

**NUCLEAR MAGNETIC RESONANCE PHENOMENA  
UNEXPLAINABLE BY QUANTUM THEORY  
NO EMPIRICAL EVIDENCE FOR NUCLEAR SPIN**

**Nuclear models**

Because there is neither theoretical evidence nor a crucial experiment for the conceptual or ontological atom fission regarding a nucleus and extra nuclear electrons, *nuclear physics* is meaningless. But there have been laborious attempts to construct nuclear models within the frame of the untenable nucleus-shell model. As mentioned earlier, even the nucleus of this model is by its own instability untenable. Two different answers have been given to the building-up principle of the nucleus. The first to be discussed is the nuclear shell model; the second is the alleged strong force that should hold together the repulsive nuclear particles.

**Nuclear shells**

The Corpuscularian nuclear shell model is as bizarre as the Corpuscularian electron shell model. Also in the nucleus, mysterious messenger particles have to fulfill its duties. Like the paradigmatic electron shell model the nucleus is not an oscillator. There are also energy levels for orbits. Concerning the Moessbauer effect the energy level interpretation is as follows:

*The nucleus of some isotope absorbs a gamma ray that has been emitted by another nucleus of the same isotope. Because the transitions take place between the same two levels, the gamma ray has exactly the right energy to be absorbed. [y]*

An inherent chip must pilot the gamma-photon to its counterpart! My interpretation: This is a resonance phenomenon between two oscillators. Analogues are two pianos. A harmony that we strike on the first piano we will hear as a resonance from the second piano. See for details Mach.

[22]



But there are also vibrating modes in recent nuclear physics. For example when unordered crowds of protons and neutrons experience nuclear vibratory motion in the giant dipole resonance.

In the quadrupole vibration the nucleus oscillates in shape. If the atom is an electron-positron cluster all phenomena should be explainable by vibrations modes and resonance.

### **Does a strong force hold protons and neutrons together?**

We can be brief because anyone can easily read the Nobel-site [nobel.se] with Yukawas Nobel lecture and a chapter on the strong force in the educational section.

In the Nobel educational section we read that

*with the discovery of the strong force, one could finally explain why the nucleus of an atom did not fly apart...*

*The strong force occurs through the exchange of gluons between quarks in different protons and neutrons. This process "glues" the nucleus together. It is similar to how neutral atoms bind together to make molecules. [nobel]*

The invention was the quark. The proton is allegedly made up of 3 charged quarks ( $+2e/3$ ,  $+2e/3$ ,  $-e/3$ ); the neutron is allegedly made up of the charged quarks  $2e/3$ ,  $-e/3$ ,  $-e/3$ . According to this theory protons and neutrons are not fundamental particles without any internal structure but particles with fractional charges and therefore structures ones. So, *due to the exchange of electrical charge* (Yukawa citing Heisenberg's suggestions) a force between proton and neutron should occur as in the case of ionic chemical bonding. But Yukawa argues at the beginning of his Nobel speech that this special nuclear force is not reducible to *electromagnetic interaction between charged particles!* This is an obvious contradiction. Then, according to the Nobel educational site, Yukawa proposed *that the strong force between protons and neutrons in the nucleus occurred through the exchange of  $\pi$  mesons ( $qq$ -bar particles)*. Exchange particles are a misconception because contraction by the alleged strong force is not explainable by 'ping pong' particles.

Unfortunately quarks cannot be seen. The Nobel educational site claims that with the Friedman/Kendall/Taylor experiment there is an empirical evidence for the existence of quarks. By using electrons accelerated to high energies for a bombardment on the neutron or proton targets experiments show large angles for the deflected electrons.

This is an indication that protons and neutrons have an internal structure, namely fractional charges of different sign. Or, if protons and neutrons were particles without fractional charges, then electrons fired at them would be deflected by smaller angles. But it is a fallacy to argue that there are exactly 3 fractional charges inside of p and n and that these charges have the above mentioned magnitudes.

### **The $\alpha$ -particle nuclear model**

Moszkowski wrote in the Handbuch der Physik [Ha] on the  $\alpha$  -particle model:

*The fact that no other heavy particles are emitted in radioactive decay, indicates that  $\alpha$  -particles have special stability... It was thought... that  $\alpha$  -particles exist as stable subunits of nuclei but the development of the neutron-proton-model of nuclei made this viewpoint untenable.*

Comment:

to be on the wrong or on the right track – that is the question!

