

# The 5G Safety Dilemma: Plea for Urgent Scientific Research in the European Context

**Dirk K F Meijer\*, Jos Timmer and Hans Geesink**

**\*University of Groningen, The Netherlands**



## Summary

In the current social and political discussion about the effects of EMF radiation (EMF = Electro-Magnetic fields) on life processes in humans, animals, and also in plants, there is currently a rather fierce discussion in which the points of view are apparently far apart. When safety limits were defined, they appeared to be wrongly based on only thermal effects of EMF radiation, while non-thermal effects have been clearly demonstrated in thousands of peer-reviewed publications. In addition, often no account is taken of the fact that 5G radiation can be pulsating, modulated and multiple antenna steered. A recent meta-analysis of 720 biomedical publications showed an evident EMF- frequency band pattern indicating that there are alternate and discrete (coherent) health promoting frequencies but also harmful (non-coherent) frequencies. The chosen 5G frequencies belong for a great part to the detrimental zones. This finding of a consistent pattern that underlies non-thermal EMF effects on health, clearly contradicts the still persistent denial of such effects by the “International Commission on Non-Ionizing Radiation Protection” (ICNIRP). Yet, it also follows from this data that certain favorable EMF frequencies could be used therapeutically or in a preventive mode. These could be applied in a spectrum of diseases, while also materials could be developed that could provide radiation protection. Thus, the good news is that further research to counteract non-thermal unhealthy electromagnetic effects can generate ideas for improving the balance between coherent and de-coherent waves, and thereby may open a potential novel road to innovative health technologies. The European human and animal population are increasingly exposed to new physical and chemical agents in the environment, some of which may be damaging to health. A thorough inspection of the relevant literature reveals that systematic research into the possible effects of 5G radiation and potential protection in humans is in fact scarce. We therefore advocate the immediate establishment of a Research Platform for fundamental and applied health research in the field of “EMF and Life”, within the European community.

### **The current social debate on 5G networks**

In the current social and political discussion about the effects of EMF radiation (EMF = Electro-Magnetic fields) on life processes in humans, animals, and also in plants, there is currently a rather fierce discussion in which the points of view are apparently far apart. It is striking that supporters and opponents of the installation of the 5G network, who are often very involved people, seem to fight each other with scientific arguments by referring to hundreds of scientific articles. Unfortunately, all this gives the impression of very selective operations, by which the positions on both sides continue to have a rather dogmatic character. From government side, so-called “objectively determined research results” as well as “hard data” about radiation limits for safety etc. are repeated, without realizing how these data were experimentally produced, and what their statistical significance is.

### **Current government information on 5G implementation**

Unfortunately, various government agencies do not go free here and when setting safety limits, they appear to be wrongly based on only thermal effects of EMF radiation, while non-thermal effects have been clearly demonstrated! In addition, no account is taken of the fact that 5G radiation can be pulsating, modulated and multiple antenna steered. It is known that EMF waves can also be circularly polarized by interaction with atmospheric dust and therefore may penetrate much deeper into the organism. In addition, 5G waves may exhibit interference with other EMF wave frequencies, resulting in standing waves and environmental “hot spots” of radiation that can be very taxing on EMF hypersensitive individuals. All this obviously requires new systematic research, especially in humans.

A thorough inspection of the relevant literature reveals how current science is divided in this area and, in particular, that systematic research into the possible effects of 5G radiation in humans is in fact lacking. So, it is no wonder that the confusion of speech continues and a very barren dead-lock situation has arisen in the dialogue and information on this topic. There is also no thorough investigation into preventive measures or protective materials that could help people with proven EMF hypersensitivity. Professional long-term epidemiological research, such as that currently being undertaken by the Health Council in the Netherlands, is also highly indicated.

### **Recent new research into EMF effects on health conditions in the Netherlands**

A recent meta-analysis of approximately 720 biomedical publications (ref. 1 and 10) showed an evident EMF frequency band pattern that indicates that there are alternate discrete (coherent) health promoting frequencies but also harmful (non-coherent) frequencies (ref. 1 and 10, largely confirmed in ref. 6). This pattern was consistently detected in both animate and non-animate systems and therefore was called the generalized music (GM)-scale biophysical principle. This finding of a consistent pattern that underlies non-thermal EMF effects on health, clearly contradicts the still persistent notion of the “International Commission on Non-Ionizing Radiation Protection” (ICNIRP). This committee wrongly claims that “although non-thermal EMF-effects have been observed, a general mechanism has not been identified”. In the 5G frequencies currently in use or being planned in the future, both type of frequency values can occur, so an accurate choice of the implemented frequencies is crucial. It also follows from this data that certain favorable EMF frequencies could be used therapeutically or in a preventive mode. These could be applied in a spectrum of diseases, while also materials could be developed that could provide radiation protection. A potential example is the adding of coherent EMF-frequencies to the currently chosen

5G signals and/ or their recalibration to coherent values that were shown to be life-friendly. Until now, abundant EMF-data of animal testing and human cell experiments are available, but systematic research into the effects of combined use of multiple frequencies has in fact not been done, while also systematic data on the potential interaction of EMF with environmental factors are virtually lacking!

