy goes on until the amplitude of the wave overcomes the limit of the local observability of Heisenberg Principle, beyond which the *entangled pair* changes the proper structure related to the Euclidean space-time, in a way to logging in the lowest energy area defined as “Zero Point Energy”. (ZPE)

In this “ZPE” zone of the ground state of Energy, happens the transformation of entangled packet of Q. Energy into a superposition of four waves of pure “Information Energy”.

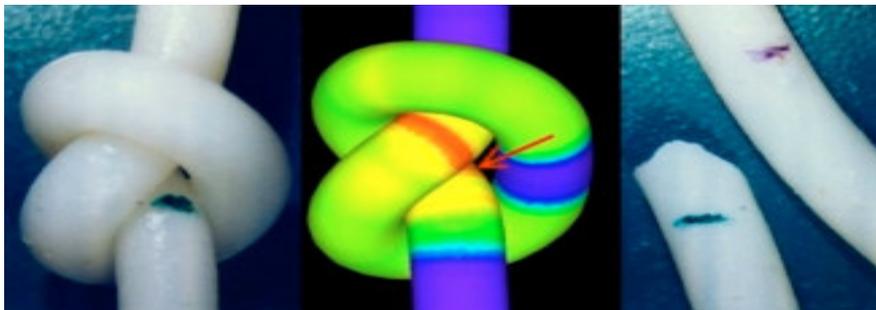
The above mind experiment simplifies in a visual image the process of “*entangling catalysis*”, by means of a conversion of the entangled pairs in pure “Information Energy”, the last living in the lowest Q. Energy side i.e. below the limit of the “*Uncertainty Horizon*”. In fact when this turning “*point-line*” is surpassed, the packets of energy associated to the entangled *W/P*, do not disappear, this because the Werner Heisenberg relation (1927), is not only a mathematical boundary of Quantum Mechanics, getting a calculation of the simultaneous measurement of mechanical complemented variables as position and momentum, but the Heisenberg Principle, defines the effective “*physical horizon*” of quantum observability in the Euclidean Space-Time. As a consequence when the “*instable entanglement*” collapses, near to the “*zero point energy*”, (7) the space-time configuration, living near to the *ground state*, changes giving rise to a *superposition of four pure waves* of “Information Energy” (**I**). The sum of the four sub-packets of (**I**) belongs as at the same Q. Energy of the previous Entangled Pairs. (8). As a matter of facts, we need to admit that a residual motion will always remain also after the “*Heisenberg Horizon*” as it is required by the complete application of the Heisenberg' relationship, resulting in the existence of a “*zero-point energy*”. As a consequence at the “ZPE” field, belongs a great part of energy, that remains excluded, when all other measurable energy like (E) and (M) disappear from a system. So that this exclusion of Q. Energy, needs to be considered as pure *Information Energy* (**I**), giving rise to a redefinition of the “*Conservation of the Total Energy Principle*”. (9).

Now looking again to renew the “*theory of catalysis*”, we would like to take into account that the mixed state of *entanglement pairs* of *W/P*, is a potentially resource of communication processing of information. Thinking in this way, we suppose that in the majority of molecular cases a direct transformation between two *entangled states of molecules is not possible*, but “*entangling*” method can be utilised *to assist all the catalytic activity*. Hence “*Entanglement-assisted catalysis*” becomes a possible mode of understanding the exchange of information in non equilibrium systems, in the presence of a superdense states of (**I**). (10)

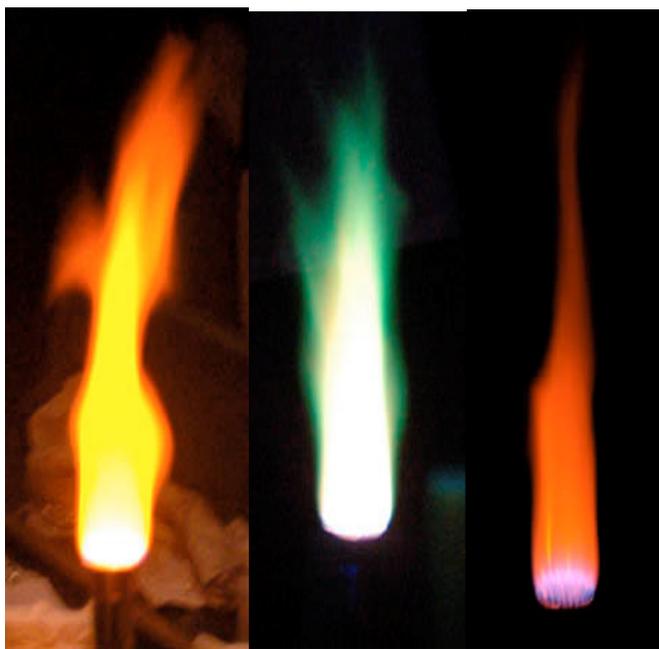
At this point it becomes important to remember, (from “*Shannon Information theory*”), *that chaos in a system decreases as the information increases*. In spite of this statement, till the “*Quantum-Entanglement Theory*”, is never found, a physical meaning for the energy that is able to favour the comprehension of the “**IN-FORM-ACTION**” of new molecules in a chemical transformation. Therefore today can be possible to rebuild the historically idea that considers “*affinity*” as the fundamental “*at distance effect*”, that causes the chemical catalytic reactions. Therefore the *Catalysis theory can be revised*, by means of considering the *extraordinary “non-localised” properties of the Information Energy*.

Traditional energy is regarded only as the carrier of *local information signals*; in spite of this, “**I**”, is a new form of Energy, having the property of a *surface non-localised energy*. So that in relation to the catalytic effects, (**I**) can be considered as a *driving information energy* to accelerate the reaction by means of finding the best energy-saving “*quantum path*”, in order to transform the chaos in a new molecular order, e.g. through avoiding the energy barriers during the bio-chemical transformations. The above correspond to an efficient method for getting a change in the redistribution of the electron density that modifies the bond interactions and permits the chemical transformation of electron's density from reactants to products.

The Nobel Prize in Chemistry (1973) Ilya Prigogine firstly open the door to an reinterpretation of “*chemical affinity as a distance effect*” summarizing in the following statement the need to reintroduce the old conception of J.J. Berzelius , for understanding the “*self organization*” of chemical transformations in out side of equilibrium context. He said : <**All chemical reactions drive the system to a state of equilibrium in which the affinities of the reactions vanish.**>. In conclusion the *collision theory* , (that assumes the necessity of a physical contact among reacting molecules), need to day to be integrated with the oldest *affinity theory of catalysis*, starting from an appropriated revision of the peculiarly “*non-local nature*” of quantum correlations of an *entangled assisted catalysis*. Personally I consider this argument one of the most important field of research to “*understanding life*”.



Model of entangled knot down conversion in two linear pieces of row



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