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English Version

**Are the  
objectives  
of research  
via Zonmw  
quite right?**

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## Colodings & else

In the issue van \*het bitje\* 1/2 October 2006 it was mentioned that the dutch government wants to make available a budget of € 16.600.000 for research on the theme \*Electromagnetic Fields and Health Research Programme\*.

The underlying basics are the recommendations of the dutch Health Council.

However, the organisation Zonmw places the accents more in the psychological and social issue than in real principal basics research, because the government still does not want to know that there are people who suffer from elektrosmog. (The main part deals with: Are you afraid of a mobile phone mast? And why? And what does your psychiatrist say?)

It is to be feared, that again research is started with the only purpose in trying to prove that all this wireless stuff is harmless.

Of course for form's sake, also so-called \*electrosensibles\* will be involved.

Those will be plucked from the street, and when they answer the question if they are electrosensible with \*yes\*, accepted into the circus.

Nobody of the researchers does know, if these people are indeed elektrosensible, for which kind of fields they are sensible, for which field strengths and in what way they may react. When and for how long.

It is long known, that humans do not have an organ that can perceive radiation, so studies for that are not necessary. With electrosensible people, certain parts in the body react in a clear protesting way, and with everybody in a different way. The reactions may also come to the surface some time later, and continue longer than the exposure.

**The working mechanism has already been researched for 90%, and scientifically proven.**

**It is mathematically calculated. But nobody wants to know.**

If one places the publications and studies of for instance Olle Johansson, Tony Fleming, Andrew Goldsworthy, Dimitris Panagopoulos and others over each other it is clear.

Give them money in order to prove the last 15 %, and we shall know what we are talking about.

But those are all studies, which can show when what may occur with completely healthy people. That may be very nice, but no research is done with the bottom, to find out why electrosensibles already react on very weak radiation sources.

**If one would start investigating this bottom side, the top side would be much clearer suddenly to start with.**

10-25 % of the population has already become sensible, and is reacting, and has therefore a number of health problems. **They also do have a right for a normal healthy life.**

But that right is them denied by the health officials and the dutch Health Counsel.

That is some sort of to blame negligence.

Now, these € 16.6 million would be a waste of money. How it is to be distributed is on the next pages.

This is what literally is mentioned in the programme :

### **Aim of the programme**

This programme will substantially enhance the Dutch knowledge infrastructure in the field of electromagnetic fields (0-300 GHz) and health, giving the Netherlands its 'own' scientific authority in this area.

### **I. Sociological/epidemiological research**

A. Public concern about the possible health effects of a number of sources of radiation has increased over the past few decades. The perception of risk is an important factor here.

Since no real solution can be found to the societal problems without directly addressing these questions, social research is one of the main research areas of this programme.

B. Research on the determinants of risk perception in individuals: what factors affect stakeholders' and the public's perception of technologies associated with the emission of electromagnetic fields?; what impact do various information, risk communication and risk management strategies have on people's ability to develop an informed opinion on electromagnetic fields and health?

C. Research in the field of the societal impact of precautionary policies.

D. As stated above: a large-scale epidemiological cohort study that addresses 'hard' endpoints such as death or diseases like cancer, may be essential in gaining a real insight into the scale of the problem. Researchers may also take 'soft' endpoints like well-being and related psychosomatic disorders, such as headaches and sleep disorders into account when designing their study.

In total, a budget of € 6.600.000 is available initially for the sociological/ epidemiological research described above.

### **II. Biological research**

Generally speaking, the main goal of this type of research is to gain a basic understanding of possible EMF effects on different parts of the organism (molecular level, cellular level and whole organism). Whereas the sociological/epidemiological research may be essential in revealing whether there are correlations between EMF and health, this type of biological or biophysical research is necessary to draw conclusions about cause-effect relationships.

B. Human experimental studies are useful for gaining more insight into acute effects of exposure to electromagnetic fields; some issues, like the occurrence and development of 'soft' endpoints such as well-being and related psychosomatic disorders like headaches and sleep disorders, can be addressed only through this type of research.

In terms of their scientific set-up and potential for social impact, experiments concerning health problems among people living in the vicinity of base stations represent a kind of transition between sociological/epidemiological research and biological research.

The Committee also believes it is important to look at higher brain functions such as cognition, and to take into account other factors, such as the functioning of the autonomic nervous system and related physiological parameters.

C. Animal experiments are particularly useful for researching the effects on organisms of field strengths above the established safety limits for humans.

D. The Committee regards it as generally important that research using in vitro techniques be conducted to establish the effects of existing and new signal types.

In total, a budget of € 7.450.000 will initially be available for biological research as described above.

### **III. Technological research**

As this is a relatively new field of research, relatively few good measurement devices and models are available at present. This is a big problem in conducting experiments, especially under

uncontrolled field conditions. Where devices and models are available, it is vital that the strength of electromagnetic fields in homes and workplaces be measured in an expert manner. Experience has shown that inaccurate measurements and interpretation of data can lead to great public concern. It is therefore highly important that a specialised group of experts be set up in the Netherlands who would at least play an important advisory role in the characterisation and measurement of exposure in the various studies in the programme, and might also have a role in implementing the research.

B. Although a better characterisation of near-field exposure and the derivation of reference values for various realistic exposure situations are thought to be of great importance, the development of tools and models that allow better characterisation of exposure in, for instance, epidemiological studies or in specific (sometimes extreme) work situations is essential for the success of the programme as a whole.

In total, a budget of € 2.550.000 will initially be available for technological research as described above.

**When I understand them correctly, they want to train building biologists themselves and develop new measuring equipment. As if there is not enough available on the market. Really the work of theorists, who never see the daylight.**

### Research areas - instruments matrix

		Instruments	
Version 3,2 - After GR advise, RIVM / EMVIA and discussions in the field		# projects	30
6 September 2006			costs project €
main category research	research priorities		€ 16.600.000,00
Infrastructure	Focal point, social / statistical aspects of EMF&Health	1	€ 1.350.000,00
Sociological res.	Research into determinants of perception of risks from electromagnetic fields	4	€ 1.500.000,00
	Impact of precautionary measures on risk perception	1	€ 250.000,00
Epidemiological res.	RF: Prospective cohort study of adult mobile phone users	1	€ 3.500.000,00
Infrastructure	Focal point, biological aspects of EMF&Health	1	€ 1.350.000,00
Human experimental res.	RF: Laboratory studies of relationship between RF exposure and health problems, and effects on cognition	1	€ 750.000,00
	RF: Health problems among people living in the vicinity of base stations; research in the living environment	12	€ 2.600.000,00
Animal experimental res.	Effects of EMF on whole organisms that cannot be tested on humans or in vitro	2	€ 1.600.000,00
In vitro research	Effects of new and existing signal types	4	€ 1.150.000,00
Infrastructure	Focal point, dosimetry and technological aspects of EMF&Health	1	€ 1.350.000,00
Dosimetry	Macro-level: Characterization of exposure in epidemiological studies; characteristics of exposure and distribution among populations studied; development of methods for valid estimation of exposure resulting, for example, from mobile phone use; measurement of exposure to electromagnetic fields in the workplace and the living environment	2	€ 1.200.000,00
			<b>€ 16.600.000,00</b>

Bron: EMF-H Programme Proposal 3.40

In Germany is in accordance with the Rheinland-Pfälzisch-Hessisches Mobilfunksymposium the research \*Dosis-Wirkung\* planned by the BUND. But they undertake this together with the Verband Baubiologie, who will accompany this technically with measuring. The essential protocols are determined and the necessary manpower trained. They expect to start in January 2007. Remarkable is, that **many factors of the present elektrosmog** in the houses are to be catalogued.

