Spin - ½ spin - non zero spin – tunnel effect – fermions – bosons in nuclear magnetic resonance as in effect with using the ONDAMED

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In particle physics and quantum physics, ***spin*** *is a fundamental characteristic property of elementary particles including the force carriers (bosons*), composite particles (hadrons*), and atomic nuclei (Pauli, 1927).*

ONDAMED resonates with the atomic nucleus of tissue hydrogens (H). Any nucleus that contains an odd number of protons and/or of neutrons has an intrinsic magnetic moment and angular momentum, in other words a spin > 0. The most commonly studied nuclei are $_1H$ All nucleons, that is neutrons and protons composing any atomic nucleus have the intrinsic quantum property of spin.

The overall spin of the nucleus is determined by the spin quantum number S. If the number of both the protons and neutrons in a given nuclide are even, then *S* = 0, i.e. there is no overall spin; just as electrons pair up in atomic orbitals, so do even numbers of protons or even numbers of neutrons (which are also spin-½particles and hence *fermions *)* and giving zero overall spin. For instance: if an atomic nucleus has 1 proton and 1 neutron, each of these nucleons have their own spin and therefore a tiny magnetic moment. Each magnetic moment has a north pole and a south pole. Since these two little magnets do not like to attach to each other with their north pole and north pole, or south pole and south pole, their spin cannot be parallel but anti-parallel i.e. the north pole will attach to the south pole of the other magnet.

So you have two half's which then form an entity of two antipode spins – magnetic moments. Since they are quasi antipodes, the overall spin of this nucleus (proton and neutron) will be S = 0.

There is an overall Zero spin caused by two ½ spins "opposite" or anti-parallel to each other. If there is an overall Zero spin, there is no magnetic moment. Non magnetic moments cannot react to external electromagnetic fields.

Tissue hydrogen atoms, however, have a non-zero spin, S > 0 because they have only 1 proton. Accordingly they are ½ spin particles (Fermions*). They have a magnetic moment and will react to external electromagnetic fields such as the ONDAMED. They will resonate with and absorb energy from external electromagnetic fields if the spinning frequency and the external em field frequency are matching. The specific spinning frequency is called Larmor frequency according to the Irish physicist Joseph Larmor. It is different in each tissue (liver, gall bladder, heart etc). ½ spin particles mostly live in pairs and are called Fermions as opposed to Bosons which are independent . Photons are Bosons with a spin value of 1.
This allows the interaction of specific quantum mechanical magnetic properties of an atomic nucleus (H) with ONDAMED's specific em frequencies rendering photons of specific wave length and spectra for tissue repair.

Many scientific techniques exploit NMR phenomena to study molecular physics, crystals and non-crystalline materials through NMR spectroscopy. NMR is also routinely used in advanced medical imaging techniques, such as in magnetic resonance imaging (MRI).

A non-zero spin is thus always associated with a non-zero magnetic moment (μ) via the relation $\mu = \gamma S$, where γ is the gyromagnetic ratio. It is this magnetic moment that allows the observation of NMR absorption spectra caused by transitions between nuclear spin levels.

Nuclear magnetic resonance(**NMR**) is a property that magnetic nuclei have in a magnetic field and applied electromagnetic (EM) pulse, which cause the nuclei to absorb energy from the EM pulse and radiate this energy back out.

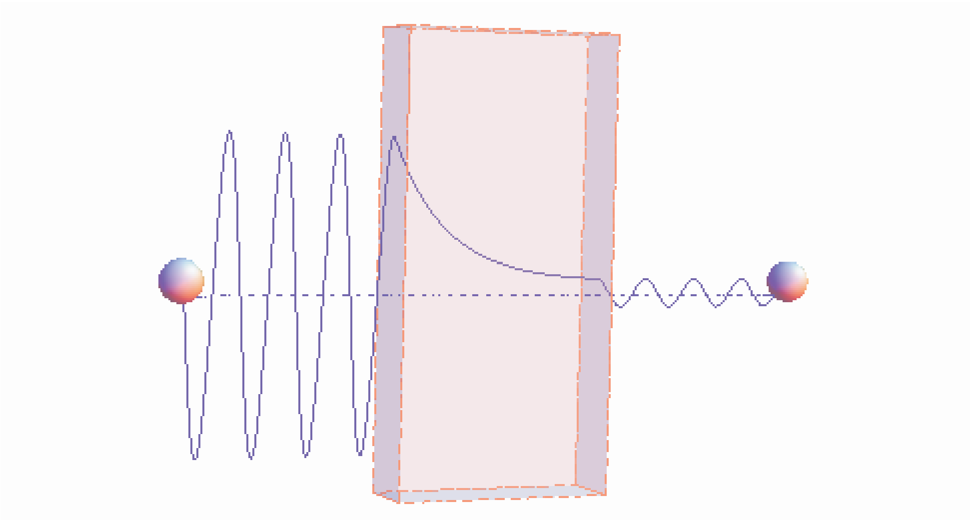
The energy radiated back out (photons) is at a specific resonance frequency which depends
on the strength of the magnetic field and other factors.

*Electron spin resonance (ESR)*is a related technique which detects transitions between electron spin levels instead of nuclear ones. The basic principles are similar; however, the instrumentation, data analysis and detailed theory are significantly different. Moreover, there is a much smaller number of molecules and materials with unpaired electron spins that exhibit ESR (or electron paramagnetic resonance) (EPR))

Wave-mechanical tunnelling (also called **quantum-mechanical tunnelling**, **quantum tunnelling**, and the **tunnel effect**) is an evanescent wave coupling effect that occurs in the context of quantum mechanics because the behavior of particles is governed by

Schrödinger's wave-equation

All wave equations exhibit evanescent wave coupling effects if the conditions are right. In other words: electrons of one em wave could migrate to another wave even through barriers if the conditions are right. Thus magnetic properties of waves are coupled with any other wave. Schematic representation of quantum tunneling through a barrier



Schematic representation of quantum tunnelling through a barrier. The energy of the tunneled particle is the same, only the quantum amplitude (and hence the probability of the process) is decreased.

*Boson

In particle physics bosons are subatomic which obey **Bose–Einstein statistics**; they are named after **Satyendra Nath Bose** and **Albert Einstein**. In contrast to fermions, which obey Fermi-Dirac statistics, several bosons can occupy the same qunatum state. Thus, bosons with the same energy can occupy the same place in space. Therefore bosons are often **force carrier** particles while fermions are usually associated with matter, though in quantum physics the distinctio photons, or composite, like mesons. All observed bosons have integer spin, as opposed to fermions, which have half-integer spin.

*Hadron

In particle physics, a **hadron** (pronounced /ˈhædrɒn/, from the Greek: ἁδρός, *hadrós*, "stout, thick") is a particle made of quarks held together by the strong force (similar to how molecules are held together by the electromagnetic force). Hadrons are either mesons (made of one quark and one antiquark) or baryons (made of three quarks). Other combinations, such as tetraquarks (an “exotic meson”) and pentaquarks (an “exotic” baryon), may be possible but no evidence conclusively suggests their existence as of 2009. The best known mesons are pions and kaons, while the best known baryons are protons and neutrons.

*Fermion:

A particle, such as an electron, proton, or neutron, having half-integral spin and obeying statistical rules requiring that not more than one in a set of identical particles may occupy a particular quantum state.

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