

## Resonance in Biological Systems- Interdisciplinary View

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### Abstract

Resonance is a fundamental phenomenon of the energetic processes between energy and matter. It thus combines organic matter and its function into a viable dynamic that means life. This applies to all forms of life: human, animal and plant organisms. The various detections of resonance in physical and quantum mechanical basic research make the difficulty of understanding clear. Nevertheless, an understanding of the interdisciplinary use must be developed. The pharmacological and medical-technical development of the present makes this necessary.

**Keywords:** Resonance, Magnetic Resonance, Clinical Significance

### Introduction

The word resonance seems to be a common term. Lexically, in colloquial language, it means reverberation. But from a scientific point of view, resonance is a basic regulatory principle, since the viability of organic matter also controls and thus maintains it. It is the principle that controls the flow of energy, influences external influences such as magnetic field effects, gravitation and energy transformations of biochemical and other physiological processes.

### Discussion

From a physical point of view, resonance is an oscillating vibration of a system capable of oscillating that is coupled to another system capable of oscillating [1]. This leads to a periodic excitation within the system due to vibration frequencies close to the resonance frequency. Quantum mechanically it means the occurrence of dynamics in different systems of the same energy. The quantum mechanical resonance introduced by W. Heisenberg in 1926 then provides the contribution to the total energy of the system [5].

In a somewhat different sense, one speaks of resonance when atoms are brought into an excited state by being irradiated with electromagnetic radiation of certain frequencies and emit radiation of the same frequency again in order to return to their green state.

The basic question of how to think of resonance was addressed by G.W. Wheland described in 1955 [7]. It is ultimately about the description of the interaction of the atoms and molecules and

their interaction based on the valence-bound theory based on quantum mechanics. The energy of an atom experiences a contribution through the resonance energy, which is related to the relative orientation of the electron spins. The spin vectors of the electrons combine to form a resulting spin vector, as do the vectors of the orbital angular momentum of the individual electrons. This idea of the contribution of the resonance energy to the energy of the atom goes back to the Russel-Saunders coupling. The resonance energy is due to the mutual electrostatic repulsion of the electrons but not directly due to the spin-spin interaction, although it is related to the relative orientation of the spins. The advantage of the resonance theory lies in the consideration that it starts with structural elements or, more precisely, with their electronic resonance integral.

Also L. Pauling refers to resonance based on the fundamental theorem of quantum mechanics, which plays a role in all chemical processes related to the ground state of molecules [6]. In quantum mechanics, the wave function  $\psi$  is the mathematical expression for the structure of the system. In its ground state, a system has the structure that offers it the greatest possible stability. The multi-layered structures each have their own wave functions and consequently cause energetic mixtures of their ground states, from which the resonance results as an expression of the system as a whole.

In the physical-chemical sense, resonance is described as the coupling of two oscillators when both have the same frequency and are at their strongest and most efficient. The effect of the resonant frequency of a magnetic nucleus is influenced by the elec-

tronic environment and the presence of other magnetic nuclei in a molecule. An electron spin arises from the fact that many nuclei possess spin angular momentum. Orbital and spin angular momentum are associated with a magnetic moment. This means that the energy of electrons and nuclei depends on an external field. The interaction energy of nuclei and the magnetic moment of the electron spin are clearly different. Magnetic nuclei are very sensitive, non-invasive probes for the electronic structure of molecules. The local field of the magnetic moments of the nuclei can differ from the applied field because it induces an electronic orbital angular momentum that creates a small additional magnetic field at the nuclei. Every magnetic moment is coupled to a magnetic field. If the magnetic moment moves, the magnetic field it generates moves. Surrounding magnetic moments react to this and are deflected. One speaks of magnetization waves or in solid state physics also related to the electron spin of spin waves. The magnitude of the ring currents that the external field induces in the molecule depends on the electronic structure of the molecule near the nucleus. For this reason, the same nuclei in different positions of a molecule have different shielding constants. Oscillations create resonance conditions that enable efficient energy transfer. According to the Foerster theory, presented in 1959, energy transfer is made possible when a donor-acceptor system is held together by covalent bonds. The rate of resonance transfer is distance dependent. An optimum of the energy transfer is reached when there is locally intense emission and absorption at a given frequency. Because large molecules in condensed phases absorb and emit in extended wavelength ranges, the rate of energy transfer is large at frequencies that overlap.