**Magnetic coupling is the bonding agent of molecules.**

**Molecules possess magnetic resonance frequencies.**

**No empirical evidence for nuclear spins.**

The principal feature of the prevailing Rutherford-Bohr atomic model is its *aufbau*: the nucleus consists of protons and neutrons; a swarm of orbiting extranuclear electrons with a shell structure surrounds the nucleus. Now for the current atomic physics also the nucleus is structured, the shell model for the nucleus claims that protons and neutrons of the nucleus, just like the extranuclear electrons, fill orbitals. Filled orbitals are those with 2, 8, 20, 28, 50, 82 and 126 nucleons. In order to save the phenomena all nucleons and all extranuclear electrons must be thought of as spinning charged bodies that possess therefore the property of a tiny magnet. Take for example uranium. In the nuclear shells we have to imagine 92 orbiting and spinning protons and 143 orbiting and spinning neutrons. This nucleus is surrounded by a swarm of 92 orbiting and spinning electrons. The uranium atom is like a swarm of bees! (For some electrons Pauli did not allow to orbit!)

During uranium fission both the extranuclear electrons shell structure and the nuclear shell structure must break down. But the results of the fission are two daughter atoms, each with ordered nuclear and extranuclear shells. Quantum physics tells us nothing about the catastrophically collapse of atomic structure. Also the wondrous resurrection of the daughter atom shell structures is not mentioned in textbooks. Only God could construct the new shells out of the remainder of fission. Fission and many other arguments show that the shell structure of the atom with its orbiting and spinning nucleons and electrons is erroneous.

The simplest element, hydrogen, consists of a proton and an electron. But the electron does not orbit the proton or it does not oscillate through the nucleus as Pauli suggests! The link between proton and electron is magnetic coupling, because both, electron and proton are tiny magnets. One proposal is that the magnets can be thought of as elementary ring magnets. So hydrogen is an electromagnetic oscillator. As I showed, hydrogen is the building block of all elements and their isotopes. Because there are no extranuclear electrons, there is neither ionic bonding nor covalent bonding nor metallic bonding for molecules. So the proposal for molecular bonding is magnetic coupling.

A molecule is an electromagnetic oscillator with many degrees of freedom. There are two varieties of hydrogen, ortho and para hydrogen. Orthohydrogen has a magnetic moment. For para hydrogen the two magnetic moments are paired against each other, so that the atom has no overall magnetic moment. There are atoms with a net overall magnetic moment like  $^1\text{H}$ ,  $^2\text{H}$ ,  $^{13}\text{C}$ ,  $^{19}\text{F}$ ,  $^{23}\text{Na}$ ,  $^{29}\text{Si}$ ,  $^{31}\text{P}$ ,  $^{35/37}\text{Cl}$ ,  $^{79/81}\text{Br}$ ,  $^{127}\text{I}$  ... (where the mass number is mostly a prime number!) and there are atoms with a zero magnetic moment. When atoms or molecules are placed in a static magnetic field, the atomic magnets (N-S dipoles) experience a torque, which aligns their magnetic poles with the external field vector. The oriented atoms are now irradiated with electromagnetic radiation.

If this radiation has the eigenfrequencies of the atomic or molecular oscillator, resonance occurs. What we measure are only resonant frequencies. Resonance is the response of an oscillator. Quantum physicists claim that the resonant frequency is identical with the frequency of an alleged magnetic moments precession of a nucleon.

The cause of the magnetic moment is the spin of the charged nucleon. But the measured resonant frequencies do not imply the existence of spinning nucleons! Orbiting and spinning electrons and nucleons are necessary ad hoc hypotheses in order to save the Rutherford-Bohr atomic model. We will later discuss these topics.

### **The physics of so-called Nuclear Magnetic Resonance**

It is a fact that some atoms have magnetic properties. Rabi's experiment for example showed that a strong external magnetic field affected the path of a beam of LiCl. The most important atom that has a tiny magnetic moment is hydrogen, because hydrogen is a building block of many molecules. Therefore, NMR is so an important tool for organic chemistry. An example is ethanol,  $\text{CH}_3\text{-CH}_2\text{OH}$ . Only the hydrogen atoms of ethanol have magnetic moments,  $^{12}\text{C}$  and  $^{16}\text{O}$  of molecules are not magnetic. Note that according to quantum theory nucleons (protons and neutrons) and electrons of the Bohr atomic model possess charge and spin. The spinning charge generates a magnetic dipole along the spin axis; therefore all nucleons and electrons possess a tiny magnetic moment. For most nuclei the spins and therefore also the magnetic moments of the nucleons are paired against each other, such that the nucleus has no overall spin and no overall magnetic moment. Also in molecules the spins and magnetic moments of the electrons are paired.

