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The Royal Society, London

Functionality Disorders in Bees, Birds and Humans

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Three magnetic field-sensitivity-systems

- 1. Bees:

  Magnetite granules

- 2. Birds:

  Stimulation of special molecules by **light** and resulting **radical pair formation** with singlet-triplet intercrossing system

- 3. Humans, Animals and Plants:

  Electron transfer (redox system) and resulting formation of radical pairs **with singlet-triplet intercrossing system**

To 1.

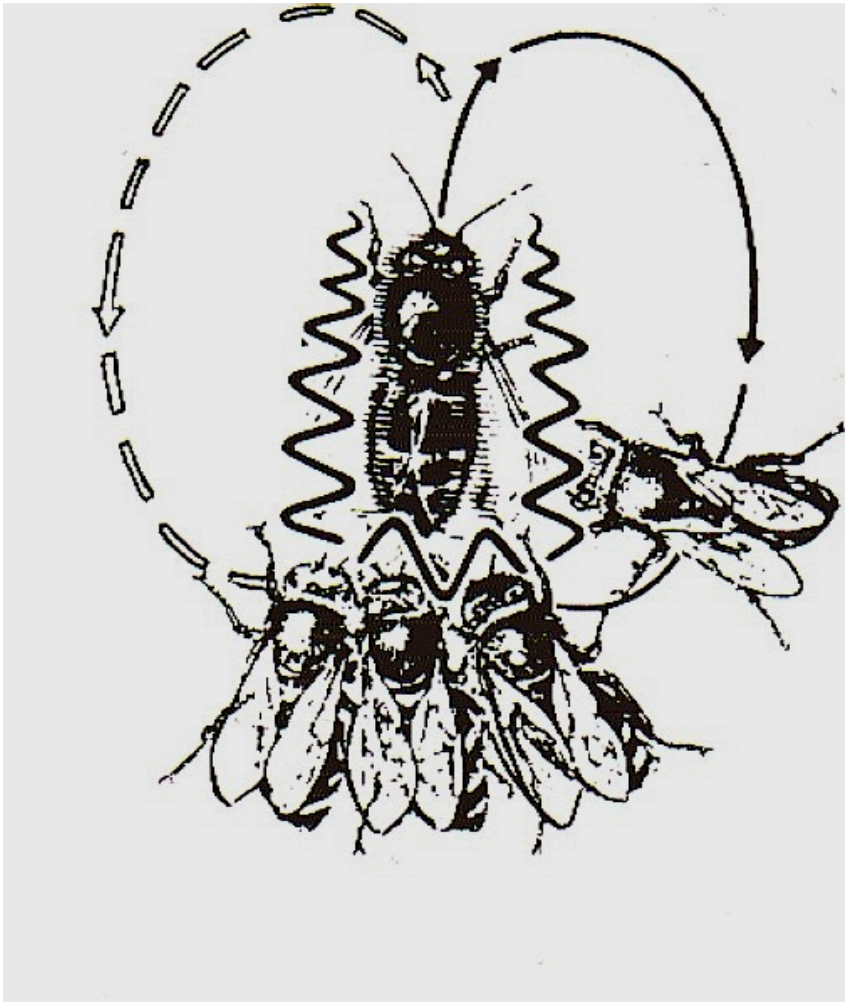
- Orientation and Navigation of Bees

The maximum sensitivity of bees to earth's magnetic variations is around 26 nT against the background of about 30 000 nT earth field strength.

With this sensitivity they oriented themselves in space and time, find their nectar and navigate back at home

About 85% of flowers are pollinated mainly by bees and propagate through the formation of fruit and seeds.

We have the utility of animals to thank for the enormous development of earth's vegetation, comprising about 200 000 species of a variety of flowering plants.



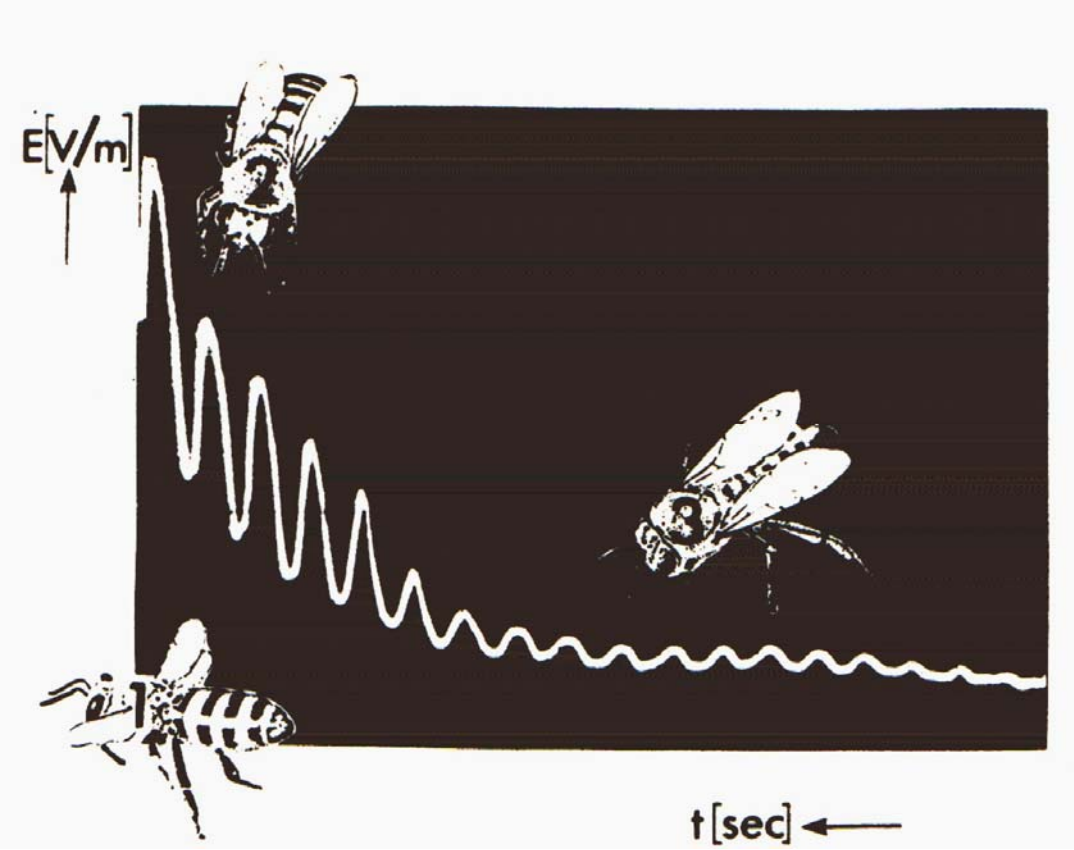
The bees make use of the natural magnetic information and transform it in electrical oscillations with help of the electrostatic charging of the body surface (Chitin) and the specific body motion - **the waggle dance** on the comb in the hive.

Thereby electrical oscillating fields are generated with information**:**

1. the direction to the new foodsource
2. the distance to the new foodsource
3. the actual time of the day

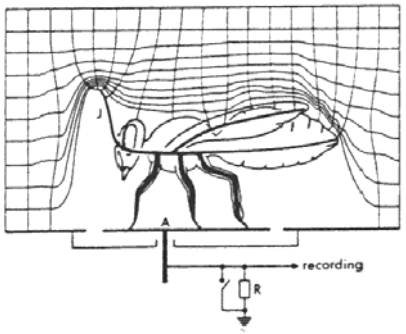
Quelle Warnke 1989

Bees transmit electrical fields



Oscillogram of the electrical field of a bee flying past (1).
The field strength rises as it approaches a receiver (2) and
drops again at a distance from the receiver (3).

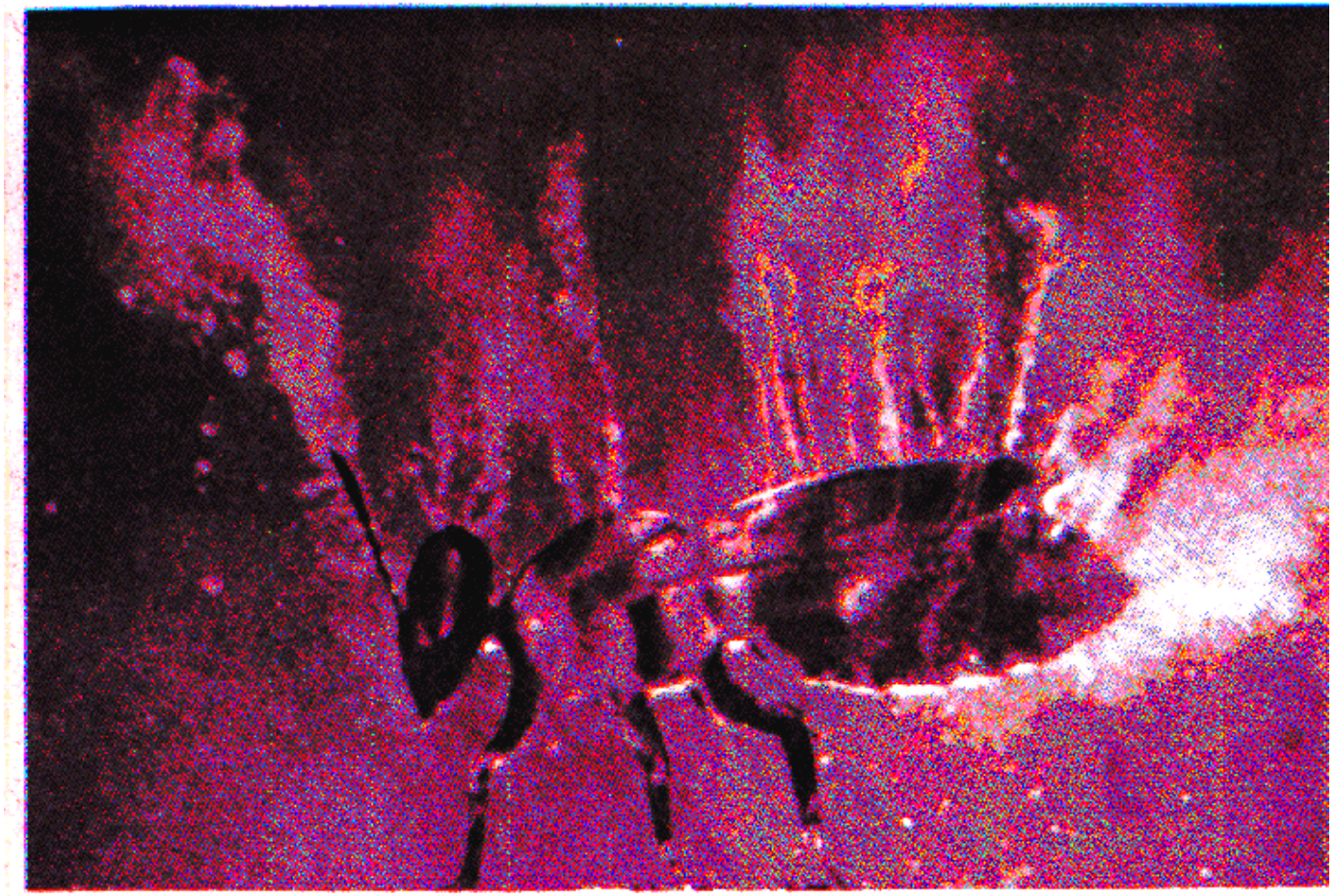
König, H. Unsichtbare Umwelt. Heinz Moos Publishers, Munich 1973. Copyright Ulrich Warnke



A bee in an electrical field

left: a construction, bottom: an experiment.

It is shown how the field strength increases around certain surface structures.



Quelle Warnke 1989

Bee in flight in an electric field

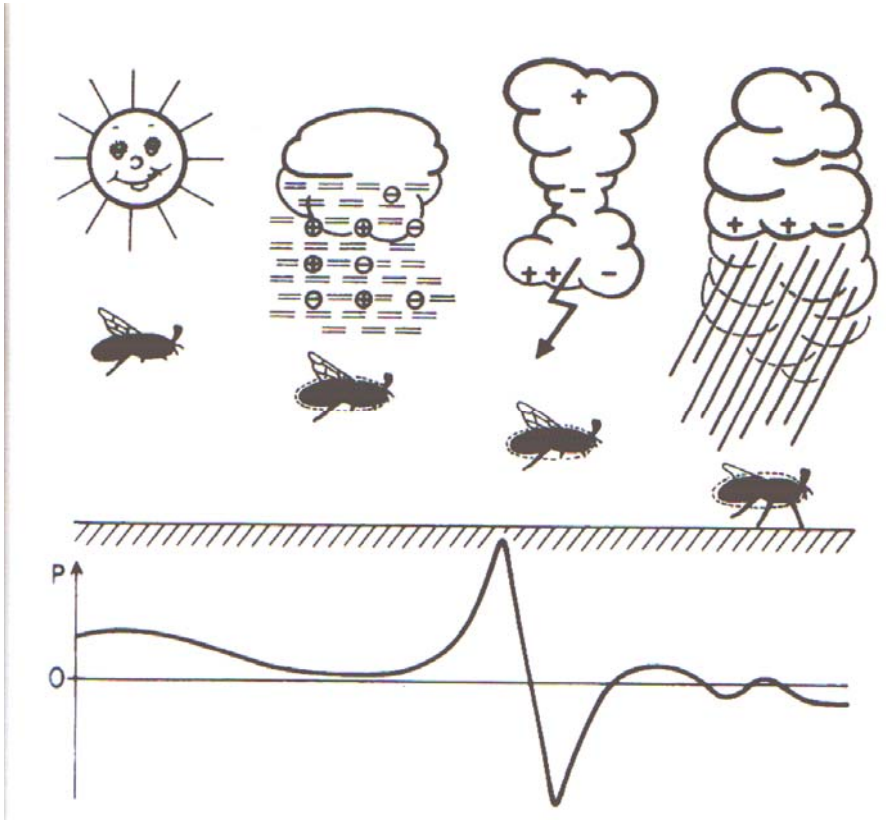
The fields around the antennae are particularly strong

Quelle Warnke 1986

The electrical charging of the insects changes typically as the weather parameters change.

The bottom curve shows the changes in the electrical field of a freely flying bee as a function of the weather condition.

Warnke 1989



The electrical current pattern : Wing of a bee under a scanning electron microscope

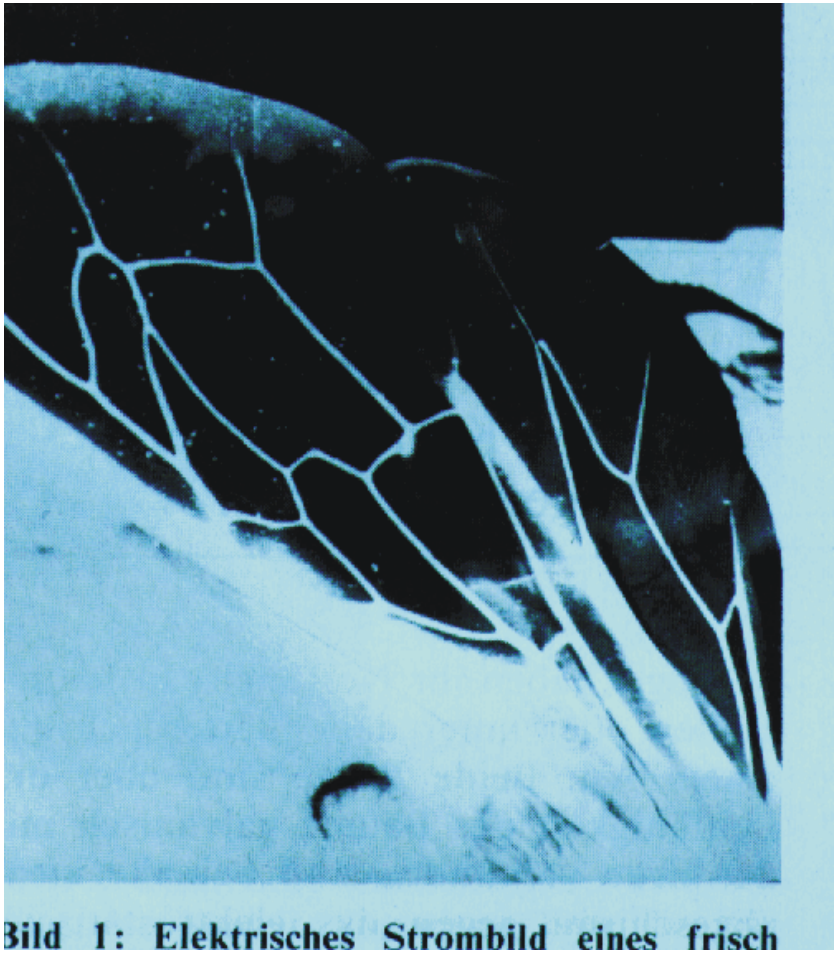


Bild 1: Elektrisches Strombild eines frisch

Warnke 1989,

All the white regions have high electron mobility, whilst the darker areas are highly electrostatically charged due to low electron mobility. Discharge here is very difficult.

Wing section of bees enlarged with scanning electron microscope.