I fear, that this will be neglected in the dutch studies.

Source: EMF-H Programme Proposal 3.40

**Appendix 4. Programme committee members (who decide in the spending of € 16.6 million)**

**Chair**

Prof. Eric Roubos Department of Cellular Animal Physiology, Institute for Neuroscience, Radboud University, Nijmegen

**Members**

Prof. Anders Ahlbom Division of Epidemiology and deputy director of the Institute of Environmental Medicine at the Karolinska Institute, Stockholm, Sweden

Prof. Floor van Leeuwen Subsection on Epidemiology, The Netherlands Cancer Institute, Amsterdam  
Comprehensive Cancer Center, Amsterdam  
Department of Clinical Epidemiology and Biostatistics, Faculty of Medicine, Vrije Universiteit Amsterdam

Dr. Maila Hietanen Non-Ionising Radiation Section of the Department of Physics at the Finnish Institute of Occupational Health (FIOH), Finland

Dr. Peter Wiedemann DPhil Programmgruppe Mensch, Umwelt, Technik (MUT)  
Risikowahrnehmung und Risikokommunikation, Krisenkommunikation, Forschungszentrum Jülich, Deutschland

Prof. Meike Mevissen Division of Veterinary Pharmacology & Toxicology, Vetsuisse Faculty Berne / University of Berne, Switzerland

Prof. Lucy Anderson Laboratory of Comparative Carcinogenesis, Cellular Pathogenesis Section, National Cancer Institute at Frederick, USA

Prof. Luc Martens Wireless & Cable research group of INTEC, University of Ghent, Belgium

Dr. Gerard van Rhoon Department of Hyperthermia, Daniel den Hoed Cancer Center, Rotterdam

Dr. Frank van den Bogaart TNO (Defence, Security and Safety), Den Haag  
Trudy Prins, MSc GGD-Nederland, Utrecht  
Harke Smits Netherlands Consumers' Association, Den Haag

All these \*scientists\* never ever have examined a real electrosensible person.

Never have tested for how they react and with which radiation sources.

Or researched in the \*timefactor\*.

They all have the starting point that the human is a robotlike machinery, which on pressing a button, may give some sort of reactions. If this does not occur immediately, than there is nothing to worry about. They do not realize at all, that the reactions to radiation sources may occur directly, but also hours later, or even a day later.

The reason is, because these \*scientists\* are not really interested in electrosensibility.

**Typical is also, that although I have clearly announced being involved in developing a classification system for electrosensibility, so far nobody showed any interest.**

Without a good classification system, any research is meaningless.

Like for instance, the last ETH study. Regarding electrosensibles this was a laughing stock.

In the next articles I want to show, that there are a number of scientists, who have researched EMF and its effects at the **bottom** of it, and have presented plausible explanations.

For many it may sound like abracadabra, but it is much more scientific than the statement of the Health Council, that electrosensibles cannot exist, because the working mechanism is not known.

There are obviously some shortcomings in the literature studies (the basics) of the Health Council, or they are just malicious, without a conscious, without scruples.

## Research EMF and health

### The flu

I want to study the symptoms of flu.

It is a saying, that elderly, the weak or for instance diabetics are more susceptible to the flu than others, and that is why these people get a notice from their family doctor in order to get the flu-injection.

Most of the people however do not get the flu. When I start investigating them, I will not find much, because this group does not have anything in their body by which the flu gets a stronghold. These are also very healthy people, who take for instance enough vitamins, and with which the immune system is still intact.

However, when I start researching elderly and diabetics, I am going to find something. That way I can make a distinction between young and older diabetics. That will show differences

### Pain

Now I want to study pain.

When I study a number of people, and finger their thumb carefully, I will find nothing remarkable.

But when I let them hammer some nails in a wall, by which they hit their thumb, and when I then finger their thumb, I will find something for sure. According to the fact if one has hit hard or soft on the thumb, or that the thumb was injured some days ago, I shall find here also something. In any case more than with healthy thumbs. And most studies look only after healthy thumbs!

### EMF and health

Many have researched the influence of EMF on health.

Regular almost only healthy people are investigated. It is not surprisingly that hardly ever something has been found with healthy people.

Often a dose-response principle is discussed.

Only at a high dose of radiation people will react. That dose however is much lower than the ICNIRP recommends, because they take the view of thermal effects, but biological effects without any form of heating can occur at much lower levels. These a-thermal effects can occur with people in regard to the condition of their immune system.

Momentarily everybody will have toxic substances and heavy-metals stored in the body, but the quantity is different from person to person. Also the threshold value is for everybody different and on a different level.

But with \*healthy\* people this threshold value is rather high, and it takes a while longer before their \*bucket\* runs over.

### Health effects

I would like to make a distinction between types of a-thermic health effects.

1. Hard (and irreversible) health effects, like cancer, tumours, DNA breaking, etc.
2. Soft (and reversible) health effects, like chronic headache, tiredness, cardiac arrhythmia, pain in arms and legs, problems stomach and bowels, etc.

## Dose-response

With mobile phone telephony, one may become electrosensible at constant doses of 200 - 2.000  $\mu\text{W}/\text{m}^2$ , when fulfilling to some conditions.

(See [www.milieuziektes.nl](http://www.milieuziektes.nl))

Real hard health effects will occur only at expositions over 10.000-20.000  $\mu\text{W}/\text{m}^2$ . That is in the Netherlands seldom with phone masts, but almost mostly with mobiles, wireless modems and some DECT phones.

That is one of the reasons why 75 % of the population still is walking around with their mobiles and does not seem to be harassed of all this wireless violence. It seems that their own body threshold has not to been reached today.

It looks quite different for people who have become electrosensible.

For that, several different reasons may be the cause. No, it is unjust to blame the transmitter masts directly.

Elektrosmog consists of a large family of disturbance sources, and this should not be forgotten. See [www.milieuziektes.nl](http://www.milieuziektes.nl) for details.

We distinguish:

- 1. electric AC fields
- 2. electric DC fields (static)
- 3. magnetic AC fields
- 4. magnetic DC fields (static)
- 5. electromagnetic waves

Any of these disturbance fields can cause electrosensitivity.

With any good building biological house investigation, these and other factors are investigated carefully.

For instance, the magnetic static fields of metal parts of beds are overlooked often: These alone are capable of making somebody electrosensible, and a phone mast is than the drop that lets the \* bucket\* overflow.