A recent, additional, analysis of 229 experiments (re.10, list 1) confirms that non-thermal electromagnetic waves are able to induce significant changes in human cells. The currently applied single or composed (modulated) frequencies in communication technology, fit for 94.2% with the proposed quantum model as related to either healthy or unhealthy behavior, offering the potential to optimize calibration of chosen EMF bands. For example, up to 80% of the planned 5G frequencies belong to the detrimental decoherent or modulated coherent frequency bands. However, the good news is that further research to counteract non-thermal unhealthy electromagnetic effects can generate ideas for improving the balance between coherent and decoherent waves, and thereby may open a potential novel road to innovative health technologies.

### **The national research infrastructure in the EMF area**

The latter aspect can therefore provide the basis for further fundamental research, in which explicitly human tissue should be involved. This in the form of thin, post-mortem, tissue slices of the brain, skin, kidney, liver, intestine and heart, techniques that have been elaborated for considerable time now, in which such tissues in vitro remain viable through incubation with oxygen and nutrients. Clear alternative here are specific cell-cultures and/or human organ material that can be grown from stem cells. Exposure to relevant EMF fields of various strengths and duration of exposure, in a spectrum of separate and combined frequencies, either modulated, pulsed or continuous in nature, can then be systematically investigated. In these in vitro tests, all kinds of metabolic processes can be measured and sometimes even electrical signals can be derived (brain slices). This can, on the long term, also demonstrate the relevance of animal experiments for the effects of EMF exposure to humans.

Furthermore, as in drug research, dedicated trials on radiation exposure of volunteers are quite possible. In such epidemiological studies, possible subtle effects of 5G and 4G radiation on behavior and cognition can be measured under the influence of discrete EMF frequencies and combinations thereof. Double-blind epidemiological research in well-defined populations of healthy, and/or objectively determined hypersensitive people can certainly be executed and, if succesful, these results could be therapeutically applied. Telecom companies would also benefit from such research, as it can help with a more focused development of transmission equipment, protective technology and also a much better assessment of risk profiles.

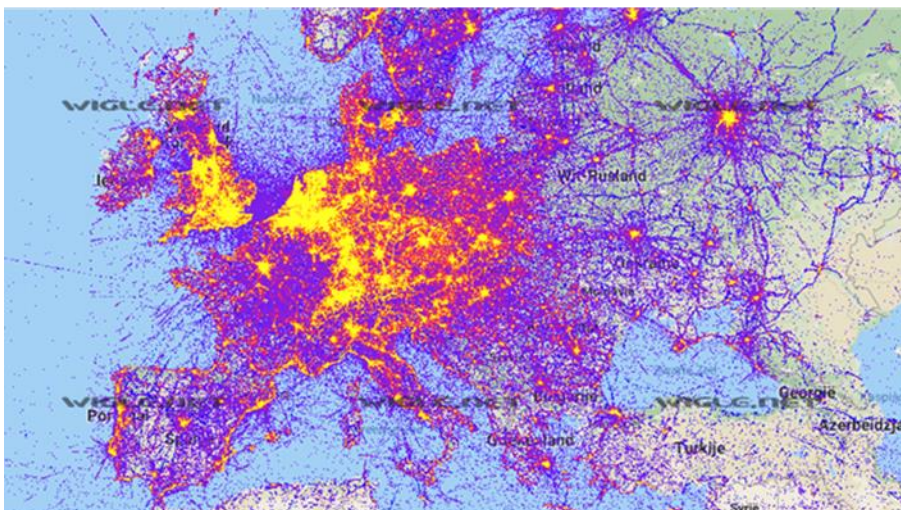
In the Netherlands,, the necessary expertise and research infrastructure for such studies is available and integrated national network of scientists and their universities and institutes can be realized in the short term. Examples include the formation of top technological institutes such as those for Food Science, Telematics and Drug Research (TI-Pharma), which certainly included a European extension.

### **Current concerns about 5G safety**

Fundamental and independent research throughout Europe (ref. 3), is all the more urgent, because its societies appear to be very concerned about the possible harmfulness of radiation. A study by the Knowledge Platform for Electromagnetic Fields in the Netherlands (Kantar 2016) showed that more than 40% of the population indicates that they fear that this type of EMF radiation is harmful to health. In the same survey, 3% of the respondents (half a million Dutch) say they experience complaints from EMF of electrical equipment. To date, insufficient research has been conducted on people who imply that they are electro-hypersensitive (EHS-ers). An independent study should look at which co-factors and what type of physiological parameters distinguish these people from people without such complaints. The “Electro-hypersensitivity Foundation” in the Netherlands has done a lot of useful exploratory work to inventory the relevant health complaints and also to find methods on how to live with this condition. The latter even includes the mapping of low-radiation zones in the country. In this framework it was indeed proposed to conduct more fundamental research into 5G in Europe and in particular into the phenomenon of hypersensitivity (ref. 15, article in “Dagblad van het Noorden”, 2018).

