

## **Desk Research**

*"The influence of electromagnetic radiation on human tissue  
with special consideration  
of the effect of magnetic field gradients"*

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## Foreword by the client

Electromagnetic biocompatibility - an issue that affects many - and, ultimately, all - of us, but about which only a few hear or want to know. Governments and official bodies insist that everything is in order and that the applicable limits will adequately protect us. People who are '*sensitive to electricity*', or even electromagnetically hypersensitive, sense that these statements come up short.

While searching for progressive knowledge several years ago, I found some scientists who have made a substantial contribution to the understanding of biological sensitivity to electromagnetic fields. Although they were internationally renowned experts, their voice was too weak to assert itself in the conflict of opinions. In my overview\*, published 10 years ago, I brought together some basic knowledge that must be borne in mind when approaching the subject. Since then, much more knowledge has been collated by researchers all over the world, confirming, sharpening and extending the progressive knowledge of the time. I would like to put forward the BioInitiative Report, which has been published on the Internet and continually updated since 2007, as an example of an outstanding overview.

The situation is certainly not an easy one for interested or affected lay people or decision-makers. Should one believe the stereotypically soothing statements that have been issuing from some quarters, more or less unchanged, for decades, or the somewhat more unsettling, increasingly solid findings coming from biologically-oriented fields such as electrobiology, biophysics and quantum biology? Where are, ultimately, the starting-points for successfully tackling problems with electromagnetic biocompatibility?

Time and again our institute, too, is asked what has actually been proved. In our view it should - in spite of the incompleteness of current knowledge - be quite possible to express fundamental, scientifically-based knowledge on the effect mechanisms of electromagnetic fields on biological systems. Due to our own research focus we are particularly interested in which role is to be attributed to the gradients of magnetic fields with regard to this issue.

Since the answers to these questions should be in no way affected by our own expectations, this time we have entrusted the task of providing an answer that is comprehensive yet focused on the essentials to an independent specialist with rich expertise.

We are pleased to present his report here.

Dr. Walter H. Medinger, Krems, July 2015

\*) Medinger W: Significance of weak static and ELF magnetic fields and their gradients with respect to electromagnetic biocompatibility. A new method for precise location of technological and geogenic stress zones. IIREC report no. 02/2005, Graz.

## Desk Research

*"The influence of electromagnetic radiation on human tissue  
with special consideration of the effect of magnetic field gradients"*

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- **Banachlocha 2010**, Spontaneous neocortical activity and cognitive function
- **Bawin & Adey, 2004** Electromagnetic fields, modulation of the functions of the brain tissue, explanations of the 'Adey window'
- **Bernhard, 1979** Biological effects of electromagnetic fields
- **Binhi et al., 2005**, Stochastic resonance and nanoparticles in cell tissue
- **Burch et al., 2002**, Melatonin release in mobile phone users
- **Cavopol 1995**, Blockage of neuronal action potentials under the influence of static magnetic fields and the measurement and analysis of static magnetic fields, blocking of the action potential in cultured neurons / Cavopol discusses field gradients as an additional criterion of an electromagnetic influence
- **Emilio Del Giudice, 2005**, Quantum electrodynamics in living matter / EdG calculates the effects of multiple frequencies, presentation of coherency domains model
- **Hänggi I and II, 2001**, Stochastic resonance, signal amplification of weak electromagnetic fields with a resonating noise signal
- **Hinrikus 2005**, Non-thermal effects in human brain tissue through microwave radiation
- **Kirschvink I, II and III, 1981-2001**, Magnetite crystals in the brain as magnetoreceptors
- **Liboff** (interpretation of Paul Galland), Biological effect of alternating magnetic fields
- **Okano et al., 2012**, Study of the medical benefits of exposure to static magnetic fields (measuring of velocity of nerve conduction on in-vitro sciatic nerve model)
- **Petty, 2000**, Real-time monitoring of white blood cells (neutrophils), comparing the effects of interferon  $\gamma$  to sine-like oscillating electric fields
- **Ramazzini Institute, 2010**, Collection of publications, non-thermal effects and mechanisms of interactions between electromagnetic fields and living matter.
- **Zimmermann, 2012**, Inhibition of cell division of cancer cells using specific modulated frequencies

### Selected overall studies and documentation

- BioInitiative Report (2007 + ff), HF fields in the microwave range have similar effects to ELF fields on biological tissue
- Athem study, 2009, Research Report no. 47 of the Gen. Accident Insurance Institution Vienna (AUVA), investigation of athermal effects of electromagnetic fields in the mobile sector
- REFLEX study, 2001-2004, Risk Evaluation of Potential Environmental Hazards From Low Energy Electromagnetic Field Exposure Using Sensitive *in vitro* Methods, European Union, Contract No.: QLK4 CT 19999-01574, Start: 1 February 2000 - End: 31 May 2004, pp. 7-243
- Mobile Communications and Health, 2006  
[author's note: informational report containing facts and figures]  
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### Discussion

- IIREC Report, 2005  
Dissipative Structure of Electromagnetic Fields in Living Systems, Chang-Lin Zhang, Frontier Perspectives, Spring 2003, Vol.12 no. 1, pp. 1-44

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## Preamble

The expectation of the customer on the client that led to this study is, from the client's point of view, realistic and reasonable.

However, the state of scientific knowledge permits an unequivocal explanation of the interactions between weak electromagnetic radiation and biological tissue to only a very limited extent using technically sound documents. There are still technical discrepancies in the disciplines that are, in your opinion, far apart on the subject - this is based on a denial of the influence of radiation, through objective scientific research, to clear warnings about the effects of radiation on lasting damage to the health of humans, animals and plants.

General acceptance by the man in the street is characterised by 'looking away' (shutdown of the prefrontal cortex on receipt of negative messages that violate the feeling of well-being), through a vague, inconclusive uncertainty ("you don't know what to believe"), to a belief that even weak radiation from small technical devices such as radio devices in mobile technology (smartphones) have an adverse effect on one's health. The only thing is that you don't know how you can protect yourself, and that you also don't want to do without the possibilities offered by communication technology, and therefore risk the consequences.

The situation is thus anything but clear and simple.

The dedicated, open-minded scientist and doctor thinks - as they should have learned - outside the box and reads specialist literature from related fields, finding a number of international publications in what are known as 'peer-reviewed journals' \*\*, which show that - in the majority of cases - radiation has a negative effect on one's health, and that this effect can be demonstrated in cell cultures (leukocytes, DNA) in special tissue structures (brain, eye, glands, skin, bones) and also in fully-developed living organisms (chicken, fish, plant).

**\*\* Explanation of the 'peer review' process:**

*'Peer review' is a procedure to ensure quality in scientific publications in the form of 'cross-opinion' or double-blind opinion. Independent experts read the article that is to be published without knowing either the author or the institution. Even the experts sometimes remain anonymous. This evaluation includes: currency, practical, technical evidence, significance of the issue, originality and validity of the approach taken and the plausibility of results in context, as well as the possibility of methodological errors.*

[Author's comment:]

The difficulty with this report lies in the evaluation if the commissioner of the peer review presupposes the proximity to classical science in the sense of Newton's world view as an assessment criterion. This is often difficult if the paper is closer to quantum mechanics or quantum optics and leaves the domain of classical physics. Many Nobel prizes in recent years would not have been awarded if these criteria had been applied to publications by Nobel Prize winners.

This is quite a dilemma in science as they are somewhat obstructing their own development with this 'examination requirement'.

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## Note on quotations from Wikipedia:

Passages from Wikipedia are cited. Wikipedia represents the current generally accepted state of science, technology and other fields and may therefore be taken as 'recognised general knowledge'. Moreover, the descriptions given in Wikipedia are objective, usually formulated so as to be short and comprehensible and are always checked by several authors, and can thus be assumed to be neutral, factual descriptions.

If it is useful to explain and illustrate the topic in terms of desk research, and no better, generally comprehensible description exists, a description/depiction taken from Wikipedia is used in addition to available publications.

[End of comment]



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## Introduction

### Tasks

The task requires a search (desk research) for scientific publications in the fields of 'influence of electromagnetic radiation/fields on biological tissue/certain organs with special consideration of the effect of magnetic field gradients'. This also includes the review and discussion of the results of different studies and documentation.

### Feasibility study

The study is feasible, however with the restriction that organ examinations are not currently possible as organs cannot exist as 'independent laboratory units'. There are, for example, no isolated, functioning kidneys that could be used for such purposes. Human bodies themselves are structured too individually to permit the levelling, parametrisation and standardisation of all interaction parameters such as body type, age, nutritional status, fitness level etc. required for a laboratory experimentation model - even against the background of 'peer review' tests.

### Adjustment of research to existing published studies

The adjustment of research relates to existing studies published internationally in a variety of disciplines (e.g. biology, neurology, biochemistry, biophysics, neuroanatomy...).

## Fundamental principles

### A

#### Abbreviations

ELF	= Extremely low frequency (3-30 Hz, previously up to 300 Hz; the upper range of 30 to 300 Hz is currently designated SLF = Super Low Frequency)
EM	= [EM(F)/emf]= electromagnetism (electric, magnetic and electromagnetic fields)
FGD	= Field gradient divergence [defined in physics as the second derivative of magnetic flux density according to the distance between two measuring points]
HF	= High frequency (from 30 Hz = 3 kHz 000); also RF = radio frequency
Hz	= Hertz (= 1 oscillation/1 second)
ICR	= Ion cyclotron resonance effect, ion cyclotron resonance
LF	= Low frequency (below 30kHz)
SAR	= Specific absorption rate
ULF	= Ultra-low frequency, (former designation of what are now known as ELF fields; the term ULF currently refers to the frequency range 300-3000 Hz)
UHF	= Ultra-high frequency (300-3000 MHz), the lowest microwave range
VLf	= Very low frequency (3-30 kHz)
VHF	= Very high frequency (30-300 MHz)

### Adey window

Starting in the mid-1970s, William Ross Adey and S.M. Bawin conducted experiments using the brain tissue of chickens and cats, which was irradiated with modulated VHF fields (30-300 MHz). In their experiments, Adey and Bawin found a narrow intensity and frequency range in which treated cells responded. Outside of these areas, however, no or only minimal response occurred. The experimentally determined frequency range of these low-frequency modulations is now known as the Adey window.

→ See also 'Selected scientific single papers (Bawin, Adey)

### Generally valid level of knowledge

What has been proven is true. However, here and there is disagreement about what may be considered proof.

This applies to the mechanistic worldview based on Newton's laws. This worldview and the resulting understanding of mechanics, global and planetary contexts has given us the knowledge that Galileo was right. Nevertheless, this is sufficient for heart and liver transplants and the construction of a Kepler space telescope (NASA, launch 03/2009; Hubble, launch: 04/1990).

It is not yet sufficient to explain what happens in the depths of molecules, atoms and electrons. One very important aspect is e.g. electron spin, the rotational direction of an electron. Sometimes it is enough to explain the 'how' and construct an application without resolving the 'whys and wherefores' down to the last detail (2007 Nobel Prize for Peter Grünberg, F.Z. Jülich and Albert Fert, Université Paris-Sud, tags: GMR [*giant magnetoresistance*] effect, quantum mechanical effect through the spin dependence of electrons, anti-magnetic coupling and spintronics).

## E

### Electromagnetic spectrum

This 'em' spectrum begins with the limiting case of static fields (without oscillation) via the sub-ELF fields of up to three oscillations per second (3 Hz) and extends to such high frequencies (oscillations per second) that the fields usually manifest themselves physically as particles.

**The following frequency ranges (units in multiples of Hz) are e.g. used in technology:**

kHz	- acoustics, loudspeakers (1000 oscillations/sec.)
MHz	- radio, television, (1 mil. oscillations/sec)
GHz	- frequency of a modern processor (1 billion oscillations/sec.)
THz	- airport scanner (terahertz = 1 trillion oscillations/sec.)
PHz	- X-ray radiation (petahertz = 1 quadrillion oscillations/sec.)

Electromagnetic waves propagate in free space at the speed of light; the speed within matter is dependent on the matter. The speed of light in free space is a natural constant and determines the relationship between frequency and wavelength.

A wave with a frequency of one megahertz (radio wave) has, for example, a wavelength of approximately 300 metres.

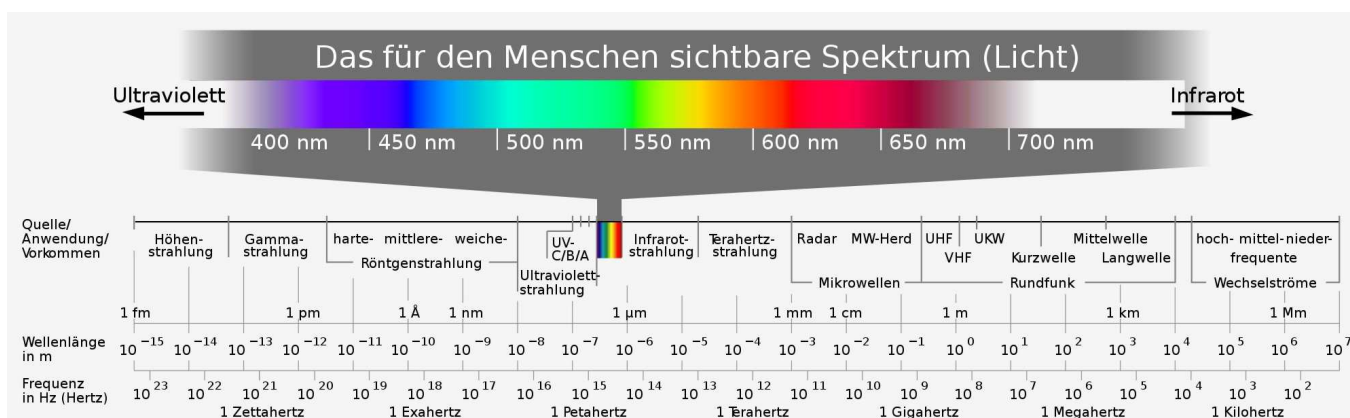
Green light with a wavelength of about 500 nm has a frequency of 605 THz, which in turn corresponds to energy of 2.5 eV (electron volts). In the case of electromagnetic waves with frequencies in the gigahertz range (lower frequencies), the wavelength is greater than is the case with light, for example: the wavelength in microwave ovens is approximately 12 cm, and about 2.5 cm in domestic satellite television receivers. [Source: Wikipedia]

The electromagnetic spectrum describes oscillations per second and wavelengths and assigns these areas tangible (e.g. infrared = heat, visible light) properties that also stimulate atoms and molecules, such as vibrations and rotations (microwaves). These range from <1Hz

(1 oscillation/second) up to the radar, light, X-ray and gamma-ray range. Gamma rays are also formed[\*] during the radioactive decay of atomic nuclei. If gamma rays come into contact with human (animal or plant) tissue, *secondary radiation* occurs in the tissue as electrons and X-rays are liberated. Overall, this very high-energy radiation - usually harmful to the organism - generates effects by breaking chemical bonds (ionising radiation).

[\* Editor's note: the Big Bang Theory controversially discusses gamma rays of 'unknown origin' from the time of the birth of the universe. Likewise, arise gamma rays may be generated during technically induced high-speed particle collisions.]

Our visible light is a very small part of the electromagnetic spectrum:



While infrared radiation is familiar as a pleasant warmth, many people have already become acquainted with the harmful effects of UV radiation (solarium, sunbathing on the beach) in the form of sunburn.

This is a well-known form of damage caused to the surface of the skin by radiation (EM radiation). Depending on the radiation, damage can occur only beneath the skin.

## Electromagnetic wave

An electromagnetic wave is a wave made from coupled electrical and magnetic fields. Examples of electromagnetic waves are radio waves, microwaves, thermal radiation, light, X-rays and gamma radiation. Electromagnetic waves in a vacuum are known as transverse waves. The interaction of electromagnetic waves with matter depends on their frequency, which can vary by many orders of magnitude.

Unlike, for example, sound waves, electromagnetic waves do not require a medium in which to propagate, and travel at the speed of light in a vacuum regardless of their frequency. The propagation velocity is reduced in matter. This is expressed through the refractive index  $n$ . [Source: Wikipedia]

The latter means that an electromagnetic wave changes its frequency when entering/passing through materials (water, cellular tissue). Electromagnetic waves can have a variety of origins, such as spontaneous emission, bremsstrahlung, molecular vibrations, Larmor frequency, movement of electrons in electrical conductors, sonoluminescence and gamma-ray bursts.

[see [http://de.wikipedia.org/wiki/Elektromagnetische\\_Welle](http://de.wikipedia.org/wiki/Elektromagnetische_Welle)]

## Electromotive force

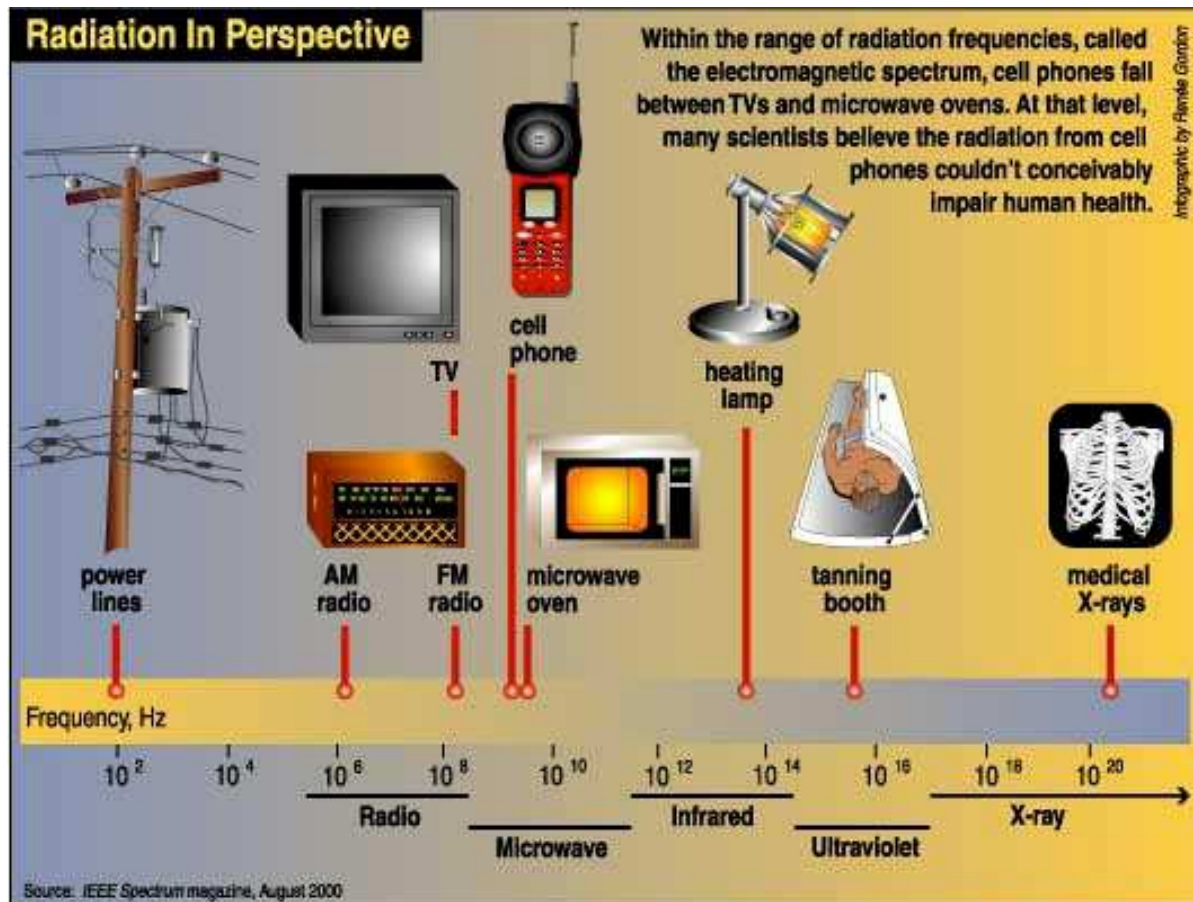
Electromotive force (EMF), also known as primary voltage, is the historical name given to the source voltage of an electric voltage source. This is defined as the ability of a system to generate a voltage. The term has been used primarily in relation to galvanic cells or for induced voltage in electrical machines such as electric motors and generators. Despite its name, the term does not describe a force in the physical sense, but electrical voltage. This term is now obsolete,

H\*

\* H comes from the German original and stands for “Handy”-Strahlung

What is 'mobile phone radiation'?

The radiation emitted by a mobile phone lies in the microwave range, which in turn forms part of the overall electromagnetic spectrum. It is a high-frequency radiation. The primary decisive factors for effects on biological tissues are frequency, time and dose.



**Power (electromagnetic output):**

[Original quote from: "Environment, Health and Safety Online",  
source: <http://www.ehso.com/ehshome/cellphonecancer.php>]

>>Newer phones are digital. The older analog [analogue] phones are expected to be phased out by 2006. The major difference is that analog phones use much more power than digital. Analog [devices/author] use about 1.3 watts, while a digital mobile phone is designed to operate at a maximum power level of 0.6 watts (see: <http://www.telecom.globalsources.com/MAGAZINE/TS/0209/PANALOG.HTM>) By comparison, a household microwave oven uses between 600 and 1,100 watts.<<

The digitisation of mobile telephony meant that microwave signals were pulsed at low frequency and showed ELF secondary modulation.