Observe the special structures serving to focus the electrical field

Quelle Warnke 1989

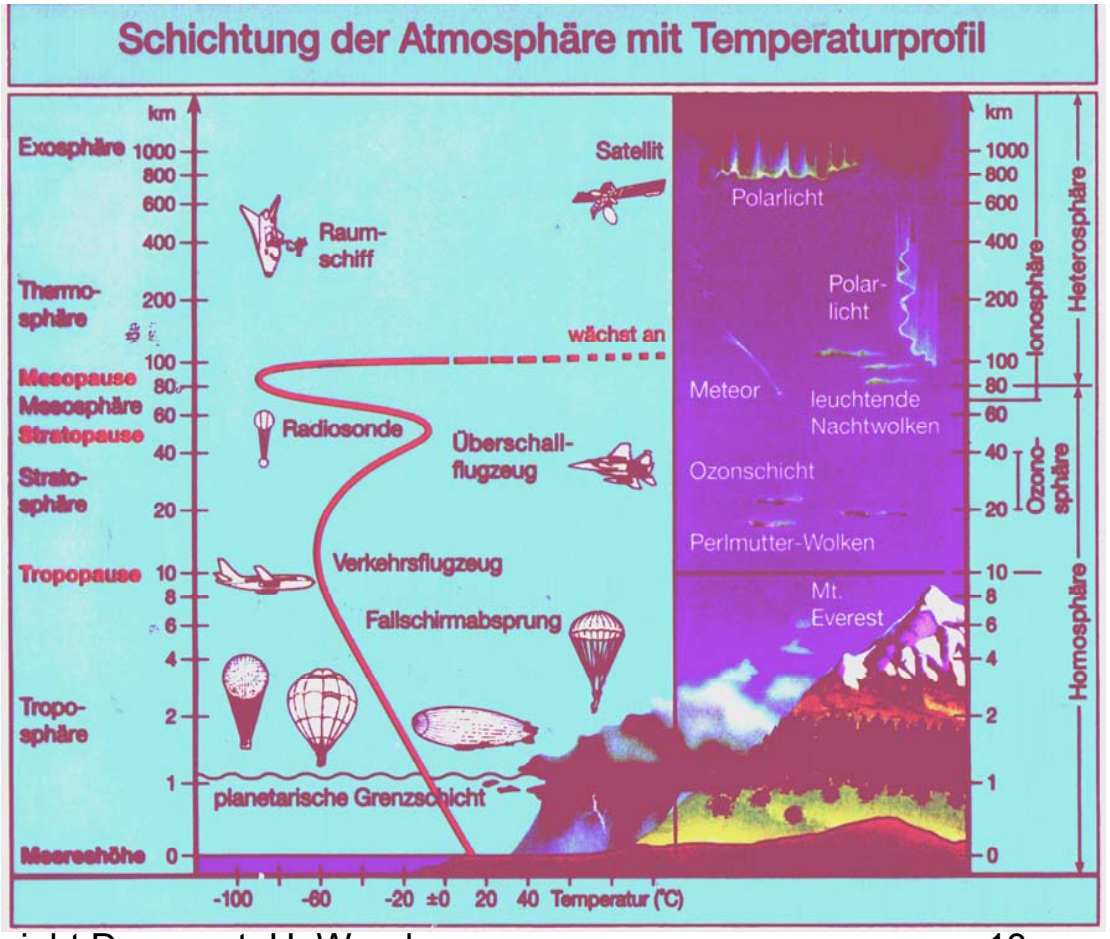
- Question: How does the bee inside the dark hive know the azimuth of the sun at any given moment for calculating the time of day?

- Answer: The magnetic rhythms of the ionosphere serve as a time indicator.

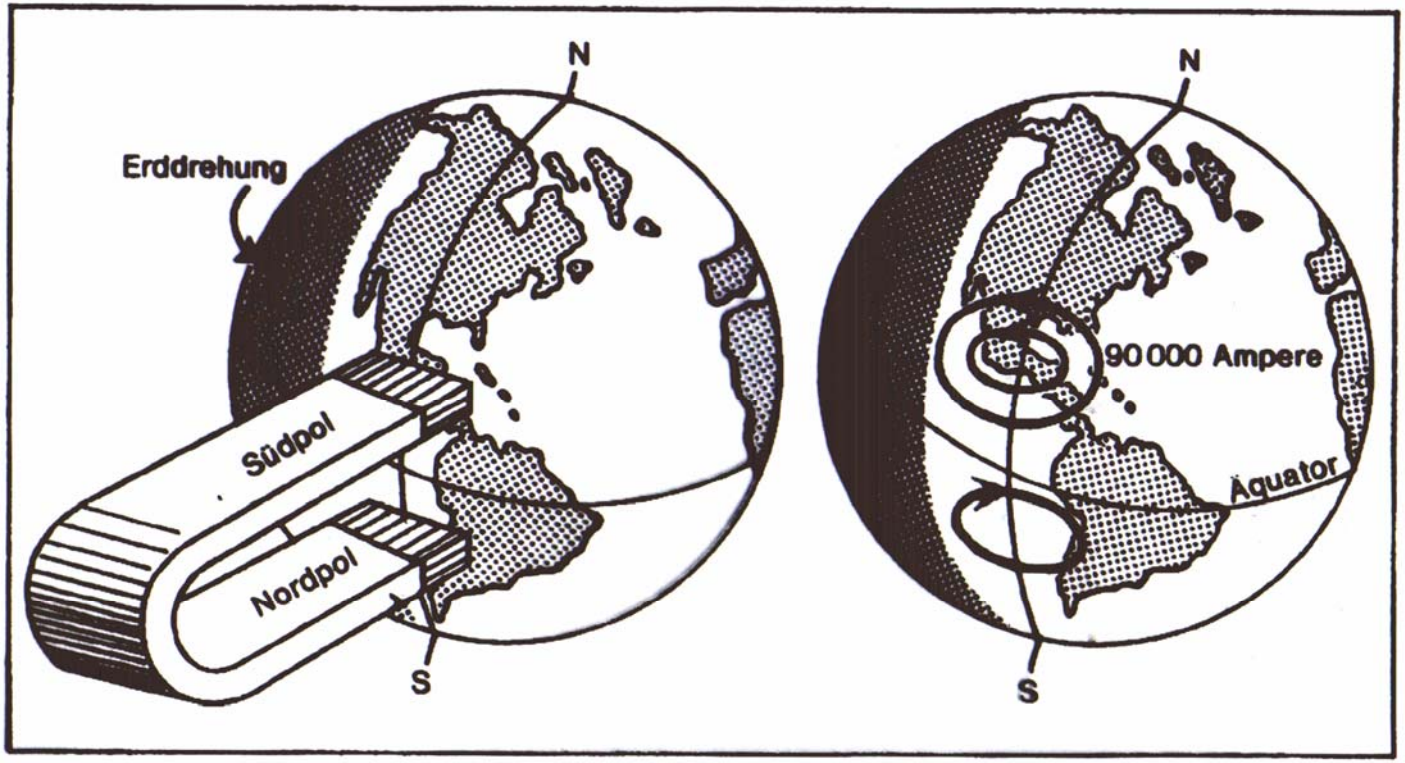
Illustration how finely nature has analysed the naturally occurring energies and forces, making these available to the organism.

The higher the sun in the sky, the more the atmosphere heats up. The higher the atmospheric temperature, the faster the atmospheric molecules move.

The faster the molecules, the more energetic the collisions between them. The larger the collision forces, the larger the air volume and the more intense the turbulences manifesting themselves also as eddies. These eddies ultimately also affect the ionosphere. The increased movement of ions in the ionosphere generates huge electrical currents. These directional electrical mass-flow currents in turn generate strong magnetic fields, that reach the earth surface with typical diurnal pattern, measured by bees.



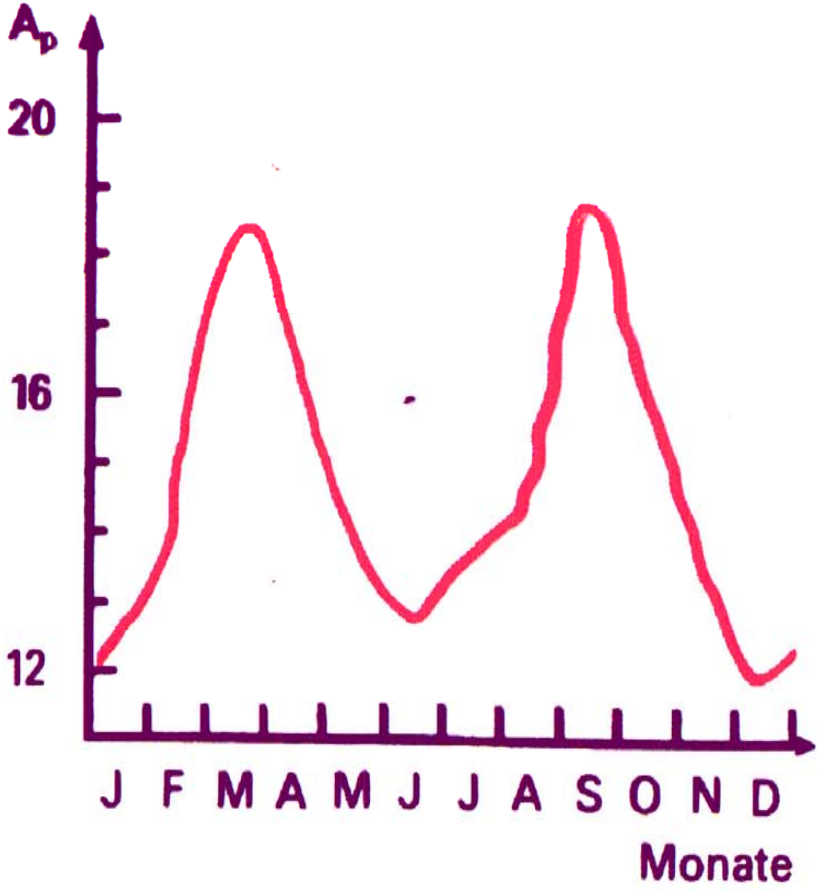
Regular earth magnetic fluctuations caused by daily radiation of the sun. It can be described by an additionel horseshoe-magnet

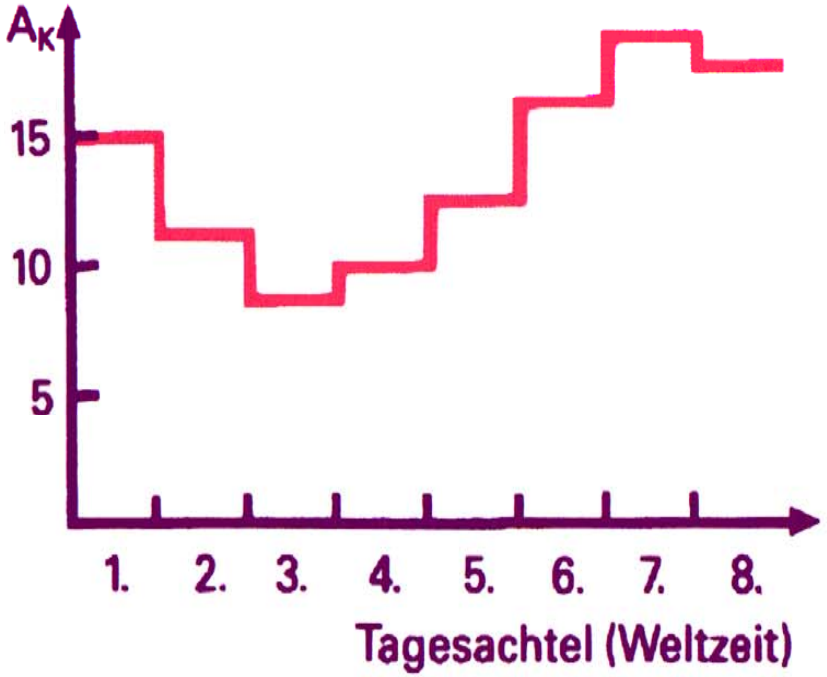


24 Die sonnentätigen erdmagnetischen Schwankungen können mittels eines riesigen Hufeisenmagneten beschrieben werden (links). Seine Pole sind in der Natur durch Stromwirbel in der Ionosphäre verwirklicht (rechts), nach **Bartels.**

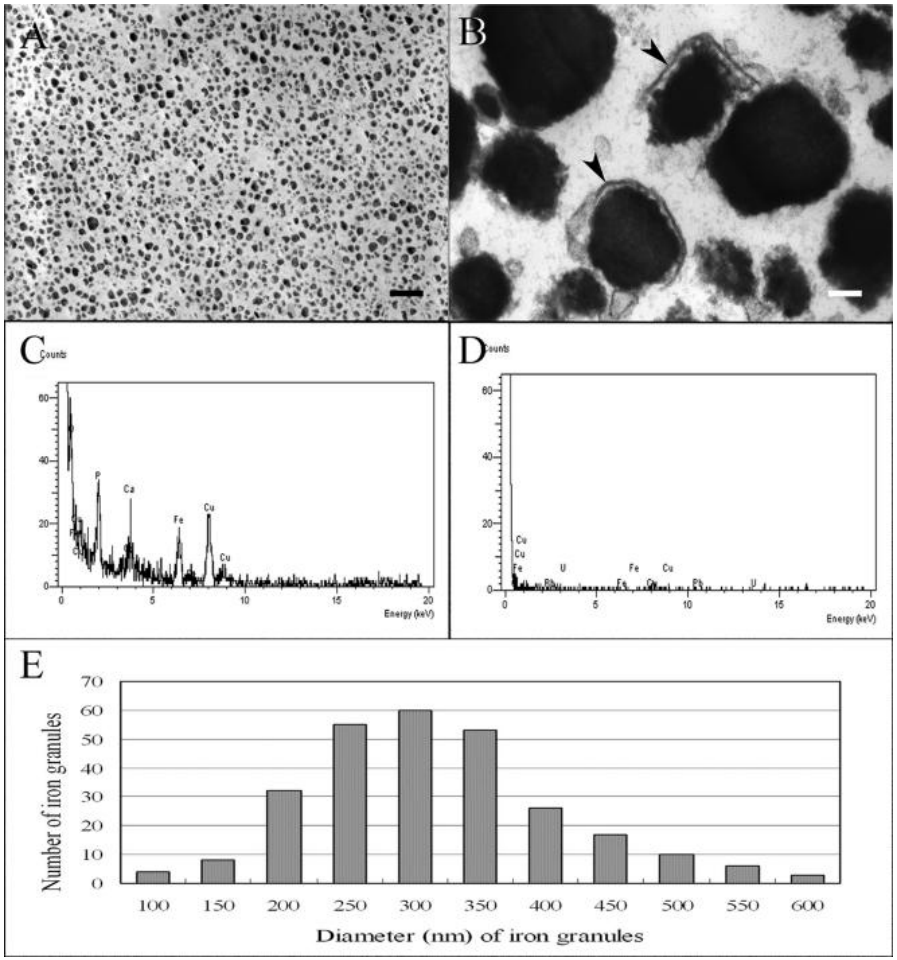
Natural magnetic field at the earth's surface

course of a year and course of a day





Perception-organs for magnetic fields of bees: Magnetite-granules

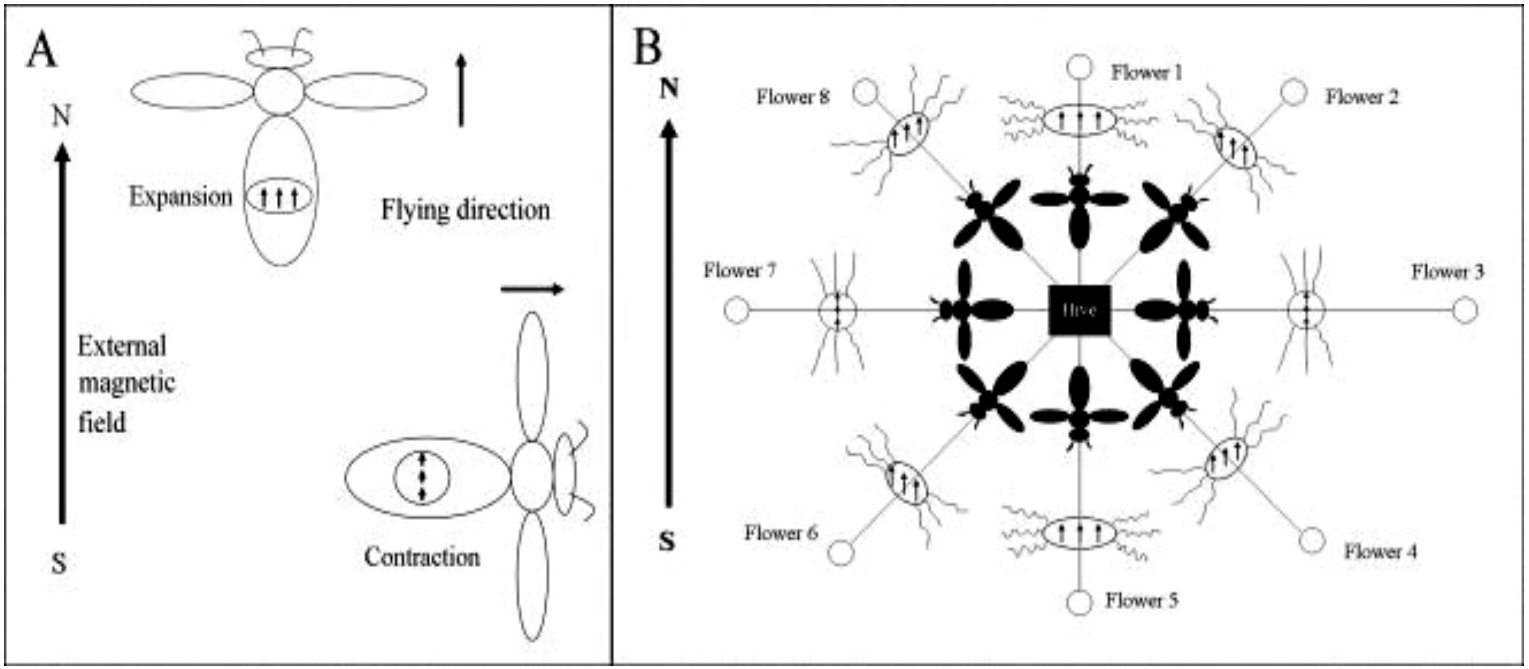


A) Iron granules in the trophocytes of the honeybee (bar: 1 µm)
B) Iron granules enclosed in lipid membranes (bar: 100 nm)
C) and D) Energy dispersing radiation analysis of the granules; they contain calcium, phosphorus and iron.
E) Histogram of the granule sizes.