### **Funding of the new EMF-Health research**

Financing could take place from government funds, in particular related to the money that will arise from the distribution and auction of 5G frequency bands or alternatively from the existing “European Defense Fund for Innovative Security Research”. NWO (Netherlands Science Organization, and ZON-MW (Healthcare Research in the Netherlands) as well as the KNAW (Royal Academy of Science) should of course be involved in the organization of this whole. A major advantage of such collective effort is that the current barren stalemate between public organizations and government could be ultimately broken. In addition, the creation of new innovative “Start-up companies” in this area can clearly generate economic benefits and jobs.



### **Legal aspects of 5G network unrolling**

The performance of more fundamental research prior to 5G implementation, would also convincingly meet the legal precautionary principle practiced by friends and enemies, which states that if a public intervention or policy measure can cause serious or irreversible damage to society or the environment, the burden of proof lies with the advocates of the intervention. This principle is in particular valid if there is no scientific consensus about the possible damage (see ref. 2). The

government is therefore obliged to conduct research that demonstrates safety and cannot hide behind the attitude of “unsubstantiated insecurity”, (see “Precaution with Reason”, (2008, ref. list 1) Health Council, Ministry of VRM, the Netherlands). Of note, very recently, summary proceedings were brought against the Dutch government on the basis of extensive documentation and arguments, by the Stop-5G NL Foundation (ref 14, list 1)

### **The selective omission of peer-reviewed articles on non-thermal EMF effects**

It is staggering that formal European reports formulated opinions that selectively omit hundreds of peer-reviewed publications (ref. 4, 5). Also, in connection with this, it was recently announced that Switzerland, the country that is most advanced in Europe with developing 5G networks, has temporarily stopped rolling out the 5G network. This is due to serious concerns about its health and safety aspects (ref. 6). Research into mechanisms of EMF hypersensitivity (EHS) is also a high priority. It is precisely in this area that TNO conducted an interesting study in 2003 that clearly described non-thermal EMF effects on life conditions (ref. 12), but the professional report, unfortunately, remained unpublished! The fact that well-founded publications about 5G radiation- induced damage, as recently discussed in Scientific American, were subsequently "neutralized" and that the opportunity for a rebuttal was denied, seems characteristic in this light (ref. 13). In fact, a similar fate occurred to the 11 articles encompassing the existing work of Prof. dr. Achermam (see ref. 5)

### **The primary objectives and success parameters of the proposed EMF-Health Research Platform**

The present proposal aims to thoroughly review the further development of the 5G network as a whole. This applies primarily to the exact choice of 5G frequencies based on the extent to which coherent/de-coherent effects on quality of life can be expected. The relevance of this should be investigated as soon as possible in human material and in human populations as well as in animals of sufficient group size. The data obtained in the intended Research Platform, apart from assisting in definite decisions with regard to further unrolling of 5G networks in Europe, can also be used technologically, for example for adapting the various 4G/5G antenna systems or for the development of effective protective materials for hypersensitive people and animals.

### **Strict boundary conditions for 5G implementation**

If it turns out that a safe radiation load is still possible in the European context, and an actual roll-out of the network is considered to be justified, one should clearly proceed gradually when introducing the technology. This could be realized, for example, by activating the antennas in only part of cities and not in other similar parts, this in order to enable epidemiological research with adequate internal controls. In addition, two other essential conditions should be met before potential implementation of the network:

- 1) The rollout of 5G should not start without a systematic and independent registration and further monitoring of existing complaints of citizens
- 2) There should be options for people who experience serious complaints from EMF, to be able to stay in selected low-radiation environments

### **Call:**

**We therefore advocate the immediate establishment of a Research Platform for fundamental and applied health research in the field of “EMF and Life”, within the European community.**

The Netherlands can take adequate initiatives for cooperation with European top institutes that have expertise in this field.

### **The European context requires an urgent concerted action**

The European human and animal population are increasingly exposed to new physical and chemical agents in the environment, some of which may be damaging to health. The impact of electromagnetic waves on health has been clearly established by many studies in recent decades (Simko, 2019; Halgamuge, 2020; Deruelle, 2020, see ref. list 2). Among these, electromagnetic fields are one of the most widespread, and their application in new technologies continues to grow. Well known examples are 5G mobile-phone technology, that is currently actively developed and commercialized. As mentioned above, there is major concern among the public and public health professionals about possible short- and long-term health effects related to EMF, while results of the available studies to date are extensively debated.