## I

### ICR effect

The ion cyclotron resonance (ICR) model was developed in the mid-1980s by Abraham R. Liboff at Oakland University in Rochester, Michigan. ICR occurs when ions (charged particles) move in a static magnetic field, e.g. in the Earth's magnetic field, with additional influence by ELF fields. The joint effect of both fields (similar to a rotation axis and torque) deflects the ions so that they are held to a circular orbit. [See: LMU Munich, Department of Biology I - Botany: Botanical Institute, Menzinger Str. 67, 80638 Munich. / Dr. Alexander Pazur: "Molekulare Mechanismen der biologischen Wirkung elektromagnetischer Felder und des Erdmagnetismus"]

## M

### Magnets, dipoles, antennae

Nowadays, magnets themselves are generally well-known. Their effect, however, is often described as 'scary' - their force cannot be felt, seen, lifted or dropped, nor can it be smelt or heard.

Natural magnets occur in the Earth's crust; these were discovered in the region of Magnesia in ancient Greece, whence they likely received their name. Natural magnets consist of magnetite, a mineral ore made from iron and oxygen [ $\text{Fe}_3\text{O}_4$ ]. The magnetic effect is a consequence of an ordered state that magnets achieve at atomic level at their cores. The production process of a naturally occurring material is triggered by the pulsating magnetic field of the Earth. (This also happens in iron-framed park benches, a process that can be easily measured with a compass - the compass needle no longer points to the north, but to the 'leg' of the bench). The ordered state is a state of the force field surrounding the atoms. If, through the process of magnetisation, the electrons of (more or less) all atoms within a particular material region receive the same angular momentum (spin), the material becomes magnetic. This ordered state then generates a higher-ordered force-field that surrounds the magnet. The magnet transmits this 'order' to other magnetisable materials. Thus can be explained the effect on water (cell and tissue water), as water ( $\text{H}_2\text{O}$ ) possesses, from a physical point of view, an positive and negative electrical pole, which characterises a dipole, i.e. the core of every antenna and every magnet. (Two free electrons at the end of the oxygen component lead to a negative partial charge/charge excess of electrons and the relative electron deficiency at the two hydrogen atoms leads to a 'charge deficit' of electrons/positive partial charge). As a molecular dipole, a water molecule thus possesses characteristics that are analogous to an antenna or magnet. These properties allow water molecules to associate (collect groups and form clusters).

A magnetic field is created around every current-bearing conductor (electromagnetism). The strength of electromagnets can be increased by placing magnetisable material (iron core) on the interior of a coil with current flowing through it.

## S

### SI units

SI stands for 'Standard International' and describes a convention on so-called base units. Base units include metres, kilogrammes and seconds, as well as ampere's for electrical current strength.

The development of these units goes back to an initiative of the French National Assembly in 1790, tasking the French Academy of Sciences with designing a uniform system of weights and measures. The basic units were originally the metre, as the ten-millionth part of the distance from the Equator to the North Pole, the gramme, as a weight (later defined as the mass of  $1 \text{ cm}^3$  of water at  $4^\circ \text{C}$  and at a pressure of 760 mm mercury) and 1 second as  $1/86,400$  of the mean solar day. In addition to these, the traditional units for distance and temperature continue to be used in the USA and the UK.



Non-compliant SI units such as ft = feet, 1 Sm or NM = 1 sea mile (nautical mile) and speeds of 1 kt = 1 knot = 1 nautical mile/hour continue to be used in shipping and aviation.

For details about the units used, see Appendices 1 to 3.

### Stochastic resonance (SR)

[Quote from Phys. Blätter, 2001, p. 16-16, P. Hänggi, Inst. f. Physik, University of Augsburg]

>> The phenomenon [SR] can be explained using the example of a marble in an egg carton: If the marble is rocked gently by a weak oscillating force, it cannot overcome the threshold of an adjacent hollow. If a random vibration then interferes with this movement, a random 'kick' at the right moment can be sufficient to lift the marble across the threshold. A statistical calculation shows that two competing mechanisms determine the answer: an increasing noise level increasingly allows excursions across the threshold (in correlation with the weak external signal); on the other hand, the sensitivity of the response wanes with increasing noise level. This results in an optimal noise intensity to permit exit from the trough. The effect has been predicted and observed in many physical systems, e.g. a bistable ring-laser, as well as in electronic, magnetic and superconducting multi-stable systems.

Because the phenomenon of stochastic resonance is based on only three elements - firstly, noise; secondly, a below-threshold signal; and thirdly, on a non-linearity in the form of a threshold - it is omnipresent. Sensory cells in nature show exactly this behaviour: they fire signal pulses only when the sensory stimulus exceeds a certain threshold.

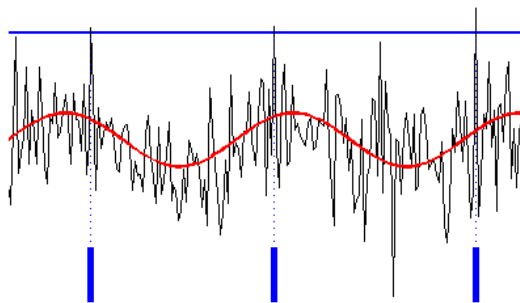


Figure:

A weak signal (red curve) is superimposed by a noise signal superimposed (black line) that goes into resonance with the 'base signal' (red line). The red line lies beneath a threshold (blue line). Below this blue line, the red line signal is undetectable by the system. Above a certain noise level, the red line signal will be strengthened so as to be 'visible' (thus triggering a reaction in the system).

These are the blue bars that here represent the 'threshold'

### Summary:

Beyond the bounds of classical physics, '*stochastic resonance*' also gains in importance in the context of quantum mechanics, e.g. for the optimisation of the transmission of information in quantum mechanics.

This explains why weak (especially pulsating) electromagnetic (alternating) fields affect nerve cells in the brain and why the brain and surrounding brain tissue in turn react and trigger reactions (in the sense of potential changes).

## W

### Science of classical physics

[Source: Wikipedia]

Classical physics encompasses the fields of physics that do not require the concepts of quantisation and four-dimensional space-time. These are classical mechanics (including celestial mechanics and classical statistical mechanics), classical electrodynamics (including optics) and classical thermodynamics.

The corresponding theories were established from the 17th century onwards and have been constantly developed since. In many areas, classical physics allows a near complete understanding of macroscopic physical processes in nature and technology. However, it fails in the description of the microscopically small (elementary particles, atoms, molecules...) and the astronomically large. Since about 1900, physics has therefore been expanded through radical new concepts that are collectively referred to as modern physics and juxtaposed with classical physics. In the context of modern physics it has been proven that some basic concepts and theories of classical physics that appear fully valid when observed macroscopically are, in fact, only approximate.

### Science of quantum physics

[Source: Wikipedia]

The term quantum physics encompasses all those theories, models and concepts that go back to the quantum hypothesis of Max Planck. This additionally encompasses all phenomena and effects that cannot be satisfactorily explained without this hypothesis. Planck's hypothesis had become necessary around 1900 because classical physics e.g. had reached its limits in the description of light or the structure of matter.

Quantum physics chiefly differs from classical physics in the following points:

- Quantum hypothesis: certain physical quantities cannot have any arbitrary value, but only certain discrete values. One says that it has been 'quantised'.
- Wave-particle duality: quantum objects show - depending on point of view - properties of waves or particles (read: mass points), but are neither one nor the other. The true nature of quantum objects eludes concrete intuition.
- Quantum physics is not determinist. This means that the outcome of an experiment is not uniquely determined by the initial values. Often, one can only make statements about probabilities.
- The outcome of an experiment is never independent of, but always inseparable from, observation. That is, the observation process affects the observed phenomenon in physical ways.

Quantum physics is, alongside the Theory of Relativity, the second cornerstone of modern physics. The differences between quantum physics and classical physics are particularly evident in the microscopically small (e.g. the structure of atoms and molecules) or in particularly 'pure' systems (e.g. superconductivity, laser radiation...). Even everyday things such as the chemical or physical properties of various materials (colour, ferromagnetism, electric conductivity...) can be understood only through quantum physics.

However, two areas of theoretical physics also form part of quantum physics:

### Quantum mechanics and quantum field theory.

The former describes the behaviour of quantum objects under the influence of fields, and the latter additionally treats fields as quantum objects. The predictions of both theories are in extraordinary agreement with the results of experiments. Their only known weakness is that, according to the current state of knowledge, they are not compatible with the General Theory of Relativity.



## Selected single scientific papers

### Banaclocha

Journal:

NeuroQuantology | June 2010 | Vol. 8 | Issue 2 | Page 191-199

Title:

Spontaneous Neocortical Activity and Cognitive Functions: A Neuron-Astroglial Bio-Magnetic and Self-Organized Process

Authors:

Marcos A. Martínez Banaclocha, Helios Martínez Banaclocha

Address:

Departamento de Patología, Hospital Lluís Alcanyis, Játiva, Spain. †Servicio de Inmunología, Hospital Universitario Virgen de la Arrixaca, Murcia, Spain.

[Quote from: "Abstract"]

>>The results of various recent and independent investigations show, unequivocally, that cerebral neocortex is continuously and spontaneously working, even without any afferent input. These findings suggest that neuronal microcircuits in the neocortex have autonomic activity and support the concept that some cognitive functions may be the result of the functional self-organisation among their cellular components. From a theoretical perspective, it is proposed that spontaneous neocortical activity can be explained not only by electrophysiological and synaptic mechanisms but also as the result of the close magnetic interactions between astrocytes and neighboring neurons. This neuron-astroglial bio-magnetic interplay may underlie spontaneous neocortical activity and consequently some "spontaneous" cognitive functions. <<

[Author's comment:]

What is the exciting core of this article, and why was it selected?

The neocortex is the multi-sensory motor part of the cerebral cortex of mammals (*please see also Appendix 10*). Learning processes run in this region of the brain, where what has been learned is also stored.

Examples of this are when a baby learns to sit up, crawl, kneel, and walk. To this end, a whole series of individual steps, e.g. balancing, falling, compensation, another try and first independent steps without falling down, are required in a baby's early days. Once the sequence of movements has been learned, the pattern is saved and the brain now only requires a single command to reel off the whole chain of commands. "Walk!" This applies to virtually all learning processes, especially for processes that end with a trained reflex action, e.g. driving a car, in sport (swimming, judo) and playing the guitar: the learning and retrieval of such processes is a consequence of the interaction of many linked (neuronal) circuits. This is known as the 'self-organisation of function', which occurs at the cellular level. It is also true that this region of the brain is constantly active, effectively producing e.g. environmental signals itself - even during sleep (biological fire alarms). The brain as a whole, and other parts of the brain, constantly produce electromagnetic waves (alpha waves, theta waves, etc.\*\*). These are electrophysiological and synaptic processes (signal transmission between cells). Banaclocha and his team say that '*neocortical activity*' can also be explained as the result of close magnetic interactions between astrocytes and neighbouring neurons [glial cells: nerve tissue between the nerve cells; see Appendix]. This 'spontaneous interplay' can give rise to brain activity, providing the basis for cognitive functions such as memory, feeling, imagination, etc.]. As it is well established that almost all processes in the brain are of an electromagnetic nature (biochemical processes would be too slow by dimensions), the conclusion that external electromagnetic fields affect inner fields is justified. Cognitive processes can thus be affected.

(\*\*) see Appendix 10.

[End of comment]

## Bawin & Adey

### Journal:

International Encyclopedia of Neuroscience, published 15 September 2004  
Third Edition; B. Smith and G. Adelman, editors, Elsevier, New York

### Title:

Electromagnetic fields, the modulation of brain tissue functions  
- A possible paradigm shift in biology

Author: W. Ross Adey, Distinguished Professor of Physiology

Address: Loma Linda University School of Medicine, Loma Linda California 92354 USA

[Original quote from the first paragraph]

>> *All life on Earth is bathed in a sea of natural low-frequency electromagnetic (EM) fields from conception to death. Generated principally by thunderstorm activity in equatorial zones, these fields exhibit peaks in the ELF spectrum between 8 and 32 Hz - the [Schumann (1957)] resonances. Their energy is measured in billions of coulombs. They are ducted worldwide between the Earth's surface and the ionosphere approximately 140 km above the Earth. With a circumference of 41,000 km, the Earth may act as a cavity resonator in this ducted propagation, with a resonant frequency around 8 Hz for waves moving at the velocity of light (300,000 km/s). Schumann fields are weak, with electric components of about 0.01 V/m, and magnetic fields of 1-10 nanotesla. We may contrast these weak extremely-low-frequency (ELF, with frequencies below 300 Hz) fields with the Earth's much larger static geomagnetic field, typically around 50 microtesla ( $\mu$ T). /.../<<*

For more information, see also: [<http://www.pimath.de/magnetfeld/schichtfrequenz2.html>]

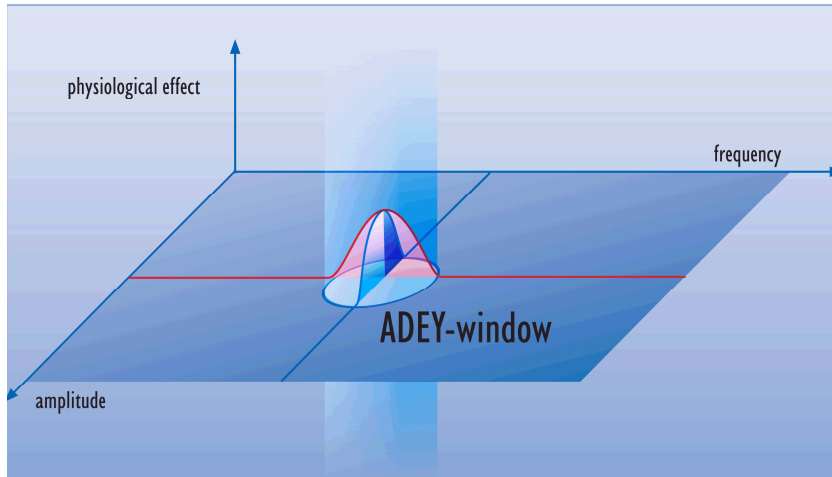
The authors here highlight the biological significance of ELF (extremely low frequency) fields, especially the Schumann resonance, although these are far weaker than the static magnetic field.

[Author's comment: the meaning of 'Adey window':]

The significance of this relationship between frequency, amplitude and biological reaction lies in the fact that organisms respond within only a narrow range. If a wave spectrum lies outside this range, a biological system cannot be forced into a reaction by increasing the intensity. This is perhaps comparable to the human ear, which (unlike with dogs) is insensitive to ultrasound and high frequency (> 20,000 Hz), or even the eye, which is *the* receiver for electromagnetic waves, situated right in the middle of the human face, and can 'only' receive and process light - that is, light in the 'visible' spectrum. The human eye cannot see ultraviolet (unlike bees) or infrared (spiders).

The 'Adey window' is a 'biological window', and is also referred to as the 'frequency amplitude window'.

This is illustrated in the following sketch:



The physiological effect is greatest when frequency and amplitude (i.e. intensity) are in a defined ratio to one another and lie within the 'window'. This window lies with defined ratios that constantly recur in biology and physics.

This was the core of the discovery made by Bawin and Adey in 1976.

These 'windows' are directly related to the Earth's magnetic frequencies and the 'Schumann-frequency', as well as the Earth's frequencies (equator and

pole frequencies).

On this, Bärtels and Piontzik(\*) stated in 2012 that: "All life on Earth is at adapted to a frequency range of 11.7 - 11.8 Hz. Likewise, all life on Earth is adapted to the frequency ranges of 7.8-7.9 Hz, 15.6-15.7 Hz and 31.2-31.5 Hz. The common frequencies generated by the Earth's frequency and the Schumann frequency are called biological frequencies."

(\*Klaus Piontzik, Claude Bärtels 2012, Planetare Systeme Band 1, printed and published by: Books on Demand GmbH, Norderstedt, ISBN: 978 384 823 2642)

[End of comment]

**Bernhard, J.**

Publication:

Z.Naturforsch. 34c, 616-627, 1979

Title:

Biologische Wirkungen elektromagnetischer Felder (Biological effects of electromagnetic fields)

Authors:

Bernhard, Jürgen, H.Priv.Do. Dr.

Address:

Institut für Radiologie, Krankenhausstr. 12, D-8520 Erlangen

[Quote - extract - from the first paragraph, p. 616:]

>> *This overview describes the results of research in the field of the interaction of electromagnetic fields with biological systems. It describes thermal and non-thermal effects. It makes no reference to any biological effect described in the literature, but a restriction is put on such biological effects as could be developed for the data-supported biophysical model concepts. The text shall elaborate that, with regard to humans, certain fundamental biophysical mechanisms may occur at certain frequencies and field strengths; but others are impossible. In addition, Chapter VI gathers several reports on biological effects at low field strengths that are currently the subject of discussion, but whose mechanisms of action are still unclear. The area of the electromagnetic spectrum discussed here is that of so-called non-ionising radiation, encompassing wavelengths greater than approx. 100 nm (12.4 eV). Electron release in oxygen (O<sub>2</sub>) occurs at about 12.5 eV, the minimum energy level for the ionisation of air (N<sub>2</sub>: 14.5 eV).*<<

[Quote - extract - from the final paragraph, p. 626:]

>> *With regard to possible mechanisms of action, this is still at the speculation stage [Author's note: this was in 1979]. However, in this regard a consensus appears to exist that - if the reported sensitivity of nerve tissue is confirmed - extraordinarily effective spatial and temporal integration mechanisms must be involved [Lit\*1]. On the other hand, Fröhlich's conceptual model for a possible non-thermal mechanism of action in the short-wave microwave range - apart from field-generated forces - is also available. Fröhlich has shown in several papers (e.g. [Lit\*2]) that biological macromolecules can possess metastable excited states with high dipole moment that are capable of far-reaching, longitudinal electrical oscillations at a frequency of approx. 1,011 Hz. Some experimental evidence appears to confirm Fröhlich's postulations ([Lit\*3,4] and literature referenced there). Mention should be made here of the results of microwave irradiation in aqueous cultures of yeast cells [Lit\*5]. At approx. 42 GHz the growth rate showed a frequency dependence in the form of sharp resonances.*<<

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- The bibliographical numbers in the original have been replaced here by the original bibliographical references. -

[Lit\*1]: H. P. Schwan, *Ann. N. Y. Acad. Pages 103, 198-213* and W. R. Adey and S. M. Bawin, / *Brain Interactions with Weak Electric and Magnetic Fields./ Neurosci. Res. Prog. Bull. 15, Mass.: MIT Press, Cambridge 1977.*

[Lit\*2]: H. Fröhlich, *Int. J. Quantum Chem. 2, 641-649 (1968).* // H. Fröhlich, *Nature 228, 1093 (1970).*

[Lit\*3,4]: S. J. Webb and A. D. Booth, *Nature 222, 1199-1200, (1969).* // W. Grundier, F. Keilmann and H. Fröhlich, *Physics, Letters 62 A, 463-466 (1977).*

[Lit\*5]: W. Grundier and F. Keilmann, *Z. Naturforsch. 33 c, 15-22 (1978).*

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## Binhi et al.

### Publication:

Abstract Book

Fröhlich Centenary International Symposium, July 1-4, 2005, Prague, Czech Republic

### Title:

STOCHASTIC DYNAMICS OF MAGNETIC NANOPARTICLES IN BIOLOGICAL CELLS

### Authors:

Binhi, V.N., Chernavskii, D.S., Lebedev, P.N., Prokhorov, A.M.

[Quote from the first paragraph:]

>> *There are many hypothetical mechanisms suggested to explain the biological effects of weak low-frequency magnetic fields. A brief review of the mechanisms may be found in the detailed discussion and in [Author's comment: Binhi et al. here refer to the work of Kirschvink, see 'K' Kirschvink I to III]. At the same time, the physical nature of these effects remains unclear. The basic problem is that the interaction energy of biologically active molecules and the MF at the geomagnetic level is very small. It is much smaller than the energy of thermal fluctuations  $kT \sim 4 \times 10^{-14}$  erg at physiological temperatures.*<<

[Author's comment: 1 erg = 0.1  $\mu$ J, or 1 J =  $1 \times 10^7$  erg (1 erg =  $1 \text{ g} \times \text{cm}^2/\text{s}^2$ )]

[Quote from the final paragraph:]

>> *The sensitivity  $S$  computed at several likely values of the elasticity of the bond between a mean magnetosome and cytoskeleton is equal to 10-20. This means a 1% MF change causes 10-20% changes in the transition probability. Thus, the limit of detectable values of the constant MF variations is found to be 200 nT, the level of geomagnetic fluctuations. Taking into account that the MF produced by a magnetosome may attain dozens mT and the changes in its mean level induced by those weak variations are the same 10-20%, we arrive to a 'magnetic stochastic biological amplification' of order of  $10^4$  functioning due to thermal disturbances.*

*The rate of the transitions and the probability of magnetosomes to be in the different states depend as well on the magnetic field direction with respect to an averaged magnetosome's orientation.*<<

[from here, free translation according to the author's understanding of what was meant by Binhi et al.]