Quelle und Copyright by: HSU, C., KO, F., LI, C., LUE, J. Magnetoreception System in Honeybees (*Apis mellifera*) PLoS ONE. 2007; 2(4): e395.

Schematic of the magnetic field orientation of a bee through use of the magnetide granules

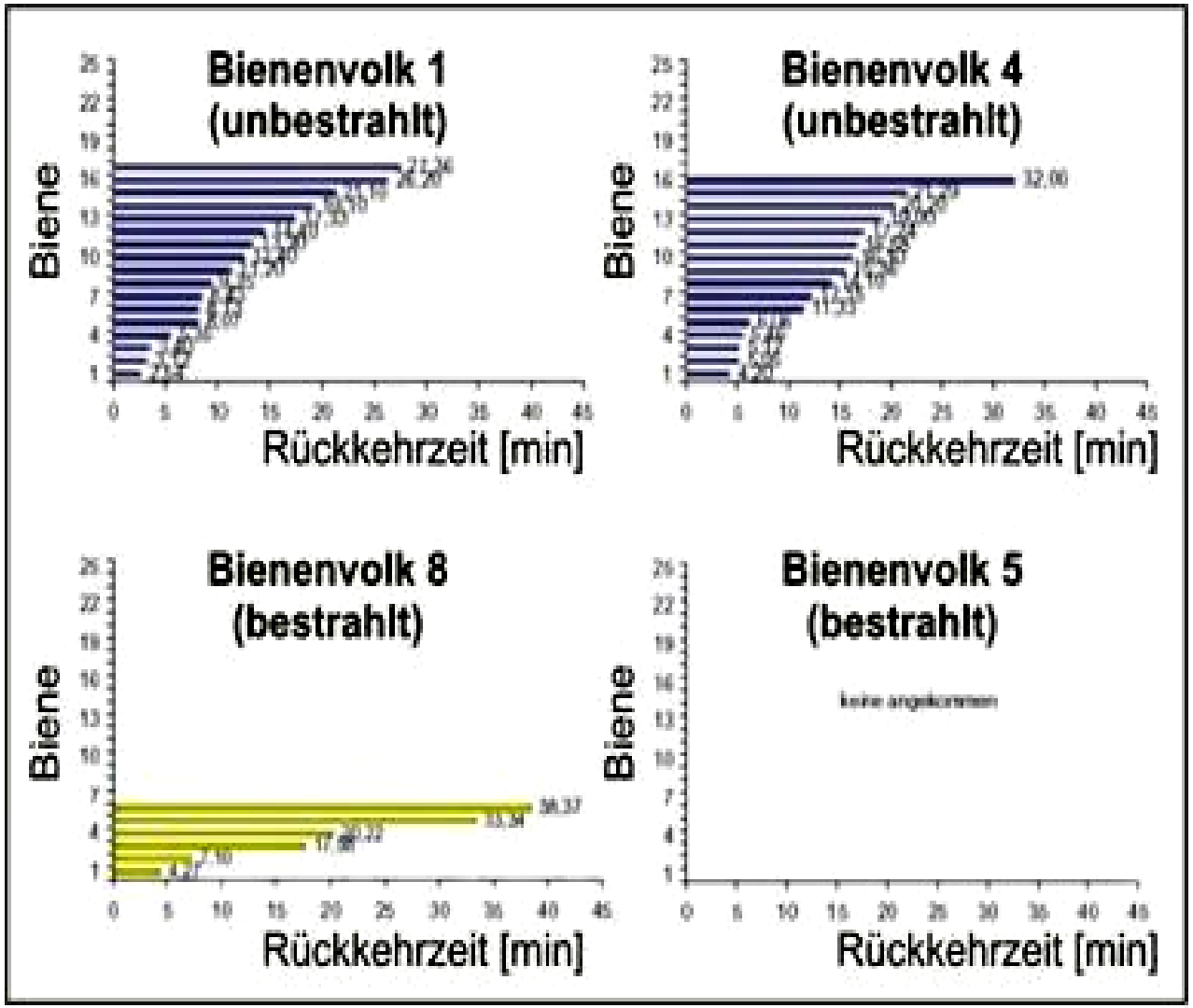
Stretching and compressing of the granules in dependence of orientation in the natural magnetic vector field



Quelle und Copyright by: HSU Hsu, C., KO, F., LI, C., LUE, J. Magnetoreception System in Honeybees (*Apis mellifera*) PLoS ONE. 2007; 2(4): e395.

- Magnetic fields of technical origin superpose the fixed programme of diurnal rhythms of the sun-earth magnetic modulation

Significant difference in the homing behaviour of bees with and without DECT cordless telephones in the hive



Top left and right: *return times of bees not subjected to a field;*
bottom: *return times and non-return when subjected to a field.*

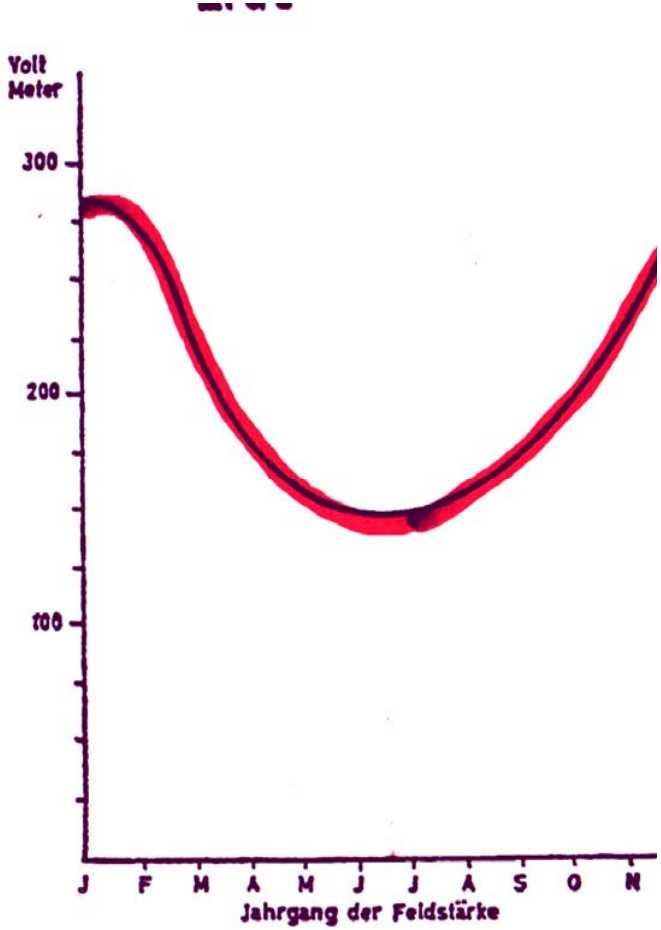
Of the bees from hives not exposed to a field, 40% returned in total, of those subjected to a field only 7% returned.

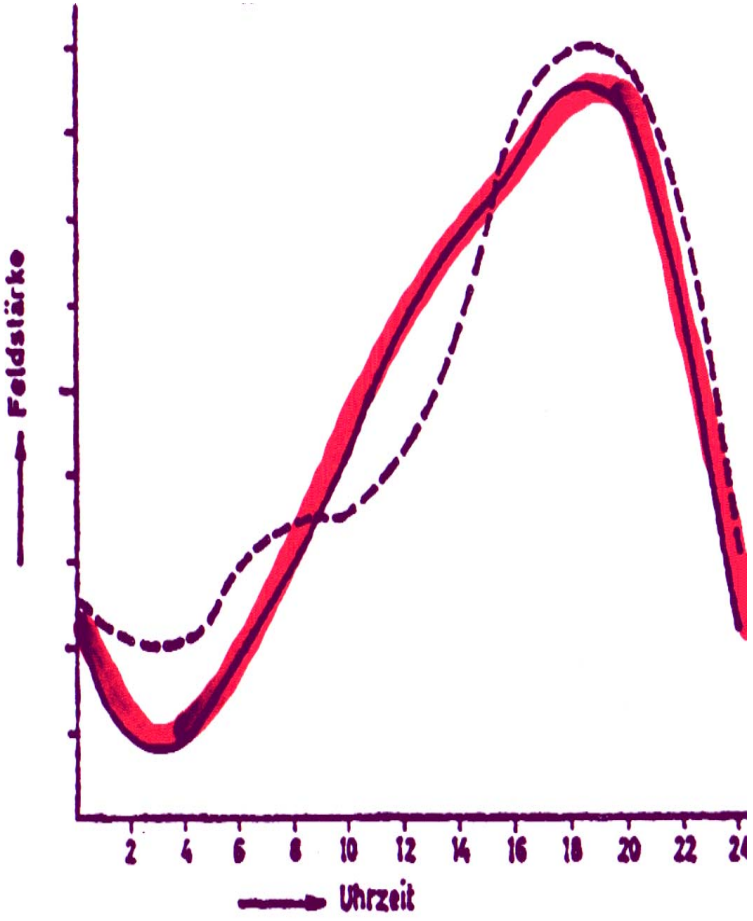
Quelle: Arbeitsgruppen Kuhn, Stever, Otten, Wunder, Harst, Univ. Landau (KUHN et al. 2001, 2002, STEVER et al. 2003, 2005, Harst et al. 2006)

Atmospheric electrical fields and electromagnetic impulse activities provide information for living beings

Natural electrical field in atmosphere

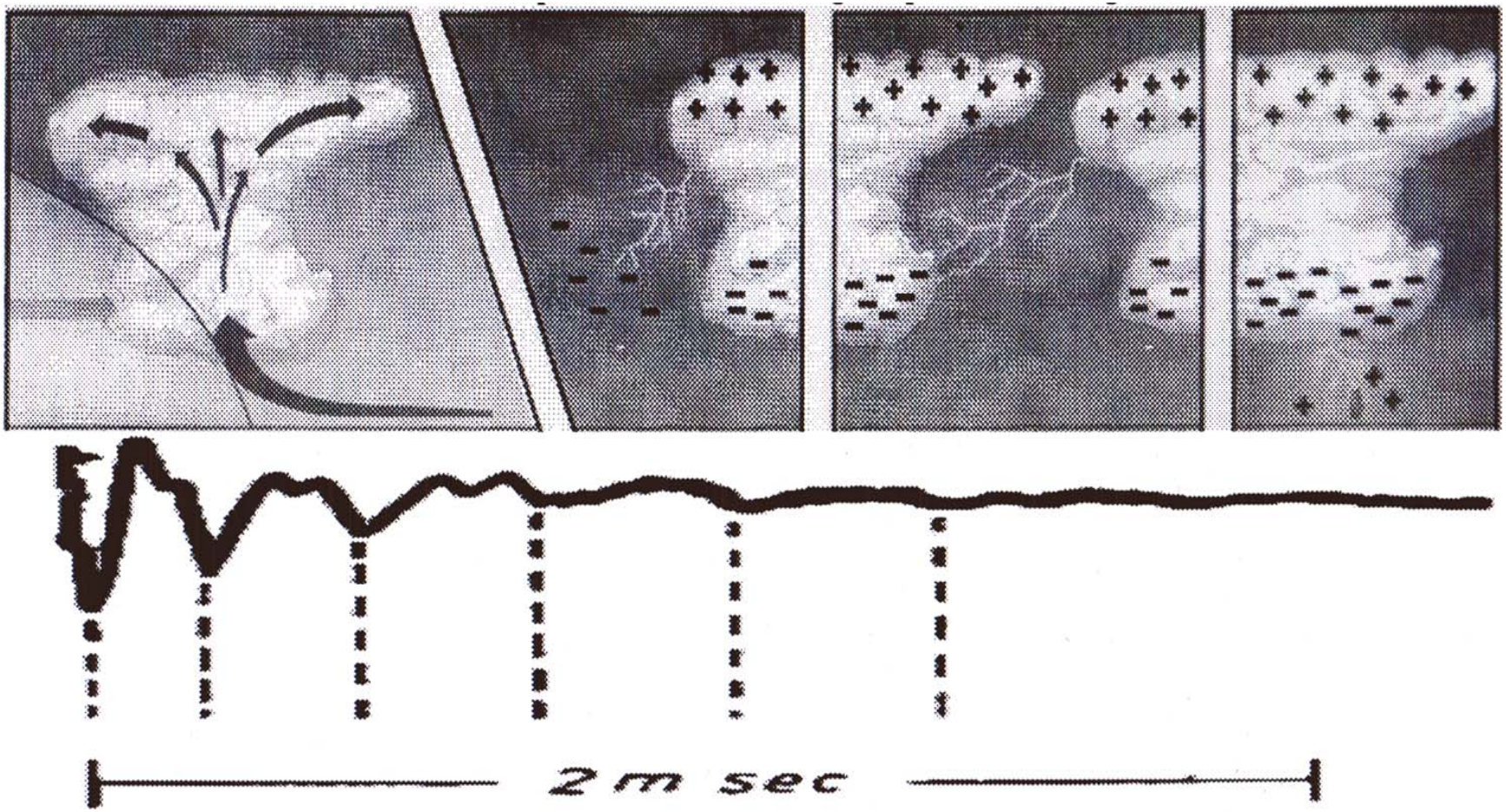
course of a year and course of a day





Friction electricity through convection in the atmosphere led to polarisation and discharge; Electromagnetic impulses (Sferics) are send out: for insects and birds this is a warning signal before thunderstorm and weatherfront

Dipl. Met. Walter Sönning / http:www.e-smog.ch/wetter

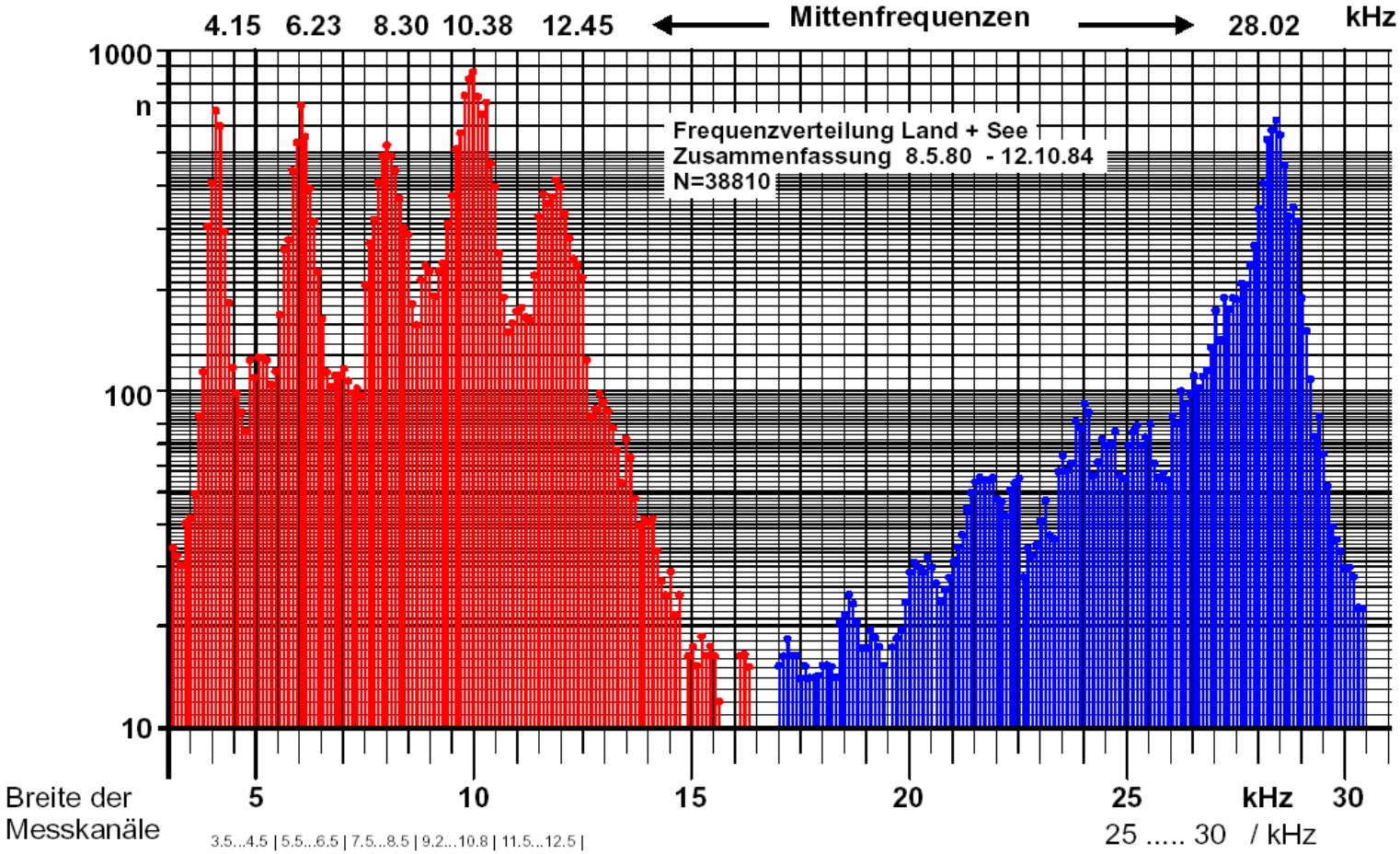


Unteres Bild aus v. Kilinski, E (1958) Lehrbuch der Luftelektrizität. Akademische Verlagsgesellschaft, Geest & Portig K.-G., Leipzig, Abb. 67, S.131