The overall magnetic moment of the ethanol molecule is only due to the hydrogen protons. Now how do the magnetic moments of nucleons and electrons of ethanol interact with an external magnetic field when the sample to be tested is placed in a strong magnetic field of usually 7.05 Tesla (= 70,500 Gauss) or 11.75 Tesla?

When a tiny magnetic moment is placed into a strong static magnetic field, it will experience a torque which will force the magnetic vector to align with the applied magnetic field in only two ways, either reinforcing (parallel orientation) or opposing (antiparallel orientation) the magnetic field vector  $B_0$ . But the antiparallel orientation of the tiny magnetic moment is very unstable! Therefore nearly all magnetic vectors of electrons, protons and neutrons have a parallel orientation with respect to the vector  $B_0$ . For any atom structure and for any molecule structure this magnetization would cause a total collapse. The dynamic equilibrium of nuclear and shell structures is not so stable that such an attack would not destroy the subtle structures. But we do not observe either a breakdown or a magnetization of the samples. Therefore the NMR technique is a crucial experiment against the possibility of the Bohr atomic model. To cancel the effect of temperature we can lower the temperature but the atoms or molecules do not experience a collapse!

(In the Stern-Gerlach experiment there is no constant external magnet field and the atoms fly only a short time through the field, so we see no complete parallel alignment of the magnetic moments.)

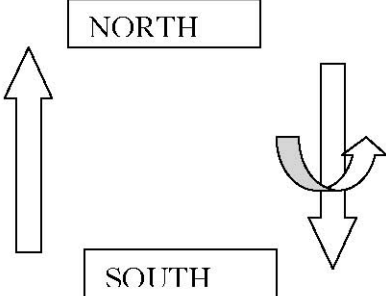
The claim of quantum theory is that the paired magnetic moments cancel each other. Indeed this is the case when we regard the effect of the paired up and down magnetic moments on something other.

But we must clearly distinguish the reverse case: when the paired up and down magnetic moments are placed in an external magnetic moment they cannot neutralize each other so that they do not experience a torque. The two magnetic moments are neighbors that experience the

torque independently due to the applied external magnetic field.

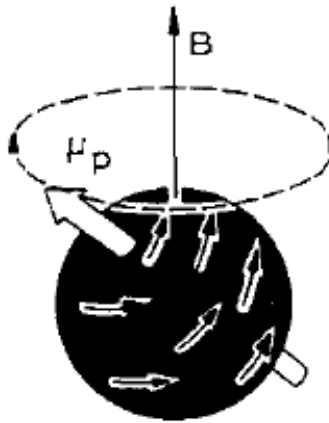
As a result, also the formerly „down“-spin nuclear and electronic magnetic moments are now „up“, i.e. they have now the same

orientation as the vector  $B_0$  of the applied field.



**Potential energy of a magnetic moment**  
A compass needle with a magnetic moment  $\mu$  lines up with the magnetic field of the Earth  $B$ , the arrow points north. This stable position has a null potential energy, i.e. the needle has no potency to work. Twisting the needle around so that it points south, the work done is  $|W| = \mu B$ . Therefore, the potential energy of this unstable state is  $\mu B$  and the needle swings back to the stable position when you let it go. Quantum physics textbooks claim that when the needle points north there is a negative potential energy. This is impossible by the definition of potential energy.

### The precessing proton – a myth



The graph from Purcell's Nobel lecture in 1952 shows the spinning and precessing proton. According to quantum theory the proton is a spinning charged body that acts like a minute magnet. The external magnetic field exerts a torque on the proton in order to align the magnetic axis of the proton with the external magnetic field.

Because of the proton's spin, the proton's axis will not align but precess about the direction of the external magnetic field. The precessing earth is an analogue...

There is no direct experimental evidence for proton spin. The spin of the proton is an assumption in order to explain the spectral lines of NMR-experiments. But if some features of spectra are not explainable in terms of the presupposed model that model is a flaw.