If one applies the 
$$S = -\frac{1}{W} \frac{dW}{d(H/H_{\text{geo}})}$$
 formula to the limit of the detectable value of constant MF fluctuations is 200 nT, which approximately corresponds to geomagnetic fluctuations in the Earth's magnetic field.

Taking into account the fact that magnetic fields that are produced by a magnetosome reach dozens of [mT], and that the average changes induced by these weak fluctuations also reach 10-20%, we achieve a magnetically stochastic biological amplification to the order of magnitude of  $10^4$ , excited through thermal turbulence.

The speed of transitions between the probability ranges of magnetosomes in the various states also depends on the magnetic field direction in relation to the average orientation of the magnetosomes.

[Author's comment:]

*"Meaning and Interpretation of the publication by Binhi et al."*

The authors provide a calculation of the influence of stochastic resonance that occurs between magnetosomes and cytoskeleton (*magnetite crystals in the cell/cellular tissue*). They calculate that, in spite of the 'loud' noise, a minimal change in the magnetic field generates a signal that is also visible above the noise and thus has an effect.

Hänggi additionally provides a comprehensive explanation and shows the effect on a fish (paddlefish) that perceives these changes, helping it to find its food (plankton) (see 'H', Hänggi). An important

parameter and a basic requirement of considerations is the assumption that there are at least two metastable states in a vibrating system that can transition from one state to another with a minimum signal (= stochastic resonance, *see Basics*).  
[End of comment]

## Burch et al.

### Journal:

Int. J. Radiat Biol. 2002 Nov., 78 (11): 1029-36, PMID: 124 562 90

### Title:

Melatonin metabolite excretion among cellular telephone users.

### Authors:

Burch JB, Reif JS, Noonan CW, Ichinose T, Bachand AM, Koleber TL, Yost MG.

<http://www.ncbi.nlm.nih.gov/pubmed/12456290>

A study by Colorado State University, USA, found significantly reduced melatonin levels in mobile phone users who made phone calls with their mobile phone for a total exceeding 25 minutes per day. The effect occurred after as little as three days. The corresponding experimental group had telephoned with their mobile phones for longer than 25 minutes on three consecutive working days. Melatonin levels were determined in every case through the taking of urine samples.

Another finding of the study was that the effect is enhanced when the subjects were additionally exposed to 60 Hz magnetic fields.

[Author's note: The power grid in the United States is set to 60 Hz, and 50 Hz in Europe]

Studies that find reductions in melatonin levels due to harmful environmental influences are regarded as highly important, as melatonin plays a significant role in fighting cancer cells. An excessively low melatonin level promotes the development of malignant tumours. For example, in 1996 and 1997 Lai and Singh found that damage to genetic material following exposure to microwave radiation could be avoided through additional amounts of melatonin. Singh and Lai had irradiated brain cells with microwaves for two hours (SAR 1.2 W/kg, frequency: 2450 MHz, pulsed and unpulsed). Four hours after irradiation, damage was found to have been caused to genetic material (single and double strand breaks in DNA) with in pulsed and the non-pulsed variants. DNA repair had been hampered and free radicals occurred more frequently. When the cells were treated with additional melatonin, the effect did not occur.

[Source: Workshop of the Research Association for Radio Applications, 24-27 November 2002, Löwenstein]



## Cavopol et al.

### Journal:

(a) Bioelectromagnetics. 1995; 16(1):20-32

### Title:

Blockade of sensory neuron action potentials by a static magnetic field in the 10mT range.

### Authors:

McLean MJ, Holcomb RR, Wamil AW, Pickett JD, Cavopol AV.

[Quote taken from: "Pain Treatment Based on Quantum Theory, Chapter: Magnetic Vibration", published on Practical Pain Management (<http://www.practicalpainmanagement.com>)]

and

(b) Bioelectromagnetics (1995)16:197-206

Title: Measurement and Analysis of Static Magnetic Fields That Block Action Potentials in Cultured Neurons

### Authors:

A.V. Cavopol, A.W. Wamil, RR. Holcomb, and M.J. McLean

### University:

Departments of Neurology, Vanderbilt University Medical Center

(a)

[Original quote from "Introduction":]

>>An important aspect of magnetic fields is that they permeate all body tissues without interference. Various cell structures, including mitochondria, are stimulated by magnetic fields, and relatively small magnetic energies are required to affect chemical reactions in cells. [Cavopol]. These effects are widespread and include increases in intracellular calcium through changes in the calcium channel, changes in the sodium-potassium pump, increases in ribonucleic acid/DNA production, increases in conversion of ATP to adenosine diphosphate, and stimulation of cyclic adenosine monophosphate (cAMP)<<

(b)

[Original quote from "Introduction"]

>> Electrically stimulated action potentials of adult mouse sensory neurons in cell culture were blocked to a large extent when the neuron was positioned in a static magnetic field of -11 mT intensity produced by an array of four permanent magnets of alternating polarity [McLean et al., 1991,1995]. In the original experiments, the magnitude of this biological effect depended on positioning of the neuron under study in the field (changes in vertical distance of cell from the array),....<<

[Original quote from (b) "Discussion"]

>>The experiments and analysis described herein were designed to discriminate which of two field characteristics, field intensity or gradient of the field magnitude is the principal determinant of AP blockade in cultured neurons. ... For this reason, the gradient of the field magnitude has to be regarded as a global indicator of field variation, not as a precise correlate of firing failure.<<

[Author's comment:]

It has been proven on cell cultures of the nervous tissue of mice that conduction in nerve cells can be blocked by magnetic fields. Field strength as such is not the decisive criterion; rather, the gradient of the field strength shows the risks of such a blockade. An exact physical criterion remained open in Cavopol's work; however, a possible and plausible solution is offered by field gradient divergence. This approach allows the gap between the results achieved and their interpretation to be closed. [End of comment]

## Emilio del Giudice

### Journal:

Electromagnetic Biology and Medicine, 24: 199-210, 2005

### Title:

Coherent Quantum Electrodynamics in Living Matter

### Authors:

EMILIO DEL GIUDICE, ANTONELLA DE NINNO, MARTIN FLEISCHMANN, GIULIANO MENGOLI, MARZIALE MILANIS, GETULLIO TALPO, and GIUSEPPE VITIELLO

[Original quote from "Introduction"]

>>Quantum electrodynamics (QED) is the universally accepted theory of the interaction of atomic and molecular components (nuclei and electrons) coupled through their electric charges and magnetic moments to the electromagnetic field (emf). Accordingly, QED is the natural conceptual framework for understanding matter, in particular living matter.<<

[Original quote from "Conclusions"]

>>The sketchy examples reported in this article show that QED is a powerful conceptual tool to investigate the "know-why" of living matter, beyond the sheer enumeration of the "know-how". In this way, it becomes possible to tackle problems so far neglected:

- a) How is a biomolecule able to find the way to meet the partner prescribed for her by the biochemical code in a very short time and (almost) without mistakes?
- b) Why are enzymes so selective?
- c) Temperature fluctuations are not suppressed, they simply do not occur; why is temperature so stable?
- d) Why does the heavy traffic of ions in our body not produce a massive Joule effect?

In living matter there is chemistry; there is electricity; there is magnetism. However, these properties behave quite differently than they do in artificial objects created by humankind.<<

[Interpretation:]

The central point of the work of del Giudice is the further development and mathematical description of a coherency domain - an assembly of (water) molecules whose diameter, due to the number of molecules within them, precisely corresponds to a wavelength, with the result that the whole ensemble is able to oscillate in unison (the same way that violinists in an orchestra play notes in unison). A wave of light has a defined length that is many times greater than the diameter of a molecule. In the case of water molecules, this corresponds to a quantity of  $30 \times 10^6$  Molecules where  $T = 0$  (ice cubes with an edge length of 1 micron [ $1 \mu\text{m}$ ]); where  $T = 300$  K (room temperature), such a 'CD (coherence domain) contains  $12 \times 10^6$  molecules. This corresponds to a number of approximately  $1.5 \times 10^6$  quasi-free electrons(\*), corresponding to a plasma within the CD; these can be excited using electromagnetic and hydrodynamic means.

[Author's note: (\*) - electrons with energy just below 0.5 eV, i.e. below the ionisation threshold]

This means: In contrast to ordinary water molecules, with a little extra energy it is easy for coherence domains of approximately 12 million water molecules (at room temperature) to liberate electrons that are then biologically available. This insight is an essential building block of a 'quantum theory of life', which renders the otherwise inexplicable precision and focus of vital processes understandable. [End of interpretation]



## Hänggi I

Journal:

Physikalische Blätter, 57, (2001), No. 1, pp. 15-16

Title:

Stochastische Resonanz, Rauschen macht sensibel (Stochastic resonance, noise makes you sensitive)

Author:

Peter Hänggi

Address:

Department of Physics, University of Augsburg, Universitätstr.1, D-86135 Augsburg

Overview of contents: See Basics of "Stochastic resonance"

[Quote, excerpt, p. 16, left column, 2. paragraph:]

>> In addition to interesting medical applications, important milestones have recently also been reached in physical SR research. An international collaborative effort has succeeded in precisely controlling the intensity of stochastic resonance through a control regimen. For example, it can be used to minimise the effect of possibly harmful electromagnetic smog on neural tissue. The working group headed by Lutz Schimansky from Humboldt University in Berlin has recently discovered revealing relationships between stochastic resonance and statistical phase synchronisation \*\*. Stochastic resonance is currently experiencing a strong upswing on the level of quantum noise, too.  
<<

\* [M. Löcher et al., Phys. Rev. E62, 317 (2000).]

\*\*[J. A. Freund, A. B. Neiman, L. Schimansky-Geier, Europhys. Lett. 55, 8 (2000).]

## Hänggi II

Journal:

CHEMPHYSCHEM, 2002, 3, 285-290

A European Journal of Chemical Physics and Physical Chemistry, Biophysics Special

Publisher: Wiley-VCH Verlag GmbH, Weinheim, Germany

Title:

Stochastic Resonance in Biology, "How noise can enhance detection of weak signals and help improve biological information processing"

Author:

Peter Hänggi

Address:

Department of Physics, University of Augsburg, Universitätstr.1, D-86135 Augsburg

[Original quote from Introduction:]

>> In everyday life, noise is generically viewed as being of harmful influence in detecting and transferring information. Stochastic [Stochastic] resonance (SR) refers to a situation where the mere addition of random noise to the dynamics improves a system's sensitivity to discriminate weak information-carrying signals. Thus, this phenomenon [phenomenon] constitutes yet another example where random perturbations [perturbations] play a useful role in enhancing detection and aiding the transmission efficiency of weak information in nonlinear systems. Because of its generic nature, this phenomenon boasts [boasts] application extending from classical and quantum physics to chemistry, engineering, and, in recent years, also in biology and medicine.<<

## Hinrikus

Journal:

The Environmentalist, 25, 187-194, 2005

Title:

Non-Thermal Effect of Microwave Radiation on Human Brain

Authors:

HIIE HINRIKUS, MAIE BACHMANN, RUTH TOMSON and JAANUS LASS

Address:

Biomedical Engineering Center, Tallinn University of Technology, 5 Ehitajate Rd, 19086, Tallinn, Estonia

[Original quote from "Summary"]

>>This study focuses on an origin of interaction mechanism of microwave radiation with nervous system—quasi-thermal field effect. The microwave field can cause fluctuations and vibration of the charged particles and membranes in tissues. The hypothesis is, that this phenomenon is similar to the effect caused by Brown motion initiated by temperature and results in the same effects without rise in temperature. The electric field of 1 V/cm can introduce disturbance of the thermal equilibrium inside a cell of 10  $\mu\text{m}$  radius, which equivalent to disturbance produced by temperature rise of 1 K. The hypothesis, that microwave heating should cause an effect independent of the microwave modulation frequency, while field effect depends on modulation frequency, was examined experimentally. The 450 MHz microwave radiation, modulated at 7, 14 and 21 Hz frequencies, power density at the skin 0.16 mW/cm<sup>2</sup>, was applied. The experimental protocol consisted of two series of five cycles of the repetitive microwave exposure at fixed modulation frequencies. Relative changes in EEG theta, alpha and beta rhythms of the group of 13 healthy volunteers were analysed. Analysis of the experimental data shows that:

(1) statistically significant changes in EEG rhythms depend on modulation frequency of the microwave field;

(2) microwave stimulation causes an increase of the EEG energy level; (3) the effect is most intense at beta1 rhythm and higher modulation frequencies. These findings confirm the quasi-thermal origin of the effect, different from average heating.<<

[Author's note: The specific result of these and other works by Hinrikus is as follows:

Hinrikus' work has shown that low-frequency modulated microwaves (exactly corresponding to the composition of mobile phone radiation!) change the rhythms of brain waves. This is not a thermal effect (i.e. on the heating of tissue), which, according to a classical (but now obsolete) school of thought, ought to be the only biologically relevant one; this, in itself insignificant, low-frequency modulation results in the disruption of the equilibrium of the cell, a thermal event that would occur only at a much higher intensity of microwave radiation. Hinrikus calls this observation a 'quasi-thermal' effect.]

## Kirschvink I

Journal:

Proc. Natl. Acad. Sci. USA / Vol. 89, pp. 7683-7687, August 1992 / Biophysics

Title:

Magnetite biomineralization in the human brain (iron/extremely low frequency magnetic fields)

Authors:

JOSEPH L. KIRSCHVINK, ATSUKO KOBAYASHI-KIRSCHVINK, AND BARBARA J. WOODFORD\*

[Original quotes: Excerpts from 'Discussion' and 'Summary']

>> *Results from these studies indicate that human brain and meninges contain trace amounts of ferromagnetic material. These magnetic particles in the human brain are diffusely and homogeneously distributed over all cerebral lobes, the cerebellum, basal ganglia, and midbrain.* <<

>> *The presence of magnetite in human tissues has potential implications for at least two biomedical issues that have been discussed extensively in the literature; these include human exposure to the strong static fields used in MRI studies and the much weaker 50- and 60-Hz fields produced by the electric power system and appliances in industrialized countries.* <<

[Author's note (\*) Magnetite is a mineral ore ( $\text{Fe}_3\text{O}_4$ ) with magnetic properties and is found in evolutionarily ancient life forms.]

## Kirschvink II

Journal:

Current Opinion in Neurobiology 2001, 11:462-467

Title:

Magnetite-based magnetoreception

Authors:

Joseph L Kirschvink, Michael M Walker and Carol E Diebel

[Original quote: Excerpt from 'Abstract']

>> *Orientation, navigation, and homing are critical traits expressed by organisms ranging from bacteria through higher vertebrates. Sensory systems that aid such behavior have provided key selective advantages to these groups over the past 4 billion years, and are highly evolved; magnetoreception is no exception. Across many species and groups of organisms, compelling evidence exists that the physical basis of this response is tiny crystals of single-domain magnetite ( $\text{Fe}_3\text{O}_4$ ). It is the opinion of the authors that all magnetic field sensitivity in living organisms, including elasmobranch fishes, is the result of a highly evolved, finely-tuned sensory system based on "single domain ferromagnetic crystals"* <<.

[Original quotes: Excerpts from 'Conclusions and future prospects']

>> *Magnetoreception may well have been among the first sensory systems to evolve, as suggested by the presence of magnetosomes and magnetosome chain structures in the 4.0 billion year old carbonate blebs of the Martian meteorite ALH84001. Although this is nearly half a billion years older than the oldest microbial fossils on Earth, it suggests that this genetic ability was brought here from Mars via the process of panspermia. In terms of the evolutionary arguments presented above, the striking similarity in magnetosome structure and organization in bacteria, protists, and vertebrates, and the deep fossil record, supports the hypothesis that magnetite biomineralization system arose initially in the magnetotactic bacteria and was incorporated into eukaryotic cells through endosymbiosis.* <<

[Author's note:]

Kirschvink continues with a (provocative) assumption that an additional extraterrestrial factor (in the

form of a meteor) may have come into play for the integration and expression of the crystals in the brain, that its occurrence in organisms is associated with a meteorite impact and, as a result, the storage and development of crystals (found in fossil microbes) had an evolutionary advantage, which is how they could have been genetically fixed. Genetics can, in principal, function this way. The presence of additional mineral material of extraterrestrial origin in the Earth's surface is also conceivable.

## Kirschvink III

Journal:

J. exp. Biol. (1981), 92, 333-335

Title:

SHORT COMMUNICATIONS, FERROMAGNETIC CRYSTALS (MAGNETITE?) IN HUMAN TISSUE

Author:

JOSEPH L. KIRSCHVINK, Department of Geological and Geophysical Sciences, Princeton University

[Original quote: Excerpt from 'Abstract']

>> *In recent years, a variety of animals have been found which are able to synthesize the ferromagnetic mineral magnetite (Fe<sub>3</sub>O<sub>4</sub>). Lowenstam (1962) originally recognized biogenic magnetite in the radular teeth of a primitive marine mollusc, the chiton (Polyplacophora), and since then it has been identified as a precipitate in several magnetically sensitive organisms, including honey bees (Gould, Kirschvink & Deffeyes, 1978), homing pigeons (Walcott, Gould & Kirschvink, 1979) and in magnetotactic bacteria (Frankel, Blakemore & Wolfe, 1979). Zoeger, Dunn & Fuller (1980) also report a localized concentration of magnetite in dolphin heads, although magnetosensory behavioural experiments have not as yet been done on them. Magnetite is biologically unique because it is both ferromagnetic and conducts electricity like a metal; consequently it interacts strongly with magnetic and electric fields. Due to the numerous industrial and research environments which expose people to artificially intense electromagnetic conditions, it is of importance to know whether or not this material might exist in human tissue.*<<

[Brief interpretation:

In this first memorandum Kirshvink - taking previous relevant findings from the animal kingdom as his starting-point - posed the crucial question as to whether magnetic 'antennae' in the form of fine magnetite crystals would occur in human tissue, too. With this question, which met with a positive response in the publication (7a), he challenged the prevailing view that humans are largely insensitive to magnetism.]

## Liboff (Galland)

The significance of this effect is, for example, explained as follows in a lecture on the topic of 'photobiology and alternating fields' at the Department of Plant Physiology, University of Marburg: [Source:

<https://www.uni-marburg.de/fb17/fachgebiete/pflanzenphysio/lehre/vmgraviphotomagneto/vl13>]

Author: Prof. emer. Dr. Paul Galland,

Address: Philipps-Universität Marburg, FB 17, Karl-von-Frisch-Str.8, 35043 Marburg

[Beginning of quote, Paul Galland]

>>**Biological effect of alternating magnetic fields**

*It has long been known that alternating magnetic fields are biologically active in many different ways. It was initially found by purely empirical means that biological reactions occur mainly at those frequencies of alternating fields that correspond to the resonant frequencies of biologically important ions. It appears that the fundamental relationship that is expressed in Eq.4(\*\*) also applies to biological systems. For this reason, dose-response curves for alternating magnetic fields typically show 'windows', i.e. areas with maxima and minima. The resonant frequencies are relatively low and can range from 1 - 50 Hz. For this reason, these fields are also described as ELF-EMF (extremely low frequency electromagnetic fields).*

Supplement from previous paragraph - reproduced here for clarity:

*There is experimental evidence that the magneto-biological effects of alternating magnetic fields are always at a maximum when the frequency  $f$  of the alternating fields ( $B_{AC}$  alternating current) that are superimposed on a static magnetic field ( $B_{DC}$  direct current), agree with the*

*Larmor frequency of a biologically relevant ion ( $Ca^{2+}$ ,  $K^{+}$  etc.). The resonant frequency  $f$  of the superposed alternating magnetic field is given by BAC (\*\*Eq.4):*

$$f = \frac{B_{DC} \times Q}{2\pi \times m}$$

[In this equation,  $Q$  stands for charge and  $m$  for the mass of the ion.]

### Explanatory models

*Early, 'simple' models of ion cyclotron resonance treated the effect of alternating magnetic fields as if they took place in an ideal gas or air environment, where collisions with other molecules are not anticipated. Models that assume that magnetic fields change the orbit of charged particles cannot apply to cellular systems, in which ions collide with other molecules on a permanent basis.*

*Explanatory models come from the fields of quantum dynamics and quantum electrodynamics. These models predict the correct resonance frequencies for certain ions and magnetic fields, but do not assume that ions will move in circular orbits. One successful theory (Binhi and colleagues in 1990 - 2006) is the so-called ion interference mechanism. Here it is assumed that an ion, e.g.  $Ca^{2+}$ , is bound to a protein, where it is located in a protein pocket. The quantum-mechanical description of the oscillating ion yields wave functions in which interference occurs. As a result of this the probability range of the ion in the protein pocket is spatially structured. The application of an alternating magnetic field changes the spatial distribution pattern of the protein pocket and can lead to detachment of the ion from the protein.<< [End of quote]*

[Author's note:

Ions, i.e. electrically charged atoms or molecules, are of crucial importance to biological processes. Science today understands (and can convincingly describe) how these ions are affected if they, in the context of a static magnetic field (which is always present in the form of the Earth's magnetic field)

are also subjected to an alternating electromagnetic frequency (as is normally the case due to existing technical fields), and this frequency change is a resonance frequency of the ion. These resonant frequencies lie in the ELF range for all biologically important ions. Biological processes can thus be disrupted by fields in this frequency range through the breaking of ions' connection with proteins.]