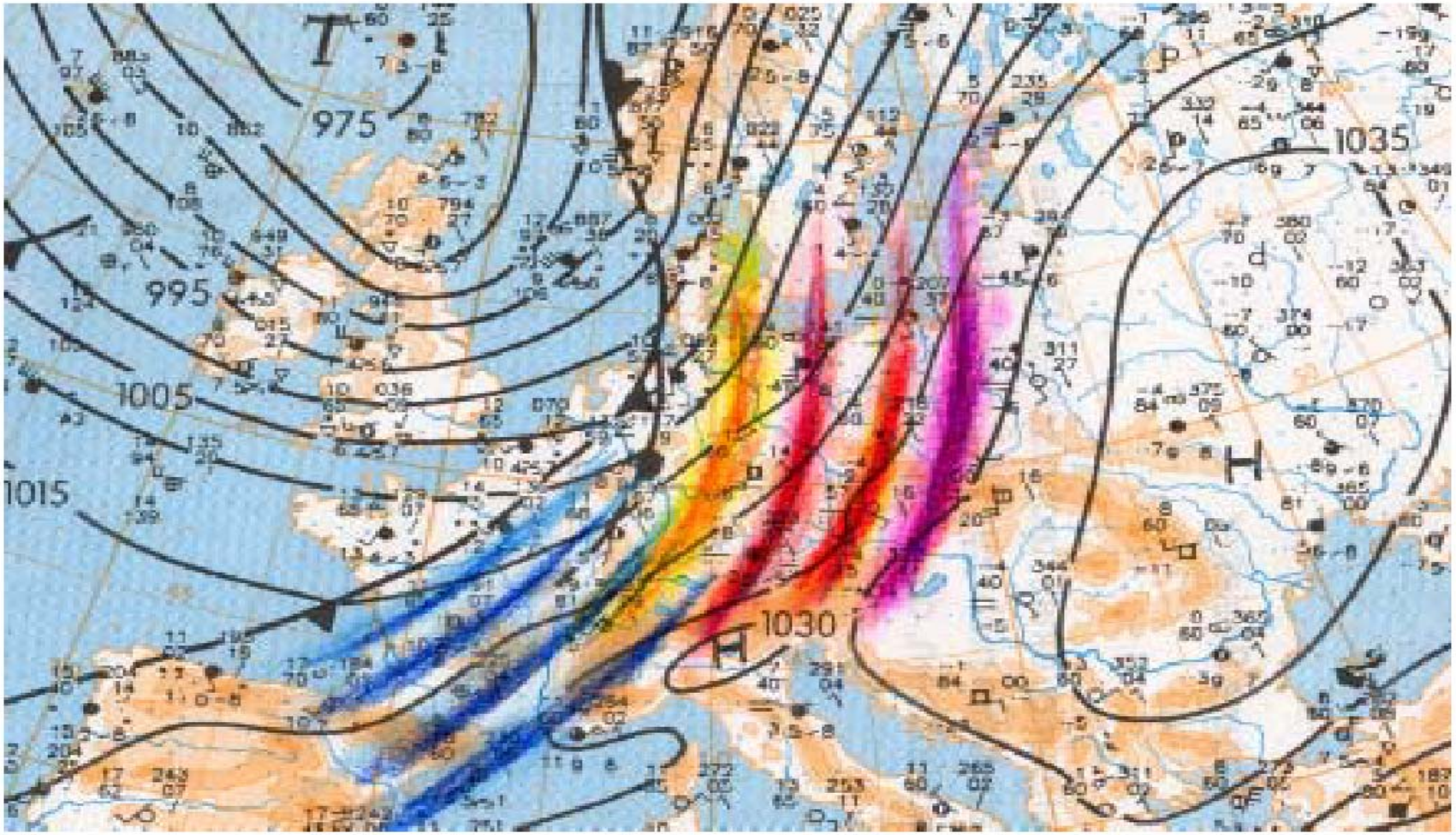
About 10 KHz (warm) and 28 KHz-Frequencies (cold) of Sferics are Informations about Weatherfront

Frequenzanteile der CD-Sferics a.t.B nach Fourieranalyse der Einzelimpulse

Das Gesamt - Spektrum der natürlichen el. magnetischen Impulsstrahlung der Atmosphäre (CD-Sferics a.t.B)

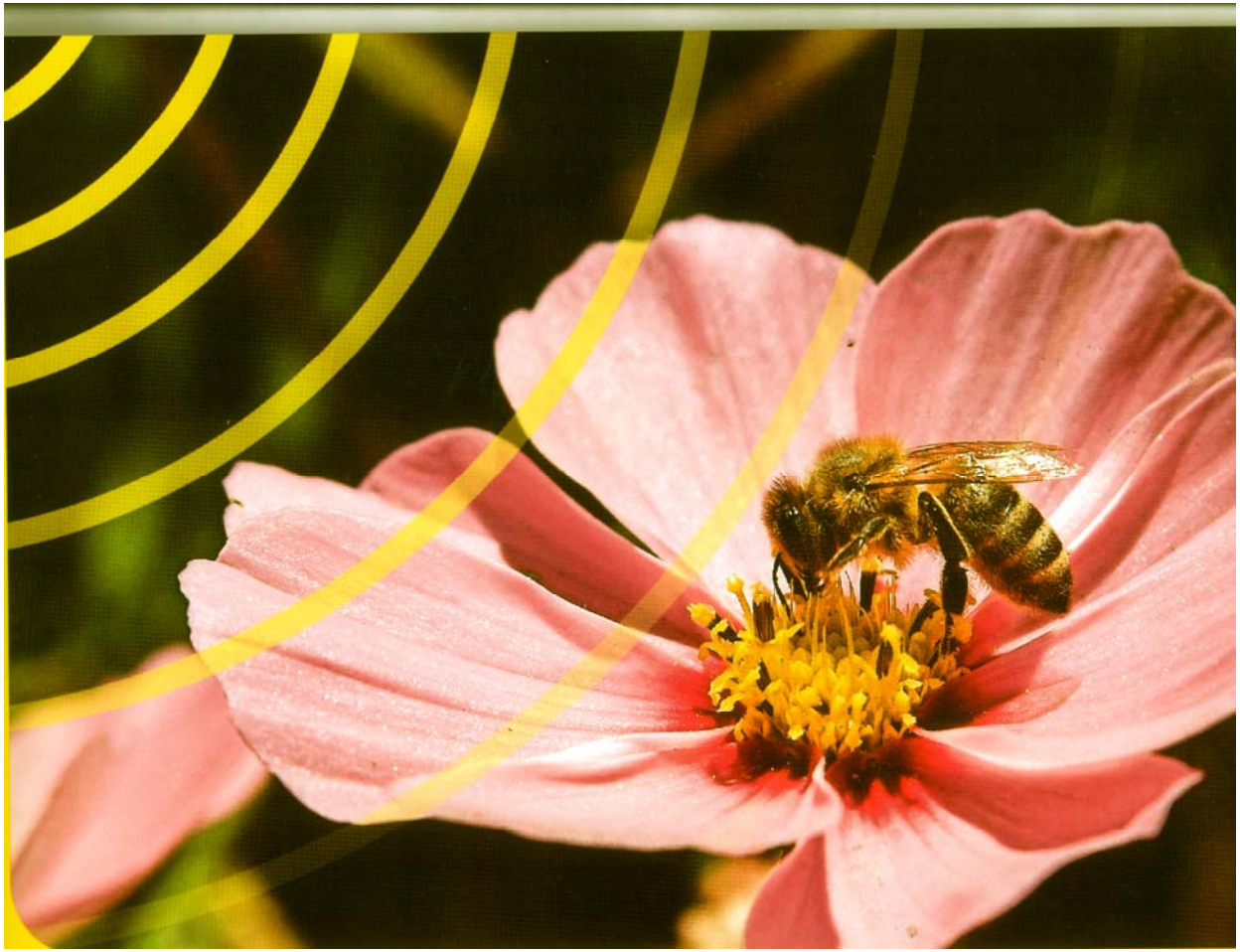


10 KHz and 28 KHz Sferics indicate warm and cold weatherfront respectivly



Beispiel für *Biotropiewellen* der *CD*-Sferics *a.t.B.* des 10 kHz und 28 kHz- Bereichs.

All magnetic and electrical unnatural fields are able to disturb orientation, navigation, and communication of insects



To 2.

- Orientation and Navigation of Birds

Feathers of birds can also be charged electrostically

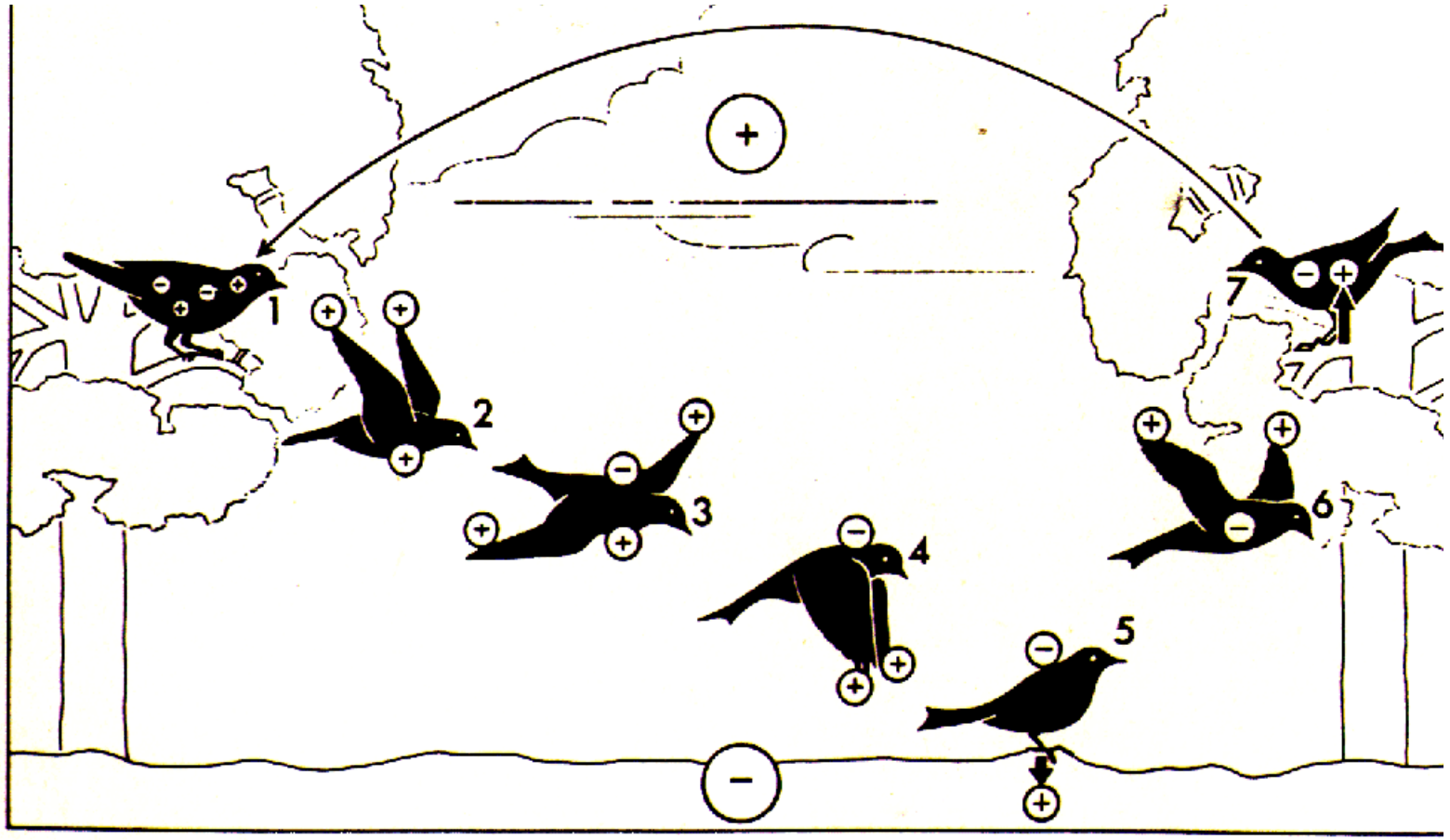
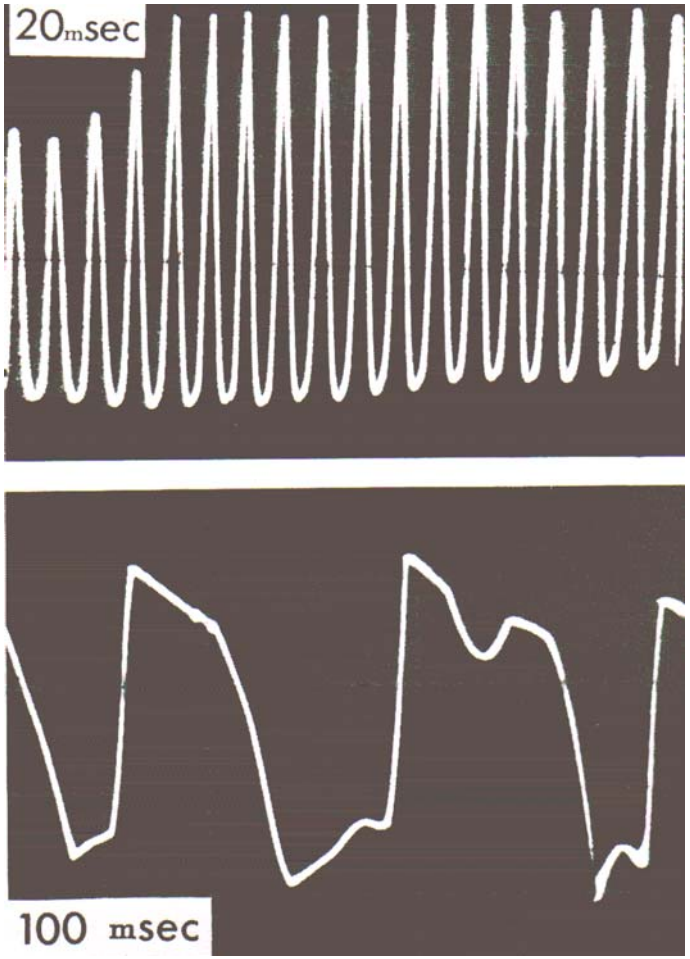


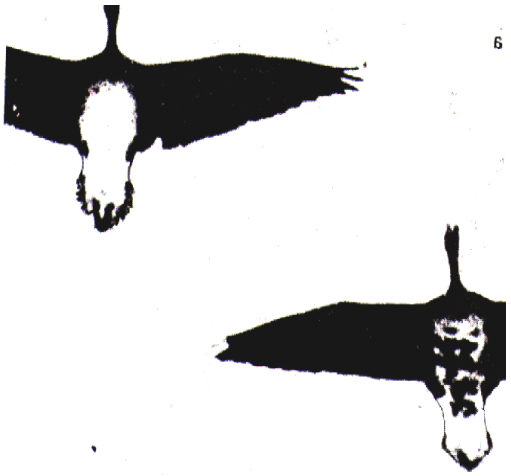
Bild 3: Elektrische Aufladung und Polarisation eines Vogels (analog zu einem fliegenden Insek

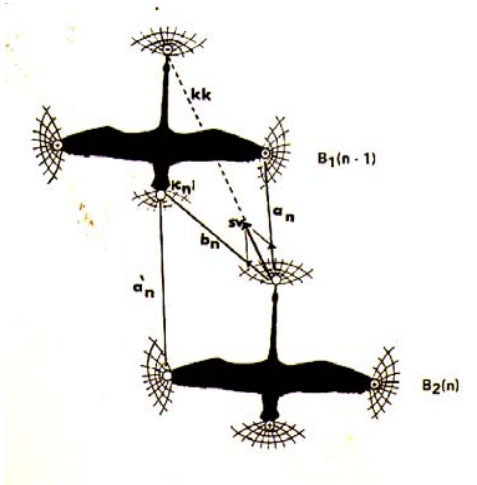
Oscillogram of the alternating electrical field around bees (top) and pigeons (bottom) in a wind tunnel.