Regarding the quantum ontology of the atom it seems to be not plausible that a charge, which is spread out over the surface of a sphere rotates. The angular velocity is an arbitrarily prescribed one.

There is no empirical evidence that a proton is an indivisible corpuscle, it is probable that it is made up of sub-particles. Then, why should the nucleus of gold (Au) work for example as such a complex machinery of 79 spinning protons and 118 spinning neutrons? We know from macrophysics that a current in a circular wire produces a magnetic field but there is no circulating charge inside the wire!

See the article *Electric current is not a flux of charges*. Therefore, the claim that spinning nuclear charges produce the magnetic features of protons and neutrons is an erroneous analogue.

### **The alleged spin-spin coupling**

The simplest case is the HH-coupling (hydrogen-hydrogen-coupling). Two single neighbor hydrogen atoms in a molecule show a splitting (doublet) of the spectral line. The claim is that about 50% of the protons of hydrogen in the external magnetic field are spin up and the remainder is spin down. Because the magnetic field of the two states differs slightly ( $\Delta B$ ), two spectral lines occur. The splitting is measured in some Hz. Hydrogen spin-spin coupling is denoted  $J_{HH}$ . For different molecules,  $J_{HH}$  has different magnitudes in Hz because distances are different between adjacent protons. The claim is that spin-spin coupling is an interaction that works either through the molecule structure or through the empty space in between.

We are not obliged to go into all details of spin-spin coupling because there are two anomalies shown in a simple case study, which contradict the premises. Therefore the model failed for the time being. Additional *ad hoc* hypotheses would only increase the lack of plausibility of the Bohr atomic model...

### **Nuclear precession and spin flip**

A photon can flip the precessing proton if and only if the energy of the photon is exactly the same as the energy difference between the states “up” and “down” of the proton. Only if this necessary condition is fulfilled, the proton can absorb the photon and flip! Spin conservation is not violated because it is assumed that the photon has spin  $\hbar$  and the two proton states have spin  $\pm\hbar/2$ .

Spin flip works with a frequency close to resonance. An antenna produces radio waves with the desired resonant frequencies.

Textbooks don't explain the mechanism of the absorption of a photon by the spinning and precessing proton. Students are confronted with the postulate that there are right-handed and left-handed photons with energy  $E = h\nu$ . The photon has to have not only exactly the necessary energy for the postulated flip but must have also the proper handedness.

The mass of the photon is no more relevant because it was the energy necessary for the flip.

The photon in its twofold nature shows also the feature of a wave but this wave has only frequency and no amplitude.

The photon is an entity of which the physical qualities are unimaginable and unthinkable...

### **$\text{BrCH}_2\text{CH}_3\text{CH}_2\text{OD}$ case study refutes spin-spin coupling model**

Regarding the 2 methylene groups ( $\text{CH}_2$ ), this molecule shows symmetry. The claim is that the causes for the splitting of the methylene spectral lines are solely the proton magnetic fields of the central  $\text{CH}_3$  group. Further it is assumed that bromine Br does not affect the spins of the methylene groups (see below). According to the spin-spin coupling theory the spin of deuterium D has no effect on the spins of the methylene group because D has spin 1 and the methylene protons have spin 1/2.