To better understand the potential mechanisms that may underly possible health effects of EMF and to characterize population levels of exposure, the “Generalised EMF Research using Novel Methods” (GERoNiMO) project was launched in 2014. This project was funded under the EU’s Seventh Framework Programme for Research and Technological Development, in order to address pertinent questions on EMF and health. An integral approach was chosen, using epidemiological studies, exposure assessment techniques, mechanistic and animal models, and expert networks applying novel methods. The following objectives were formulated:

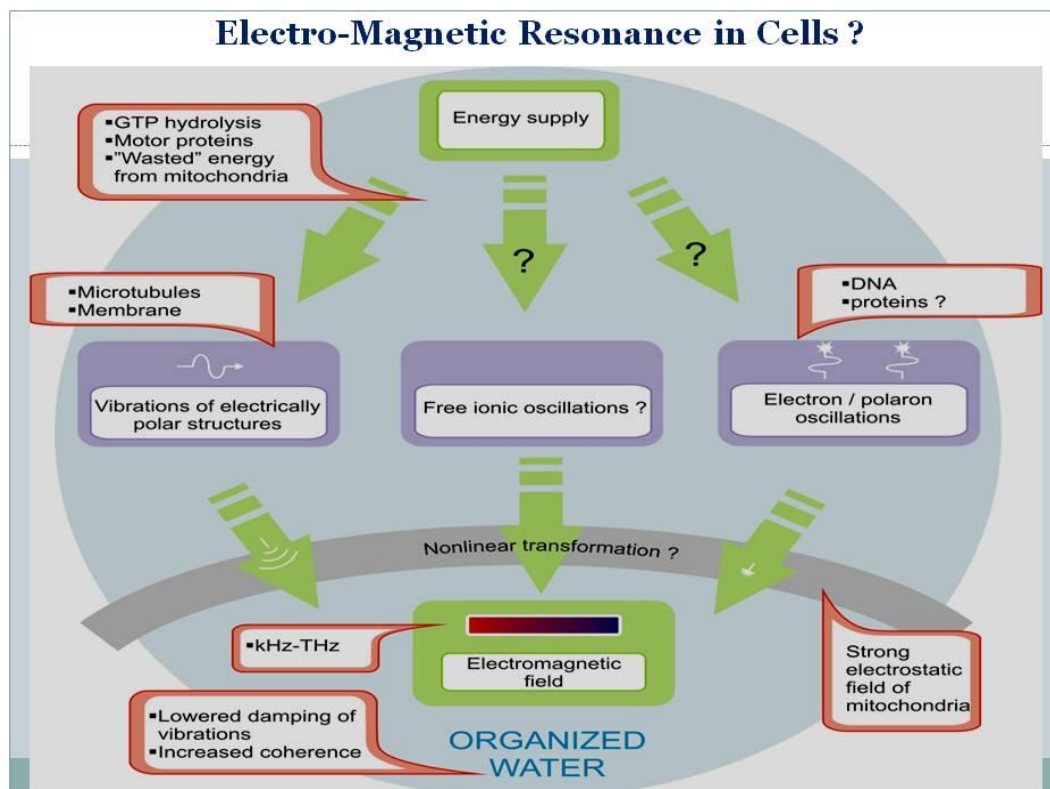
- To better understand mechanisms underlying possible health effects of EMF;
- To better characterize current and future populations levels of EMF exposure in Europe;
- To further the state of knowledge on EMF and health;
- To improve health risk assessment of EMF.

Thus, a comprehensive understanding of the mechanisms of interaction will be further elucidated. In particular, there is great interest in evaluating the induced biological responses from the point of view of the associated interaction mechanisms (Scarfi, 2019). It has been recommended that, especially, non-thermal electromagnetic studies should be investigated more systematically. I.e., studies should consider various frequencies, also in combination, to identify potential frequency-dependent effects and apply different field strengths, especially if threshold-dependent effects are expected (Bodewein, 2019).

Research about electromagnetic pulses on living cells has already been systematically undertaken the past eighty years. No less than 40.000 biological/physical reports are now available, of which a part is dealing with non-thermal biological effects on cells. Influences of electromagnetic waves causing thermal effects on biological systems are relatively well understood, and much more knowledge about non-thermal effects of electromagnetic waves has become available in the past decades. Interestingly, there are both reports available about life-sustaining as well as life-decaying non-thermal EMF frequencies (see also above).

### **More on the GM-scale biophysical principle for EMF effects on life systems**

As mentioned above, Geesink and Meijer (see reference list 1) launched the idea to organize registered electromagnetic health effects on a quantized frequency scale, and to search for a possible pattern of “healthy and unhealthy frequencies”. The fundamental notion that a physical property can be “quantized” is referred to as “the hypothesis of quantization” and is related to quantum physics theory. This means that the magnitude of the physical property can only take discrete values consisting of typical values. Indeed, if quantum mechanical principles were taken into account, the authors were able to establish a mathematical basis for the apparent band spectrum of the discrete, non-thermal, electro-magnetic field (EMF) frequencies that were shown to be related either to healthy or to diseased states. This mathematical basis is in line with the earlier formulated theories of Schrödinger and Fröhlich. It was the idea of Schrödinger (1944) that in life systems a molecular code-script should be present, which supplies information to realize biological order in life cells. Fröhlich (1988) predicted that such a mechanism in cells may consist of a constant energy flux. This, in the form of coherent waves, that create a coherent vibratory state of cell components such as proteins, lipids and DNA/RNA in order to coordinate and communicate life information in cells and between cells of the whole organisms (Fröhlich, 1988).