## Okano et al.

### Journal:

Bioelectromagnetics, 2012 Vol. 33:518^526

### Title:

The Effects of Moderate-Intensity Gradient Static Magnetic Fields on Nerve Conduction

### Authors:

Hideyuki Okano, Hiroyuki Ino, Yu Osawa, Toshiaki Osuga, and Hozumi Tatsuoka

### Address:

Research Center for Frontier Medical Engineering, Chiba University, Chiba 263-8522, Japan

[Quote from: "Abstract"]

>>Whether exposure to static magnetic fields (SMF) for medical applications poses a therapeutic benefit or a health hazard is at the focus of current debate. As a peripheral nerve model for studies of the SMF effects, we have investigated whether exposure of in vitro frog sciatic nerve fibers to moderate-intensity gradient SMF up to 0.7 T modulates membrane excitation and refractory processes. We measured the changes in the amplitudes of the electrically evoked compound action potentials for three groups: a control group without SMF exposure and two exposed groups with continuous inhomogeneous exposure to maximum flux densities ( $B_{max}$ ) of 0.21 and 0.7 T SMF for 6 h. The values of the nerve conduction velocity of C fibers were significantly reduced by  $B_{max}$  of 0.7 T SMF during the 4- to 6-h exposure period but not by  $B_{max}$  of 0.21 T SMF during the entire exposure period of 6 h, relative to the unexposed control. From these findings, we speculate that exposure to moderate-intensity gradient SMF may attenuate pain perception because the C fibers are responsible for pain transmission. Although the mechanistic reasons for this decrease have yet to be clarified, SMF could affect the behavior of some types of ion channels associated with C fibers.<<

As a study model, Okano et al. took sciatic nerve fibres from a frog 'in vitro', which they exposed to the radiation of static magnetic fields. Measurements were taken in the groups studied (Group 1 control -without exposure, Group 2+3 with continuous exposure of an inhomogeneous flux density ( $B_{max}$ ) of 0.21 and 0.7 [T] SMF over 6 hrs.). During the exposure period, nerve conduction velocity values for C-fibres were significantly reduced, with  $B_{max}$  of 0.7 [T] SMF over a period of 4-6 hours. These findings suggest that exposure to medium intensity gradient SMF may dampen pain sensations, as it is the C-fibres that are responsible for pain transmission.

The results of this work [Okano et.al] harmonise with those of Cavopol [Bioelectromagnetics (1995) 16:197-206] and with that of other authors:

### Title:

"Quantum Theory Underpins Electromagnetic Therapies for Pain Management"

Subtitle: Exploring the use of quantum-based energy medicine modalities for the treatment of pain in clinical practice

### Authors:

Robert D. Milne, MD, Private Practice Family Medicine and Integrative Medicine, Milne Medical Center Las Vegas, NV and Richard Sorgnard, PhD, Morhea Technologies, Las Vegas, NV



## Petty

### Journal:

Biophysical Journal, (2000), Vol.79, 3001 - 3008

### Title:

Interferon-g and Sinusoidal Electric Fields Signal by Modulating NAD(P)H Oscillations in Polarized Neutrophils

### Authors

Allen J. Rosenspire, Andrei L. Kindzelskii, and Howard R. Petty

[Original quote from: Introduction]

>>It is now generally accepted that information necessary for the control of cell function is often encoded in cytosolic calcium oscillations (Berridge, 1997; Corkey et al., 1988; De Koninck and Schulman, 1998; Goldbeter, 1996; Gu and Spitzer, 1995; Tsien and Tsien, 1990). However, other oscillating metabolites could also encode physiological information (Hess and Boiteux, 1971; Kindzelskii et al., 1997). In this report we examine the relationship between NAD(P)H oscillations and the control of cell function. We confirm previous findings that adherent and spontaneously polarized neutrophils, but not nonpolarized neutrophils, exhibit NAD(P)H oscillations ( $t \approx 20$  s) (Kindzelskii and Petty, 2000). We show that the oscillation is strongly linked to and in fact appears to regulate reactive oxygen metabolite (ROM<sup>\*\*\*</sup>s.u.) production, an important neutrophil effector function (Babior, 1978). Treatment of neutrophils with interferon-g (IFN-g) increases both the amplitude of the NAD(P)H -oscillation and the production of reactive nitrogen metabolites (Adachi et al., 1999). We now show that AC electric fields with proper frequency and phase characteristics resonate with cellular NAD(P)H. Remarkably, in a manner analogous to that of treatment with IFN-g, resonating AC electric fields increase the NAD(P)H oscillatory amplitude, directly leading to concomitant increases in ROM production.<<

[Original quote from: 'Discussion', final paragraph, p. 3008]

>>Thus it appears that amplitude modulation of metabolic signals is a normal intracellular signaling mechanism that can be directly accessed by external electric fields. This suggests that it may be possible in some circumstances to substitute for chemical (i.e., cytokine) control of cell metabolism and function by the direct intentional application of ultra-low-frequency electric fields. However, it also seems possible that under some circumstances, ultra-low frequency environmental electric fields may inadvertently tap into the metabolic signaling pathway we describe and, as a consequence of enhanced ROM<sup>\*\*\*</sup> production, induce DNA damage.<<

[\*\*\*ROM:

The nomenclature is not clear-cut; there are synonyms for 'reactive oxygen metabolite' such as e.g. 'reduced oxygen metabolites' or 'ROS' such as 'reactive oxygen species'. This refers to a group of key mediators in mitochondrial metabolism that are partly responsible for pathophysiological tissue disorders. 'ROM' are also held responsible for so-called 'free radicals', which - if present in excessive quantities - adversely affect cell efficiency, even depleting the mitochondria.]

[Source: Sudhir V. Shah (1995): "The Role of Reactive Oxygen Metabolites in Glomerular Disease". Annu. Rev. Physiol. 57, 245-62 / see Appendix 7]

## RAMAZZINI INSTITUTE

Journal:

EUR. J. ONCOL. LIBRARY, Volume 5, An ICEMS Monograph

Title:

NON-THERMAL EFFECTS AND MECHANISMS OF INTERACTION BETWEEN ELECTROMAGNETIC FIELDS AND LIVING MATTER

Collection of publications with 387 pages, overview of various international scientific papers, for overview of contents see Appendix 6

Address:

National Institute for the Study and Control of Cancer and Environmental Diseases "Bernardino Ramazzini", Bologna, Italy 2010

[Original quotes from: "Preface, author: Morando Soffritti"]

>>Electromagnetic fields are waves that transport energy through space. They are characterized by wavelength and frequency, the two of which are inversely correlated. The shorter the wavelength, the greater the frequency.

/.../Scientific data regarding the long-term effects, in particular carcinogenic risk, of the exposure to non-ionizing electromagnetic fields were not reported in the literature until the 1970s. In 1979 two American researchers, Wertheimer & Leeper, published for the first time the results of an epidemiological study that demonstrated an increased carcinogenic risk, specifically leukemic, in children residing in close proximity to electric installations and therefore exposed to non-ionizing electromagnetic fields from electrical current at extremely low frequency.

/.../

The scientific knowledge available today regarding electromagnetic fields remains limited [Author's note: data as of 2009]. Nevertheless, on the basis of recent epidemiological studies, and while awaiting new experimental data, it is advisable to limit exposure to electromagnetic fields as much as possible. This is especially true for children and adolescents, the most vulnerable segments of the population, and has been recommended by both the Swedish and UK health authorities.<<



## Zimmermann

Journal:

British Journal of Cancer (2012), 106, 307 - 313

Title:

Cancer cell proliferation is inhibited by specific modulation frequencies

Authors:

Zimmermann, J.W., Pennison, M.J., Pasche, B., et al.

[Quote from: "Abstract"]

>>**RESULTS:** *The growth of HCC and breast cancer cells was significantly decreased by HCC-specific and breast cancer-specific modulation frequencies, respectively. However, the same frequencies did not affect proliferation of nonmalignant hepatocytes or breast epithelial cells. Inhibition of HCC cell proliferation was associated with downregulation of XCL2 and PLP2. Furthermore, HCC-specific modulation frequencies disrupted the mitotic spindle.*

**CONCLUSION:** *These findings uncover a novel mechanism controlling the growth of cancer cells at specific modulation frequencies without affecting normal tissues, which may have broad implications in oncology.*<<

[Quote from: 'Results, pp. 312-313']

>>p. 312: *HCC-specific modulation frequencies began to hinder cell proliferation after 7 days of exposure and the anti-proliferative effect increased over a 7-week period. The anti-proliferative effects of HCC-specific modulation frequencies were observed only in HCC cells, but not in breast cancer cells or normal hepatocytes. //*

p. 313: *The amount of electromagnetic energy delivered is far too low to break chemical bonds or cause thermal effects, necessitating alternative mechanistic explanations for observed biological outcomes //* .<<

[Author's note: electromagnetic radiation has both desired and undesired effects.

Desired effects include e.g. data transfer in the context of the transmission of information via radio, as well as positive therapeutic effects. Undesirable effects include negative effects on cell division, nerve conduction velocity, rate of cell division, cell membrane potential and cognitive performance. Here, the radiation (the electromagnetic wave by itself), is not the 'core' signal, but also the modulation, pulsation and resonance, both with the surrounding tissue and with the (electromagnetic) background noise with which the 'signal wave' resonates, thus providing an enhancing factor (increase in amplitude).

## Selected overall studies and documentation

(1)

**ATHEM study, 2009, Austria**

Authors:

for AUVA:

Dipl.-Ing. Dr. Hamid Molla-Djafari, ALLGEMEINE UNFALLVERSICHERUNGSANSTALT (General Accident Insurance Institution), Adalbert Stifter Strasse 65, 1200 Vienna

and for Seibersdorf Labor GmbH:

Dipl.-Ing. Gernot Schmid, Department of Electromagnetic Compatibility, Seibersdorf Labor GmbH, 2444 Seibersdorf

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Dipl.-Ing. Dr. Georg Neubauer, Department of Electromagnetic Compatibility, Seibersdorf Labor GmbH, 2444 Seibersdorf

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Ao. Univ. Prof. Dr. Christopher Gerner, Med.Univ. Vienna, Inner Clinic 1, Inst. for Cancer Research, Borschkegasse 8a, 1090 Vienna.

Ao. Univ. Prof. Dr. Wilhelm Mosgöller, Med. Univ. Vienna, KIM-1, Dept.: Institute for Cancer Research, Borschkegasse 8a, 1090 Vienna]

The particular aspect of this study is the fact that the Principal is an insurance company, specifically, the General Accident Insurance Institution (AUVA), Vienna.

The study runs to 174 pages. 100% of the study contents are the results of Seibersdorf Labor GmbH and the Medical University of Vienna's own research. The project was coordinated by the Medical Faculty of the University of Vienna, which developed test facilities itself and, partially, other test set-ups such as the REFLEX study.

## The objectives of the ATHEM project were:

[Quote from: 1.1.3 Objectives of the ATHEM project, p. 9]

>>

- *Improvement of data through objective research.*
- *Contribution to the science-based consensus solution to protect against harmful HF-EMF immission.*

*In particular, the following - often controversially discussed - problem areas were addressed: establishment and implementation of objective, reproducible exposure conditions for studies with HF-EMF*

- *HF-EMF effects on the brain*
- *Effects on the immune system*
- *Effects on protein formation in cells<<*

## Overview of results

All tests were conducted in the GSM 900 (+1x with GSM-1800) and UMTS band in the form of 'double-blind, multi-cross-over' procedures

### Brain/CNS

Following exposure, changes could be detected in the EEG in both the alpha and the theta bands, stronger in UMTS than in GSM, and primarily in the alpha band in GSM.

Cognitive effects were likewise significantly altered. Response times were shortened, but with an increasing error rate.

[Quote from: 3.6 Summary - 'Cognitive effects', p. 93]

>>*The effects of exposure were partially comparable with, and confirmed previous tests. Additionally, significant new significant effects occurred that may help to clarify the mechanism of the effect of weak HF fields on the central nervous system*

*. These are:*

- *in agreement with previous studies, changes were found in the EEG spectrum, in particular increased power in the alpha range.*
- *However, changes to the spectrum that affected the other frequency bands also occurred in the course of the experiment.*
- *It is significant that the increase in the alpha component took place during the first five minutes of exposure and*
- *had still not changed up to more than fifty minutes afterwards. These changes were more pronounced with UMTS than with GSM.<<*

### Immune system

[Quote from: 4.7, discussion, pp. 110-111]

>>*According to the current state of research, no general statement can be made based on published literature. This is mainly due to the fact that previously registered effects had been recorded under varying conditions (different cell systems, different frequency ranges, etc.). The chosen exposure conditions in the work in question resulted in no significant change in the immune parameters being studied.<<*

[Quote from: 4.9.2 Gene activation (based on the immune system/ author's note), pp. 113-114]

>>*Genes that were altered in their expression were ankyrin, a membrane-associated protein, and cofilin, a protein that plays a role in the organisation of actin fibrils, and two enzymes, a nucleoside diphosphate kinase and a phenyl-alanine hydroxylase. Finally, a sequence of a nuclear protein whose function is not yet entirely clear, but that is possibly involved in the cell cycle, was also affected. The remaining clones were Alu sequences, so-called 'junk' DNA, which are not active genes. The lack of agreement between the samples of individual blood donors, and the fact that a*

*non-specific activation of this magnitude in chip technology is to be expected in any case, mean that no conclusions can be drawn on the effect of GSM exposure on gene expression.<<*

### **Influences on protein formation within the cell**

[Quote from: 5.1, Protein analysis in human cells, p. 118+ff]

*>>Three different human cell types were used in the studies as studies of DNA breaks had already been performed:*

- *Fibroblasts (line ES1)*
- *Transformed T-lymphoblasts (Line Jurkat)*
- *Primary normal leukocytes that had been isolated from whole blood immediately before<<*

This subproject utilised the frequencies GSM-1800 and UMTS-1950.

[Quote from: 5.4.5 "Interpretation" (Author's note: The Interpretation refers to the differentiation between sensitive and non-sensitive cells, in this case 'white blood corpuscles' - a mixture of B- and T-lymphocytes with monocytes)]

*>>The activation, and thus natural induction, of protein synthesis evidently facilitated the production of reactive cells from inactive, non-sensitive cells. One possible explanation for this would be that cells with a high protein synthesis rate are more sensitive than those with a lower protein synthesis rate.<<*

[Quote from: 5.4.8 Studies on the sustainability of the effects found, p. 136]

*>>The observed effects of mobile phone exposure (GSM & UMTS) show significantly increased activation of protein synthesis in the exposed cells after a period of eight hours. The question arises as to how long such an activated state can persist following the end of exposure.<<*

[Quote from Discussion: 5.5.2, Health Implications, p. 137]

*>>It is not yet possible to satisfactorily estimate possible health risks based on the results . According to available data, this is a temporary effect that is not detectable two hours after irradiation.*

*However, there are diseases and pathophysiological conditions that make the possible deterioration of disease symptoms through increased protein synthesis, as found during exposure, at least conceivable. A variety of neurogenerative (neurodegenerative) diseases are triggered, inter alia, by nerve cells having a relatively high rate of protein synthesis that can no longer be managed by the cell's protein transport and distribution apparatus. Cell degeneration observed in neurodegenerative diseases is mainly attributed to this mechanism.*

*In this context, a further induction of protein synthesis rates in sensitive nerve cells might seem a health risk.<<*

[Author's comment:]

Effects occur in each of the examined areas that can be attributed to exposure to radio waves with frequencies in the MHz and GHz range. All effects influenced normal processes in human metabolism and in biochemical control loops. All effects were athermal effects.

(2)

### REFLEX study, 2006, Europe

One of the longest, most extensive studies on this topic was the Reflex study, performed over a period of fifty-two months between February 2000 and May 2004.

REFLEX stands for: **R**ISK **E**VALUATION OF POTENTIAL ENVIRONMENTAL HAZARDS **F**ROM **L**OW ENERGY **E**LECTROMAGNETIC FIELD **E**XPOSURE USING SENSITIVE IN VITRO METHODS

The REFLEX project involved twelve research groups from seven European countries.

The basic idea in the planning of the REFLEX project was:

Despite decades of effort, epidemiological and animal research is unable to answer the fundamental question of whether EMF poses a risk to human health. The REFLEX project therefore aimed to find out whether the conditions are met for such an assumption at cellular or molecular level.

[Quote from: presentation at the 7th 'Electromagnetic fields in the environment' workshop; Ministry of Environment and Conservation, Agriculture and Consumer Protection NRW, Düsseldorf; 2 December 2004,

and at the mobile communications seminar on 23 and 24 September 2004 in Brussels, jointly organised by the European Commission and the mobile phone industry.

Prof. Dr.med. Franz Adlkofer, VERUM Foundation, Munich, head of the study]

### >>Summary and conclusions:

- 1) *It follows from the in vitro studies performed as part of the REFLEX project that RF-EMF under half the applicable safety limits is capable of generating DNA strand breaks in certain, but by no means all, living cells and increasing the number of micronuclei and the chromosome aberrations. Based on these findings it can be assumed that RF-EMF has a genotoxic effect on different cell systems. Whether these genotoxic effects can also be detected in vivo has not yet been sufficiently researched.*
- 2) *In several REFLEX laboratories results were obtained showing that RF-EMF below the applicable safety limits is capable of modifying gene and protein expression in various cell systems. The extent of the cellular response is obviously dependent on the genetic background. The present state of research does not allow the prediction of which cellular processes are affected by RF-EMF as a result of a modified gene and protein expression such that the physiological range is exceeded.*
- 3) *In vitro studies performed as part of the REFLEX project give no convincing indications that RF-EMF below the applicable safety limits is capable of having a direct influence on the proliferation, differentiation and apoptosis of cells. The defective regulation of cell proliferation, cell differentiation and apoptosis is the pathophysiological basis of all chronic diseases such as e.g. cancer and Alzheimer's, and the at least an indirect influence of RF-EMF cannot thus far be ruled out, the clarification of this issue must be central to future research.*
- 4) *In summary, it can be stated that the REFLEX data in no way prove a causal relationship between exposure to RF-EMF and the development of chronic diseases, or even functional disorders. However, they do increase the likelihood of such an assumption. The progress achieved consists essentially of showing new paths for directing future research. As long as the state of knowledge remains inadequate, the REFLEX data suggest that the precautionary approach should be recognised by the decision-makers in industry and politics for the protection of the population.<<*

'Official opinion':

**Mobile Communication Seminar, Brussels, Sept 23-24, 2004**

**ERGEBNISSE DES SEMINARS:**

- **Es gibt bis heute keinen Beweis dafür, dass RF-EMF unterhalb der geltenden Sicherheitsgrenze kausal zur Entstehung von Erkrankungen oder auch nur Befindlichkeitsstörungen beitragen.**
- **Die Nullhypothese, d.h. die Tatsache, dass etwas nicht existiert, kann aus theoretischen Gründen nicht bewiesen werden.**
- **Es sind bis heute keine biologischen Mechanismen bekannt, die durch RF-EMF unterhalb der geltenden Sicherheitsgrenze ausgelöst werden und zur Krankheitsentstehung beitragen können.**
- **Vorsorgemaßnahmen sind als Folge dieser Überlegungen sinnlos, ja kontraproduktiv, weil sie die Angst in der Bevölkerung eher schüren als vermindern.**

**REFLEX**

*>>As can be seen, the results of the final report are clearly in contradiction with official opinion. If the REFLEX results are true, which can now hardly be doubted, then the third of the three pillars of reasoning has collapsed, meaning that the statement about preventive measures barely seems tenable.<<*

[Author's comment:]

The results of the REFLEX project are confirmed and strengthened by the international scientific papers, studies, data and facts gathered in this desk research alone.

Against this background, the third pillar of reasoning of the 'official EU reasoning' collapses, after which an additional precautionary measures are considered superfluous.

The second pillar of reasoning (that the 'non-existence of risk is not provable') belongs to the sphere of philosophy and permits no substantive conclusions.

The statement contained in pillar no. 1, (that there is no causality to the emergence of diseases, or even mood disorders) unfortunately confirms the 'wannabe feel-good principle' that leads to the 'shutdown of the prefrontal cortex' in most 'users' - (see Preamble, p.5, third paragraph). Both 'users' and providers are affording themselves the luxury of ignoring a potential threat.

Those who wish to ignore the influence of radiation are embarking on the path of ignorance, and those who support it make themselves guilty of willful endangerment.

The discussion about the threat is still unobjective as far from the whole spectrum of effects is illuminated by EM radiation. Time and again, only the thermal aspect (e.g. heating and combustion) and the ionizing section of radiation (X-rays and gamma radiation) is discussed. Other sections, such as athermal, non-ionizing and magnetic sections, are just as important on the biological, cellular level as 'measurable' external phenomena (sunburn, burns inside).



Developers would be well-advised to put their energy into the development of devices that can function at lower, more biologically compatible frequencies and pulse rates, as well as with lower SAR values (as an initial technical orientation), such as the development of antennae that radiate away from the head.

Please refer to Appendix 11 to understand how transmission frequencies are chosen. Frequency bands are allocated and auctioned by the German Federal Network Agency.