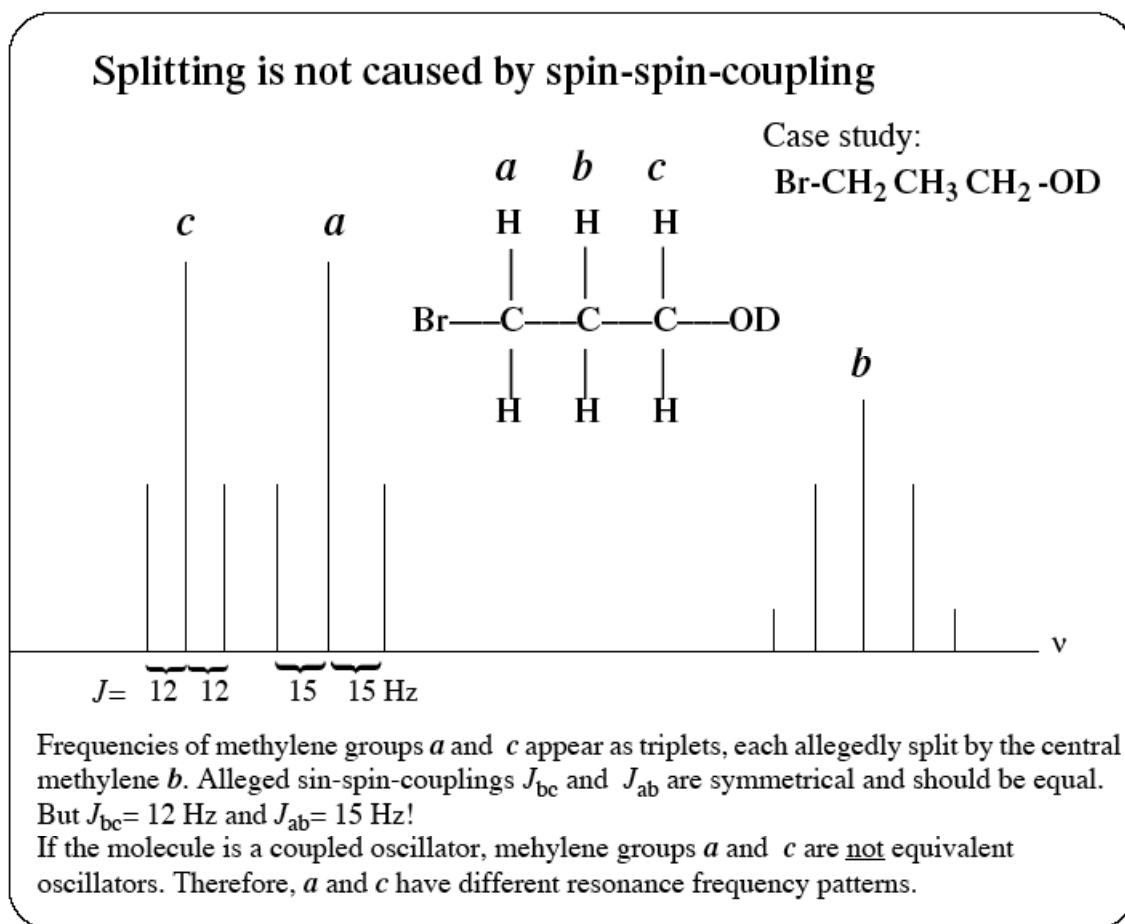
Again, in terms of the standard atomic model of quantum theory the spin-spin coupling for the two lateral methylene groups *a* and *c* is solely due to the central methylene *b*. Because of the perfect symmetry, the magnitude of the spin-spin-coupling constant should be the same for the

lateral methylene groups. If we assume these premises the splitting of the two methylene groups should appear completely identical because the causing interaction is symmetric.

But the coupling constants of the methylene triplet splitting are considerably different:

$$J_{bc} = 12 \text{ Hz vs. } J_{ab} = 15 \text{ Hz!}$$

Therefore the assumed symmetry condition is violated. The conclusion is that there must be an intrinsic flaw in the model of spin-spin coupling!



It is remarkable that in a tutorial this anomaly is mentioned and frankly commented: *...there is no simple way to predict this ahead of time.* [young]

The physics of spin-spin coupling is also remarkably selective: Only the neighbor central methylene is the cause for the triplet splitting of the lateral methylene groups. Regarding the two lateral methylene groups themselves, there is no spin interaction considered!

Sometimes one can read in textbooks: they are too far away. But the twofold distance is physically not too far away.

The lateral Br atom and the lateral OD-group distances to the adjacent methylene groups are not widely spaced but there is neither a NMR spectral line for Br and OD nor a spin-spin coupling due to Br or OD!

According to quantum physics the tiny magnetic moments of all paired protons cancel out. The paired magnetic moments of the neutrons also cancel out. Only the unpaired magnetic moments

of the protons respective of the neutrons produce interacting magnetic moments.

Regarding the coupling constant  $J_{\text{HH}}$  for the case study here, there are the following unpaired protons: 7 unpaired protons of the 7 H-atoms and 1 unpaired proton of Br.

Deuterium D has 1 unpaired proton (spin 1/2) and 1 unpaired neutron (spin 1/2), their spin pair up to a net spin 1. Therefore, as expected by quantum theory, D does not show in the proton spectrum.