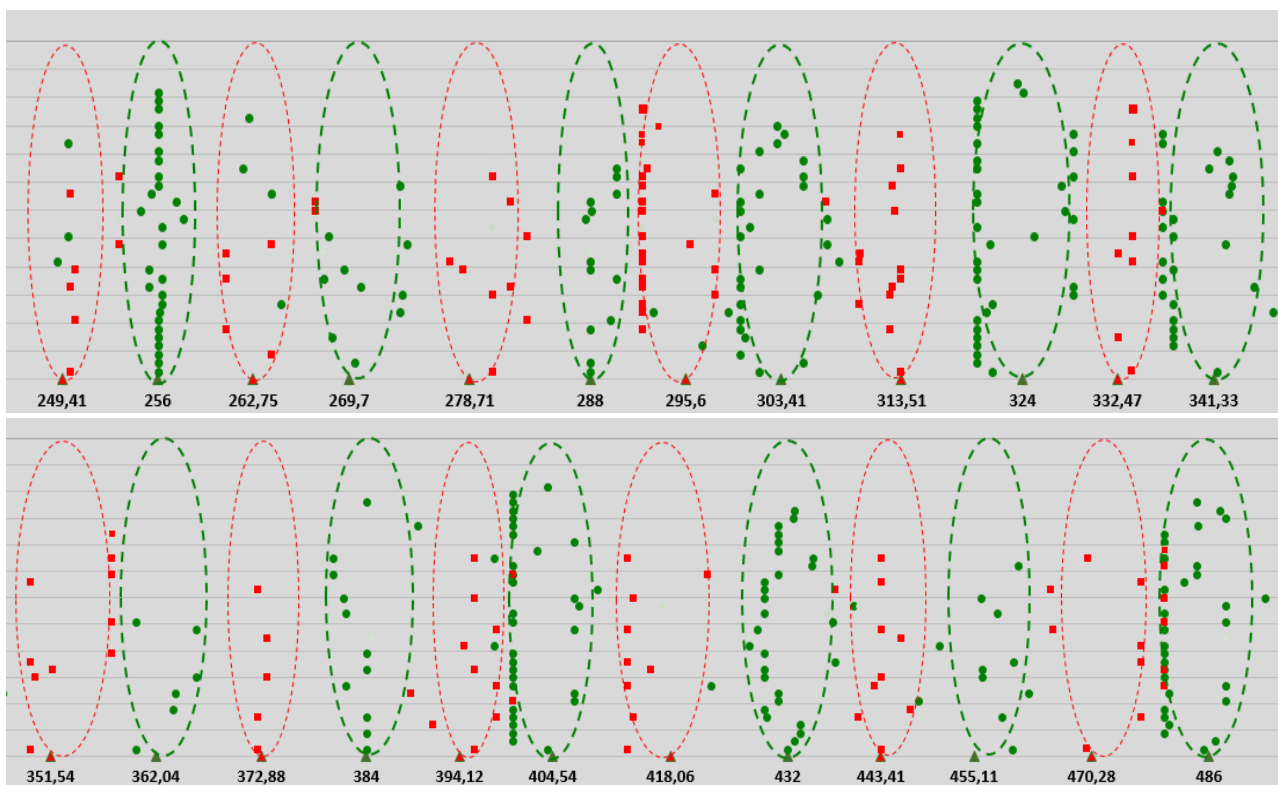


**Figure 1:** EMF-resonance in various organelles in the cell results from internal energy sources and/or exposure to external EMF radiation. Through coherence of wave information (Meijer and Geesink, 2019), local EM fields may arise, partly mediated by organized water domains on different cellular levels (De Loof, 2016).

The proposed equation (called life algorithm) by Geesink and Meijer predicts a discrete distribution of energy:  $E_n = \hbar \omega_{ref} 2^{n+p} 3^m$ , and is in line with both the models of Fröhlich and Davydov. The proposed wave equation was in fact inferred from a meta-analysis of 724 biomedical publications from 1970 till 2020 of beneficial and detrimental biological effects caused by external exposure of

life systems. These included cultured cells, whole animals and also human tissues, exposed to non-thermal EMF in the range of extreme low frequencies (ELF) up to Terahertz (THz) frequencies. Based on this study, a distinct causal relation was shown between exposure of discrete non-thermal EMF-frequencies and healthy or unhealthy effects on living cells and/or biomolecules. It was concluded that external exposures to non-thermal Hz, KHz, MHz- and GHz electromagnetic fields can lead to unhealthy conditions depending on wave frequency, pulsing properties, field intensity and exposure time. The effects of applied single or composed frequency patterns related to healthy or unhealthy conditions, as mentioned in the 724 reports, fitted for 94.2% with the proposed frequency band pattern predicted by the life algorithm quantum model (see ref's:1 and 10, list 1 and ref's list 3)

Consequently, this meta-analysis of biomedical literature provided clear bio-physical evidence for the presence of the abovementioned molecular code-script that may be instrumental in the supply of information for inducing biological order in life cells through states of coherence. The particular acoustic scale (Pythagorean-like pattern, at frequencies of one-tenth of a Hertz till Peta Hertz,  $10^{15}$  Hz), showed a pattern of 12 bands that can be positioned on a fractal frequency scale. The typical coherent electromagnetic frequencies (green points) are positioned within a striking small mean bandwidth. Interestingly the decoherent electromagnetic frequency states (red points) are precisely positioned just in between coherent electromagnetic frequency states.