Nowadays, the armed forces no longer need frequency supremacy. Listening facilities are all derelict. Listening is different today; see the NSA, and Edward Snowden's report.

#### Overview of SAR values of commercially available mobile phones:

Since 2002 the German Federal Office for Radiation Protection has regularly raised the SAR values of commercially available phones for phone manufacturers.

#### Radiation values of mobile phones:

*Dear Mr Steven Jobs in heaven*  
you can do it better than that in Silicon Valley.

I-Phones with SAR values of 1 W/kg - 'antiques', even today, devices from Taiwan and Korea have SAR values of 0.2 W/Kg.

(see: [http://www.bfs.de/de/elektro/strahlenschutz\\_mobilfunk/schutz/vorsorge/SAR\\_Werte.pdf](http://www.bfs.de/de/elektro/strahlenschutz_mobilfunk/schutz/vorsorge/SAR_Werte.pdf))

Now the situation is such that communication about SAR values would be an important, and the correct, step; however, it should not be forgotten that this would only be a first step, with the 'long journey' still to come.

A discussion on SAR exclusively would not be relevant because the basis of this limit value debate would only concern the heating of biological tissue. Nothing else. The actual discussion concerns far more than the reduction of the power level.

However, low SAR values are certainly better than high ones in terms of consumer protection. This is especially true in the context of 'smartphones' being used by more and more young people and children, and almost all day long. But be careful - even a low power level will, over time, affect cell structures and cellular and tissue functions.

[End of comment]

(3)

#### Mobile communications and health

##### Publisher:

Province of Upper Austria, Department of Environmental and Plant Technology - Environmental

The report starts with two core statements:

[Original quote from page 2:]

>> *Statements such as the following can be found in brochures and messages sent by mobile network operators:*

*"13,000 scientific studies on the effects of electromagnetic fields currently exist."*  
(SWISSCOM, MOBIL COMMUNICATION - ENVIRONMENT AND HEALTH)

*"20,000 scientific papers currently exist on this subject."*  
(MOBIL COMMUNIATION FORUM)

*Even medical organisations (e.g. the Baden-Württemberg Chamber of Physicians, 2005) occasionally speak of 'thousands of studies'.*

*All these statements are false and based on a fundamental misunderstanding. It is assumed that everything all scientific studies on EMF (electromagnetic fields) that have been and will be published are devoted to the issue of health and biological effects. However, this is true in only a very small proportion of cases.*

*A further misconception: all EMF are equal.<<*

The report provides an overview with tables, illustrations and conclusions on issues in the sense of the task and shows a very critical view of reality and how it is distorted by the influence of interest groups and what the current state of technical and scientific knowledge is.

Particularly fascinating is the section on page 26 ('SAR value') showing the effect of radiated energy on water which, with its dipolar structure (a dipole - analogous to a minimagnet - with antenna-like properties), is in a position to convert the radiated energy into rotational energy, and how a change of field strength and frequency is thus effected, which can give rise to second- and third-order consequences. This applies just as much to the ions in tissue, irrespective of their size.

The report serves as an easily comprehensible and comprehensive elucidation: knowledge of this report should be a requirement for anyone expressing an opinion on biological EMF risks, either as an expert or as a lay person.

(4)

#### **BIOINITIATIVE Report**

BioInitiative Working Group, Cindy Sage and David O. Carpenter, Editors.

A Rationale for Biologically-based Exposure Standards for Low-Intensity Electromagnetic Radiation  
BioInitiative Working Group 2012; [www.bioinitiative.org](http://www.bioinitiative.org), 31 December 2012 (first published in 2007)

[Original quote]

*>>The BioInitiative 2012 Report has been prepared by 29 authors from ten countries, ten holding medical degrees (MDs), 21 PhDs, and three MsC, MA or MPHs. Among the authors are three former presidents of the Bioelectromagnetics Society, and five full members of BEMS(\*). One distinguished author is the Chair of the Russian National Committee on Non-Ionizing Radiation. Another is a Senior Advisor to the European Environmental Agency. As in 2007, each author is responsible for their own chapter.<<*

(\* BEMS: Bioelectromagnetic Society, leading international scientific society in the field of the biological effects of EMF

The full report comprises 1,557 pages.

Some key points are summarised here.

The great strength of the BioInitiative Report ([www.bioinitiative.org](http://www.bioinitiative.org)) is that it is independent of governments, existing institutions and industry, as well as of professional societies that



adhere to old standards. For this precise reason the BioInitiative Report represents a solid, evidence-based(\*) assessment of the situation with regard to scientific and health policy assessment.

[\* = see Appendix 5]

Statements from the report:

[Section II, Summary for the Public, B, 5]

There is clear consensus among the members of the *BioInitiative Working Group* that the existing public safety limits are inadequate for both ELF and RF.

[Section II, Summary for the Public, C, 6]

It seems that it is the information (rather than heat transmitted by electromagnetic radiation) that causes biological changes - some of these biological changes may lead to loss of well-being, cause disease and even lead to death.

[Section II, Summary of the Science, A, 1]

There is little doubt that exposure to ELF causes childhood leukemia.

[Author's note: not 'may cause', but 'causes']

[Section II, Summary of the Science, A 3, 2, 8]

While there is some evidence that other childhood cancers are related to ELF, insufficient studies have been performed on this topic.

[Section II, Summary of the Science, A 3, 3, 9]

People who have used a mobile phone for ten years or longer have higher rates of malignant brain tumours and acoustic neuromas (tumours of the auditory nerve). This is even worse when a mobile phone is used primarily on one side of the head.

[Original quote from: Section II, Summary of the Science, A 3, 3, 10]

*The risk of brain tumor (high-grade malignant glioma) from cordless phone use is 220% higher (both sides of the head). The risk from use of a cordless phone is 470% higher when used mostly on only one side of the head.*

[Original quote from: Section II, Summary of the Science, A 3, 5, 11-12]

*Laboratory studies that examine human breast cancer cells have shown that ELF exposure between 6 mG and 12 mG can interfere with protective effects of melatonin that fights the growth of these breast cancer cells. For a decade, there has been evidence that human breast cancer cells grow faster if exposed to ELF at low environmental levels. This is thought to be because ELF exposure can reduce melatonin levels in the body. The presence of melatonin in breast cancer cell cultures is known to reduce the growth of cancer cells. The absence of melatonin (because of ELF exposure or other reasons) is known to result in more cancer cell growth.*

[Author's note: "Concise summary:

ELF exposure at a level of 0.6 to 1.2 microtesla impairs the protective effect of melatonin against the growth of breast cancer cells. "]

[Section II, Summary of the Science, B, 13]

'Alzheimer's' is a disease of the nervous system. There is strong evidence that long-term exposure to ELF is a risk factor of Alzheimer's disease.

The following contains information on

- the nervous system
- the immune system
- DNA
- increased production of stress proteins (heat shock proteins)

---

Reports point to risks to which human beings are exposed in particular situations (when using private radio equipment - e.g. smartphones or cordless phones) and generally in public ('hot spots', other users).

A fairly small part of the report deals with the therapeutic benefits of ELF.

[Table 1-1, BioInitiative Report Overall Conclusions

"Section 15 Therapeutic Uses of EMF at Low-Intensity Levels"]

Further excerpts from the report are beyond the scope of this desk research.

## Discussion

The topic of the 'effects of electric, magnetic and electromagnetic fields tables on humans' has been the subject of study for around fifty years. There is general agreement that there is an effect in relation to radiated power. This can be seen from observation of the effects of radioactive radiation which, ultimately, forms just a small part of the electromagnetic spectrum as a whole, albeit the part with the most visible effects and manifestations (from skin burns to poisoning and organ failure).

In most cases, however, parts of human tissue in the form of cell structures, and certain cell types (white blood cells, brain cells, nerve cells) were taken for study so as to facilitate laboratory conditions where there is a clear description of the experiments is possible and reproducibility exists.

Brain and eyes occupy a special position as tissue structures, as they can also be regarded as organs.

No clear study results on the effects on organs such as liver, kidney, stomach and other internal organs have yet been found, which does not mean that they do not exist. For the human heart (ECG, blood pressure), there are exceptions in the form of individual papers (Bernhard 1979, Fröhlich 1968, 1970, Hänggi, 2001). It is often the case that not all studies are published worldwide in the big 'journals'. Many papers exist in e.g. Russian, Chinese or French that appear in state-owned publications, thus escaping the general research in English-language literature.

It is estimated, worldwide, there are twice as many publications as those published in the specialist press in English (personal communication with scientists).

### **The core results of published studies and papers found are:**

Electromagnetic radiation has positive and negative effects. So far, it is overwhelmingly the negative effects that have been described. The most dangerous results are changes in genetic material (strand breaks in DNA regions, resulting changes in the functionality of the cell membrane (membrane channels, mineral balance, etc.) and disturbed process rhythms in nerve cells. Changes in cognitive performance are classed as particularly unpleasant, as these (supposedly) trigger faster response times in everyday life, but are associated with higher rates of wrong decisions.

A deterioration of the immune and nervous system is further described.

Among the positive effects of electromagnetic fields on human tissue, one should consider the reduced growth of cancer cells under certain conditions [Zimmermann], as well as pain relief [Okano] and a similar effect on neutrophils to interferon-g [Petty].

Positive effects also include the papers by Guido Ebner and Heinz Schürch, Switzerland (formerly Ciba, later merged with Geigy), which showed that, through the application of amplitudes, it is possible for modulated electric fields to trigger the genetic material such that unused 'old sequences' can be reactivated from evolutionarily ancient stages of development. GE succeeded in influencing chicken, salmon and corn (in egg form/as seeds) so that changes in the genetic material are inherited. [Lit: "Der Urzeit Code" by Luc Bürgin, Herbig Verlag München, 2014, 4th edition]

see also:

- Agricultural Patent => EP 0791651 A1
- Pisciculture Patent => EP 0351357 A1

However, in addition to the direct effects (activation of EM field - measurement of changes in 'targeted' tissue/cell group), there are also indirect changes to tissue.

### **Figurative comparison (a):**

In a moving car a fuel pipe is rusted so much that petrol vapour escapes and ignites in the exhaust. The vehicle catches fire and burns and/or causes an accident.

The cause is the rust and the fire (damage) is a third-stage consequence. Rust does not lead to fire. The conclusion that one has nothing to do with the other is wrong in this example. The chain of development is crucial.

#### Figurative comparison (b):

A beam of light (white light) strikes a water surface, passes through the water layer and exits. The light that comes out is no longer white, but coloured. The electromagnetic (light) wave is separated into its component parts (as in the rainbow and prism effects). One sees white light and coloured light. The conclusion that colour was 'added' is incorrect. The 'colours' are already present in the white light as a whole - as a kind of integrative information - and are made visible again after passing through a medium (matter). It is not the entry into water or glass that is the cause of the colour, but the composition of white light as a sum of various EM frequencies themselves. Passage through a 'denser medium' (glass and water are denser than air) shows that short-wave radiation (blue/UV light) passes through the mater/medium faster than longer-wave radiation (red/infrared light) .

It follows that there are reasons for this that are not immediately apparent, and that there are effects that reveal themselves only as a second or third consequence of an event. In addition there are effects in which it is not the direct 'exposure' of a frequency that leads to the influencing, but the gradient magnetic fields between adjacent points in space. The same is true for EM radiation that encounters biological tissue such as e.g. skin, eyes, brain, cells, cell membranes, cells and cell components of plants, the lateral line organ in fish, magnetoreceptors in pigeons etc. An effect can only manifest itself as a third consequence.

Against this background, studies of field gradients as an additional order of effect have become increasingly important. Cavopol writes:

[Quote from Discussion]

*>> /.../ in order to distinguish which out of two field properties, field strength or gradient of field strength is the principal determinant of APBlockade in cultured neurons./ ..../ For this reason, the gradient of the field strength must be viewed as a global indicator of the field change and not an exact match for the failure of the 'firing' (absence of action potential change) / ..../<<*

This describes a second or third-consequence impact of EM radiation on the nervous system via the brake on the action potentials of neurons.

This is largely known and accepted in the case of electrical fields [see Deutsches Ärzteblatt International, 2002, Appendix 9], but not in the case of magnetic fields. However, the contemplation of pure static magnetic fields would also be pointless because technical fields often occur only as electromagnetic fields. Human beings live within in pulsating magnetic fields that are inductive, i.e. can induce a current, even in humans. Moreover, ion cyclotron resonance shows that the interaction of static magnetic fields and EM alternating fields can have special, biologically effective consequences.

Taking into account that, since the beginning of their evolution, human beings have always been exposed to three natural pulsating EM fields\* and that every piece of DNA can also be described as a molecule with a positive/negative partial charge, just as every protein has a 'carboxyl end' (with a 'COO<sup>-H</sup> group' with a partial negative charge), one can see that humans have, in any case, been receptive to electromagnetic fields since the beginning of their evolution. In principle, any electrically polar molecule can be understood as being 'dipole', making humans 'electromagnetic beings'.

\*[ 1. Solar frequencies through 'solar wind' irradiation (solar winds are charged particles) plus solar eruptions, 2. the Schumann frequency, as a result of the cavity capacitor effect between the Earth's surface and the ionosphere and 3. the pulsating terrestrial magnetic field itself, which is constantly 'shaken in circles' by the Earth's liquid iron/nickel core in combination with the wobbling motion of the planet itself, thus inducing a magnetic field as an electrical conductor.]

In addition, this terrestrial magnetic field is spread around the whole planet in a multi-grid structure (\*\*1. the Hartmann and / 2. the Curry grid and 3. the Benker cube system).

\*\*[Lit: Piontzik, Gitterstrukturen des Erdmagnetfeldes, BOD, 2007, <ISBN: 9-783833-491269> and Bärtels, Piontzik, Planetare Systeme, 2013, BOD Norderstedt, <ISBN: 978-3-8482-3264-2>

Thanks to the ion-rich blood constantly pumping through their veins alone, every human being is themselves an electrical conductor in which a current is induced when they move through a magnetic field (such as taking a walk through the Earth's magnetic field).

This is due to the physical principle of Lorentz force:

$$\vec{F} = q(\vec{v} \times \vec{B})$$

when  $F$  = force  
 $q$  = charge,  
 $v$  = velocity  
 $B$  = magnetic flux density.

The Earth's magnetic field as a whole has a gradient structure that pulsates (varies in amplitude). Conversely, every additional, external EM field will induce a current or build a directed force field in an electrical conductor (human). The consequence of this could explain the high sensitivity to some frequencies with low field strength and flux density, as well as the sensitive reaction of neurons and action potentials to magnetic field gradients.

**The 2005 IIREC Report** writes [IIREC, No 2/2005, 1 September 2005, p. 5 of 27]:

[Quote from: Conclusions and Outlook"]

>>Current research shows that biological systems are highly sensitive to static and extremely low frequency (ELF) magnetic fields, showing athermal resonance-like reactions. The significance of the Earth's magnetic field and its technically influenced gradient has been demonstrated by geobiological research. Our ongoing work has shown that the precise localisation and quantification of biological stress caused by magnetic field gradients requires the evaluation of field gradient divergence (FGD).<<

Very similar content, albeit from a different angle, can be found in the work of Chang-Lin Zhang of the College of Life Science of Zhejiang University, Hangzhou, China: Dissipative Structure of Electromagnetic Field in Living Systems, Frontier Perspectives, Spring, 2003, Vol.12, no. 1, pp. 1-44

[Quote from: Quantitative evaluation of "Coherence, Harmony and Wellness", p. 44]

>>Originally, the word coherence meant being united, consistent, or sticking together. With the development of the Laser technique, the word coherence was defined as being in the same frequency and in the same phase of waves. As the further study of coherence in a living system, the word coherence is defines as "a state in which all elements keep their independence and have all possibilities to make co-operations with others." /.../ In light of the dissipative structure of electromagnetic field in living systems, the co-operation between elements in a system could be practically measured by means of evaluating the changes of the wave spectrum through the increase of beating frequencies, which come from the couplings between oscillators, since most elements in a living system are oscillators that are permanently emitting electromagnetic waves.<<

Zhang further states that the expanded definition of coherence approaches that of the old concept of 'harmony' and the new concept of 'wellness'. He sees this as an approach to evaluating the 'wellness' of the body/mind system and monitoring the effects of holistic medicine.

>author's personal note beyond the scope of desk research <

Science needs - especially for the issue of the hazard potential and its evaluation - experts who can function as a kind of 'fire cause investigator'. But such experts are still very rare.

→ It isn't 'mainstream'.

**Among the aspects that have, until now, been completely disregarded are:**

1. Every atom, every molecule, every protein has a bipolar structure and thus, electromagnetic properties.
2. Human existence would not be possible without a current flowing through the human body, there would be no nerves, no nerve impulses, no nerve conduction velocities and as a consequence, no motion (heartbeat, blood circulation), no locomotion (walking, swimming), with all the ensuing consequences.
3. Every biochemical and biophysical reaction in the human body is, at the same time, always an electrophysiological and electromagnetic reaction.
4. The human cell itself is an evolutionary symbiont. Every human cell lives with and from another (incorporated) cell, the mitochondrion, which is commonly referred to as the cell's powerhouse. The cell's actual energy production, in the form of ATP, comes from the citric acid cycle of the mitochondrion, and this process is known to be a purely electrochemical process - the transfer of electrons. Thus humans are, themselves, first-degree symbiotes.
5. In addition to this, humans have not only organs, but also functional systems such as the immune system or a feedback system consisting of blood pressure and heart rate. The immune system is a symbiotic function of bacteria that live in the human intestine (E.Coli), which are in turn highly sensitive to electromagnetic fields (e.g. the Tn5 transposon reaction (errors in the genetic material of bacteria leads to antibiotic resistance)
6. This makes humans themselves first- and second-grade symbionts.
7. All this together makes humans 'electromagnetically sensitive beings'.

**Let's go back to the BioInitiative Report.**

In the 2012 edition Section II, B, Purpose of the Report, 5, it says:

**Main Reasons for Disagreement among Experts**

1. Scientists and public health policy experts use very different definitions of the standard of evidence used to judge the science, so they come to different conclusions about what to do. Scientists do have a role, but it is not exclusive and other opinions matter.
2. We are all talking about essentially the same scientific studies, but use a different way of measuring when "enough is enough" or "proof exists".
3. Some experts keep saying that all studies have to be consistent (turn out the same way every time) before they are comfortable saying an effect exists.
4. Some experts think that it is enough to look only at short-term, acute effects.
5. Other experts say that it is imperative we have studies over longer time (showing the effects of chronic exposures) since that is what kind of world we live in.

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6. Some experts say that everyone, including the very young, the elderly, pregnant women, and people with illnesses have to be considered - others say only the average person (or in the case of RF, a six-foot tall man) matter.
  7. There is no unexposed population, making it harder to see increased risk of diseases.
  8. The lack of consensus about a single biological mechanism of action.
  9. The strength of human epidemiological studies reporting risks from ELF and RF exposures, but animal studies don't show a strong toxic effect.
  10. Vested interests have a substantial influence on the health debate.



## Summary and conclusions

There are influences that demonstrable in a variety of tissues and cell cultures. There are also medical conditions that can be both improved and aggravated by electromagnetic radiation.

Here, it is not about radiation from radio waves (electromagnetic radiation). This radiation is distinct from e.g. X-rays or radioactive radiation in that it is

1. athermal and
2. non-ionising,
3. extends over wide frequency ranges (from a few Hz to THz),
4. can trigger not only direct 1:1 phenomena, but also second and third sequences in the tissue,
5. by generating 'harmonics' when passing through tissue that then actually produce damaging effects and
6. that they can interact with the Earth's magnetic field at certain frequencies and thus, for example, interferes with ion transport through the cell membrane (ICR effect) and
7. that the frequency itself triggers the intensity of an interaction (Adey window).

The harmful effects of radioactive radiation are known and recognised throughout the world and clearly defined boundaries and limits are in place to combat them.

Although limit values are in place for EM fields (electromagnetic radiation), these only take the form of regulations [BImSchV\* in Germany], otherwise only recommendations that widely diverge within Europe, as shown in Appendix no. 4.

[\*BImSchV = Bundesimmissionsschutz Verordnung (Federal Immission Control Ordinance), see also ECOLOG Institut 1/2000]. On this occasion it should be mentioned that the limit values in Russia and Switzerland are far below those in place in Germany. Why is that the case?

Electromagnetic fields affect biological, and thus human, tissue. In the vast majority of cases studied so far the impact is negative, i.e. either damaging to the cells or related to changes in cellular metabolism or, in the worst case, causing direct damage to genetic material (double strand breaks in the DNA).

The decisive factor in the health of the individual is that they no longer carry on as if it's 'business as usual', but open their mind and take responsibility for the operation of a radiation source. It is not the thermal effect that is damaging (as with overheating of the tissue by radioactive radiation or intense X-ray diagnosis) - because we simply so do not expose ourselves to this type of radiation - this danger is well-known, but the 'new threat' is the relevant frequency of a weak, 'non-ionising', 'athermal' radiation.

**Children are most at risk !**

### WHO statement of 05/2010

Mobile phone radiation is now classified in category 2b 'possibly carcinogenic to humans' by the WHO. 266 chemicals and activities are listed in this category, for example, work as a firefighter or in chemical purification, exhaust gases from a gasoline engine, coffee as a risk factor for bladder cancer and the outlawed pesticide DDT.