Yes, elektrosmog is a complicated extensive chapter.

When one has become electrosensible, this may be manifested in sensibility for lowfrequent fields like for instance fluorescent lights, electrical appliances, etc., or sensibility for highfrequent fields, like phone masts, mobiles, DECT phones, wireless modems, or for lowfrequent as well as highfrequent sources. Also the \*dirty power\* from the wall plug of our mains can play a role here. Some feel the effect of for instance an Alpha Filter in wall socket (which lower the VLF load in the electric mains).

Mostly overlooked is the fact, that many electrosensibles may react at levels of 1  $\mu\text{W}/\text{m}^2$ ; some at 0,1  $\mu\text{W}/\text{m}^2$ .

In praxis it is found, that very subtle, hardly measurable radiation sources may result in intense reaction.

It all has to do with our \*biological window\*.

Many scientists and technicians cannot understand how this working mechanism exists.

(But remember the image of the sore thumb)

## Biological window

Suppose I am going to shoot at you with a rifle, which has a telescopic sight. I aim beside, and you do not feel anything.

Then I aim at your foot. That hurts, but you won't die on it. The same goes for a hand or arm. In the hospital, the bullet will be removed, and some time later, no trouble at all.

It is different when I aim at your head. There are people, where the bullet went straight through the head, and left at the other side, and who still do live,

But when I aim at the heart, death is instantaneous.

That way electrosensibles may be considered.

Heavy electrosensibles do have a big biological window. Everything that enters there causes reactions. Medium electrosensibles do have a smaller biological window, and as such do react to less elektrosmog sources.

(Some \*gadgets\* may result that certain small parts in this biological window are closed, or filtered, in such a way that one is less hindered by certain elektrosmog sources. Be ware that nothing at all is changed in those sources. Nothing will be \*neutralizes\* or \*harmonized\*, or whatever it is called.)

Heavy electrosensibles, hindered by many sources, have succeeded in boosting their immune system by following up a number of advices, and are now better resistant against the daily amount of elektrosmog.

Where before every phone mast was a torture, as well as DECT phones, the situation is now, that phone masts do not cause adverse health effects, and most of the DECT phones either. They still are \*felt\*, but without physical complaints.

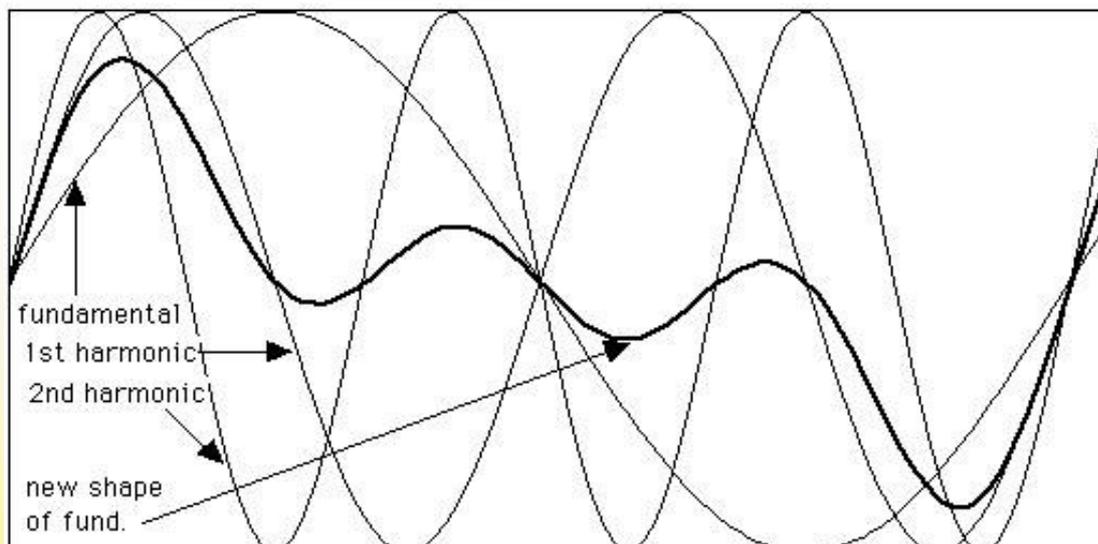
**Striking is, that strong DECT signals do not cause any effects, but some very weak DECT signals do, like for instance the instability of a leg.**

(There are quite a number of persons, who on the street or in a shop find themselves very suddenly on the floor; by unexplainable reason a leg was suddenly become incapable, the muscles refused instantly.)

Many researchers use certain frequencies.

However, electrosensibles do not react to those frequencies alone, but on the synergy. It is the resulting wave of the highfrequent carrier wave with on top the lowfrequent pulsed information. And that looks quite different.

The image below shows a sample how a first and second harmonic of a wave can result in a quite different one.



And nobody has so far investigated how that may be with our mobile phone signals. Our ether consist of a cacophony of widely different signals.

We know that a DECT phone is pulsed with 100 Hz, and a high frequency carries uses between 1880 and 1900 MHz. Would it be possible, that the biological window of one person is par example \*receptive\* for 1883.6 MHz and another person for 1896.2 MHz, and this relative to the pulsrate?

The question also arises, which will be seen as the biggest elektrosmog source, per person personally. That difference must be made also.

Of course rousing of public sentiment is often the case, and many times the word cancer is used.

And contrary the official numbers, the last 20 years the number of brain tumours have increased with 40 %.

But those tumours and cancers are in fact trivial.

Something much worse is going on.

It seems that we already have started in destroying many future generations. Yesterday!

## **Destruction future generations**

The European Commission has published a report about the effects of electromagnetic fields on health, in which the following projects are discussed:

the Advice pulsed fields project

the Reflex project

The Ramp2001 project

the Perform-A project

the Cemfec project

the Guard project

The Interphone project

the THz-bridge project

the EMF-NET project

This .PDF file can be downloaded in several languages from:

[http://europa.eu.int/comm/health/ph\\_determinants/environment/EMF/brochure\\_en.pdf](http://europa.eu.int/comm/health/ph_determinants/environment/EMF/brochure_en.pdf)

In connection with this and based on the EU rapport I like to quote remarks by Andrew Goldsworthy:

*Having read it, I found the complacency in relation to the genetic effects of mobile phones breathtaking. When we have clear evidence of damage to DNA from mobile phone signals reported by several EU labs and also other reports of damage to human sperm and the DNA of insect eggs, we need to act immediately with a well publicised warning about the possible risks to fertility and future generations. We cannot afford to wait for years for the EU to sanction and await the reports from animal experiments.*

*In a previous posting, I have indicated that this DNA damage could come from DNAase leaking through lysosome membranes that have been electromagnetically weakened by calcium loss. Whether you believe this explanation is probably irrelevant. The fact is that non-thermal electromagnetic DNA damage has been experimentally proven and has potentially very serious consequences.*

*The genetic risks from electromagnetic exposure seem much more serious than the risk of getting*

cancer. The vast majority of even double stranded DNA breaks are unlikely to activate a cancer-causing gene. Their effects may not be even noticeable in the damaged cells so long as they still contain the necessary genetic material somewhere in their chromosomes. They should still undergo successful mitosis leading to normal cell division, but things could go badly wrong in gamete formation.