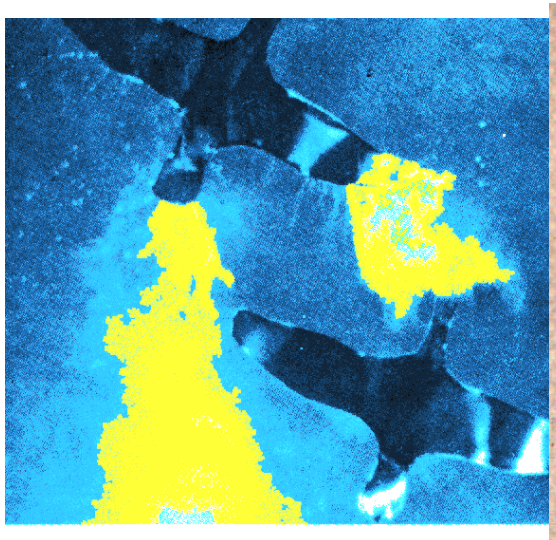


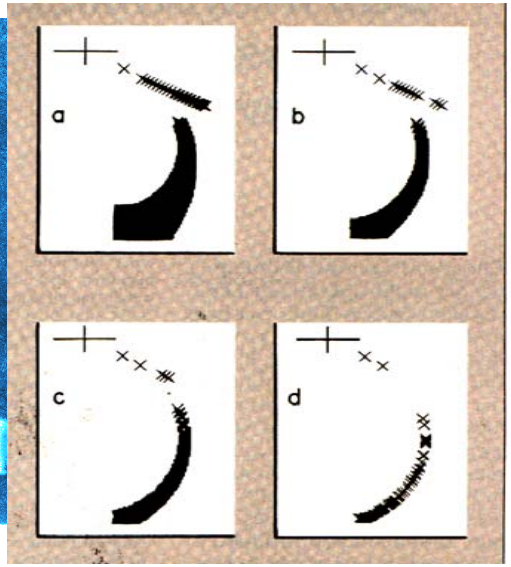
Quelle Warnke 1989

Birds use electrical fields for formation flying









Top left: *Two geese in formation flight.*

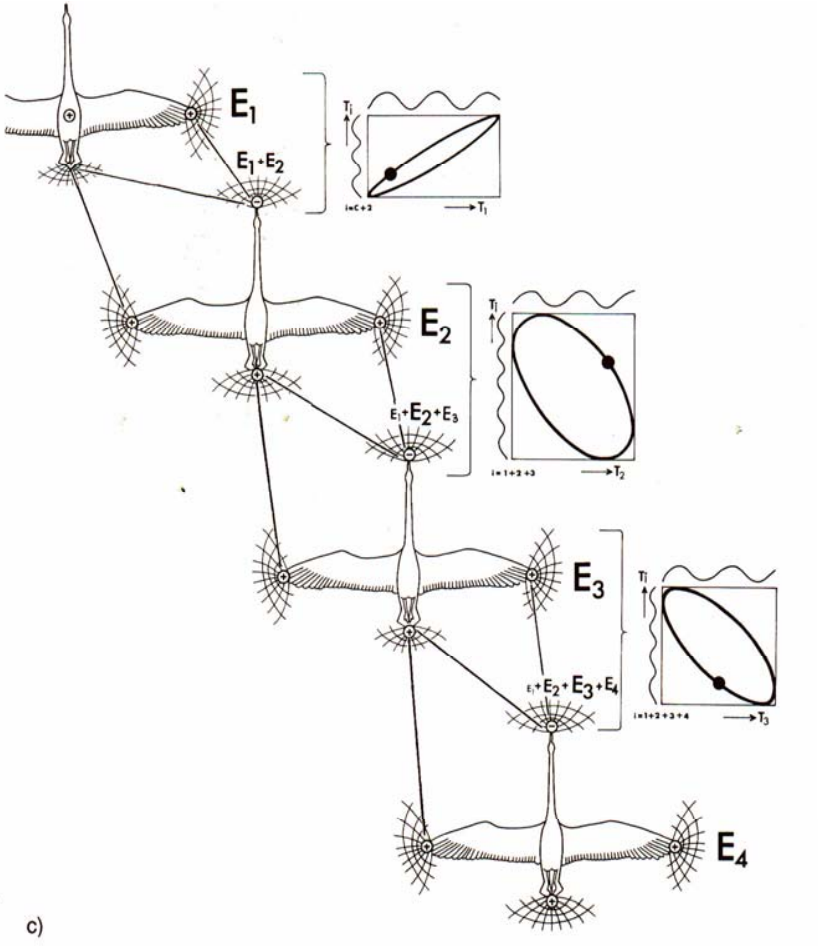
Bottom left: *Experimental model to visualise the electrical field forced between these birds.*

Top right: *Vector diagram of the field distribution.*

Bottom right: *Calculation of the position of the bird behind with reducing degrees of freedom a-d.*

Quelle Warnke 1989

V-formations can be constructed by means of an equation

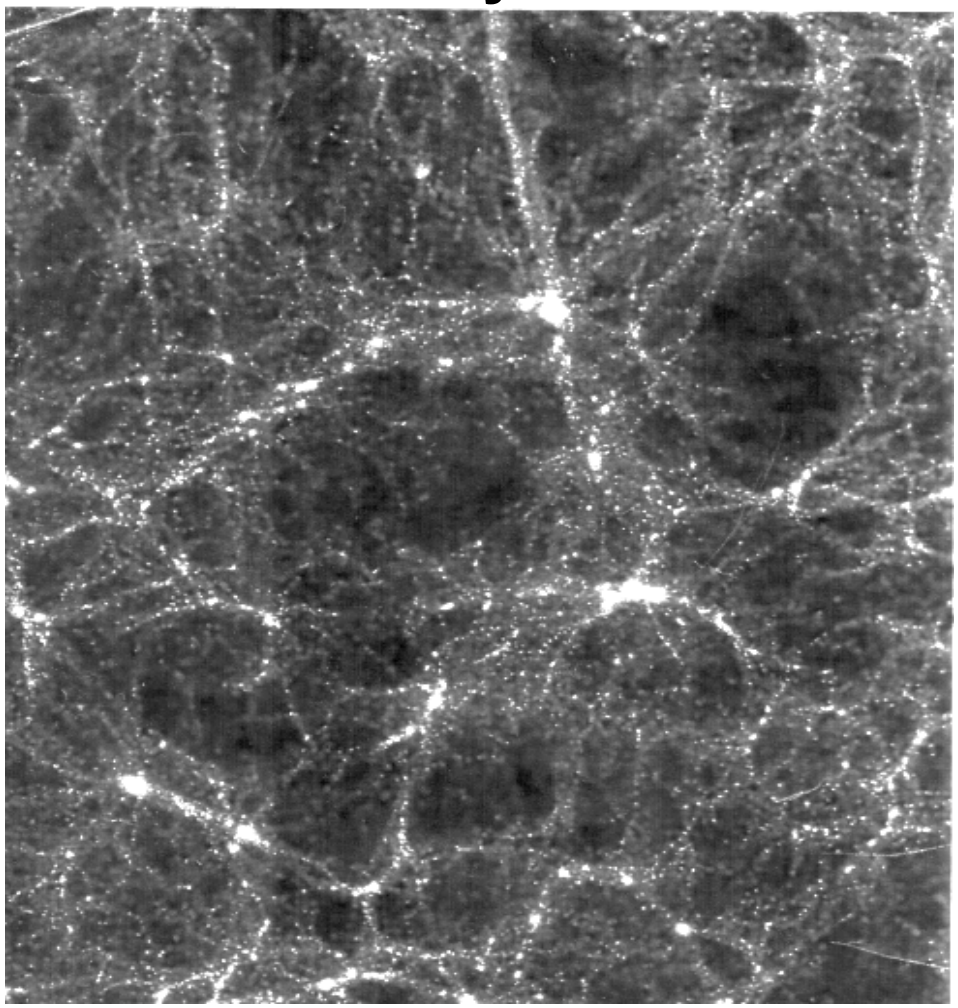


The formations are given by the Coulomb forces between birds that are electrically charged in flight by friction with atmospheric molecules. The electrical capacity of the animals and the strictly isolation in air give high electric charge and high voltage.

Comparisons with photographs of natural bird formations show that the assumptions are correct

Quelle Warnke 1989

All flying organisms and also other animals, including humans, are caught up in an “impenetrable” network of electric, magnetic fields and electromagnetic oscillations - mainly of technical origin



The superpositions illustrated in this model result in points of particularly high power density or field strengths.

To 3.

- In principle the same mechanism of disturbance and damage affects birds and other animals, including humans, and probably also plants.

- The question for the **primary mechanism** of action in a **non-thermal** way can be answered

by looking at

- 1. the **sensibility for static and alternating magnetic fields** of radical pairs

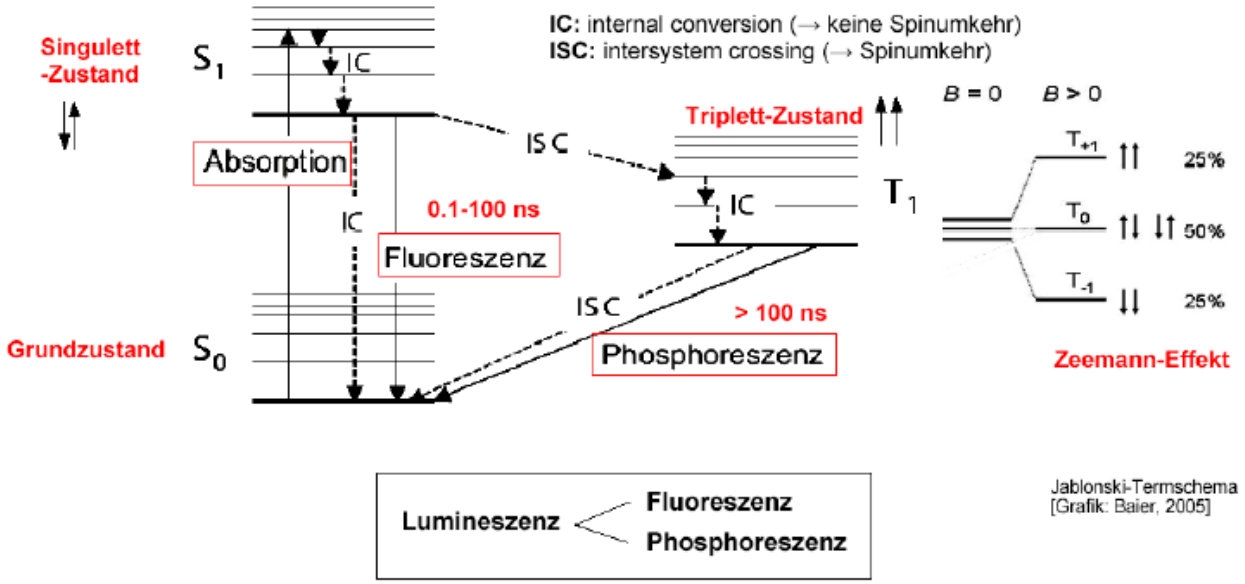
and

- 2. the **sensitivity for electromagnetic high frequency fields** of radical pairs

Two radicals join to form radical pairs through spin coupling

Stimulation modes: Singlet and triplets states

- moderner quantenmechanischer Ansatz



Triplet conditions are energy traps and **can be attained only by intersystem crossing (ISC),** not however through direct absorption of radiation.

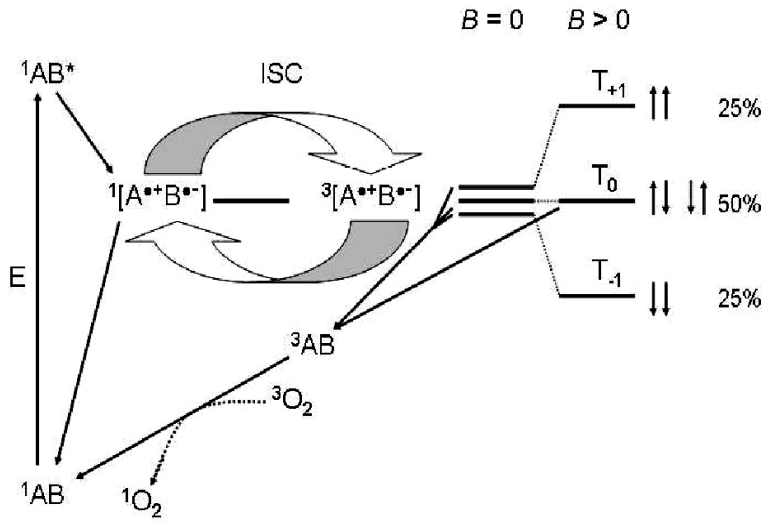
T1>S1 transitions are also only possible through ISC

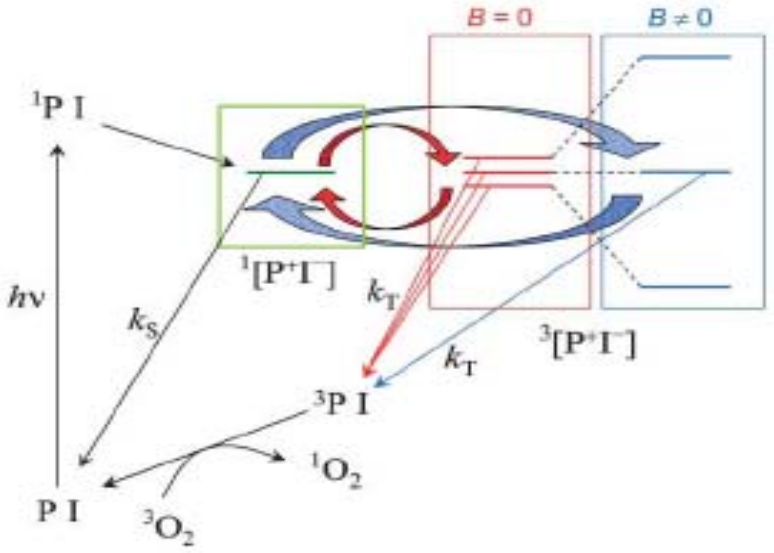
* Baier, J. (2005). **Lumineszenz-Untersuchungen zur Generierung und Relaxation von Singulett-Sauerstoff in zellulärer Umgebung.** *Dissertation*, Universität Regensburg.

Where is the problem?

- The two atoms or molecule radical pairs can only recombine to a neutral molecule if they are in the singlet condition.
- Weak magnetic fields as well as electromagnetic high frequency fields can generate a spin-flip and cause ISC to the triplet condition.
- Recombination is now no longer easily possible.

Non-thermal effect:
Magnetic fields and electromagnetic fields can cause ‚Intersystem-Crossing (ISC) ' and Zeemann-Effect





ISC from singlet to triplet state is the mechanism for the formation of reactive singlet-oxygen from inhaled triplet-oxygen!

MF induced ISC from singlet to triplet state reduces the recombination possibility to 50% by splitting of energy.
<u>Consequence: free radicals diffuse</u>

http://www.uni-marburg.de/fb17/fachgebiete/pflanzenphysio/lehre/vmgraviphotomagneto/vl12

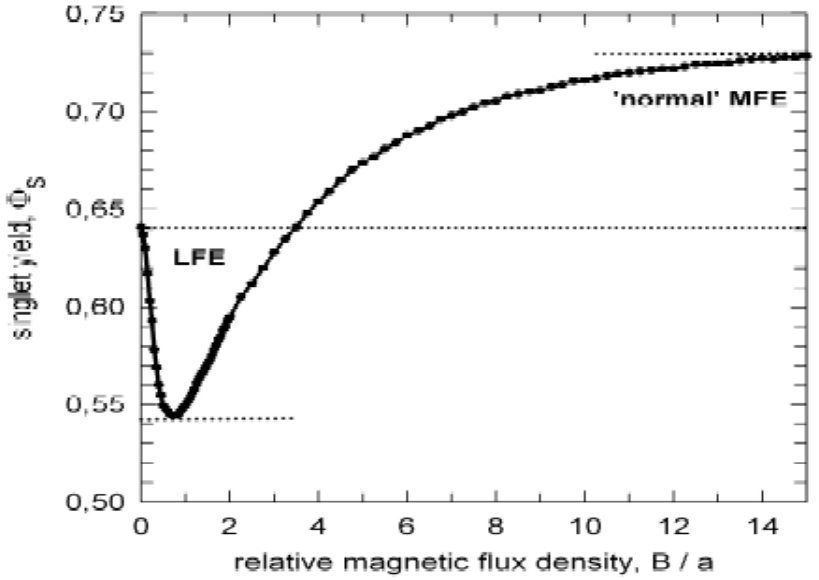
Magnetic field effect on singlet oxygen production in a biochemical system†

Yan Liu,[a] Ruth Edge,[a] Kevin Henbest,[b] Christiane R. Timmel,[b] P. J. Hore*[b] and Peter Gast[a]

- Triplet-conditions are strictly prohibited for reactions so that these conditions dissociate to radicals.