But the Br-atom shows an anomaly: quantum physics should predict also a multiplet structure for the Br- NMR-spectrum, but Br is “transparent”, i.e., not a single spectral line appears!

Recall that there are 2 stable isotopes of Br:



For both, Br-79 and Br-81 there is an unpaired proton because the number of protons is an odd number (35). There should be a split spectrum for bromine and spin-spin coupling between the unpaired bromine proton and the adjacent protons of the methylene group. Why do we not observe the alleged spin transitions and spin couplings that spectra show? There is no explanation possible in terms of current quantum theory. It seems to me that a new *ad hoc hypothesis* is hardly to find in order to explain the Br anomaly. (Also other nuclei such as Cl and I have nuclear spin but are transparent for NMR spectroscopy!)

The mentioned anomalies of the standard atomic model show that the NMR spectra are not caused by flips of precessing protons, i.e. when the exciting frequency has the magnitude of the resonant frequency of the precessing proton. The anomalies signify a refutation of the model of spinning nucleons in a shell-structured nucleus.

The constant intervals of the splitting patterns indicate that this are phenomena of an oscillating molecule that has oscillating patterns analogous to the overtones in music. Overtones (harmonics) of a musical instrument are resonant frequencies, the fundamental tone being the dominant resonant frequency.

Regarding the molecule as a musical instrument the multiplets of the spectra can be thought of as the secondary tones (secondary resonant frequencies) of the fundamental tone (the dominant resonant frequency). The more degrees of freedom the oscillating molecule group has, the more eigenfrequencies are possible. Regarding the  $\text{BrCH}_2\text{CH}_3\text{CH}_2\text{OD}$  molecule there is only one symmetric axis, namely the axis  $\text{Br} - - - - \text{OD}$ . Obviously, the methylene groups a and b are not physically symmetric with respect to the perpendicular axis. Therefore, splitting of a and b is not identical!

In our case study the intensities of the triplet spectral lines show a constant proportionality of 1:2:1. This indicates that the oscillating H atom has 3 vibration modes: there is a central (dominant) frequency  $n_d$  and 2 secondary frequencies  $n_d \pm n$ .

The proportion of the amplitudes is  $1:\sqrt{2}:1$  (recall that the energy is proportional to the amplitude squared). There is every indication that this hydrogen oscillator is a structured one and that the structure is proportioned. The present author proposes a hydrogen model that consists of 4 elemental ring magnets with charges  $+ - + -$ .

The atomic bonding is due to magnetic coupling; the chemical bonding of molecules is also due to magnetic coupling. This magnetically coupled oscillator has many degrees of freedom.



### **Chemical shift is not possible due to electron shielding**

In the case study of the  $\text{BrCH}_2\text{CH}_2\text{CH}_2\text{OD}$  molecule the methylene group adjacent to oxygen ( $c$ ) is shifted  $d = 3.75$  and the methylene group adjacent to bromine ( $a$ ) is shifted  $d = 3.4$ , where  $d = 0$  is the value for the standard tetramethylsilane (TMS) molecule. The claim is that different frequencies for  $a$  and  $c$  result from a small difference of the magnetic field. The difference results allegedly from the circulation of electrons of the molecule. Different H nuclei of the respective methylene groups have different electron density surrounding them. Therefore the nuclei are shielded from the applied field  $B_0$  by electron magnetic fields of different magnitude.

Consequently, the frequency lines do not coincide but are shifted.

But for the molecules of organic chemistry there is an even number of electrons so that the electron magnetic moments cancel within each molecule. Only if the molecule is thought of as a coupled oscillator, methylene groups  $a$ ,  $c$  have different dominant resonant frequencies because they are not equivalent oscillating groups.

### **„Decoupling“ does not occur**

Chemical shift and spin-spin-coupling are not explainable in terms of the standard atomic model of quantum theory. So-called homonuclear decoupling cannot explain the decoupling of spins. To stop spin coupling means to stop spin! In terms of the oscillator model „decoupling“ is very easily explainable: Regarding a piano, a soft touch of a key produces overtones. If you press the key strongly you hear the dominant frequency.

The same occurs with the oscillator molecule. You have for example two resonant frequencies, and then if a second radio frequency oscillator signal is set to continuously irradiate the molecule at the center frequency the side frequencies disappear and the molecule vibrates with the dominant resonance frequency at the center!

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