"The evidence, which is constantly being added to, is strong enough to justify the 2b classification (for mobile phone radiation, ed.)," says Jonathan Samet, head of the working group at the University of Southern California

[SOURCE: Süddeutsche Zeitung, 31May 2011, chapter: "Knowledge"] and

[<http://www.sueddeutsche.de/wissen/studie-der-weltgesundheitsorganisation-verdaechtige-handy-strahlung-1.1103987>] and

[WORLD HEALTH ORGANIZATION / INTERNATIONAL AGENCY FOR RESEARCH ON CANCER / IARC MONOGRAPHS / ON THE EVALUATION OF CARCINOGENIC RISKS TO HUMANS

Non-Ionizing Radiation, Part 1: Static and Extremely Low-Frequency (ELF) Electric and Magnetic Fields VOLUME 80]

Another example from the 'world of technology' is the development of cars.

In the course of the development of ever-denser traffic and faster vehicles, an increasing amount of accidents occurred, with gruesome injuries and fatalities. Eventually, after a German automotive group had developed the first safety measures and was able to demonstrate their positive effect, the legislature intervened in the individuality of the car driver by requiring that they and the industry take certain safety measures and regulate their speed (e.g. through speed limits and seatbelts, headrests, crash-stable passenger cells, three-point seat belts, safety glass etc.).

This is exactly what is needed for radio communication.

It is not the quantity or intensity of radiation that threatens our health and well-being; in reality, it is fine signals, patterns, structures, gradients of EM waves and fields that can have profound biological effects.

Preventive measures are required for as long as we do not know more than we do today.

To clarify the customary terminology and choice of 'mobile/cell phone' and 'smartphone', it here should be explicitly pointed out that neither mobile phones nor smartphones are telephones, but **radio devices**.

[Note: a telephone has a cord that leads into a box on the wall. No cord = not a telephone. A **radio device**, however, has an antenna → Transmission of data/information by **electromagnetic waves**.

Mobile phones, smartphones, cordless phones, wireless LAN (WiFi) and Bluetooth transmitters/receivers are such **radio devices**, like 'walkie-talkies'.

Every **radio device** works with **electromagnetic waves = radiation**. It doesn't work any other way.]

## European Environment Agency

In 2007 the European Environment Agency (EEA), which is based in Copenhagen, announced through its director, Prof. Jacqueline McGlade, that: "Even though phones emit weak radiation, there is sufficient evidence for effects being caused, even with weak radiation, that we must act now."

McGlade also refers to the report of the BioInitiative Group.

## Basic mechanism of action:

[generally accepted state of knowledge (1998, ICNIRP guidelines)]

In the low frequency range, the effect of an external field on humans is, according to current research, mainly judged by the currents induced in the body:

- the magnetic field induces eddy currents within the body
- the electric field causes displacement currents within the body (see fig.).

At the appropriate strength, these currents can affect cellular functions and the nervous system, up to the excitation of sensory, muscle and nerve cells.

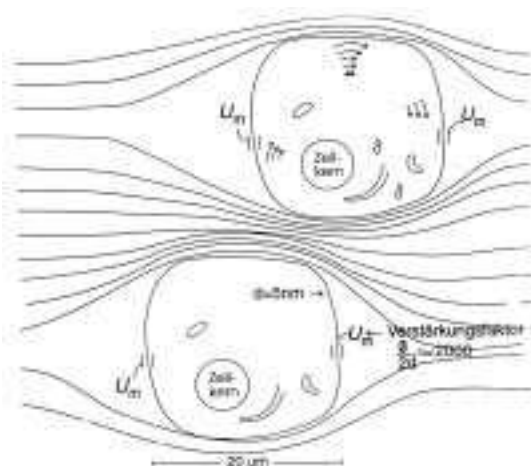
The external magnetic field passes through the body practically unaffected, while the external electrical field is weakened by a factor of  $10^6$  due to the conductivity of tissues inside the body. However, field strength is again increased within cell membranes.

## What does this mean?

Interpretation of relationships and effects on the cell membrane.

[Source: Bernhardt, J. H.: Biophysikalische Approximation; Ergebnisse und Bewertungen (Biophysical Approximation; Results and Evaluations) in: „Wirkungen niederfrequenter Felder“ (Effects of Low-Frequency Fields), Publications of the International Commission on Radiological Protection, Volume 28, G, Fischer-Verlag Stuttgart 1994]

Image: Course of power lines or field lines in the region of biological cells in the low frequency range.



The consequences are, on the one hand, the occurrence of potential differences at the cell membrane, and the other, field enhancements on the membrane surface that interfere with the rest potential and can lead to ion fluctuations.

While the interior of the cell is practically field-free in the low-frequency range due to the low conductivity of the cell membrane, the membrane is capacitively bridged at frequencies from approx. 1 MHz.

However, relevant additional membrane potentials that lead to irritation occur only at very high field strengths.

Desk research concludes that, up to the year 2000, approximately 20,000 studies existed worldwide on the subject of health risks from mobile phone radiation.

At a rough estimate, more than a thousand more have appeared worldwide in the last fifteen years.

## Summary of 'frequency bands' and their effects on humans

Frequency range	Designation	Mechanisms of action	Measurement parameters
0 Hz	Static field		
0 - 30 Hz	SubELF		
30 - 3000 Hz	ELF (Extra Low Frequency)	Force action, excitation of nerve and muscle fibres	
3 kHz-30 kHz	VLF (Very Low Frequency)		E-field: [V/m]
30 - 300 kHz	LF (Low Frequency)		H-field: [A/m] Magn. flux density: [T]
300 kHz - 3 MHz	MF (Medium Frequency)		
3 - 30 MHz	HF (High Frequency)	Heat effect Hotspots	
30 - 300 MHz	VHF (Very High Frequency)		Power flux density [watt/m <sup>2</sup> ]
300 MHz - 3 GHz	UHF (Ultra-High Frequency)		
3 - 30 GHz	SHF (Super High Frequency)		
30 - 300 GHz	EHF (Extra High Frequency)	Warming of the skin	

## Tabulated summary of selected single papers and studies

Bibliography	Page	studied medium	Effect
Banaclocha	17	Cerebral cortex, neocortex	Impairment of cognitive functions
Bawin & Adey	18	Brain, brain tissue, magnetite crystals	Magnetosomes respond to electromagnetic and magnetic fields Discovery of the 'Adey window'
Bernhard	20	Review, biological effects of electromagnetic fields on humans, heart, eyes, circulation	The influence of stochastic resonance allows humans and other life-forms to perceive even very weak M-fields if a 'noise signal is in resonance with the information signal'.
Binhi et al.	21	Theoretical paper, general explanatory model of how weak signals below the noise threshold can be effective	Mathematical consideration of the values that allow the influence of stochastic resonance
Burch et al.	22	Humans; melatonin secretion in 'mobile' users	Reduction of melatonin secretion in electromagnetic fields
Cavopol et al.	23	Neurons in cell culture	Alteration of action potentials, up to blockade. Analysis of the results leads to the consideration that there are other, as yet unknown, effects that may be caused by gradient effects
Emilio del Giudice (EdG)	24	People, life-forms in general	EdG's theory of quantum electrodynamics of EDG permits answers to questions such as e.g.: how a biomolecule is able to find its biochemical reaction partner quickly and accurately; why enzymes are highly selective; and more. The EDG explanatory model is a coherency domains model (this is now considered confirmed.)
Hänggi I and II	25	Human, neuronal tissue	The phenomenon of stochastic resonance is used to explain why life-forms, despite a noise signal in the vicinity, can themselves recognise/discover very weak EM fields, even if they are below the 'noise threshold'
Hinrikus	26	Human, brain, nervous system	Changes in EEG rhythms depending on the modulation of microwave radiation

Kirschvink I, II, and III	27	Human, brain, brain tissue	Magnetite crystals in the brain and the cerebral cortex allow humans to sense weak, magnetic and electromagnetic signals, too. The magnetite crystals could function as receiving antenna.
Liboff, (Galland)	29	Cell membrane	Relationship between alternating magnetic fields, their biological effects and the external magnetic field. The effect is greatest when the frequency of the alternating fields (which is superimposed on a static magnetic field) coincides with the Larmor frequency of a biological active ion.
Okano et al.	30	Ischiadic nerve of a frog (in vitro studies)	Nerve conduction velocity was significantly reduced, depending on the field. → Potential application in the treatment of pain.
Petty	31	Neutrophils (white blood cells)	Intracellular processes can be triggered with electrical fields. This affects cell metabolism and can produce similar effects, such as interferon- $\gamma$ .
Ramazzini Institute	32	Collection of various works on athermal effects and interactions between electromagnetic fields and living matter	Weak, low- and high-frequency fields affect all areas of the human body (immune system, blood pressure, ECG, EEG, nervous system and more)  Children and adolescents are most at risk
Zimmermann	33	Breast cancer cells	It was possible to downregulate the division (growth) rate of cells through the influence of EM fields.
Athem study	34	Brain/CNS, immune system, protein synthesis of the cell,	Influences due to EM fields could be determined in both EEG and cell growth, as well as in various human metabolic processes.
REFELEX study	37	Cell cultures of human neuroblastoma cells, embryonic stem cells of mice, human lymphocytes and embryonic stem cells	DNA double-strand breaks occur - below the applicable safety limits.

Mobile communications and health	39	Explanatory report on the effects of electromagnetic fields on human health	
Bioinitiative Report 2012	40	ongoing and constantly updated and extended report by an international working group	<p>There is clear consensus among the members of the <i>BioInitiative Working Group</i> that the existing public safety limits are inadequate for both ELF and RF.</p> <p>There is little doubt that exposure to ELF causes childhood leukaemia.</p> <p>People who have used a mobile phone for ten years or longer have higher rates of malignant brain tumours and acoustic neuromas (tumours of the auditory nerve).</p>



## EMF appeal

The appeal should apply here due to its international and independent character as the final result summary of desk research.

The results of the desk research are consistent with those of the scientists who wrote the following appeal to UN Secretary-General Mr. Ban Ki-Moon:

**International Appeal**  
**Scientists call for protection from**  
**non-ionising electromagnetic field exposure.**

Release date: May 2015

As of now, this appeal has been signed by 190 scientists from 39 countries.

New ones are constantly being added.

[Original quote - excerpt:

### >> **Scientific basis for our common concerns**

*Numerous recent scientific publications have shown that EMF affects living organisms at levels well below most international and national guidelines. Effects include increased cancer risk, cellular stress, increase in harmful free radicals, genetic damages, structural and functional changes of the reproductive system, learning and memory deficits, neurological disorders, and negative impacts on general well-being in humans. Damage goes well beyond the human race, as there is growing evidence of harmful effects to both plant and animal life.*

*These findings justify our appeal to the United Nations (UN) and, all member States in the world, to encourage the World Health Organization (WHO) to exert strong leadership in fostering the development of more protective EMF guidelines, encouraging precautionary measures, and educating the public about health risks, particularly risk to children and fetal development. By not taking action, the WHO is failing to fulfill its role as the preeminent international public health agency.<<*  
 [end of quote]

The full appeal can be read at: <https://emfscientist.org/>  
 [This is strongly recommended; author's note]

Download text as PDF from the [emfscientist.org](https://emfscientist.org/) website:

- Press Release announcing International EMF Scientist Appeal (May 11, 2015)
- Description of International EMF Scientist Appeal

This concludes the desk research.

As of October 2015, Dr.rer.nat. C. Bärtels, PD

## Appendices

### Fundamental principles

#### Appendix 1

#### Table of SI units

Basic dimension Dimension name	Dimension symbol	Symbol	Unit	Unit symbol	Unit definition
Length	<i>l</i>	L	metre	m	Distance covered by light in vacuum during a period of 1/299,792,458 seconds.
Mass	<i>m</i>	M	kilogrammes	kg	The kilogramme is equal to the mass of the international kilogramme prototype.
Time	<i>t</i>	T	Second	s	The duration of 9192,631,770 periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the caesium <sup>133</sup> atom.
Current strength	<i>I</i>	I	Ampere	A	Constant current that will produce an attractive force of $2 \times 10^{-7}$ newtons per metre of length between two straight, parallel conductors of infinite length and negligible circular cross section placed one metre apart in a vacuum. [1]
Thermodynamic temperature	<i>T</i>	Θ	Kelvin	K	1/273.16 of the thermodynamic temperature of the triple point of water of a precisely defined isotopic composition.
Amount of substance	<i>n</i>	N	Mole	mol	The amount of substance of a system that contains as many elementary entities as there are atoms in 12 grammes of carbon isotope <sup>12</sup> C in an unbound state. When using the mole, the entities used must be specified and may be atoms, molecules, ions, electrons, other particles or groups of such particles of a precisely specified composition.
Luminous intensity	<i>I<sub>v</sub></i>	J	candela	CD:	The luminous intensity, in a given direction, of a radiation source that emits monochromatic radiation of frequency $540 \times 10^{12}$ Hz and has a radiant intensity in that direction of 1/683 watts per steradian * [2] .

[1] Equally, the magnetic constant  $\mu_0$  corresponds to exactly  $4\pi \cdot 10^{-7}$  H/m.

[2] The steradian, or square radian, is a measure of the solid angle. It is included in the SI unit system as a derived unit. The symbol of the steradian is sr. On a sphere with 1 m radius a steradian encloses an area of 1 m<sup>2</sup> on the spherical surface. The solid angle of the surface of a sphere is  $4\pi$  sr.

The definitions of the base units are not final, but will be constantly refined in step with advances in testing equipment and according to revised fundamental considerations.

## Appendix 2

### Table of relevant units and terms for the purposes of the task

Name	Symbol	Unit of measurement	Definition
absorption			Weakening of the intensity of particle or wave radiation as it passes through matter. The energy contained in radiation is converted into another form of energy (e.g. heat). The energy absorbed by biological tissues forms the basis for calculating the dose absorbed by organisms
AKR mice			Laboratory mice that already have a predisposition to the formation of leukaemia.
alpha emitters			Radionuclides that emit alpha particles (helium nuclei).
equivalent dose	Sv	sievert	Product of the energy dose (absorbed dose) in the ICRU soft tissue and the quality factor of publication no. 51 of the International Commission on Radiation Units and Measurements (ICRU Report 51, ICRU Publications, 7910 Woodmont Avenue, Suite 800, Bethesda, Maryland 20814, USA). When there are several types of radiation and energy, the total dose equivalent is the sum of their determined individual contributions. The equivalent dose is a measured quantity. It is referred to using the unit sievert (Sv). 1 $\mu$ Sv = microsievert is the millionth part of a sievert. 1 mSv = millisievert is the thousandth part of a sievert
athermal effects			A number of different effects on exposure to electromagnetic fields that occur independently of tissue heating.

becquerel	Bq	'Decay activity'	SI unit of activity. Activity equal to 1 becquerel (Bq) occurs when one atomic nucleus decays per second. 1 becquerel (Bq) = $2.7 \times 10^{-11}$ curie
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blood-brain barrier			The blood-brain barrier is a selectively permeable barrier between the blood vessels and brain tissue that actively controls the exchange of substances between the blood and the central nervous system, keeping harmful substances away from the neurons. The blood-brain barrier is formed by the inner cell layer of small blood vessels in the brain (capillary endothelial cells) and the surrounding auxiliary cells, the astrocytes.
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Bluetooth			Bluetooth is a radio technology for wireless data transmission between electronic devices, making it possible to exchange photos and videos or send business cards between mobile phones. The Bluetooth standard has three classes and can transmit over distances of approx. 10, 50 or 100 metres. The majority of mobile phones have a range of approx. 10 metres. Incidentally, the name refers to a 10th-century Danish Viking king who was nicknamed 'Bluetooth'.
bystander effect			The term 'bystander effect' describes the observation that damage is caused not only to cells that are hit by radiation, i.e. receive energy depositions, but is additionally found in cells that have not been hit, known as 'bystander cells'.

determinist			Non-stochastic; deterministic radiation damage is that in which the severity of the damage increases with the dose, usually accompanied by a threshold value such as e.g. skin redness, eye cataract.
dosimetry			Quantitative detection of exposure to ionising radiation or electromagnetic fields.

EDGE			EDGE is the abbreviation for 'Enhanced Data Rates for GSM Evolution'. This technology increases the data rate in GSM mobile radio networks about 23-fold to achieve a maximum transfer rate of 210,000 characters per second (210 kbit/s) in GSM/EDGE networks.
electrical field			Condition of the space around a charge that manifests itself through force effects on other electric charges.
electrical field strength		$\frac{V}{m}$	Measure of the strength and direction of the force on a charge in an electric field, divided by the charge.
electrical charge	C	coulomb	Property of bodies consisting of a force of attraction developing between charged bodies. An arbitrary distinction is made between positive and negative electrical charges. Charges with the same charge sign repel each other and those with different signs attract.
electrical current	A	ampere	The electrical charge flowing through the cross-section of a conductor per time unit.
eddy-current			Electrical current produced by induction in a conductive body
electric voltage	V	volt	Measure of the work required to convey a charge in an electric field from one point to another, divided by the charge.

frequency	f	$\frac{1}{\text{sec}}$	Hertz is the unit of frequency, indicated as oscillations (events) per second
GPRS		$\frac{\text{kbit}}{\text{sec}}$	GPRS stands for 'General Packet Radio Service' and is an extension of the GSM standard for increasing transfer rates for data services. Depending on the phone, data transfer rates of up to 64,000 characters per second (64 kbit/s) are achieved with GPRS. Conventional GSM mobile phones achieve only 9,600 characters per second (9.6 kbit/s).
gray	Gy	$\frac{J}{\text{kg}}$	Gray is a SI unit of absorbed dose; the unit of measurement is [joule/kilogramme]. It is not used for 'non-ionising' radiation.
Hall probe			The Hall probe is based on the Hall effect and is used for the measurement of static magnetic fields.
induction			Process in which electrical current (eddy current) is generated in a conductor by changing the magnetic flux enclosed by the conductor.
electrostatic induction			Process by which a redistribution of charge takes place in a body through an external electrical field so that surplus positive or negative charges occur locally on its surface.
infrared radiation			Optical radiation in the wavelength range of 780 nm - 1 mm
LTE			'Long Term Evolution', the further development of UMTS, designated the fourth generation (4G) of mobile communications.
magnetic field strength		$\frac{A}{m}$	Measure of the strength and direction of the magnetic field.
magnetic flux density	T	tesla	The quantity describes the induction effect of the magnetic field. Magnetic flux density and magnetic field strength are connected through permeability $\mu$ (a material constant).
magnetic induction	T	tesla	Measure of the number of magnetic field lines per area.
magnetic field			Condition of a space that is expressed through dynamic effects on magnetic dipoles (such as e.g. a compass needle).
power flux density	S	$L = \frac{W}{m^2}$	Power flux density is a measure of the power of an electromagnetic field acting perpendicularly on a surface. It is measured in watts per square metre.

sievert	Sv		SI unit of equivalent dose and effective dose: 1 sievert (Sv) = 100 rem 1 sievert = 1,000 millisieverts (mSv) = 1,000,000 microsieverts (µSv) This information is not used for non-ionising radiation.
specific absorption rate	SAR	$SAR = \frac{W}{kg}$	The absorbed radiation power related to the mass of a body. Measured at 6 min exposure time and 10 g of tissue.
transmitting power			The electrical output radiated from an antenna.
UMTS			UMTS is a mobile radio standard that facilitates the quick transmission and reception of large data volumes. The abbreviation stands for 'Universal Mobile Telecommunications System'. UMTS is also often referred to as third generation (3G) after the analogue mobile radio (first generation) and GSM (second generation). '4G', see 'LTE' above
WLAN			WLAN stands for 'Wireless Local Area Network' and is used to connect computers via radio. WLAN is frequently used for Internet access. WLAN has a range of approx. 30 to 300 metres.

Additional to **Appendix 2**, Definition and Explanation of Terms

**ICR effect:**

- $f$  = frequency in Hz  $q$  = electrical charge of ion (product of the number of charges and the electrical elementary charge<sup>(\*)</sup>  
e.g.  $+1e$  for  $K^+$ )
- $B$  = magnetic flux density of the static component of the Earth's magnetic field [ca  $40 \times 10^{-6}$  T]
- $2\pi = 6.2831$
- $m$  = ion mass (product of the mass and number of atomic mass unit  $u^{**}$ , e.g. 39.0983  $u$  for potassium)
- (\*) The elementary electric charge  $e$  is  $1.60 \times 10^{-19}$  C.
- (\*\*) The atomic mass unit  $u$  is  $1.66 \times 10^{-27}$  kg.

$$f = \frac{q \times B}{m \times 2\pi}$$

**Pulsating geomagnetic field**

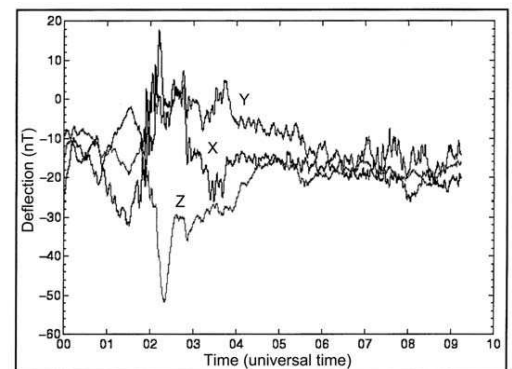
Magnetogram, taken on 28 January 2000, 09:13:35  
at the geomagnetic research station in Kiruna, Lapland,  
Sweden.