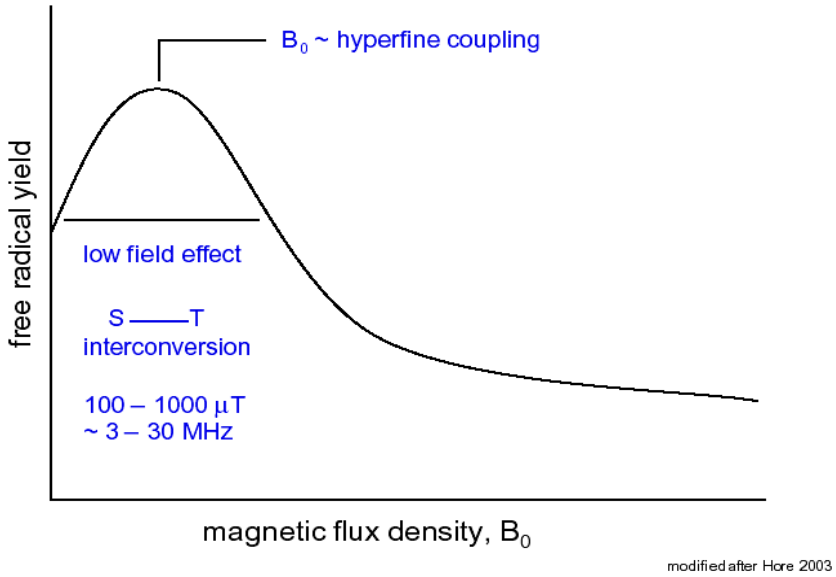
- These free radical diffuse and can damage structures in the neighbourhood.

Yield of singlet molecules in dependence of the magnetic flux density



Weak fields lower the number of singlet conditions .
MF represented as multiple of the hyper-fine interaction.
LFE = low-field effect;
(nach Timmel und Henbest, 2003)

Formation of free radicals in dependence of the magnetic flux density



modified after Hore 2003

Weak fields increase the occurrence of radicals. The less singlet conditions occur, the more the free radicals, as well as resulting by-products are released.

Two general rules of effectiveness

1.

- **The stronger the magnetic differences of the two radical intermediates, the more strongly they react to magnetic fields and high frequency oscillations.**
  - Therefore, a participation of **iron-containing molecules** is especially effective.

2.

- **The sensitivity of radical pairs to weak magnetic and electromagnetic fields increases with lower decay rate.**

- **Red ox proteins (enzymes) have a very low decay rate**

- At the decay rate of 1 per µs a magnetic field with 5 µT is still significantly effective in triplet yield, not however at the faster decay rate of 10 per µs.

- The evolution has optimized this process evidently using the naturally occurring external fields of energy. (Mohtat et al. 1998).

This lifespan of radical pairs is especially long in some enzymes (micellar cage)

- Within an enzyme, the reaction-molecules are locked up like in a cage.
- This applies to a number of enzymes:
- - **Cytochrome P-450** (used for reduction of pharmaceuticals, steroid hydroxylation),
- - **Lipoxygenase** (key enzyme for prostaglandins and thromboxane-synthesis),
- - **Cyclo-Oxigenase** (prostaglandin generation from arachidonic acid,
- - **Oxidases: Xantinoxidase, NADH-Oxidase, Cytochrome-oxidase**.

Static magnetic fields, ULF/ ELF/ VLF alternating magnetic fields and electromagnetic HF fields of limited frequencies form an interdependent reaction system

- **1. Weak magnetic fields**

  Regarding their effects on intersystem crossing, **static and low frequency pulsed alternating fields up to 100 KHz have the same effect.**

- **2. Alternating magnetic and electromagnetic high frequency fields**

  The system transition of singlet to triplet condition and back (**InterSystemCrossing ISC) means a spin flip**. This spin flip happens within a defined time frame and is therefore subject to a characteristic frequency (event per unit of time). This **characteristic frequency is causally correlated to the strength of external influencing magnetic fields**. Alternating magnetic fields, which are in resonance with this characteristic frequency, destroy the normal ISC.

For the **magnetic fields** commonly occurring in our environment **(earth fields plus technically produced magnetic fields) the resonance frequencies are between 0.1 to 100 MHz.**

The requirement is that the force vectors of the electromagnetic waves are not in parallel alignment with the magnetic dipole of the radical pairs

Variability of the effects of low and high frequency fields
=> Differences of individual magneto-sensibilities

Weak magnetic fields cause **singlet-triplet-transitions** with a **frequency** of γBo/2π. γ =gyro magnetic moment; Bo = magnetic fluxdensity

- The time for the transition is therefore **dependent on the strength of the magnetic field** and lies in the order of micro - until nanosecond,

  typical: per 1µT ► 40 000 ns.

- **Electromagnetic frequencies and/or impulse-rise time lying in resonance cause spin-flip and can disturb the S-T-transition**,

  for example

  1 µT ► 40,0 µs ► 25 KHz

  10 µT ► 4,0 µs ► 250 KHz

  50 µT ► 0,8 µs ► 1,25 MHz*

  100 µT ► 0,4 µs ► 2,5 MHz

- The effect is working however only if the **alignment of the electromagnetic wave-vector doesn't proceed parallel to the magnetic dipoles** of the radical-pairs.

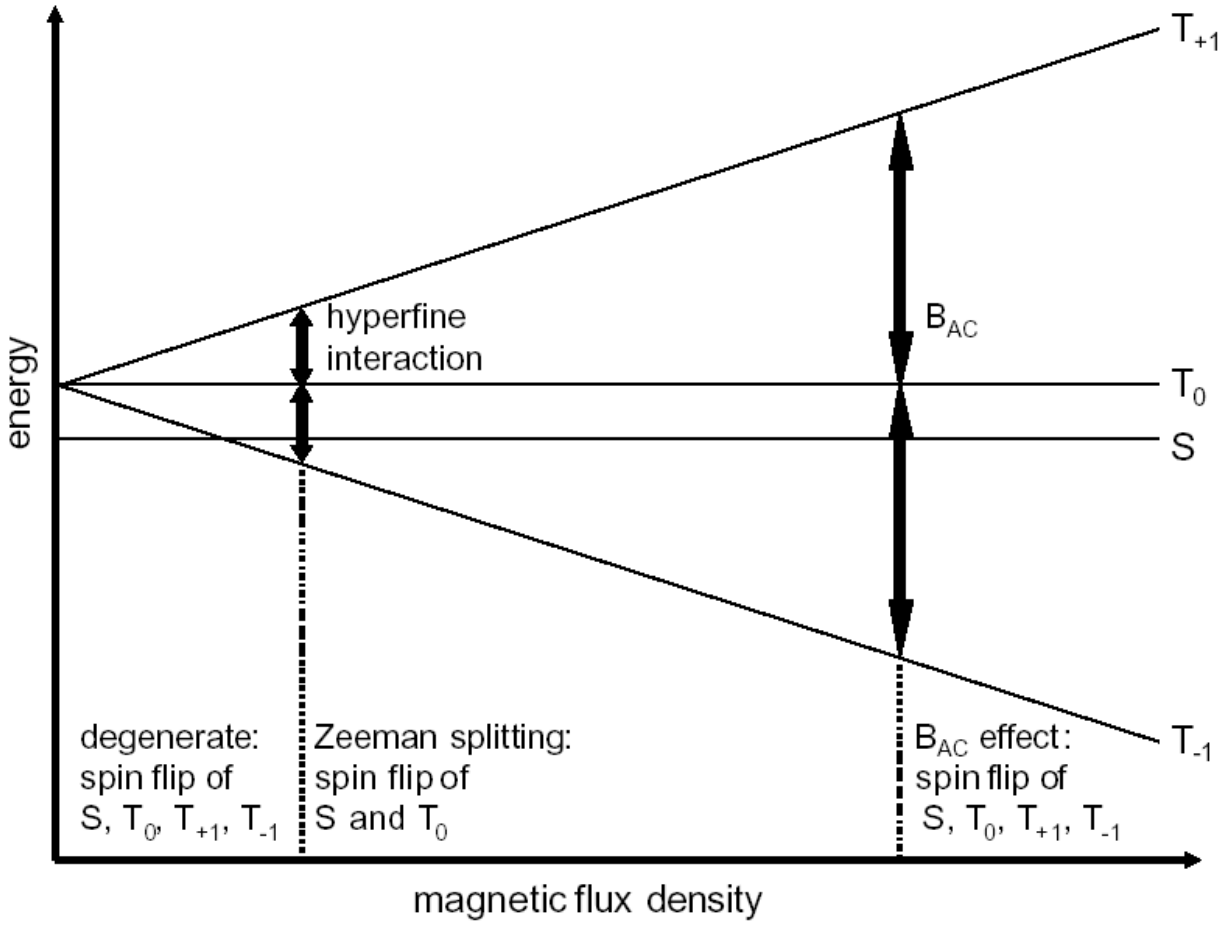
*proved by Thalau et al. 2005

Another effect in radical pairs: External magnetic fields cause a splitting of the triplet-energy condition and create absorption-possibilities for electromagnetic high frequency-fields (Zeeman - effect)

- The recombination to the basic state is now complicated and lasts longer, since due to the Zeeman effect, **50 % of the molecules (**T+1 and T-1) **are excluded from a recombination** possibility. Thereby, the resulting **triplet products are increased**.

  Leask 1977 , McLauchlan 1981

Spin energy in dependence of the magnetic flux density



Zeeman-splitting occurs above the hyper-fine coupling. Within this range, T+1 and T-1 cannot take part in the S-T-interconversion and recombination.

Below the hyper-fine coupling, the system has 'degenerated' and all four spin conditions, S, T0, T+1 and T-1 are involved in the spin interconversion.

Absorbed electromagnetic alternating fields can deliver energy for spin flip

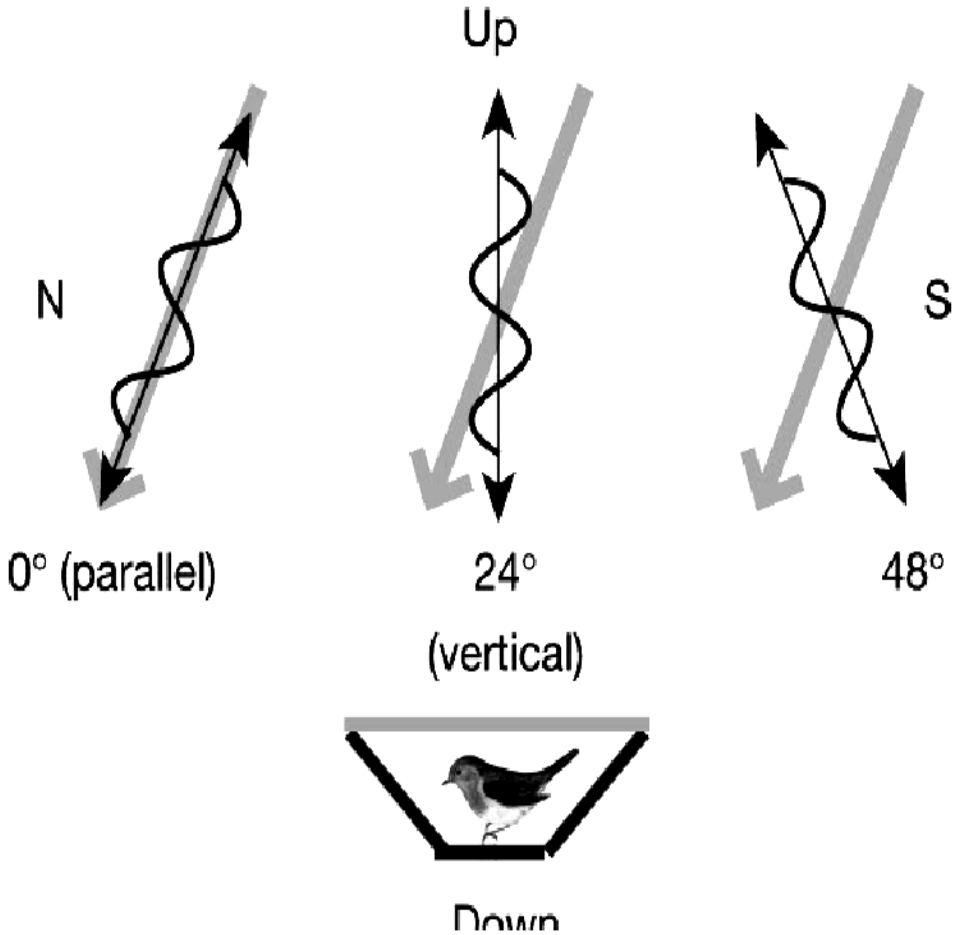
Conclusion

- **Weak magnet-fields, 1 - 100 µT, 0-100 KHz, and/or very weak high frequency-radiation, ≈85 nT, 25 KHz - 100 MHz,**

- **- increase the lifespan of radicals**
- **- increase the production of resulting damaging by-products**
- **- inhibit the fast neutralization of stimulated conditions**

For example: birds in this case are disorientated.

Alternating magnetic fields can prevent the magnetic orientation of birds



A robin is sitting in a funnel.

Gray fat arrows = geomagnetic field-lines (Frankfurt, inclination = 70º).

Wave-line = magnetic alternating-field wide band (0.1 - 10 MHz) or singles-frequency (7.0 MHz and 1.315 MHz).

The magnetic alternating-fields are in resonance with the ‚Inter-system crossing' of the Cryptochrom-radical pair and interfere with the singlet-triplet-transition, **if parallelism of the vectors doesn't exist**.

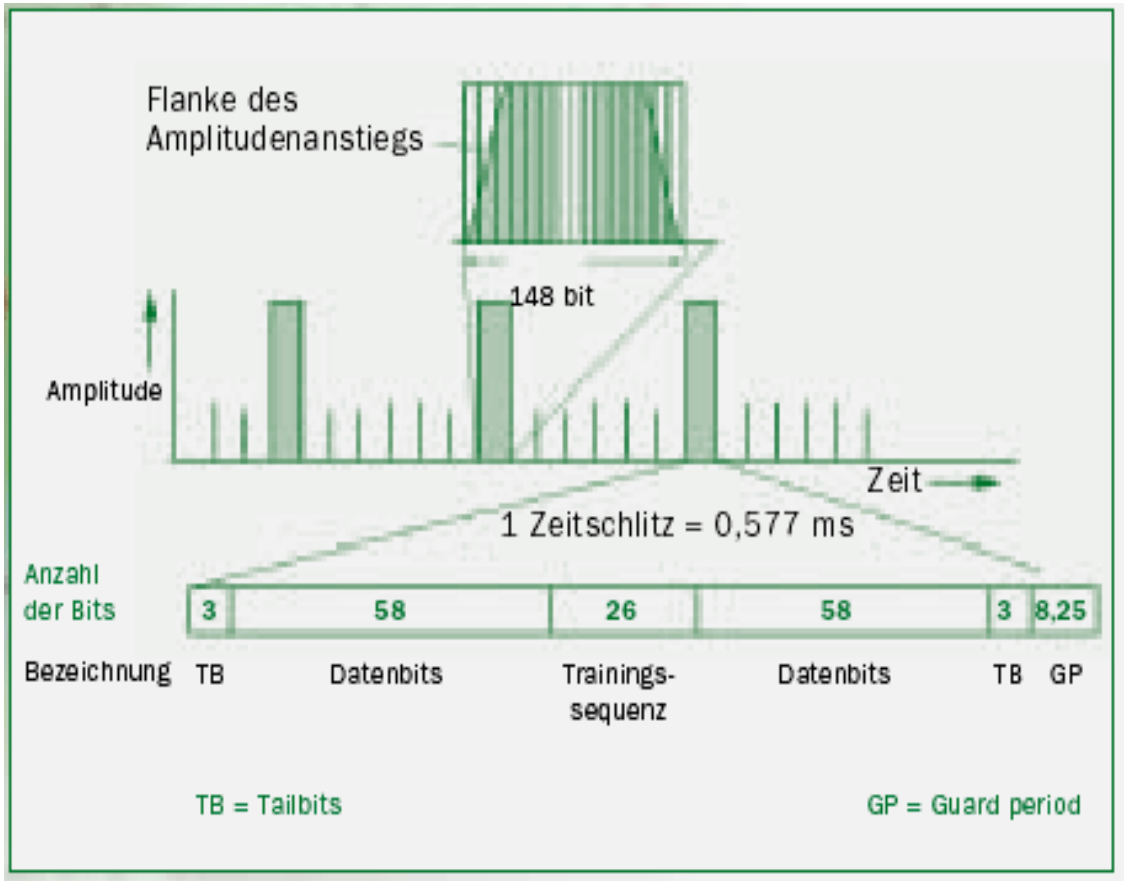
Consequence: **Disorientation of the birds**

Ritz et al. (2004) Nature 429, 177-180.

Where do the resonant frequencies come from?

- We have seen now, that frequencies with an effect on ISC are in the area of some KHz to a maximum 100 MHz.
- However, the frequencies of wireless telecommunications lie clearly in a much higher range of 900-2500 MHz.
- How does this fit?
- The resonances emerge not only through oscillations but also through modulations, interferences and **pulse ramps** (impulse rise and descent time with Fourier analysis), particularly through **switch on and off processes such as phase disruptions**.