For example, because a haploid gamete has only one set of genes, any deficiency cannot be made good by having a "spare" set on a homologous chromosome, the gamete may not survive and there will be a loss of fertility.

Also damage may be done by the mis-pairing of homologous chromosomes during meiosis. This is because, although even double stranded breaks in the DNA of cells in the germ-line can be repaired by rejoining the cut ends, there is no guarantee that they will be rejoined exactly as they were. Pieces of chromosome may be left out (deletions) joined in backwards (inversions) swapped between different parts of the chromosome (translocations) or even attached to the wrong chromosome. In most cases the new arrangement will work until it comes to meiosis when homologous chromosomes try to pair along their entire length. If their genes have been "rearranged" by electromagnetic exposure, they will not pair properly in the zygotene stage of the first meiotic prophase and may even tie themselves in visible knots in the attempt. Such mal-formed pairs are then usually torn apart unequally in the later stages of meiosis and the gametes formed are rarely fertile.

Believe it or not, the above is the "good news". Really severely damaged embryos will just not be conceived.

The bad news is that DNA damage that is too small to prevent normal meiosis and fertile gamete formation may still contain faulty genes that are not normally expressed until embryo development. These could still affect the offspring. Such faulty genes are often non-functional (they behave as recessives) and may not show up for several generations until they become homozygous (i.e. when both parents provide the same mutation).

Sometimes the result may be obvious physical or mental abnormalities (Down's Syndrome is caused by a whole extra chromosome) but on other occasions the effects may be less obvious but nevertheless detrimental. Can we afford to take this risk with unborn generations?

Yes, I would agree with the EU that whole animal experiments are necessary, but we should not take unnecessary risks in the meantime and it might be advisable to limit our use of mobile phones until more is known and safer forms become available.

Just using hands-free types may not be the answer since having them anywhere near the body may have similar effects. The human body is a good conductor of high frequency signals and can even act as an antenna (you have probably noticed how you can often improve the reception of a transistor radio just by holding the antenna). It could therefore transmit signals from the phone to relatively distant parts of the body, on whichever part you put it. Also, there is no linear relationship between signal strength and non-thermal biological effects (instead there are "windows" for their efficacy) and we may not need a high SAR in the affected organs such as the cells in the germ line and the gonads to cause damage.

Perhaps mobile phones should at least be sold with a government health warning. Each individual could then make up his/her mind as to what is the more important. Is it the convenience of using a mobile phone and boosting the profits of the phone companies or is it the well-being of future generations of their offspring. The risk of developing cancer is perhaps trivial by comparison.

It concerns mostly research with higher doses of elektrosmog radiation.  
And it is good, that such research takes place, but it concerns only half of the problem.

## Key question

**Why is it, that electrosensible persons do react at extreme low levels of elektrosmog, and than also of a certain type?**

That is the sixty-four thousand dollar question.

This should be researched in the first place. If we have an answer to that question, the rest lies on the table.

But so far, in all research projects, no electrosensibles were investigated beforehand.

There was no determination in which way they are sensible.

Nor for what. For which elektrosmog sources.

## Classification system

We are busy starting up a classification system for electrosensibles.

It will be stipulated for which sources they are sensible, and at which levels.

The reactions in the body will be measured.

It is already known which measuring equipment is necessary for that.

Those are different appliances, which will be coupled together.

Such a research fall outside the programme of Zonmw, so we have to look for sponsors ourselves.

Look, research has been done with weak electromagnetic fields on several \*things\*, but not on real electrosensible people.

And people who call themselves electrosensible may not be electrosensible at all. Only after this has been verified, one may assume that they are. Candida Albicans for instance may give the same adverse health complaints as electrosensibility.

## Calcium and potassium ions

In the book “**Plant Electrophysiology – Theory and Methods**”, Edited by Alexander Volkov, Andrew Goldsworthy has written a chapter \*Effects of weak time-varying electromagnetic fields\*.

Here also, he describes, that by the influence of electromagnetic fields calcium and potassium ions in and around cells can be influenced.

Ions can pass through biological membranes only via protein channels.

The theory is concentrated on the interaction between ions and channels sensors, resulting in irregular passing through these channels. This way it is explained why pulsed fields are more bioactive than continuous ones, and why low frequencies are more bioactive than higher ones.

It is all clear and simple and demonstrated via exact mathematical calculations.

In the aforementioned chapter can be read:

1. The observed biological effects of weak electromagnetic fields differ in different organisms and tissues, and their expression may also depend on their previous history.
2. The fields involved are usually too weak to cause significant heating.
3. The fields concerned usually contain both electrical and magnetic components but either can be effective on its own.
4. Pulses are often more effective than sine waves.
5. Weak fields may be more effective than strong ones and there may be one or more "amplitude windows" where they give maximal effects.
6. Only low frequencies work and some specific frequencies such as 16Hz may be especially effective to give so called "frequency windows".
7. Radio frequencies can have biological effects, provided that they are amplitude modulated with a biologically active low frequency.

The article handles the following points:

1. Weak time-varying electromagnetic fields are detected by living organisms because they generate eddy currents in and around their cells.
2. Low frequency eddy currents selectively remove calcium ions that normally stabilize cell membranes and replace them by less effective monovalent ions (mainly potassium), which increases their permeability.
3. This process is enhanced at the ion cyclotron resonant frequency for potassium because it increases the kinetic energy of potassium ions in the diffuse ion layer around the membrane and therefore their ability to replace calcium.
4. Voltage-gated calcium ion channels are involved indirectly by amplifying the effects initiated by the change in phospholipid permeability.
5. Radio waves that are amplitude modulated at the resonant frequencies for biologically active ions give responses because the asymmetrical motion of ions adjacent to the membrane demodulate the signal and promote their resonance.
6. The electromagnetically-induced increase in membrane permeability weakens cellular compartmentation and in lets more free calcium ions into the cytosol to interfere with cell signalling.

Andrew Goldsworthy writes:

*The experimentally determined removal of calcium from cell membranes by exposure to electromagnetic fields is likely to destabilize them, increase pore formation and membrane permeability (calcium is about 60 times more effective than monovalent ions in stabilizing membranes). For a mathematical treatment and further references, see Ha B-Y (2001) Stabilization and destabilization of cell membranes by multivalent ions. Physical Review E 64: 051902.*

*So as you can see, these findings are consistent with my hypothesis that it is changes in the permeability of the phospholipid part of the membrane by calcium-loss that are the main driving force behind the biological effects of electromagnetic fields. In particular, it explains why increasing the chemical activity of either calcium or potassium ions by excitation at their appropriate resonant frequencies gives opposite biological effects.*

Furthermore the working mechanism has been published and supplied with mathematics, physics and molecular data, and can be found in the following publications:

- 1) Panagopoulos DJ, Messini N, Karabarbounis A, Filippetis AL, and Margaritis LH, (2000): **A mechanism for Action of Oscillating Electric Fields on Cells**, Biochemical and Biophysical Research Communications, 272(3), 634-640.
- 2) Panagopoulos D.J., Karabarbounis, A. and Margaritis L.H., (2002), **Mechanism for action of electromagnetic fields on cells**, Biochem. Biophys. Res. Commun., 298(1), 95-102.