The components of the geomagnetic field pulsate between 20  
and 50  $\mu$ T in three spatial directions.

Nowadays the Earth's magnetic field is recorded and  
supervised by the SWARM satellite group.

→ ESA/SWARM

[http://www.esa.int/Our\\_Activities/Observing\\_the\\_Earth/The\\_Living\\_Planet\\_Programme/Earth\\_Explorers/Swarm/ESA\\_s\\_magnetic\\_field\\_mission\\_Swarm](http://www.esa.int/Our_Activities/Observing_the_Earth/The_Living_Planet_Programme/Earth_Explorers/Swarm/ESA_s_magnetic_field_mission_Swarm)





## Appendix 3

SI units in radiology/radiation protection (application with ionising radiation)

Physikalische Größe	SI-Einheit	alte Einheit	Beziehung
Aktivität	Becquerel (Bq) 1 Bq = 1/s	Curie (Ci)	1 Ci = $3,7 \cdot 10^{10}$ Bq * 1 Bq = $2,7 \cdot 10^{-11}$ Ci = 27 pCi
Energiedosis	Gray (Gy) 1 Gy = 1 J/kg	Rad (rd)	1 rd = 0,01 Gy * 1 Gy = 100 rd *
Äquivalentdosis	Sievert (Sv) 1 Sv = 1 J/kg	Rem (rem)	1 rem = 0,01 Sv * 1 Sv = 100 rem *
Ionendosis	Coulomb pro Kilogramm (C/kg)	Röntgen (R)	1 R = $2,58 \cdot 10^{-4}$ C/kg * = 0,258 mC/kg * 1 C/kg = 3876 R
Energiedosisleistung	Gray pro Sekunde (Gy/s)	Rad pro Sekunde (rd/s)	1 rd/s = 0,01 Gy/s * 1 Gy/s = 100 rd/s *
Ionendosisleistung	Ampere pro Kilogramm (A/kg)	Röntgen pro Sekunde (R/s)	1 R/s = $2,58 \cdot 10^{-4}$ A/kg * = 0,258 mA/kg *

[Source: German Federal Office for Radiation Protection, (Bundesamt für Strahlenschutz) Annex JB10]

## Appendix 4

### Limit values in mobile communication

#### European countries

The following countries are based on (identical to or directly comparable with) ICNIRP limit recommendations:

Denmark, Germany, Estonia, Finland, France, Great Britain, Ireland, the Netherlands, Norway, Austria, Portugal, Romania, Sweden, Spain, Czech Republic, Turkey, Hungary

The ICNIRP limit value recommendations for mobile communication frequencies are

- approx. 41 V/m and 4.5 W/m<sup>2</sup> at 900 Mhz
- approx. 58 V/m or 9 W/m<sup>2</sup> at 1800 MHz and
- 61 V/ m and 10 W/m<sup>2</sup> for UMTS.
- These recommendations were also adopted in the Recommendation (1999/519/EC) of the Council of the European Union, which is used by the majority of EU member countries.

The '*Salzburg Resolution* ' (2000) sets the target to 0.1 µW/cm<sup>2</sup> (= 1 mW/m<sup>2</sup>) or 0.614 V/m for public space at a pulsed radio frequency (RF).

The following countries have significantly deviating regulations (for further information, see the link in the table below):

Country	Limit value
Belgium	Approx. 21 V/m at 900 MHz and 28 V/m at 1800 MHz Brussels Region: 3 V/m per 2G, 3G and 4G mobile radio system
Italy	20 V/m from 3 MHz - 3 GHz for temporary exposure 6 V/m and 0.1 W/m <sup>2</sup> by 3 MHz - 3 GHz for exposure exceeding 4 hours
Luxembourg	3 V/m for prolonged exposure due to mobile phone base stations, otherwise in accordance with ICNIRP
Liechtenstein	Currently as in Switzerland
Switzerland	in accordance with ICNIRP for temporary exposure 4 V/m (900 MHz) or 6 V/m (1800 MHz) for 'sensitive areas'
Russia	10 V/m 300 - 2400 MHz
Poland	0.1 W/m <sup>2</sup> and 6 V/m from 300 MHz to 300 GHz

[Source: the Commission on the Application of the Council Recommendation of 12 July 1999 (1999/519/EC) to limit the exposure of the population to electromagnetic fields (0 Hz - 300 GHz) - Second Implementation Report 2002-2007]

## Non-European countries

The following countries follow (are identical to or directly comparable with) the ICNIRP limit recommendations:

Australia, Brazil, Israel, Japan, Canada, Singapore, South Africa, South Korea, Taiwan, USA

The following countries have significantly different regulations:

Country	Limit value
<b>Australia</b>	In Australia, limits according to ICNIRP have applied since March 2003. At the local level, considerably more stringent limit regulations, such as in New South Wales with $0.01 \text{ mW/m}^2$ , are in place following public pressure. However, in recent court cases for their application to individual facilities it was decided in favour of national limits.
<b>China</b>	$0.1 \text{ W/m}^2$ or $6 \text{ V/m}$ from 300 MHz to 300 GHz for prolonged exposure, e.g. residential areas, hospitals, schools etc. $0.4 \text{ W/m}^2$ for temporary exposure, e.g. factories, government offices, parks, etc. This standard is currently being revised
<b>India</b>	$f/2000 \text{ W/m}^2$ from 400 - 200MHz, $1 \text{ W/m}^2$ from 2000 MHz (equivalent to 1/10 of the ICNIRP recommendation with respect to power flux density)
<b>New Zealand</b>	$2 \text{ W/m}^2$ and $27.5 \text{ V/m}$ from 400 MHz - 300 GHz

[Source:]

[http://www.ralf-woelfle.de/elektrosmog/redir.htm?http://www.ralf-woelfle.de/elektrosmog/allgemein/recht\\_a.htm](http://www.ralf-woelfle.de/elektrosmog/redir.htm?http://www.ralf-woelfle.de/elektrosmog/allgemein/recht_a.htm)

## Appendix 5

### Types of different study models/clinical trials

#### Evidence-based medicine / evidence-based (report)

**Evidence-based medicine (EBM)** is a more recent trend in medicine that raises an explicit requirement that patient-oriented decisions should be taken, as far as possible, on the basis of empirically proven effectiveness during medical treatment.

In evidence-based medicine, a **clinical trial** and clinical research are forms of survey (gathering of information and facts). Studies are performed with patients or healthy volunteers.

The goal is to check medications, certain forms of treatment or medical interventions or medical products for their efficacy and safety. Clinical trials are conducted in order to answer scientific questions and improve medical treatment.

The first use of a promising medical treatment in humans should therefore take the form of a clinical trial with the objective of testing the safety and efficacy of new therapies. However, such a trial can take place only if sufficient data are available for a reliable implementation and there is a positive vote of the ethics committee in question. In order to minimise external interference, such trials are conducted in a controlled environment. [Source: Wikipedia]

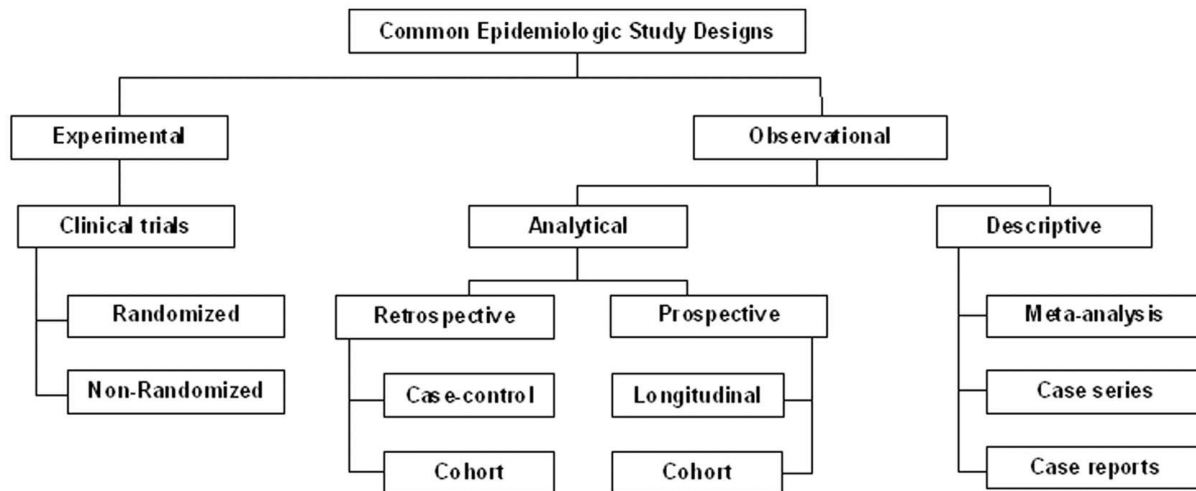
Such studies - studies that meet these criteria - could be found for the question posed in only two cases.

- REFLEX study
- ATHEM study

#### Study design is of central importance in the choice of study:

- Study registration (see below)
- Protocol
- Selection of subjects/patients
- Definition of parameter to be measured
- Type of dosage
- Type of control group
- Method of data evaluation

## Overview of various studies



### Studies using the 'blind analysis technique'

A **blind study** is a form of an experiment in which the subjects do not know whether they belong to the experimental or the control group, eliminating the influence of expectations and behaviours that would be triggered by this information. Blind studies are particularly widespread in medical and psychological research.

A study is open when the patients know whether they are receiving the active treatment or the placebo.

On the other hand, a study is

- **single-blind** when patients do not know which substance (control or active) they are receiving (the subject is 'blind').
- **double-blind** when both the patient and the treating physicians do not know who gets which substance (subject and assistant are 'blind').
- **triple-blind** when neither the patients, nor the attending doctor, nor those who perform the evaluation know who is receiving which substance (subject, assistant and evaluator are all 'blind'). Only the principal of the study knows who has received which substance.

### Case-control study

A case-control study investigates whether individuals with a particular disease (known as cases) have been exposed more frequently or to higher doses than similar individuals without the disease (known as controls).

### Nested case-control study:

A particular disease is often been studied in more detail as part of a cohort study. For this purpose, all individuals with this disease (known as cases) and a random subset of individuals without the disease (known as controls) are selected from the cohort. Further targeted interviews or surveys are subsequently conducted on this sub-group. This type of study is called a nested case-control study, as the case-control study is incorporated into a cohort study.

### Cohort study

An investigation in which a group of individuals (cohort) whose exposure conditions are known are observed over an extended period of time. The various exposures are associated with the occurrence of diseases.

### Cross-sectional study

Cross-sectional studies involve a variety of people from a target population at a fixed point in time (date). Information on the disease status and current or previous exposure for the selected individuals is collected simultaneously.

### Feasibility study

A feasibility study investigates whether and under what conditions a planned complex investigation can be successful.

### Cross-over study (ATHEM)

A controlled clinical trial can be conducted as either a cross-over study or in parallel groups. In a cross-over study the same subjects are sequentially administered both the testing and the control substances (e.g. bioequivalence). Through a randomising process, every participant is randomly assigned the order in which they receive treatments. Between treatments a wash-out phase must be observed; this is specifically defined depending on the pharmacokinetic properties of the drug.

[Source:

Journal:

Deutsches Ärzteblatt, Jg. 105, Issue 11, 14 March 2008, A 565

Title:

Critical evaluation is an essential component of medical practice

Authors:

Jürgen Windeler, Gerd Antes, Johann Behrens, Norbert Donner-Banzhoff, Monika Lelgeman]

### Crossover placebo study

Crossover test E placebo crossover trial, clinical study trial design

Here, the effect of the verum (active substance) is compared to that of a placebo (non-active substance). The patient cohort is divided into two groups, one beginning with the active medication, the other with the placebo. The medications are reversed after half of the test period. This type of study design facilitates the objective determination of the objective characteristics of a new drug, irrespective of external factors. Instead of a placebo, the verum can be tested in the same manner against another drug that has the same characteristics and is already well-known in order to obtain an objective comparison of effects.

[Source: Lexikon der Neurowissenschaft (Lexicon of Neuroscience), Spektrum akademischer Verlag ©, 2000, Heidelberg]

[Author's note:]

External factors can include e.g.:

- Treatment A is only effective after (e.g.) two weeks, so that its effect (only) occurs with treatment B, 'measured with it' and attributed to Treatment A
- Treatment A spreads to Treatment B
- nursing staff performing Treatment A are much nicer

Placebo: 'substitute drug' without active ingredients (= dummy preparation, dummy treatment)

Verum: the real medicine with active ingredients (= real preparation/treatment)

## Appendix 6 Bibliography

(to 11) RAMAZZINI INSTITUTE

Journal:

EUR. J. ONCOL. LIBRARY, Volume 5, An ICEMS Monograph

Title:

NON-THERMAL EFFECTS AND MECHANISMS OF INTERACTION BETWEEN ELECTROMAGNETIC FIELDS AND LIVING MATTER

Contents of the publication of the Ramazzini Institut, 2010 Bologna, Italy

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## Appendix 7

*Annu. Rev. Physiol.* 1995. 57:245-62  
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# THE ROLE OF REACTIVE OXYGEN METABOLITES IN GLOMERULAR DISEASE

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**KEY WORDS:** free radicals, glomerulonephritis, oxidants, glomerular function

## INTRODUCTION

A large body of evidence accumulated over the last decade indicates that partially reduced oxygen metabolites are important mediators of ischemic, toxic, and immune-mediated tissue injury (7, 19, 30, 32, 52, 82). Numerous studies have examined the role of reactive oxygen metabolites in leukocyte-dependent and -independent models and the biological effects these metabolites have in glomerular pathophysiology (9, 21, 73, 74). In this review, I define the term reactive oxygen metabolites, briefly recount the sequence of events that led to the consideration of these metabolites as important mediators of tissue injury, and present the available evidence in support of the role of reactive oxygen metabolites in glomerular disease, including the recent studies in which the role of intrinsic antioxidant defenses are beginning to be delineated.

Oxygen normally accepts four electrons and is converted directly to water. However, partial reduction of oxygen can and does occur in biological systems, which leads to the generation of partially reduced and potentially toxic reactive oxygen intermediates (33, 53). Thus sequential reduction of oxygen along the univalent pathway leads to the generation of superoxide anion, hydrogen peroxide, hydroxyl radical, and water (33, 53).

oxygen → superoxide → hydrogen peroxide → hydroxyl radical → water.  
(free radical) (free radical)

245

0066-4278/95/0315-0245\$05.00

## Appendix 8

### Coherence-domain model of the water

[Quote - extract - from: Lecture notes from the University of Marburg, Biology (FB17), Plant Physiology, Prof.Dr. Paul Galland]

As early as the 1920s and '30s quantum mechanical models of water were developed (Landau) that pointed to the microscopic structure of water. According to this line of thinking water - H<sub>2</sub>O - consists of a stochastic phase (about 60%) that is characterised by the classical Brownian motion of individual molecules, and a coherent phase (about 40%) in which about  $1.5 \times 10^7$  water molecules form a coherent domain.

Coherence in quantum mechanics means a space or time interval within which a particle property (e.g. spin) can be represented by a wave function with occupation probability = 1 The *entanglement* of numerous particles (fermions) results in a new particle (boson) with new properties, which cannot be described simply as the sum of the individual particles.

/.../

Can the existence of the water CD be proved experimentally? Yes. / ... / is shown that the theory predicts that alternating magnetic fields distort the quantum ring of orbiting ions and can cause leakage of ions. The exit of ions becomes apparent through the change in the water's conductivity at certain frequencies of the alternating magnetic field (resonance frequency). This occurs with a variety of ions, e.g. also with organic, dissociated acids. Several hundred molecules form a coherent quantum ring. How can one picture the biological effect of alternating magnetic fields? Based on the CD model, one must assume that biologically important ions such as Ca<sup>2+</sup>, K<sup>+</sup> etc. are released in both stochastic and coherent domains. However, bioavailability is but probably only given in the stochastic phase, where the ions can interact with enzymes and proteins. Alternating magnetic fields that are tuned to the resonant frequency would allow ions to emerge from the CD and make proteins available. This would lead to a mobilisation of ions within the aqueous phase and thus to a biological effect.

## Appendix 9

### Effects of alternating magnetic fields on bacteria and protists

[excerpts; the original table contains 37 reactions in 31 organisms]

Organism	Magnetic flux density	Reaction	'Reference'
Corynebacterium glutamicum	4.9 mT, 50 Hz	30% more ATP	Lei & Berg 1998
Escherichia coli	65, 97 nT, 16, 60 Hz	altered enolase activity	Dutta et al. 1994
Escherichia coli ***	1.2 mT, 50 Hz	increased Tn5 transposition  *** <i>Tn5 can be found in Shewanella and Escherichia bacteria. The transposon codes for antibiotic resistance to kanamycin and other aminoglycoside antibiotics.</i>	Chow & Tung 2000a

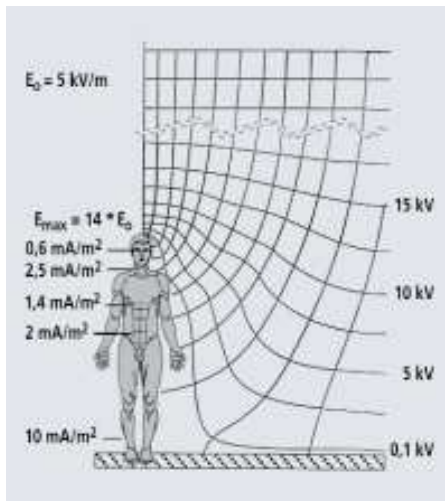
/.../			
Halobacterium halobium	5 - 90 mT, 0 - 0.3 Hz	Growth: stimulation/inhibition	Moore 1979
Gonyaulax scrippsae	1.2, 11.5 mT, 50 Hz	amended bioluminescence	Berden et al. 2001
Salmonella typhimurium	14.6 mT, 60 Hz	Protection against heat stress	Williams et al. 2006
Helianthus annuus	20 mT, 16 2/3 Hz	Weight increase	Fischer et al. 2004
Actinidia deliciosa, Kiwi	3.5 mT, 50 Hz	morphological anomalies of pollen tubes, helical growth	Dattilo et al. 2005

[Source: <https://www.uni-marburg.de/fb17/fachgebiete/pflanzenphysio/.../vl13>  
Lecture notes of the Department of Plant Physiology, University of Marburg  
Photo- and Magnetobiology 13]

\*\*\* [Author's comment:] A possible additional explanation of why there has been such a sharp rise in resistance to antibiotics in mammals (humans, pigs) and reptiles (chickens) in recent years, leaving aside the massive use of medication in factory farming. E.Coli is the most widespread intestinal bacteria in all forms of life and responsible for a properly functioning immune system. Antibiotic resistance may be affected if the DNA in a coli bacterium is disrupted by unregulated transposon effects.

## Appendix 10

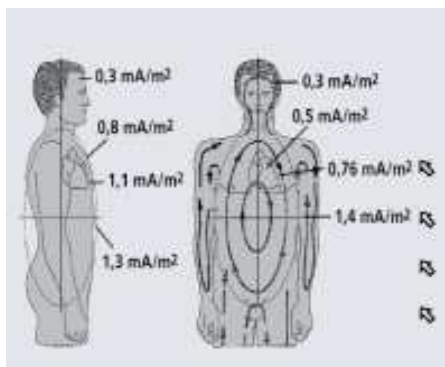
### Field distortions in electric fields



Distortion of an electric field (50 Hz) by a stationary, earthed human.

Unlike in an undisturbed field strength of 5 kV/m (i.e. without a human being present), field strength multiplies fourteen-fold around the head.

Average current densities in the body range from about 0.6 mA/m<sup>2</sup> in the head up to 10 mA/m<sup>2</sup> in the ankles.



Induction of electric fields or currents in a body that is exposed to a 50 Hz magnetic field (external magnetic flux density 100 µT). The induced current densities are greatest at the periphery and decrease within the body.

[Source: Deutsches Ärzteblatt, Jg. 99, No. 2, 5 July 2002;  
From: Bernhardt JH: Physikalische Einflussfaktoren (Physical Influence Factors). Praktische Umweltmedizin (Practical Environmental Medicine). Springer, Lose Blatt Systeme (Loose-leaf Systems). Berlin, Heidelberg: Springer-Verlag, 1997; 1-27].

## Appendix 11

### The brain: description of individual technical terms

#### Astroglia

Glial cell is a collective term for cells in the nervous tissue that can be structurally and functionally delineated from the nerve cells (neurons). About half of the cells in the human brain are glial cells. According to current knowledge, the glial cells form a supportive framework for, and ensure the mutual electrical insulation of, the nerve cells. However, recent findings have shown that glial cells play a considerable role in the transport of substances and fluids and in the maintenance of homeostasis in the brain and are involved in the process of processing, storage and transmission of information.

Astrocytes, star cells or spider cells (from the Greek; composite of astron, 'star' and kytos, 'cell') constitute the majority of glial cells in the central nervous system of mammals and are therefore also known as astroglia. These are star or spider-shaped cells whose appendages form the boundary membranes of the brain surface (or pia mater) and blood vessels.