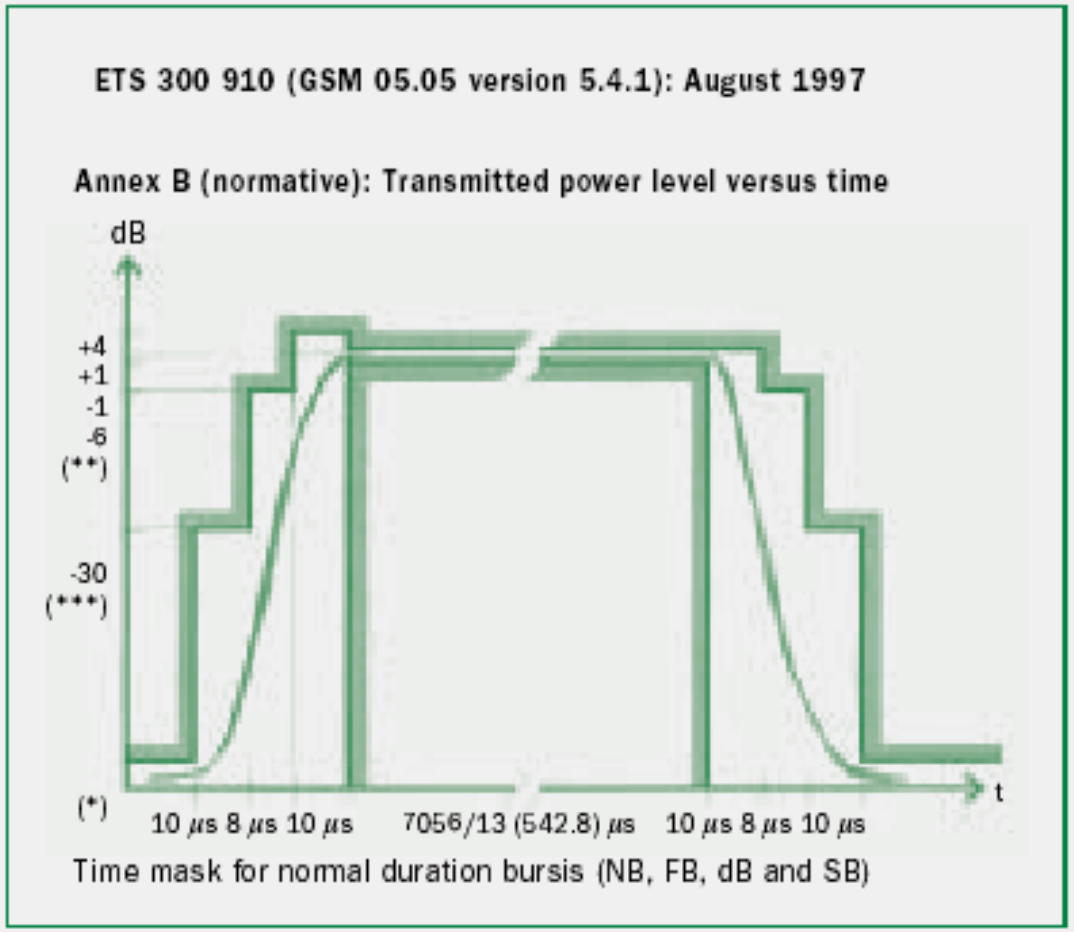
Construction of a typical radiation-burst of a mobile base station with pulse ramps



Digital telecommunication signals consist of a number of bursts in time. The bursts shown on the diagram are not simply rectangles. If you magnify the diagram, you can see three "Tailbits", that determine the angle of incline and decline of each flank. Bioactive frequencies are hidden in these pulse ramps (Fourier analysis).

- Eberspächer J, Vögel HJ. GSM – Global System for Mobile Communication. Verlag B.G. Teubner, Stuttgart 1997, S. 82-

The three "Tailbits" at the start and end of the burst determine the frequency content of the flank



•The amplitude-alteration of the 3 Tailbits corresponds to 8 and 10 µs

• (**50 to about 63 KHz)** .

•The industry take a median value of approximately 18 µs

• **(about 28 KHz).**

•To the official specification, a time window of maximum 28 µs is intended

•(**about 18 KHz)**

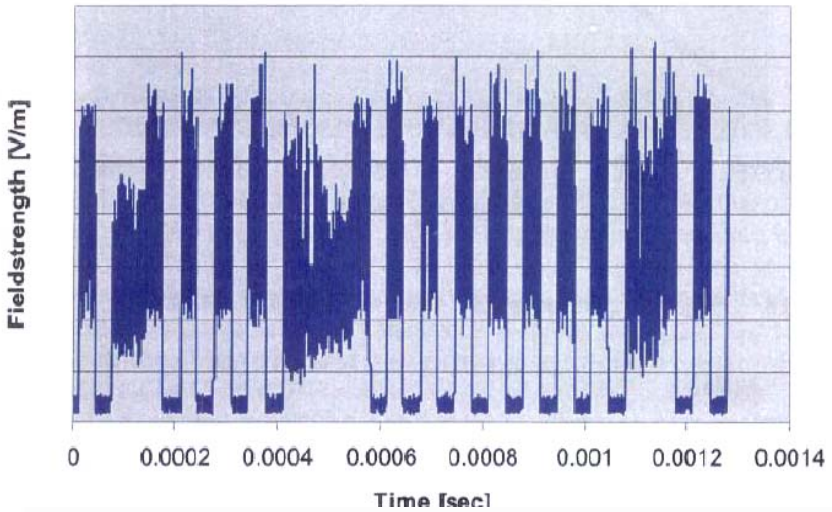
That means resonance conditions to the radical pair mechanism at very weak magnetic fields

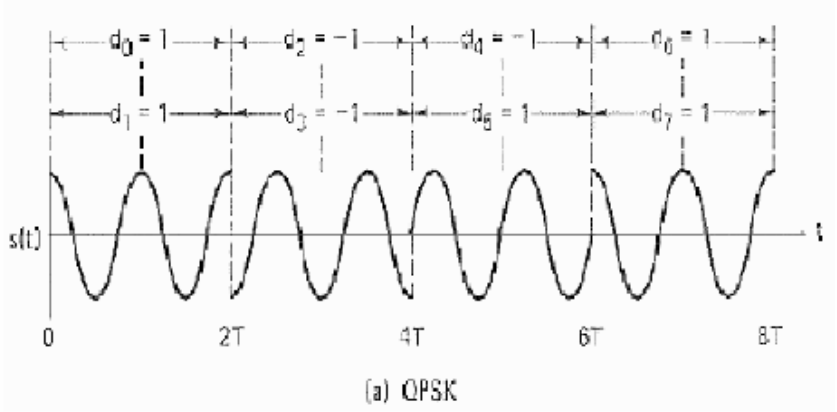
Fmax = 0,35 or 0,5/ramp time of pulse

Examples for amplitude-frequencies

(demodulation in cells > 20 MHz until now is not proved)

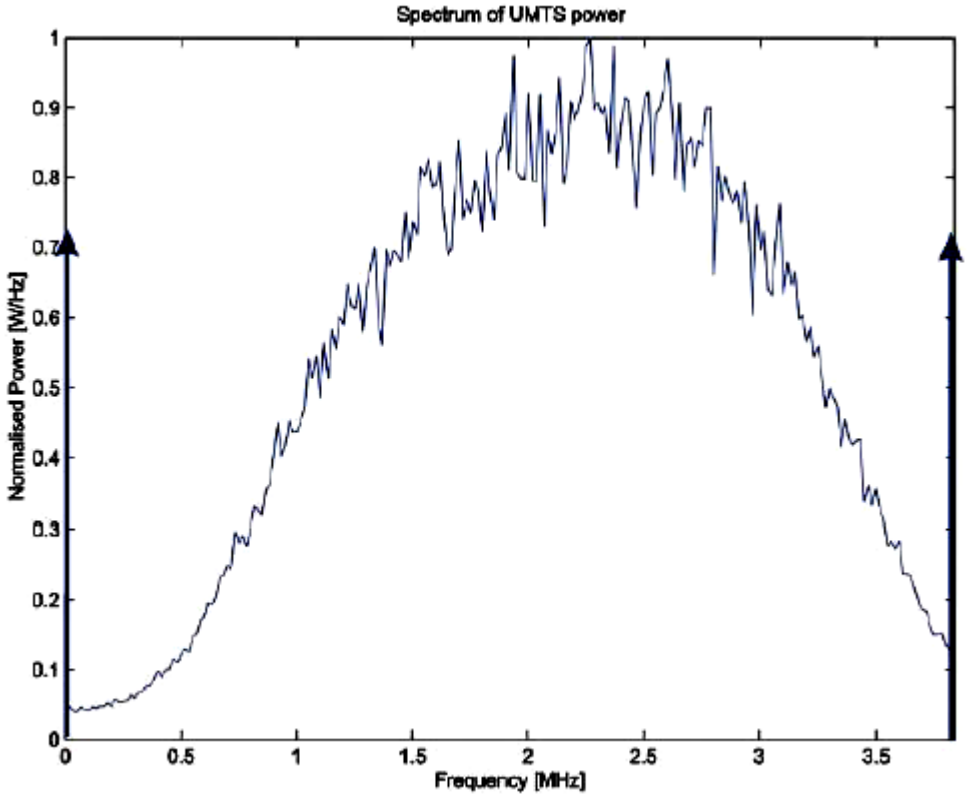
and phase-jumps as bio effective parameters





(a) QPSK

Intensity-spectrum of UMTS amplitude-frequencies with maximum about 2 MHz



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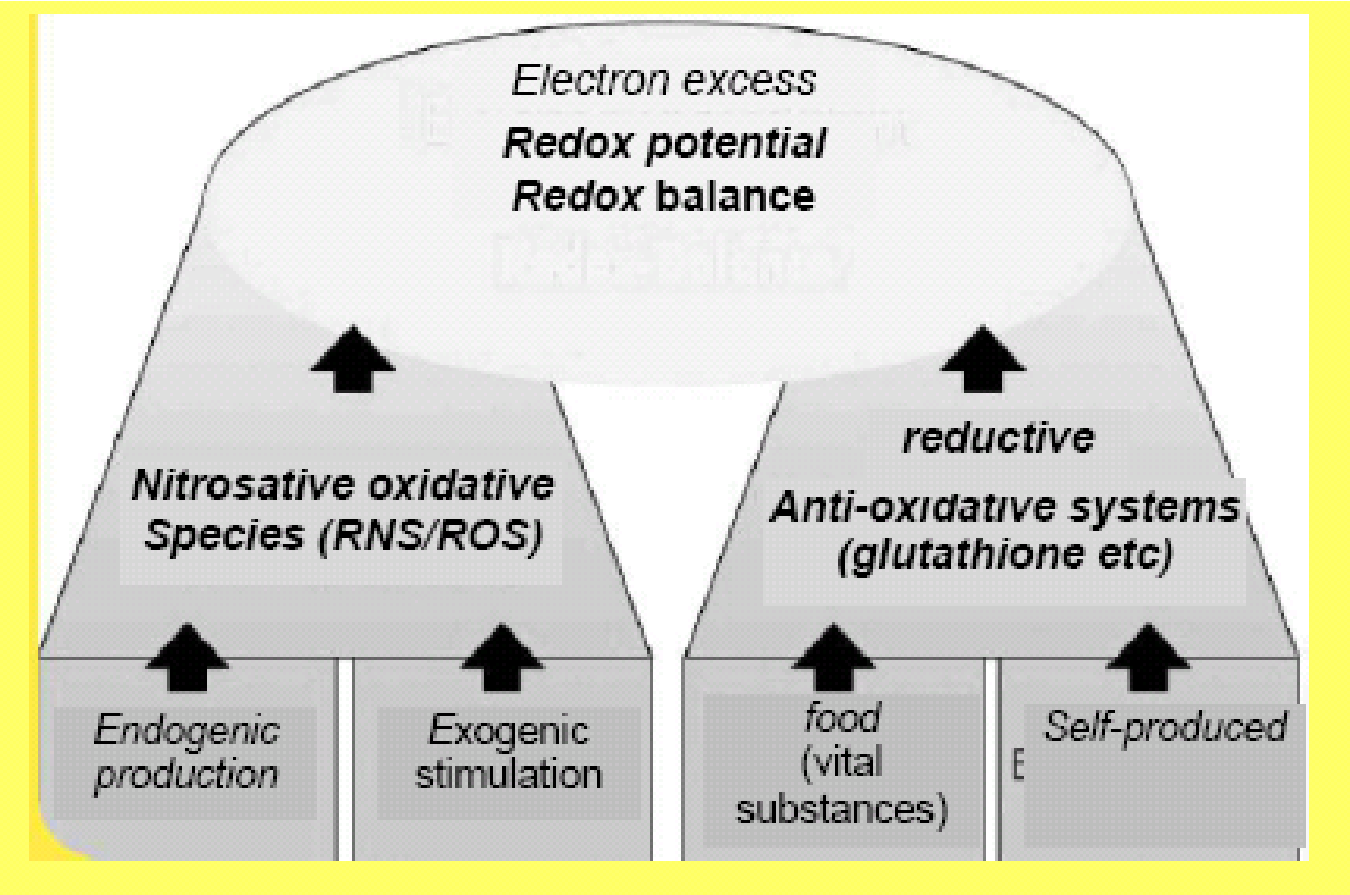
- Free radicals and ROS/RNS increase caused by magnetic and electromagnetic fields are published frequently

- How does the organism cope with the flood of free radicals and reactive oxygen and nitrogen species ROS/RNS?

Substances with an excess of electrons are indispensible for metabolism if humans and animals want to remain healthy. Magnetic fields and electromagnetic oscillations destroy this electron excess and form nitrosative-oxidative species (RNS/ROS)

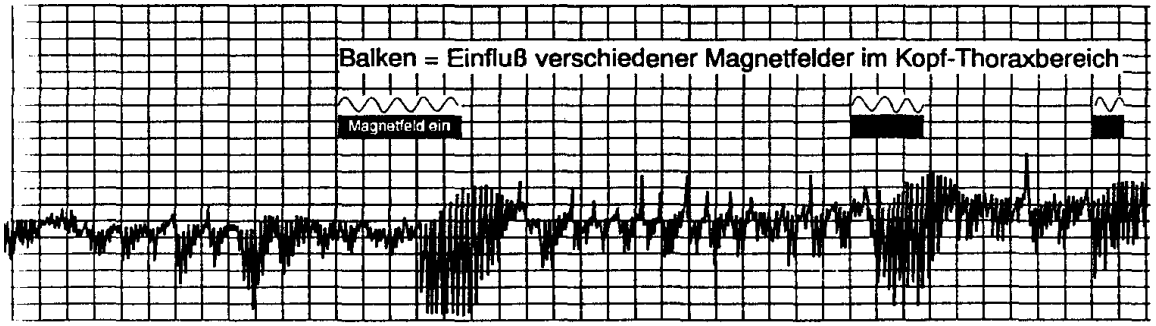


The situation is fatal to a person if anti-oxidants are also absent in the diet.

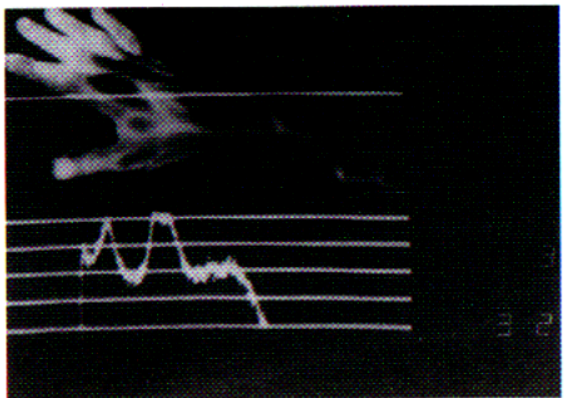
The key enzyme NADH-Oxidase: Overdose carries high damage potential

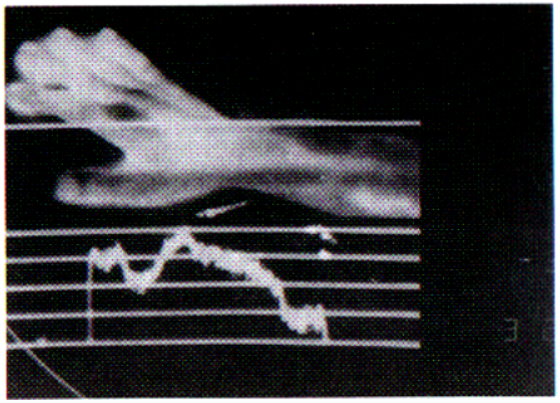
- This oxidase with red ox active subunits mediates electrons through membranes of cells to the extra cellular space.
- Fact is that the enzyme **NADH-Oxidase is stimulated by cell phone** frequencies and **produces the free radical peroxide anion O2-°**
  (FRIEDMAN et al 2007).
- It is a new finding, however, that **NADH-Oxidase** also forces the formation of NO through **stimulation of the enzyme eNOS**.
  (SUZUKI et al. 2006, RACASAN et a. 2005)
- This **stimulation of eNOS is another source of increased peroxide anion radical formation** (SEINOSUKE et al, 2004)**.**
- The enumeration of this fatal cycle of over-stimulation is not yet finished, because the **NADH-Oxidase-System stimulates also the formation of toxic hydrogen-peroxide (H2O2**), which in turn increases NO-production by about up to 100% (LI et al. 2002).