Also a good article is that by **Pietro Volpe**:

**Interactions of zero-frequency and oscillating magnetic fields with biostructures and biosystems**

[http://www.rsc.org/delivery/\\_ArticleLinking/DisplayArticleForFree.cfm?doi=b212636b&JournalCode=PP#search=%22%20Panagopoulos%20DJ%2C%20Messini%20N%2C%20Karabarbounis%20A%2C%20Filippetis%20AL%2C%20and%20%22](http://www.rsc.org/delivery/_ArticleLinking/DisplayArticleForFree.cfm?doi=b212636b&JournalCode=PP#search=%22%20Panagopoulos%20DJ%2C%20Messini%20N%2C%20Karabarbounis%20A%2C%20Filippetis%20AL%2C%20and%20%22)

Andrew Goldsworthy writes:

An advantage of my own proposal is that it accounts for why the release of calcium from membrane surfaces is stimulated by the resonant frequency for potassium and why the resonant frequencies for calcium and potassium seem to give opposite biological effects.

Incidentally, I first published the notion that electromagnetic fields had their biological effects by altering the balance between calcium and potassium ions bound to membranes in 1999. It occurs as an afterthought in Goldsworthy A et al. (1999) **Biological effects of physically conditioned water**. Water Research 33 1618-1626.

*But if the fields are weak, only the more strongly charged ions, such as divalent calcium, will be significantly affected. If the frequency is low, they will have time to diffuse far enough from the membrane to be replaced by other more weakly charged ions (such as monovalent potassium) that are less affected, before the field reverses. This can account for the electromagnetically-induced release of calcium from brain and other tissues observed by many workers, which only occurs at low frequencies and low amplitudes. In effect, it gives an "amplitude window" for calcium release at low frequencies.*

*These can be explained by ion cyclotron resonance increasing the kinetic energy of the free monovalent ions that might replace calcium in the membrane. Ion cyclotron resonance occurs when ions move in a steady magnetic field. They go into orbit around its lines of force with a characteristic "resonant" frequency, which is directly proportional to the charge/mass ratio of the ion and the strength of the steady field. If they are simultaneously exposed to an alternating electromagnetic field at this frequency, they resonate and absorb its energy to increase the size of their orbits, and so increase their kinetic energy. The resonant frequency in the Earth's magnetic field for potassium ions (by far the most abundant monovalent cation in living cells and therefore the one with the best chance of replacing membrane-bound calcium) is 16Hz. This is almost certainly why there is a frequency window at 16Hz where you have unusually large rates of calcium release and other biological effects.*

Little is known that in last October a large symposium took place in Crete. More than 220 studies were presented there on the

**4th International Workshop on Biological Effects of Electromagnetic Fields**

Again a-thermal biological effects were reported. Perhaps something for a next issue of \*het bitje\*.

So far I have added some loose remarks, in order to show that so much is already known, and that they are still busy in delving deeper.

But it shows also, that we still do not know why electrosensibles do react vehemently to very weak signals, and others do not at all.

Could it be, that with them, the proportion calcium / potassium is disturbed permanently?

Think again about my example of the sore thumb.

A healthy normal thumb, or one, which has been slashed with a hammer.

Scientists search for the reason why the thumb shows all colours of the rainbow, or how big the force was when the hammer hit the thumb. We are only interested in the question why the gentle touching of a sore thumb hurts, and why not with a healthy thumb. That one only hurts when is being squeezed.

For that reason I do fear, that the planned studies by Zonmw will show only blanks, and only will confirm what several inquiries among local residents since long is known.

Of course it is good knowing when healthy people can be affected in their health by elektrosmog, but I am more interested in the question about electrosensible persons.

What is wrong in their body?

If we know the answer to that question, the solutions are nearby.

We know a number of symptoms, but not what is going on.

**That is why basic research on the base, on the underside, is required as first condition.**

Those 16.6 million Euro serve obviously only to set up a prestigious \*dutch\* knowledge economy; as if the \*dutch\* were smarter and better than the since many years operating foreign institutes. Politicians think wrongly: technology is progress.

### Self-Field Theory

The Australian scientist Tony Fleming handles his SFT and comes to the next position: Photon chemistry and SFT.

*SFT on the other hand has examined the fields and found that it is just plain wrong to use a single variable to describe the point-point fields as is done in Coulomb's law. So this is a fundamental error at the heart of electromagnetics and therefore at the heart also of quantum theory. The distance should be broken up into two distinct orthogonal directions, or two distance variables (taken between the two centres of rotation in the case of the EM field and the three centres of rotation in the case of the strong nuclear field. It also sees the photon's mass as non-zero because the SFT equations apply equally at the speed of the electron OR the speed of light. This results in the eigenvalue equation of the atom being a balance between the particles AND the field. SFT is 'discovered' by direct substitution of Maxwell's equations and NOT the derived potential equations which require renormalization and its inaccuracies due to Heisenberg's uncertainty principle.*

*In SFT, Gravity is NOT seen as a warping of extrinsic space, but a force due to the field (photon) interacting WITH the massive particle. The Lorentz transformation of the speed of light is similarly INTERNAL to the photon, due to the photon's internal structure and NOT due to space at all.*

*Have a look at the presentation at:*

[http://unifiedphysics.com:80/Photon%20chemistry\\_UP\\_Mar\\_2004.pdf](http://unifiedphysics.com:80/Photon%20chemistry_UP_Mar_2004.pdf)

*for a view of quantum theory as seen by SFT. QT has a lot to do with the masses involved being unequal. When they are equal we don't get a quantum effect but a continuous physics.*

There can be read:

*There appears to be a spectroscopy associated with the photon where the photon is part of an atomic structure, this appears to give rise to a complex interaction of atoms with any external physical structure. In other words another level of chemistry.*

*Three basic photonic situations*

*(1) photon is part of an atom*

*2) photon is radiating between atoms*

*We shall examine (3) isolated photon - this is similar to an isolated atom which is theoretical and not found in reality.*

Then follows a very technical exposition, followed by a conclusion:

*Conclusions*

*(1) assuming (isolated) photon has finite rest mass and doing EMSFT study we find BALMER-LIKE analytic but continuous frequencies*

*(2) where the photon is part of an atomic structure, this may give rise to a complex interaction of atoms and its photons with any external physical structure with any external physical structure*

***In other words another level of chemistry***

Other writings by Tony Fleming:

*My own take on ions is that they can be messengers for causing reactions with DNA and proteins. When these ions enter the cytoplasm for instance, they can accept/shed energy and this energy can be shed/accepted by the DNA and other proteins. Hence the cell's ambient internal energy state is important in how the energy transition states play out. We must remember that photon chemistry can lead to SUDDEN changes that imply not so much a FORCE at work rather an complete structural change. This can be induced by shedding and accepting of photons by a molecule who field shape changes. Once this happens all the forces change as in metaphase. So the essential physics is related to the protein field (or photon) structure and how this changes which is a question of energetics rather than a dynamics, although both are important. Energetics is about changing balances and when this happens, forces tell you what happens during those changes.*

*The difference compared with normal people is a lower spin state of atoms, ions, molecules and proteins compared to the normal person. This could be due to lower concentrations of magnetite in areas of the body. This causes a higher probability of damage or sensitivity due to spurious E-fields which might occur in many ways. Sorry this is brief. I'm trying to discuss this issue with the group in general via my maths thread. This spin state is a magnetic effect and occurs in all atoms and structures in the body. That is why magnetite throughout the body is important.*

Other:

*"Franz Popp and others at the International Institute of Biophysics in Neuss, Germany have for several years now been observing low levels of photon emission termed bioluminescence from various biosystems, including strands of DNA. These photons originate from a coherent field within all living organisms. Their function is to provide intra and intercellular regulation and communication. These findings of weak biogenic fields have previously required a scientific mechanism to support them. SFT does indeed predict energy states associated with DNA's spine of hydration. As the hydrated protein changes energy, photons of specific energy are sent and received in a two-way exchange by other hydrated ionic messengers within the cytoplasm. Since the internal field of a*

water molecule is exposed to other external fields, they interact to assume field states according to the particular photon chemistry. This forms the much sought after theoretical mechanism describing cell-cell communication. Photon chemistry also provides a theoretical basis by which DNA stores data such as photons and phonons within its nuclei. We now have a theoretical understanding of biofields and how they are used to communicate with the environmental milieu”.

As far as Self-field theory goes, it's a 'new' theory and so far it fits all the data that has been thrown at it, including much OUTSIDE of BEM.

(I have no idea why it was missed for one hundred and fifty years-in the early pre-quantum era; they almost found SFT rather than quantum mechanics but this is another story that deserves its own discussion.) As far as BEM goes, it suggests that there are various levels of interaction going on.

For a start there are photonic mechanisms at work in the DNA, on another level, it says that inside the cell, there is a slowly changing balance during the cell cycle, and yet on another level the cells are cooperating to cause fields at various points inside tissues.

In the first instance, forget the external world and its elektrosmog. Let's centre on the cell in its own endogenous environment. Now inside cells microtubules are important in being able to transport forces and fields from spindle to cromatid see J.Gaglioli

<http://www.crab.rutgers.edu/~gagliard/science.pdf>

The fields inside the cell come from the changes induced by the changes in energy INSIDE the cell. These changes are primarily two-fold:

one source is the action of the surrounding cells; that can either align themselves or rotate so as to cause changes in electric or magnetic fields inside a particular cell. I see a form of self-field theory being involved in this process. We are talking about Maxell-Lorentz equations being used to determine the extra- and intra-cellular fields. There may be a diffusion of charge within the plasma membrane by dipolar proteins that reach across the membrane to provide access to these extracellular membrane fields into the intracellular region. This is one source of energy. Ionic messengers (eg Ca 2+) of specific energy can diffuse across the membrane via ionic gateways. These ions carry specific energies to the DNA. It is here that photon chemistry does its work. The DNA can be altered by the specific photon energy carried by the ionic messenger. The specific energy changes the quantum state of the DNA and I see this as similar to what we call transcription.

Also there are precise energies associated with various points in the cell cycle:

prophase, matephase, apoptosis etc. This knowledge is being used to change the cell's state.

[http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list\\_uids=15126372&dopt=Abstract](http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=15126372&dopt=Abstract)

The use of acoustics and EM is being used to treat the thoroughbreds and will be published soon as Liz says at [www.unifiedphysics.com](http://www.unifiedphysics.com).

In terms of 'negative' and 'positive' effects then, we can see that the frequency spectrum needs to take into account all the 'negatives' as well as the 'positives' (as is the current mandate of standards setting authorities). It is a matter of keeping up with the research as it is happening. My example of the car gives us examples to follow; it was only recently that the restraining harness was made compulsory in most OECD countries.

Engineering design is all about retrofixing.

\*\*\*\*\*

But we are currently going down a path that begins with the simplest formulation of how magnetic fields act and react to other fields. So far we have been looking at cyclotron resonance. In

effect the magnetic field seems to 'confine' the energy in a narrow cross-sectional region which we use in tokamak design. The larger the energy the smaller the radius. We need to ask: (1) does this mean we can go on indefinitely adding energy and narrowing the confinement? And (2) is this a real effect in biological tissues?

(1) No we can't keep going indefinitely getting smaller. Eventually we reach the limit where the motions are comparable to the 'uncertainty'. This is the Heisenberg uncertainty principle beyond which classical EM analysis and the current methods used by quantum mathematics both fail. It is also reaching the level where the model of an electron moving in a magnetic field is not sufficiently detailed; we need to expand the model. For instance the electron is currently assumed to have an intrinsic spin.

(Note that we find in self-field theory that this electron spin is EXTRINSIC and caused by factors outside its point-like structure. For instance when an electron is ejected from an atomic structure due to an EM force imbalance, it leaves with two spinorial motions much like a photon, or a phonon, as per the observations of the 'quantum nature' of the electron by Thompson in the mid 1920's. More about SFT later)

(2) Yes it DOES apply to biological tissues, but limited to electrons and ions that are moving. Looking at ion channel dynamics and how such dynamics may be affected by these cyclotron resonances was looked at by Ross Adey, Carl Blackman, Durney, and many others. Ross Adey found what he called 'frequency windows' which were supported by a series of controversial experiments at both AC and modulated frequencies; but which were also refuted by others.

As far as biological tissues are concerned we need to go further down the mathematics trail and look at how magnetic fields can affect solid structures including crystals (we eventually want to look at liquid crystals). I have been looking at another text I have by Charles Kittel "Quantum Theory of Solids" 2nd Revised Edition, Wiley, 1987. Kittel was more interested in solid state physics eg the transistor. We find that as we raise the magnetic field, there are fewer electrons able to freely move around in the metal because of the change in the Fermi level. At the link below we find the maths behind the Fermi level. It is used to Kittel to study electron populations in solid crystals (transistors)

<http://jas.eng.buffalo.edu/education/semicon/fermi/functionAndStates/math.html>

But concepts like Fermi level are important to biology too. There is nothing wrong in principle in using it to examine the behaviour of ions and electrons in biological tissues also. For instance we could assume that Reba Goodman's mice hearts are a structured array of cells much like a solid state transistor. But unfortunately they're not structured like metallic crystals.