**Figure 2.** Measured frequency data of living cell systems that are life-sustaining (green points) and detrimental for life (in red squares) versus calculated normalized frequencies. Biological effects were measured following exposures or endogenous effects of living cells *in vitro* and *in vivo*, at a spectrum of frequencies apparently patterned in bands of Hz, kHz, MHz, GHz, THz, PHz range. Green triangles plotted on a logarithmic x-axis represent published life-sustaining frequencies; red triangles



*represent reported life-destabilizing frequencies. Each point indicated in the graph is taken from published biological data and represent a typical frequency for the reported biological experiment(s). For clarity, points are randomly distributed along the Y-axis.*

The term coherence is defined here as the physical congruence of wave properties within wave packets, exhibiting a property of stationary waves (i.e. temporally and spatially constant) that enable wave interference, known as constructive. In particular, processes are called coherent when the variability of the phase differences between the signals is relatively small, whereas the wave processes, defined as incoherent, the phase difference has a high degree of variability.

***Further research to counteract non-thermal unhealthy electromagnetic effects by the currently emerging of communication technology is highly needed. For example, improving the balance of coherent and decoherent waves, may restore healthy conditions. The collective knowledge can open potential novel roads to innovative technologies in telecom research and healthcare.***

**First Author Contact: em. Prof. dr. Dick K.F. Meijer**  
**Email: [meij6076@planet.nl](mailto:meij6076@planet.nl). tel. nr. 0031-050-3180593**

#### **Reference list 1: The proposal for an EMF-Health Research Platform in Europe**

1. Sonderkamp T, Geesink JH, Meijer DKF, (2019). Statistical analysis and prospective application of the GM-scale, a semi-harmonic EMF scale proposed to discriminate between “coherent” and “decoherent” EM frequencies on life conditions. *Quantum Biosystems*, 10(2), 33-51  
<https://www.quantumbionet.org/quantumbiosystems/>
2. Voorzorg met rede, (2008). Gezondheidsraad, Min. VRM, Nederland  
<https://www.gezondheidsraad.nl/documenten/adviezen/2008/09/26/voorzorg-met-rede>
3. European Parliament (2020): Effects of 5G wireless communication on human health,  
[https://www.europarl.europa.eu/RegData/etudes/BRIE/2020/646172/EPRS\\_BRI\(2020\)646172\\_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/BRIE/2020/646172/EPRS_BRI(2020)646172_EN.pdf)
4. Starkey S J, (2016). Inaccurate official assessment of radiofrequency safety by the Advisory Group on Non-ionizing Radiation. *Rec Environ Health.*, 31, 493-503  
<https://www.degruyter.com/view/j/reveh.2016.31.issue-4/reveh-2016-0060/reveh-2016-0060.xml>
5. Flydal E, (2020). Head of Swiss Radiation Protection Committee accused of 5G-swindle. Nordic countries deceived, too. [https://einarflydal.com/wp-content/uploads/2020/02/Einar-Flydal-The-Accusations-against-R%C3%B6sli-and-the-BERENIS-20200220\\_v-3.pdf](https://einarflydal.com/wp-content/uploads/2020/02/Einar-Flydal-The-Accusations-against-R%C3%B6sli-and-the-BERENIS-20200220_v-3.pdf)
6. Bodewein, L. Schmiechen K., Dechent D., Stunder D., Graefrath D., Winter L., Kraus T., Driessen S. Systematic review on the biological effects of electric, magnetic and electromagnetic fields in the intermediate frequency range (300 Hz to 1 MHz). *Environmental Research* Volume 171, April 2019, Pages 247-259.
7. Switzerland halts rollout of 5G over health concerns, jan. 2020.