Viewed in this way and transferred to the smallest structure, the atom, one speaks of resonance when photons of certain energies is absorbed in the shell of an atom. This assumes that the energy is equal to the energy difference between the two states. This oscillation thus occurs when the incident photons are in resonance with the energy level of the atom. Transferred to biological systems, certain tissues and organs have a spectral sensitivity and, when they resonate with photons, initiate cellular signaling cascades and activate electrical signals, among other things.

These resonance phenomena in the coupling of a magnetic moment to a magnetic field and the generated flipping of the spin also include the possibility of positive feedback. This occurs when the signal is self-reinforcing. The amplitude only increases until the energy buffer is exhausted. The positive feedback in the systems thus forms the basis of self-organization [4].

This consideration opens up an idea of the viability and death of a cell. Apoptosis is a normal cellular event in which a precisely coordinated sequence of events leads to cell death. Since the process of apoptosis is controlled by receptor-mediated signaling pathways, it is not difficult to deduce that resonance and its disruption is a crucial system in the course of life.

In biology and physiology, the term signal transduction is commonly used as a process by which cells react to external stimuli. These stimuli are sent as a signal into the interior of the cell and lead to the cellular effect via a signal chain. Within the resulting

signal cascade, the original signal can be significantly amplified due to the physical principles described. Signals from different signal paths are also integrated in the sense of a crosstalk and form a signal network. A particularly important form of extracellular stimuli in the biological sense is that of basic physical elements such as magnetic fields and gravitation. Life is not possible without their influence, an effect that is shaped by evolution.

If one restricts this fundamental biological consideration to medical activities, one has to realize that the entire therapeutic strategy, often hidden under terms such as effectiveness in its different grading or toxicity, is reflected in it, but must also be taken into account [3]. A system that is easily recognizable is the pulsating magnetic field resonance forms of diagnostics and therapy. Diagnostically, the coupling of electron spin and magnetic radiation field is used to gain insights into the morphology and function of the molecules and thus of the organs. The different gradations of the intensity of applied magnetic fields in diagnostics change the functionality of the nerve conduction of the body in the sense of hyperpolarization, which is to be regarded as fleeting and therefore can be neglected at the current magnetic field strengths. In contrast to this, the low-intensity energetic application of the pulsating and frequency-specific mixed magnetic fields is suitable for developing therapeutic effects as energy input [2]. This means a stimulation of the metabolism and the neurovegetative performance of the body with increased blood circulation, improved oxygen uptake and immune performance. In the case of resonance, the system absorbs and stores energy with every vibration. Under the influence of the energy supply, a state of settled vibration will arise in which the amplitude of the vibration frequency and the excitation frequency remain constant and match. After switching off the excitation, the system gradually comes to rest in the form of a damped oscillation with a natural frequency. The theoretical evaluation of the resonance is based on criteria such as amplitude, phase and energy resonance.

## Conclusion

Organic systems and the environment form a functional unit. In this regulatory system, resonance plays an energetically transforming role. The system of resonance can be explained quantum mechanically. It is per se a lawful factor of energetic mediation towards organic matter. You have to take note of this indispensable mode of action, targeted influence for the optimal benefit of the therapy strategies to bring. While this is a task of basic research in the pharmacological sense, the pharmacological developments and, among other things, the medical therapeutic applications and especially the physical therapy strategies in terms of the tolerability of resonant processes must be consciously recognized and observed. Empiricism alone is not enough.

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