Own test results:
NO measurements in the respiration phase:
Provocation with weak pulsed magnetic fields



Changes in the blood circulation of the hand caused by NO after exposure to a weak pulsed magnetic field





Warnke, U. (1994) Der Mensch und die 3. Kraft.
Popular Academic Verlag, Saarbrücken

First complex: Stimulation of free radicals such as superoxide O2-° and NO leads to

- *- activation of protooncogenes*
- *- damage to the genome of the mitochondria*
- *- damage to the genome of the cell nucleus*
- *- damage to the membranes*
- *- oxidation of the polyene fatty acids of the membranes; release of cardiolipins (auto antibody formation)*
- *- oxidation of SH groups, causing inhibition of enzyme*
- *- activation of proteases (cell damage)*
- *- activation of transcription factors.*

*Hyperoxidanionen O2-° (alte Bezeichnung: Superoxidanion)

Second complex: Stimulation of highly toxic peroxinitrite from superoxide anion O2-° together with NO

(O2-°+ NO = ONOO°)

- *The affinity of NO to superoxide O2-° is three times as strong as the affinity of O2-° to the neutralising superoxide dismutase;*

The peroxinitrite

- *- oxidises vitamin C*
- *- oxidises uric acid*
- *- oxidises cholesterol*
- *- oxidises sulfhydryl groups (destroys thioles)*
- *- oxidises polyene fatty acids of the membranes (initiates lipid peroxidation)*
- *- causes DNA breaks*
- *- activates kinases (phosphor lipase 2)*
- *- activates polymerase (PAPP); this destroys NAD+, leading to a cellular*
- *energetic catastrophy.*

- *NO and peroxinitrite react to form nitrogendioxide (NO2); this deactivate superoxide dismutase (MnSOD), i.e. inhibiting the neutralising enzymes of the mitochondria (mt-Mn-SOD). These reactions alone result in massive disruptions of the metabolism.*

- **Third complex: Stimulation of highly toxic peroxide radical (HO2°-) from superoxide and peroxinitrite with the involvement of hydrogen**

- Peroxide HOO° has a redox potential of +1000 mV, making it highly oxidising.
- An addition to the listing in complex 2, peroxide also oxidises:
- - *Polyene fatty acids*
- - *Tocopherol (Vit E)*
- - *Lycopene*
- - *Co-enzyme Q 10*

Overview: Physiopathological consequences of nitrosative/oxidative stress

I. *Disruption of mitochondrial activity*

II. *Disruption of sugar utilisation (pathological lactate acidosis)*

III. *Disruption of the neurotransmitter function*

IV. *Disruption of the cholesterine metabolism*

V. *Disruption of the steroid hormone synthesis (corticoids)*

VI. *Disruption of the haem system*

VII. *Generation of mutations, esp. the mitochondrial DNA (hereditary)*

VIII. *Disruption of apoptosis*

Damage 1

- **Inflammation processes set in and set free further materials** (tumor necrosis factor TNFa and again and again nitrogen-monoxide) that cause damage in overdose.

- The point of view is that inflammations increase in our Western industrial society continuously, and that arteriosclerosis like heart attack - the cause of death number 1 - is based on inflammation.

- This view has already become generally accepted in the scientifically active medical practise today.

Damage 2

Disturbance of the metabolism:

- **Aerobic glycolysis** (glycolysis despite existing oxygen) is activated by the body as an ‚emergency measure ’.

This leads to:

- - stimulation of **proto-oncogens** (initial stages of cancer-genes)
- - elevated release of **peroxide-radicals**
- - lactic acidosis (**hyperacidity**).

Damage 3

Finally, the **genome of the cell, especially the DNA of mitochondria mutates**. Exactly this pathological change can be passed on via the maternal line.

- Thus, the **damage is passed on to future generations** and incriminates the entire gene pool of humanity.

Damage 4

After many years of exposure:

> **carcinogenic degeneration** of the cell

- The radical pair effect depends mainly on

- -the flux density of the earth's static magnetic field (30-60 µT) plus manmade (technical) static magnetic fields and alternating fields - in relation to the radical pair system to about 100 KHz,

- -the resonance frequencies of the radio- and microwaves,

- -the lifespan (longevity) of the radical pair system,

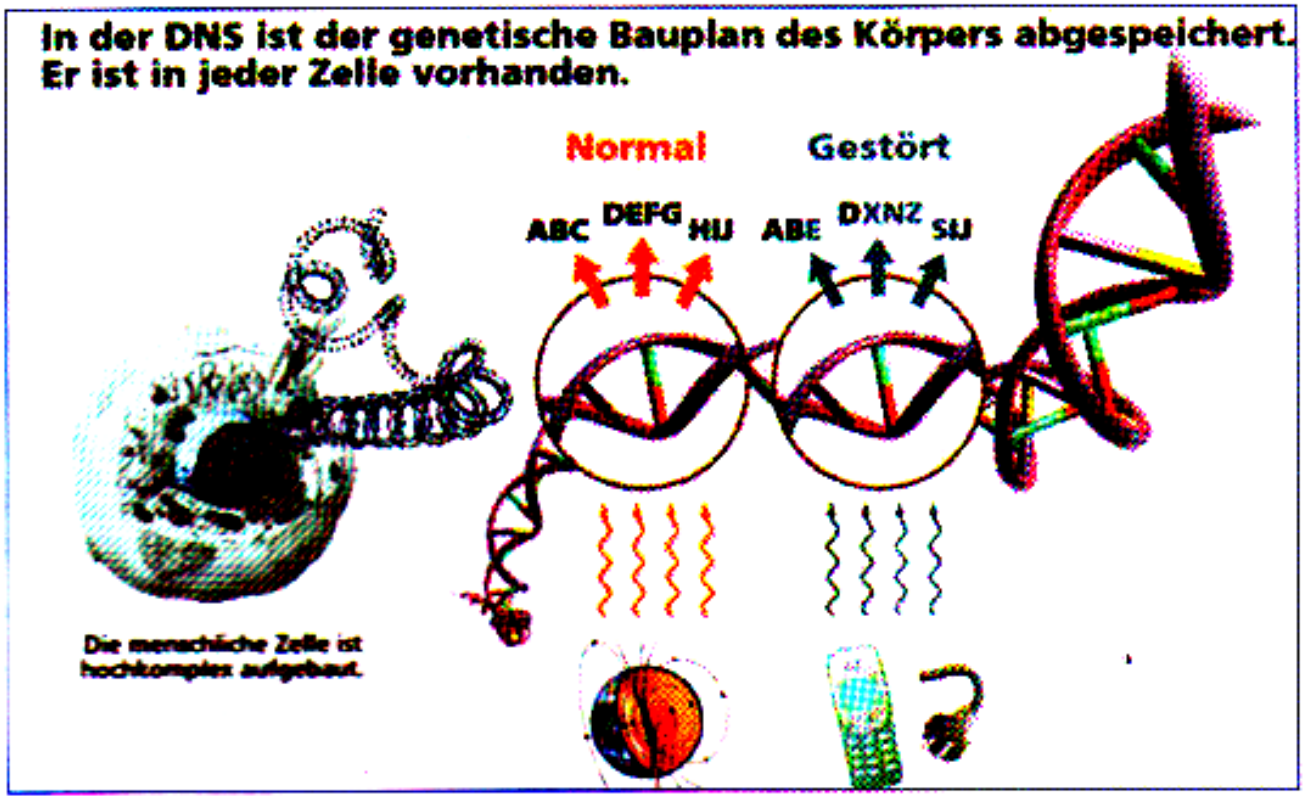
- -the nuclear spin, its projection and its nuclear magnetic moment (intensity of the hyperfine coupling),

- -the angle between the positions of the force vectors from magnetic field on one hand and high frequency electromagnetic fields on the other hand.

- In dependence on these parameters diverse phenomena emerge within the molecule function (Buchachenko 2000).

“Programming " of the DNA through electric/magnetic/electromagnetic fields

Free radicals increases the expression of certain proteins (enzyme)

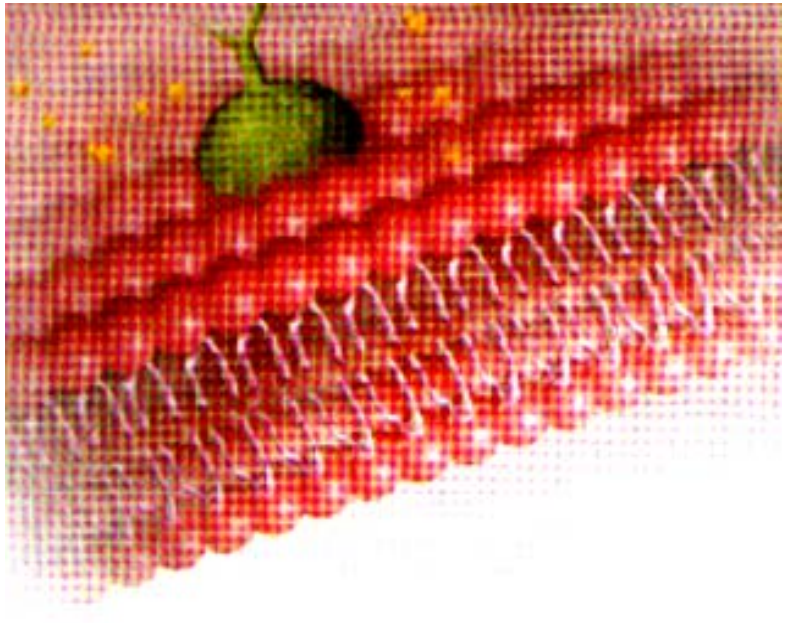


Fehlsteuerung der Zellen durch Informationseintrag über verschiedene Strahlungsfrequenzen

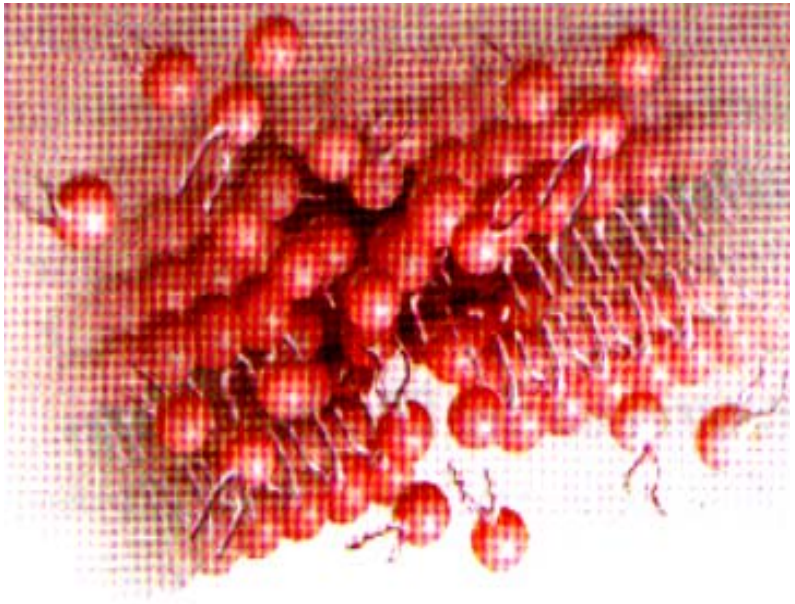
Bildquelle: Horst Schweiger/Reihard R. Köcher (2004) Universale Ganzschau und die Gesundheit –fördernde Technik. Magazin 2000 plus Oktober 10, S.22-29

The important balance of the level of free radicals

For example nitrogen monoxide NO: Release through electromagnetic impulses and drying up
Too little NO: Disturbances of almost all more vital functions
Too much NO: Damages of the membranes of the membrane cells



left:
intact membrane and receptor



right:
membrane attacked by free radicals

The damage is dependent on the existence of antioxidants and amino acids (food-content).

A dramatically current problem:

(Acquired Energy Dyssymbiosis Syndrome, AEDS)

- **Acquired and hereditary mitochondropathiy: In the last 30 years, an increasing number of systemic illnesses has been found to be caused maternally transmitted mutations of mitochondrial DNA:**
- **More than 200 defined illnesses have been described as such, including:**

- **o Severe myopathies**
- **o Encephalopathies**
- **o Alzheimer‘s**
- **o Parkinson‘s**
- **o Diabetes**
- **o Heart defects**
- **o Multiple Sclerosis**
- **o Cancer**
- **o Age related illnesses**

The extreme variability of individual reactions to electromagnetic radiation and the lack of reproducibility of test results can be explained by the fact that many effects require a certain combination of prerequisites

Influencing electromagnetic fields can only cause resonance effects if the longevity of the radical pairs is guaranteed, a) by prevention of the diffusion of the individual radical pairs for longer time, normally the diffusion-time amounts to approximately 10 ns, b) by cageing of the radical pairs in proteins (micelles) c), cohesion of charged radicals through strong Coulomb's forces.

Influencing electromagnetic fields can only cause resonance effects if simultaneously influencing magnetic fields with their size of the magnetic flux density fix certain time-transitions.

Influencing electromagnetic fields only can cause effects if the magnetic field and the high frequency radiation cross under an angle and don't proceed parallel.

Further decisive influences on potential effects are: The strength of the magnetic field, the strength of the respective nuclear-magnetic field-coupling, the power density of the high frequency field.

Beside the above mentioned physical constellations, which are mainly external factors, there is a number of internal factors, which can influence potential effects: conditions of equilibrium that can have extreme variations within an organism and between individuals:

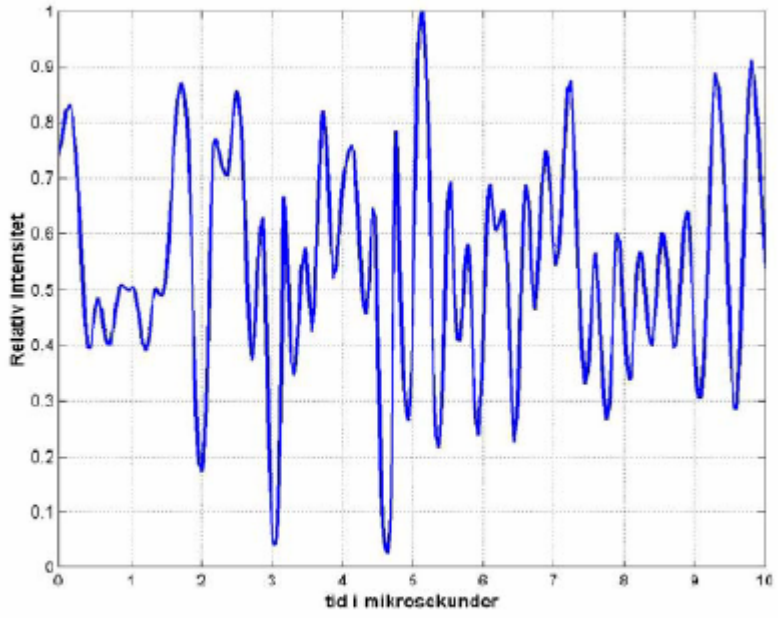
The levels of the biradical singlet-oxygen on the one hand and the radical nitrogen monoxide (NO) on the other hand are responsible for paramagnetic spin influence in membranes,

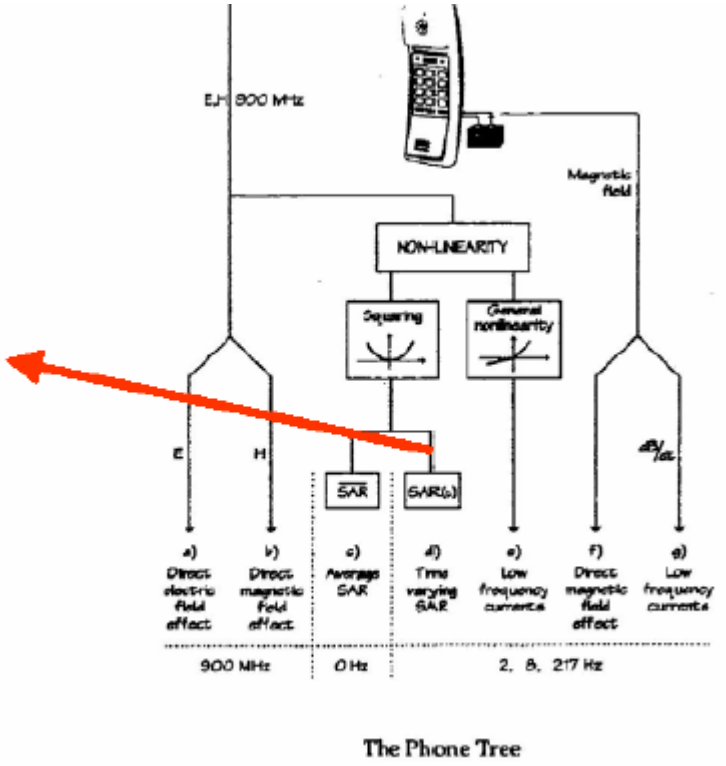
The level of free radicals and radical pairs per time unit on the one hand and antioxidant-capacity on the other hand,

High frequency fields parallel to magnetic fields relative to radical-pair Inter Crossing System, on the one hand and anti-parallelism through change of direction of the person in the surrounding magnetic field on the other hand,

Existing high frequency resonance relating to a certain magnetic field strength at a given place on the one hand and additional static and low-frequency fields at the same place, that would neutralise the resonance-condition, on the other hand.

Amplitude-frequencies in the range of microsecond





The Phone Tree

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