Below is the result of googling on 'heart tissue structure'

[http://science.nasa.gov/newhome/headlines/msad05oct99\\_1.htm](http://science.nasa.gov/newhome/headlines/msad05oct99_1.htm)

[http://www.wellcome.ac.uk/doc\\_WTX023668.html](http://www.wellcome.ac.uk/doc_WTX023668.html)

[http://science.nasa.gov/headlines/y2002/14feb\\_heart.htm](http://science.nasa.gov/headlines/y2002/14feb_heart.htm)

What we find is that cells form around 'fibres' that grow inside the heart. The unnatural fibrous structure is 'higgledly piggledy'. So what about the natural fibres??

OK, this is the next instalment of the mathematics 'seminar' to show how magnetic fields operate. I found an old treasured text book that gives a good analysis of a relativistic electron acting under

various B-field configurations: Melvin Schwartz "Principles of Electrodynamics" Dover, 1987 ISBN 0-486-65493-1.

In this text, Schwartz goes through the mathematics to derive the motion of a charged particle in a constant B-field. Beginning with Lorentz's force equation:

$$F = qE + qv \times B$$

where  $E_{\text{vec}} = 0_{\text{vec}}$  and  $B_{\text{vec}} = B_0 \hat{x}$

He derives the scalar equations of motion:

$$d^2x/dt^2 = \omega_0^2 y \quad \text{---(1)}$$

$$d^2y/dt^2 = -\omega_0^2 x \quad \text{---(2)}$$

$$d^2z/dt^2 = 0 \quad \text{---(3)}$$

Integrating (3) twice gives  $z = v_{0z}t + z_0$

After integrating (2) we obtain

$$dy/dt = -\omega_0 x + \text{const which can be inserted into (1)}$$

Choosing the origin as our centre-of-motion, we obtain

$$d^2x/dt^2 = -\omega_0^2 x \quad \text{(4)}$$

Hence  $x = R \cos(\omega_0 t + \delta)$  and  $y = -R \sin(\omega_0 t + \delta)$ .

If the particle speed is  $v_0$ , then  $R^2 \omega_0^2 + v_{0z}^2 = v_0^2$ .

If  $v_{0z} = 0$  this simple case is just a circle where  $R = (m c v_0) / (q B_0)$ .

This means that the stronger the  $B_0$  field the SMALLER the radius.

OK, here endeth this small lesson. This relationship is important to recall later on when we need to think about the electron moving in the atom. Back soon.

For many, this goes far beyond the normal prose, but I want to show, that the problemacy is being thought after seriously and definitions constructed.

That is why I posed a direct question:

Hello,

that is all very fine.

Andrew Goldsworthy and Dimitris Panagopoulos have their theories about how the cells do react.

Concerning the bioelectromagnetics, the working of EMF on humans, many engineers go out from the point, that a certain level of radiation, a certain Wattage, is necessary in order to have any (heat) effects.

That is not true, because we nowadays speak about a-thermal effects.

But all studies regard normal conditions, like normal people.

A dose-response is looked after.

But we already have people who are NOT normal.

I mean the already electrosensibles, and for them this dose-response does NOT apply.

I have found, that with levels of elektrosmog, where normal people are not bothered at all, certain electrosensible persons may get very strong reactions.

And those levels are very, very weak.

To give an example:

A person, who has recovered a lot from electrosensibility, is not bothered by mobile phone masts

anymore.

The masts are *\*feeled\**, but no body reactions do occur anymore.

Now, walking on the streets, strong signals from cordless DECT phones do not give reactions, but some weak DECT signals may give strong effects, like a leg going numb, and the person is falling. Of course I have checked this with my meters.

My big question is:

What makes electrosensibles tick ?

What is wrong with their calcium and potassium ions?

What is wrong with their photon chemistry?

Why do they react to very low, hardly measurable, levels of elektrosmog?

And not to other strong signals?

How is their *\*biological window\** functioning?

Sure, I know that a fool may pose questions, many *\*wise\** cannot answer.

But I think, that in this group, the *\*wise\** are the top, the cream of the cream.

I am looking forward to the answers.

Longitudinal waves may also play an important part in this.

Charles Claessens

To that the following response from Tony Fleming came:

Hi Charles

You raise many good points. The thinking of some over the past decade or two has been to talk about the thermal threshold below which noise *ONLY* exists. But this is not true. We know photons don't collide in the same way as atoms or molecules, ions or proteins.

Photons tend to find a home where their energy is 'coherent', where their spin states and orbital lengths fit into an atomic (or molecular) energy system to form a 'coherent' field system. Maybe there's a local minimum configuration, or stability criterion in these structures. This raises something I've not talked about yet and that is 'resonance' within atomic structures. This is a topic you'll find Linus Pauling talking about in his earlier work, but not too many people are aware of what this means today. An analogy is the way in which stars of various size produce elements by fusion in their internal nuclear dynamics; some can produce reactions up to a certain point in the periodic table and then their size prevents them going any further. The eigenstates of atoms are similar. All the particles in an atomic configuration are 'orthogonal' to each other. This orthogonality is across both time and space as distinct from the usual mathematical concept of space orthogonality. Fourier analysis talks about orthogonality in the time and frequency domain and it was the basis of early thinking about quantum mathematics. Within the atomic structure we find that all sub-particles (including all photons) occupy an eigenstate in both space and time across the whole structure (the spinors for each particle have both a time and a spatial characteristic). Change the ambient energy and you change that part of the atomic structure that can adapt, in particular the binding energy of the photons (and where sonar energy is present, i.e. phonons, the gluons inside the nucleus). Thus as more energy is added (or reduced) the atom adapts its field structure until it is eventually forced to change its spin and radial states. All this while the electrons, protons, neutrons

remain in their fixed eigenstates UNTIL enough energy is supplied or extracted at which time the atomic eigenstates of the protons, electrons, and neutrons change their state according to the chemistry.

All this occurs below the thermal threshold. As in my reply to Selcuk, this is energetics rather than dynamics. Photons are 'ghost-like' being able to pass by one another as long as they are not coherent with each other. There is no ordinary van-der Waals force with photons because they are tiny dipoles.

If we think in terms of biological states as culminating in the body's internal or external bio-fields surrounding either cells or the complete body, we can get an idea of the range of human responses to EM fields, including diseased states such as electrosensitivity and magnetosensitivity resulting from electrosmog, or diseases such as autism, depression, schizophrenia. My feeling is that these people have a 'biofield' disability. For electrosmog diseases we can think in terms of a reduced external biofield configuration or an enlarged external biofield structure. For neurological diseases I would imagine the neurones are damaged e.g. wrong DNA energetics leading to wrong recall of images and sounds. I have seen reports where serial killers have frontal lobe damage. I know this may not be much solace to the mothers and fathers of murder victims but it may be that at some point in the future we may be able to 'fix' those murderers before they murder by correcting those faulty neurones. (I'd love to wave a magic 'frequency' wand over Baghdad at the moment eh??)

I am confident that given our best efforts to understand the bioelectromagnetic genesis of such diseases we can find cures using 'frequency medicine' to augment our current usage of chemicals such as drugs e.g. the next generation of homeopathic solutions, when we understand the way in which these solutions are working and can apply this knowledge to find new ways to treat some of the current scourges of mankind.