<https://www.ft.com/content/848c5b44-4d7a-11ea-95a0-43d18ec715f>

8. Meijer D K F, (2018). Organization of Drug Research in the Netherlands from the year 2000: FIGON and Dirk K.F. Meijer.  
[https://www.researchgate.net/publication/334721497 Organization of Drug Research in the Netherlands from the year 2000 FIGON and Dirk KF Meijer](https://www.researchgate.net/publication/334721497_Organization_of_Drug_Research_in_the_Netherlands_from_the_year_2000_FIGON_and_Dirk_KF_Meijer)
9. Commentaar van Stichting EHS op de “Verkenning van de blootstelling aan elektromagnetische velden afkomstig van 5G-systemen” RIVM Rapport 2019-0214 – 49 pp. R. Stam et al. 2019.
10. Geesink J H, Meijer D K F (2020). An integral predictive model that reveals a causal relation between exposures of non-thermal electromagnetic waves and healthy or unhealthy effects. Researchgate.net/publication/340504334\_An\_integral\_predictive\_model\_that\_reveals\_a\_causal\_relation\_between\_exposures\_to\_non-thermal\_electromagnetic\_waves\_and\_healthy\_or\_unhealthy\_effects
11. International EMF Scientists Appeal : Scientists warn of potential serious health effects of 5G  
<http://www.5gappeal.eu/the-5g-appeal/> and <https://emfscientist.org/index.php/emf-scientist-appeal>
12. Zwamborn A P M, 2003. Effects of global communication system radio frequency fields on well being and cognitive functions of human subjects with and without subjective complaints. TNO Physics and Electronic Laboratory Report.  
<https://www.emf-portal.org/en/article/12820>
13. Moskowitz J M, 2020. Scientific American Created Confusion about 5G's Safety: Will They Clear It Up?  
<https://www.saferemr.com/2020/02/will-scientific-american-clear-up.html>
14. Kort geding tegen de Nederlandse overheid om 5G te stoppen, (Summary proceedings brought against the Dutch government) <https://stralingsbewust.info/2020/01/15/stichting-start-kort-geding-tegen-de-nederlandse-staat-om-5g-te-stoppen/>
15. Voorstel Stichting EHS voor Europees onderzoek, Dagblad van het Noorden, 2018. Wetenschap: doe meer onderzoek naar 5G. (Proposal for doing more scientific research into 5G)  
<https://stichtingehs.nl/actueel/nieuws/doe-europees-onderzoek-naar-5g>

## **Reference list 2: Supporting references for non-thermal effects of EMF radiation on life systems**

16. Bodewein, L. Schmiedchen K., Dechent D., Stunder D., Graefrath D., Winter L., Kraus T., Driessen S. Systematic review on the biological effects of electric, magnetic and electromagnetic fields in the intermediate frequency range (300 Hz to 1 MHz). Environmental Research Volume 171, April 2019, Pages 247-259.
17. Deruelle F. The different sources of electromagnetic fields: Dangers are not limited to physical. Journal Electromagnetic Biology and Medicine, Published online: 10 Mar 2020.
18. Fröhlich, H. (1988). Biological Coherence and Response to External Stimuli. Berlin, Heidelberg, New York: Springer.

19. Halgamuge M. N., Efstratios Skafidas, Devra Davis. A meta-analysis of in vitro exposures to weak radiofrequency radiation exposure from mobile phones (1990–2015), *Environmental Research*, Available online 13 February 2020, 109227.
20. Scarfi, MR, Mats-Olof Mattsson, Myrtil Simkó, Olga Zeni. Special Issue: “Electric, Magnetic, and Electromagnetic Fields in Biology and Medicine: From Mechanisms to Biomedical Applications” *Int. J. Environ. Res. Public Health* 2019, 16, 4548; doi:10.3390/ijerph16224548 [www.mdpi.com/journal/ijerph](http://www.mdpi.com/journal/ijerph).
21. Schrödinger, E. *What Is Life? & Mind and Matter* Cambridge University Press (1974) ISBN 0-521-09397-X.
22. Simkó M., Mats-Olof Mattsson. 5G Wireless Communication and Health Effects—A Pragmatic Review Based on Available Studies Regarding 6 to 100 GHz. *Int. J. Environ. Res. Public Health* 2019a, 16, 3406; doi:10.3390/ijerph16183406.

**Reference list 3: Publications (2016-2019) by Ir. Hans (JH) Geesink and Prof. dr. Dirk K. F. Meijer, University of Groningen**