#### Brainwaves

Brainwaves are oscillations in the voltage inside the brain.

An EEG facilitates measurement of the voltage fluctuations at the surface of the head.

Depending on what state a person is in (e.g. awake, relaxed, asleep), their brainwaves oscillate in varying frequency bands (e.g. alpha waves in the relaxed state).

Brainwaves can be stimulated with the aid of external stimuli. This means that humans in a relaxed state can be shifted into states in which learning is improved or they can mentally programme themselves effectively.

Our brain waves are divided into **five categories** according to their **frequency**:

• Gamma	100 - 38 Hz (Hertz = oscillation/second)
• Beta	38 - 15 Hz
• Alpha	14 - 8 Hz Hypothalamus region/Schumann resonance
• Theta	7 - 4 Hz
• Delta	3 - 0.5 Hz

#### Neocortex

The neocortex is defined as the multisensory and motor section of the cerebral cortex of mammals. The separate terms of archicortex (inter alia, hippocampus) and palaeocortex (among other things: the olfactory bulb) also exist. The cortex (Latin: 'bark', 'rind' or 'shell') is the grey outer layer of the cerebral cortex, which surrounds white substance.

#### Prefrontal cortex

The prefrontal cortex receives sensory signals and has a correlative connection to the integration of the contents of memories and emotional evaluations and thus organises both motor and emotionally appropriate behaviour.

The prefrontal cortex contains

- dopaminergic inputs from the midbrain,
- noradrenergic inputs from the locus coeruleus,
- serotonergic inputs from the Raphe nuclei and
- cholinergic inputs from the interbrain.



- Other transmitters are GABA, glutamate and aspartate.

The prefrontal transmitter system differentiates itself up to adolescence.

[This also explains why children are most at risk, as this brain region is not yet fully developed in them.]

### Cerebral

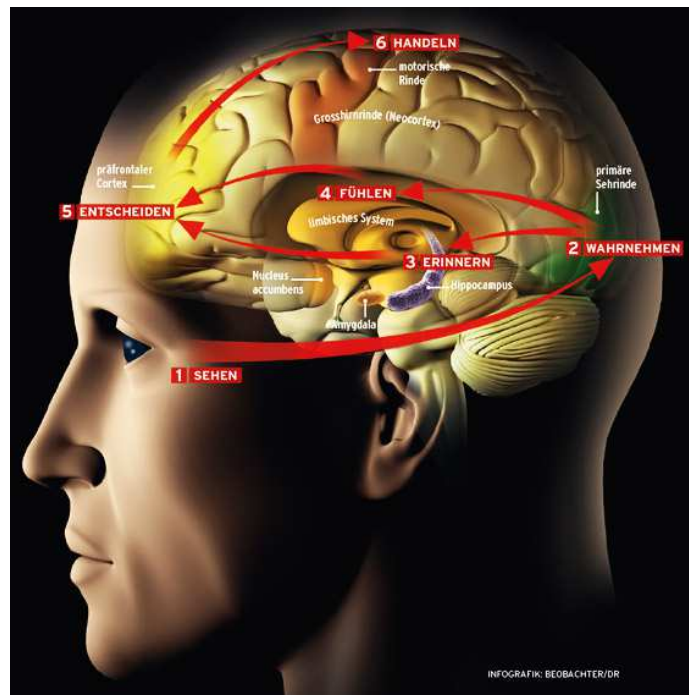
In biology and medicine this term encompasses 'structures associated with the brain'.

### the human brain

#### process chain:

seeing → perceiving → feeling/remembering  
→ **deciding** → acting

["You have to want it" is the generally understood rule of thumb on the functioning of the brain to ensure that individuals perform sustainable actions.]



## Appendix 12 - Telecommunication and frequency bands, allocation of transmission frequencies

In Germany, the Federal Network Agency [BNetzA] enjoys a kind of 'frequency sovereignty'. This therefore also allows the 'Agency' to auction off frequencies. Formerly it was the regulatory body of Deutsche Post, which belonged to the Federal Ministry of Post and Telecommunications. The 'BNetzA' was founded in 1998, after Deutsche Post was privatised.

In the summer of 2015 new frequencies were 'released' and auctioned off. The auction took the form of an open, ascending, simultaneous, multi-round auction.

### Mobile Broadband Proproject 2016

Az: BK1-11 / 003

The frequency blocks abstractly auctioned in 2016 were assigned as follows in August 2015:

Information taken from the website of the Federal Network Agency:

[http://www.bundesnetzagentur.de/DE/Sachgebiete/Telekommunikation/Unternehmen\\_Institutionen/Frequenzen/Oeffen](http://www.bundesnetzagentur.de/DE/Sachgebiete/Telekommunikation/Unternehmen_Institutionen/Frequenzen/Oeffen)

#### 700 MHz range



#### 900 MHz range



#### 1.8 GHz range



#### 1.5 GHz range



[Author's comment: at web address:

>>

[http://www.bundesnetzagentur.de/SharedDocs/Downloads/DE/Sachgebiete/Telekommunikation/Unternehmen\\_Institutionen/Frequenzen/OffentlicheNetze/Mobilfunk/DrahtloserNetzzugang/Projekt2016/Frequenzen700bis1800\\_pdf.pdf;jsessionid=554EB102BA6290B05FF57F0EA9AAA167?\\_\\_blob=publicationFile&v=2](http://www.bundesnetzagentur.de/SharedDocs/Downloads/DE/Sachgebiete/Telekommunikation/Unternehmen_Institutionen/Frequenzen/OffentlicheNetze/Mobilfunk/DrahtloserNetzzugang/Projekt2016/Frequenzen700bis1800_pdf.pdf;jsessionid=554EB102BA6290B05FF57F0EA9AAA167?__blob=publicationFile&v=2) <<

a PDF document from the Federal Network Agency can be downloaded showing the distribution of frequencies for telecommunications companies.

After 16 days and 181 rounds, the auction for mobile broadband frequencies ended in Mainz on 19 June 2015. All three companies, Telefónica Germany GmbH & Co. OHG, Telekom Germany GmbH and Vodafone GmbH, were successful and were able to bid for frequencies according to their business models:

Company	Frequency volume	Hammer price
Telefónica Deutschland GmbH & Co. OHG	700 MHz: 2 x 10 MHz	
	900 MHz: 2 x 10 MHz	
	1800 MHz: 2 x 10 MHz	
Telekom Deutschland GmbH	700 MHz: 2 x 10 MHz	
	900 MHz: 2 x 15 MHz	
	1800 MHz: 2 x 15 MHz	
	1500 MHz: 20 MHz	
Vodafone GmbH	700 MHz: 2 x 10 MHz	
	900 MHz: 2 x 10 MHz	
	1800 MHz: 2 x 25 MHz	
	1500 MHz: 20 MHz	
Total		5,081,236,000 EUR

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[Author's comment:]

Doing business with the providers is about one thing: a very, very large amount of money. Currently it amounts to approximately 5 billion Euros.

Demand is generated on the 'USER' market based on a continued increase in so-called 'Mobile data volume' (i.e. in order to transfer more images in less time). One might ask the question: Why is this important? How did things work before - without maximized mobile data volume?

However, in the author's opinion, a much more exciting question would be: What would a 'harmless' mobile future look like - e.g. in the case of the commander's communicator in the science-fiction film series *Star Trek: "Kirk to Enterprise"*? In the film, the crew members wear their 'communicator' directly above the heart.

If all mobile communication standards are added together, c. 2 billion people worldwide are accessible via mobile telephony, according to an October 2005 announcement by the GSM Association and the GSA. In 2003 (according to Deutsche Bank) GSM technology was worth 277 billion US dollars.

In mobile communications as a whole, efforts aim towards a technological solution and the biological components are largely avoided. The effective benefit is questionable, if only because of the ever-increasing play factor among users.

No official regulations exist for the full low-frequency range. A variety of paths are, however, open:

1. partial low-frequency ranges are also marketed.
2. A mobile operator is the first to offer a technical solution, and convinces the user in the market to utilise the potentially less dangerous frequency bands.

It is certain that the providers have the technical and intellectual basis for finding solutions to this issue.

They will only want this when there is sufficient demand in the market.

[End of comment]

In the GSM range (frequency band about 890-1990 Hz, upper and lower belt), sub-ELF and ELF frequencies occur that are present in the biologically active window from 2 to 7.8 Hz. This is physically plausible via the application of harmonics, which are created in both matter waves (water,

bridges, foundations, air - acoustics - etc.) and in electromagnetic waves. The modulation of a carrier wave would not otherwise make sense. It is this modulation that makes the sending of a message signal possible.

For the structure of GSM, see the following tables.:

### GSM in Germany

The network architecture of GSM is designed for the transmission of voice.

<b>Beginning of installation:</b>	1991 (trial operation), launched in the summer of 1992
<b>Deployment area:</b>	Germany, Europe-wide roaming
<b>Transmission:</b>	Voice and data signal, digital
<b>Ultimate capacity:</b>	approx. 10 million subscribers
<b>Standard:</b>	GSM-900

### Technical features

<b>Transmission method:</b>	TDMA (Time Division Multiple Access):
<b>Frequency range (upper band):</b>	935 ... 960 MHz
<b>Frequency range (low band):</b>	890 ... 915 MHz
<b>Channel spacing:</b>	250 kHz
<b>Channels per cluster:</b>	100 (8 connection/conversations possible on each channel through time division)

## GSM systems and frequency ranges

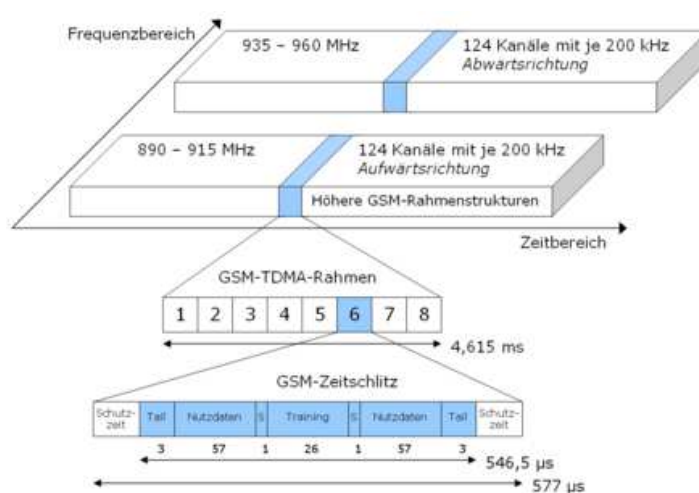
System	Name	Frequencies	Use
<b>GSM-900</b>	Global System for Mobile Communications	890 ...915 MHz (uplink) 935 ...960 MHz (downlink)	D-networks in Germany
<b>GSM-R</b>	Global System for Mobile Communications	876...880 MHz (uplink) 921 ...925 MHz (downlink)	Railway radio
<b>DCS-1800</b>	Digital Communication System	1710...1785 MHz (uplink) 1805...1880 MHz (downlink)	E-networks in Germany
<b>PCS-1900</b>	Personal Communication System	1850...1910 MHz (uplink) 1930...1990 MHz (downlink)	Networks in the USA

GSM-900 systems transmit in the main frequency bands 890-915 MHz (upload) and 935-960 MHz (downlink). These frequencies are used by the D-networks in Germany. In addition there are the expansion frequency bands 880-890 MHz and 925-935 MHz. The GSM-R frequencies 876-880 MHz and 921-925 MHz are reserved for railway radio.

DCS 1800 systems transmit in the 1710-1785 MHz and 1805-1880 MHz frequency bands. These frequencies are used by the E-networks in Germany. In 1999, the D-network operators acquired additional frequency bands for DCS-1800 in order to compensate the bottlenecks in the GSM 900 frequency ranges and to have more capacity available in areas with high mobile communication load. As GSM-900 and DCS-1800, due to the different frequency ranges, utilise different technologies, dual-band mobile phones are required to use both frequency ranges. As a rule, all GSM-enabled mobile phones sold in Germany also have dual-band capability.

The GSM/GPRS/EDGE mobile network (2G) will be scaled back in the coming years. However, the system will not, in the longer term, be shut down, as too many devices rely on the 2G network. If demand falls, frequencies will be freed up for 3G (UMTS) and 4G (LTE).

## GSM framework

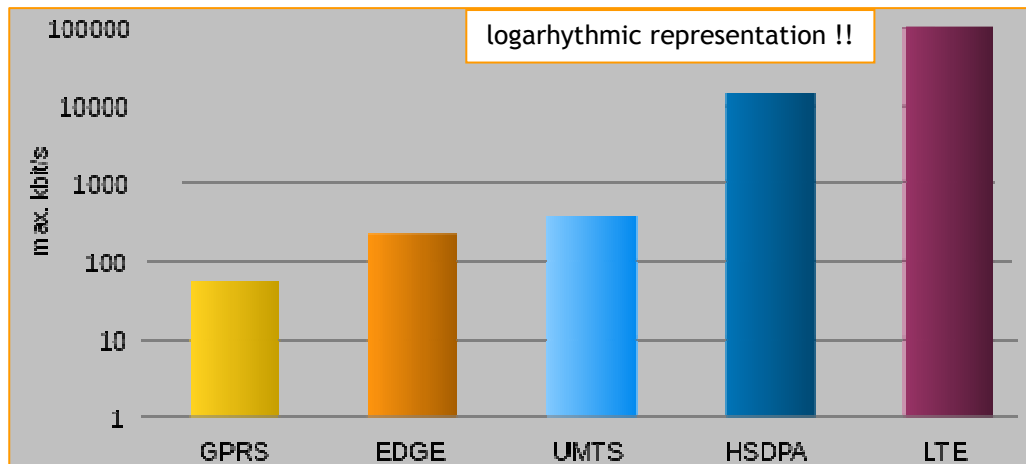


structure:

In a 'new market' such as that of the 'maximised mobile data volume' [mamoDavol\*] more frequency bands required that enable image and video data transmission will necessarily be required.  
[\*a neologism of the author, not meant entirely seriously]

Currently, the task is achieved through the use of shorter frequencies - as with LTE.

The graph below shows the transmission rates of LTE compared to other frequency bands.



(Long Term Evolution, LTE for short, transmits in the 3.9 GHz range)

Here, it is clear that supply is generating demand.

## Appendix 13 - Conversion table for high frequency fields

Electr. field strength E	Magnet. field strength H	Magnet. flux density B		Power flux density S			
		μT	mG	W/m <sup>2</sup>	mW/m <sup>2</sup>	μW/m <sup>2</sup>	μW/cm <sup>2</sup>
100	0.265	0.333	3.334	26.55	26 550	26 550 000	2 655
10	0.0265	0.0333	0.333	0.265	265	265 000	27
9	0.0239	0.0300	0.300	0.215	215	215 000	22
8	0.0212	0.0267	0.267	0.170	170	170 000	17
7	0.0186	0.0233	0.233	0.130	130	130 000	13
6	0.0159	0.0200	0.200	0.095 57	95.57	95 570	10
5	0.0133	0.0167	0.167	0.066 37	66.37	66 370	7
4	0.0106	0.0133	0.133	0.042 47	42.47	42 470	4
3	0.007 96	0.0100	0.100	0.023 89	23.89	23.890	2
2	0.005 31	0.006 67	0.067	0.010 62	10.62	10 620	1
1	0.002 65	0.003 33	0.033	0.002 655	2.655	2.655	0.2655
0.9	0.002 39	0.003 00	0.030	0.002 150	2.150	2.150	0.2150
0.8	0.002 12	0.002 67	0.027	0.001 699	1.699	1.699	0.1699
0.7	0.001 86	0.002 33	0.023	0.001 301	1.301	1,301	0.1301
0.6	0.001 59	0.002 00	0.020	0.000 956	0.956	956	0.0956
0.5	0.001 33	0.001 67	0.017	0.000 664	0.664	664	0.0664
0.4	0.001 06	0.001 33	0.013	0.000 425	0.425	425	0.0425
0.3	0.000 796	0.001 00	0.010	0.000 239	0.239	239	0.0239
0.2	0.000 531	0.000 667	0.0067	0.000 106	0.106	106	0.0106
0.1	0.000 265	0.000 333	0.0033	2.65E-05	0.0265	26.5	0.0027
0.01	2.65E-05	3.33E-05	0.000 33	2.65E-07	0.000265	0.265	0.000 027
Conversion table for high-frequency fields (far fields). Blanks have been inserted for improved readability. <a href="http://www.umweltinstitut.org/elektrosmog">www.umweltinstitut.org/elektrosmog</a>							

Conversion of power flux density/field strength\*\*:

1 mW/m <sup>2</sup>	=	0.6 V/m
1 V/m	=	2.65 mW/m <sup>2</sup> = 0.26 μW/cm <sup>2</sup>
1 mW/m <sup>2</sup>	=	0.1 μW/cm <sup>2</sup> = 10 <sup>-3</sup> W/m <sup>2</sup>
1 W/m <sup>2</sup>	=	10 mW/cm <sup>2</sup>

Conversion of magnetic field strength/induction (μr =1)\*\*:

1 A/m	=	1.25 μT
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[\*\*Source:]

Bavarian State Office for Occupational Safety, Occupational Medicine and Safety Technology, Pfarrstr. 3, D-80538 Munich



## Appendix 14 - Final thoughts

- A personal note from the author.

According to the overall result of this desk research that there is a serious risk when dealing with electromagnetic radiation, the user is, perhaps, left with a feeling of helplessness, as no real minimum-risk alternatives are currently offered, which is hardly to be expected with the current, well-functioning business model.

Allow me, therefore, to make a few recommendations, not only for users, but also for future studies.

The user has the option to protect themselves from unwanted effects of electromagnetic radiation. There are several options in this regards, extended from simple headset (preferably with acoustic couplers) to information carriers, magnetic gradient compensation to special antennae.

The best way to protect oneself, however, is to use one's 'smartphone' as little as possible and to keep it well away from one's head when using it (and even then with loudspeakers or headphones).

For all the criticism of the current use of mobile phones and smartphones, it seems appropriate to also take a look at the studies to throw itself and question a study can do. "But very often the call goes, "But science can solve that."

Please allow me (outside desk research) to, in the following paragraph, briefly examine the possibilities and the 'pros and cons' of studies.

The examination protocols certainly have one shortcoming in common: they do not investigate the person as a whole in their everyday life and, even if that were possible, the comparison is lacking in terms of a double-blind study. How should it work? Transmit with a non-sending mobile phone? Take a region of people without a mobile phone as a comparison? Sure, there are such regions, but there aren't any signposts, car traffic or computers, either. So what, then, should a control group look like? And would permanent exposure ever be morally and ethically justifiable - if it emerged as an evidence-based result that such exposure causes cancer?

Then there is the difficulty of long-term study. One group ('verum') would have to phone for, say, 400-500 hrs every month over 10 years - and the other group ('sham') - no phoning at all (what should they do? Write letters? Send messengers on horseback?). Any halfway compromise would be lazy. And then, one would also need to block out technological development, such as e.g. the development from analogue to digital devices, technical reduction of SAR values and transmission power, while retaining the same transmission and voice quality. All of this is unrealistic.

What must happen first is the raising of awareness among and sober and neutral education of the public. Precautionary measures would then make sense. Network operators and mobile phone manufacturers must leave their comfort zone and show what they can do. Working together, a technical solution is possible in terms of (technical) electromagnetic compatibility (this is, today, already the everyday for the police/fire brigade/air traffic control), extended to include 'biocompatibility' - i.e. 'EMC type B'. Such initiatives already exist. Unfortunately, public interest is still relatively small.

Experts see this issue differently (see the EMF Appeal to Ban Ki-moon).

A similar situation has already occurred once in industrial history, with asbestos; on 15 July 1900, the Austrian, Ludwig Hatschek, the owner of an asbestos factory, received an Austrian patent for Eternit as a building material <http://de.wikipedia.org/wiki/Asbest>]. - one hundred years separated the granting of the patent and the EU-wide ban, with the result that today it is still necessary to demolish or redevelop (public) buildings. What harm has been caused to the public! [see: <http://www.zeit.de/2009/06/Asbest>].

In order to achieve a 'halfway' neutral study, a protocol could (we are confident) be developed that would take the form of juxtaposing groups of subjects every year or two with the same profile, with frequent and infrequent *callers* amongst them. These groups would then be medically monitored for e.g. ten years. Statistically relevant statements concerning people as a whole, and not just tissue, nerves or immune cells, could then be made on the set of studies.

At the present state of science, it may be safely assumed that it is not a question of '*if*' EMF have effects on biological tissue - the question is clearly answered in the affirmative - it is rather a matter of '*how*' alternating EM fields affect biological systems and organs when a universal explanatory model will be available. This will certainly go far beyond the current understanding of a 1:1 action-reaction mechanism. This primarily involves a much more comprehensive understanding of human nature, including its evolution (symbiotic characteristics), symbiotic cell structure (mitochondria) and the entire structure of matter (bipolar properties of atoms, molecules, proteins, and cells). Models have been introduced that allow the making and checking of forecasts. If one then still wishes to better understand, or even clarify, the '*why*', one would certainly have an effective approach to protecting the population from the negative effects of EMF radiation.

Ass.Prof., Dr.rer.nat. C. Bärtels, Mettmann, October 2015