Charles I'll think some more about your other concerns.

Cheers Cobber.

Tony

And here a what older announcement by Tony Fleming:

As to photonic chemistry it does suggest the phonon and the photon combine to give us a gluon, the unit of field inside nuclear regions; in fact one of the most elementary equations of this new chemistry gives

$$3 * \text{photon} + 3 * \text{phonon} = 4 * \text{gluon}$$

where the gluon consists of THREE sub-photon particles and where the phonon can be described as similar to a photon but turned to 90 degrees. so it loses energy as it travels unlike the photon which loses very little. these losses would be due to collisions in the energy-rich vacuum; the cross-sectional area of the phonon is far greater than the photon which has a tiny cross-section.

All this means that photon chemistry (which includes the reactions of the phonon) may well be involved with small bits of metal 'infecting' sensitive regions of the brain for instance.

Consider the following: we are looking at how signals from neuron to neuron inside the brain might be 'polluted' say so that images and visions inside the brain are distorted as wrong memories and

wrong psychological responses are made because the frequency was slightly wrong and the wrong DNA transcription was made. This we suspect how schitzophrenics hear voices and see strange things that others don't hear or see. this is concerned with accessing the brain's stored memories via DNA transcription.

Of course this is nothing to do with tinnitus, but it could be a similar type of damage whereby the lines of communications between and inside cells are not functioning quite right.

## Candida

Like I mentioned before, people with Candida may have the same complaints as electrosensibles, without being electrosensible. It is therefore advisable to consult your physician or therapist. By means of a good bioresonance therapy, Candida can be treated successfully also. In the building biology special Petri dishes with a specific Agar can be used. Below some samples of typical Candida molds, the blue \*balls\*.



There is also a simple do-it-yourself test. Spit in the morning (when sober) in a glass of pure water and see what happens.

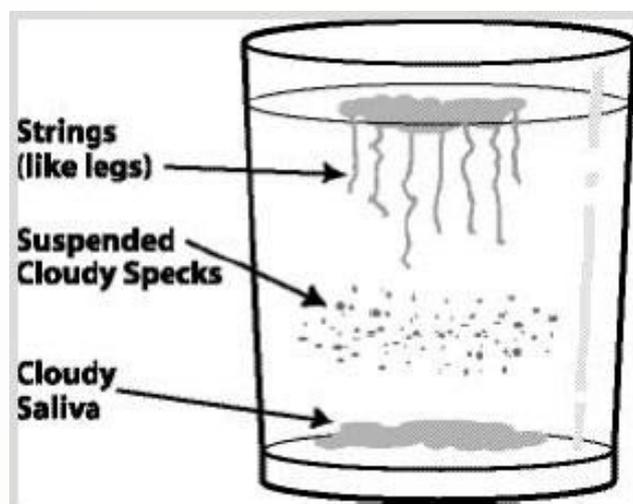
When the saliva travels down quickly in long strings, you will have probably Candida and is it time for consulting your physician.

**First thing in the morning**, before you put **ANYTHING** in your mouth, fill a clear glass with room temperature **bottled water**. Try not to use tap water to eliminate the possibility of mineral and chemical contamination.

Work up a bit of saliva, then spit it into the glass of water. Check the water every 15 minutes or so for up to one hour.

If you have **candidiasis**, you will see **strings** (like legs) traveling down into the water from the saliva floating on the top, or "**cloudy**" saliva will sink to the bottom of the glass, or **cloudy specks** will seem to be suspended in the water.

If there are no strings and the saliva is still floating after at least one hour, you probably have Candida under control. **Congratulations.**



## TWO ANALYTIC ESTIMATES FOR THE MASS OF THE PHOTON

ANTHONY H J FLEMING

Biophotonics Research Institute, P.O. Box 81 Highett 3190, Australia

**AIM:** To determine the mass of the photon from physical theory. According to self-field theory (SFT) there is structure within the photon giving it Balmer-like transition frequencies at which the various radial and spin eigenstates of the structure change. Once the photon mass is known, the transition points can be obtained. This photon spectroscopy may be an important mechanism behind a range of biological phenomena including homeopathy, low levels of photons observed to be emitted from strands of DNA, electrosensitivity and the emerging application of EM and acoustic frequencies for therapeutic medical uses.

**METHOD:** SFT is used to estimate the mass of the photon using two different physical phenomena, one the motion of the photon within the hydrogen atom, the other the motion of the photon within the solar system. In contrast to the probability densities of quantum mathematics, SFT obtains the motions of the electron and the proton for the hydrogen atom in the form of eigensolutions to a system of partial differential equations based on the

Maxwell-Lorentz equations. In the analysis Dirac's constant  $\hbar = \frac{q^2}{4\pi\epsilon_0 v_e}$  appears as the

energy per cycle of the electron or proton. The photon transits between proton and electron performing relativistic spiralling motions many times each cycle of the electron and proton that move coherently with one another. The phase length of the photon each time it transits  $\frac{\pi}{2}$  (quarter cycle) maintains the overall coherency of the atom's internal energy providing a method to analytically determine the energy of the photon compared with the energy of

the electron  $m_\gamma c^2 = \frac{\hbar v_e}{4c}$  or  $m_\gamma = \frac{q^2}{16\pi\epsilon_0 c^3} = \frac{q^2}{4 \cdot 10^7 c}$  (1). A second estimate is given by

the photon's transit from Mercury to Sun, a 'ground state' of the solar system. Based on the Compton wavelength but as in (1) using the spiral's total length  $m_\gamma = \frac{2h}{\pi\lambda_{Me}c}$  (2).

Physical constant	Symbol	Known value
Dirac's constant	$\hbar$	$1.05457168 \times 10^{-34} \text{ J} \cdot \text{s}$
Speed of light	$c = (\epsilon_0 \mu_0)^{-1/2}$	$2.99792458 \times 10^8 \text{ m s}^{-1}$
Fundamental unit of charge	$q$	$1.602189 \times 10^{-19} \text{ C}$
Permittivity of free space	$\epsilon_0$	$10^7 / (4\pi^2) \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2}$
Perihelion of Mercury	$\lambda_{Me}$	$0.460 \times 10^{11} \text{ m}$

**Table 1: Physical Constants.**

**RESULTS:** Using the constants in Table 1, the mass of the photon can be evaluated from (1) as  $0.214 \times 10^{-53} \text{ kg}$  or from (2) as  $0.306 \times 10^{-53} \text{ kg}$ . Both values are commensurate with the experimental estimates on the upper limit of the mass listed by the Particle Data Group. The difference between the estimates is probably due to the chaotic nature of Mercury's orbit around the Sun compared with the electron and proton in the hydrogen atom.

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## colofon het bitje

**Eindredactie:** Charles Claessens  
**Ontwerp en vormgeving:** Charles Claessens

**Redactie:**  
 Charles Claessens      [info@hetbitje.nl](mailto:info@hetbitje.nl)      tel 0032-14-388632

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