1. Geesink J. H. and Meijer D.K.F. (2016a). Quantum Wave Information of Life Revealed: An Algorithm for Electromagnetic Frequencies that Create Stability of Biological Order, with Implications for Brain Function and Consciousness. *NeuroQuantology*, vol. 14, pp 106-125, <file:///C:/Users/Dick/Documents/911-2447-1-PB.pdf>
2. Meijer D.K.F and Geesink J.H. (2016). Phonon Guided Biology. Architecture of Life and Conscious Perception are mediated by Toroidal Coupling of Phonon, Photon and Electron Information Fluxes at Discrete Eigenfrequencies. *NeuroQuantology*, vol.14, issue 4, pp 718-755 <http://www.neuroquantology.com/index.php/journal/article/view/985>
3. Geesink J. H. and Meijer D.K.F. (2016b). Bio-Soliton Model that Predicts Non-thermal Electromagnetic Frequency Bands, that Either Stabilize Living cells. <https://arxiv.org/pdf/1610.04855> and ELECTROMAGNETIC BIOLOGY AND MEDICINE, 2017, vol. 36, no.4, 357-378 <https://doi.org/10.1080/15368378.2017.1389752>
4. Meijer D K F and Geesink J. H, (2017). Guided folding of life’s proteins in integrate cells with holographic memory and GM-biophysical steering. *Open Journal of Biophysics*, 8, 117-154 [https://file.scirp.org/pdf/OJBIPHY\\_2018071615175972.pdf](https://file.scirp.org/pdf/OJBIPHY_2018071615175972.pdf)
5. Geesink J.H. and Meijer D. K.F. (2017 a). Electromagnetic Frequency Patterns that are Crucial for Health and Disease Reveal a Generalized Biophysical Principle: the GM scale. *Quantum Biosystems*, 8, 1-16
6. Meijer D. K. F. and Geesink J. H. (2017 c). Consciousness in the Universe is Scale Invariant and Implies the Event Horizon of the Human Brain. *NeuroQuantology*, 15, 41-79 <https://www.neuroquantology.com/index.php/journal/article/viewFile/1079/852>
7. Geesink J.H. and Meijer D. K. F. (2018 a). Mathematical Structure of the GM Life Algorithm that May Reflect Bohm’s Implicate Order. *J. Modern Physics*, 9, 851-897 [https://file.scirp.org/pdf/JMP\\_2018041015321535.pdf](https://file.scirp.org/pdf/JMP_2018041015321535.pdf)

8. Meijer D. K. F. and Geesink J. H, (2018a). Favorable and Unfavorable EMF Frequency Patterns in Cancer: Perspectives for Improved Therapy and Prevention. *J. Cancer Therapy*, 9, 188-230  
<https://www.scirp.org/journal/PaperInformation.aspx?PaperID=82944>
  
9. Geesink J. H. and Meijer D. K. F, (2018b). A harmonic-like electromagnetic frequency pattern organizes non-local states and quantum entanglement in both EPR studies and life systems. *J. Modern Physics* 9, 898-924  
[https://file.scirp.org/pdf/JMP\\_2018041015494906.pdf](https://file.scirp.org/pdf/JMP_2018041015494906.pdf)
  
10. Geesink J. H. and Meijer D. K. F. (2018c). Semi-Harmonic Scaling enables Calculation of Masses of Elementary Particles of the Standard Model. *J. Modern Physics*, , 9, 925-947  
[https://file.scirp.org/pdf/JMP\\_2018041015591721.pdf](https://file.scirp.org/pdf/JMP_2018041015591721.pdf)
  
11. Meijer D. K. F. and Geesink J. H. (2018b). Guided folding of life's proteins in integrate cells with holographic memory and GM-biophysical steering. *Open Journal of Biophysics*, 8, 117-154  
[https://file.scirp.org/pdf/OJBIPHY\\_2018071615175972.pdf](https://file.scirp.org/pdf/OJBIPHY_2018071615175972.pdf)
  
12. Geesink J. H, and Meijer D. K. F. (2018c). Evidence For a Guiding Principle in Quantum Physics. *Quantum Biosystems*, 9, 1-7 [http://www.quantumbiosystems.org/admin/files/QBS%209%20\(1\)%201-17%20\(2018\).pdf](http://www.quantumbiosystems.org/admin/files/QBS%209%20(1)%201-17%20(2018).pdf)
  
13. Meijer, D. K. F and Geesink J. H, (2018 c). Is the Fabric of Reality Guided by a Semi-Harmonic, Toroidal Background Field? *International Journal of Structural and Computational Biology*.  
<https://pdfs.semanticscholar.org/43a5/dbabe7ce98c06d45451e2329a19327c42dbc.pdf>
  
14. Geesink, J.H and Meijer, D. K. F, (2019a). A novel biophysical quantum algorithm, predicts superconductive properties in animate and inanimate systems, *Quantum Biosystems*, 10, 1-32  
<https://www.quantumbionet.org/quantumbiosystems/>
  
15. Geesink, J. H and Meijer, D. K. F. (2019 b). Water: the cradle of life via its coherent quantum frequencies. *Water Journal*, in the press
  
16. Sonderkamp, T, Geesink J.H , Meijer D. K. F, (2019). Statistical analysis and prospective application of the GM-scale, a semi-harmonic EMF scale proposed to discriminate between "coherent" and "decoherent" EM frequencies on life conditions. *Quantum Biosystems*, 10(2), 33-51  
<https://www.quantumbionet.org/quantumbiosystems/>
  
17. Meijer D. K .F, Geesink J. H, (2019). Life and Consciousness are Guided by a Semi-Harmonic EM Background Field. *NeuroQuantology* ,Vol. 17, Issue 4, 37-44  
<https://www.neuroquantology.com/index.php/journal/article/view/2074>
  
18. Geesink J. H, Meijer D.K.F, Igor Jerman I, (2020). Clay minerals: Fractal Quantum Information Network and the Origin of Life. Submitted
  
19. Geesink J.H, Meijer D.K.F, (2020). An integral predictive model that reveals a causal relation between exposures to non-thermal electromagnetic waves and healthy or unhealthy