

The EMF Research Book (draft edition)

**A collection of theories and hypotheses for the study of biological and health
effects of electromagnetic fields**

Mads Rohde

2024-11-09

Table of contents

Preface	4
1 Introduction (draft)	5
I Characteristics (draft)	6
Characteristics of electromagnetic fields and radiation	7
2 Nomenclature (draft)	8
II Effects (draft)	9
3 Thermal theories (draft)	10
4 Non-thermal theories (draft)	11
4.1 The interaction with specific biological components	11
4.1.1 Melanin	11
4.2 The Zeeman effect (Chiabrera et al. 2000)	11
4.3 The Rouleaux Effect	11
4.4 Microbiome	11
5 Ionizing radiation theories (draft)	12
6 Specific diseases	13
6.1 Cardiovascular disease	13
6.1.1 Blood pressure	13
6.2 Cancer	13
7 Psychological theories (draft)	14
III Exposure assessment	15
8 Real world measurements (draft)	17
8.1 5G exposure	17

9 Exposure in general	18
9.1 Fifth generation mobile phone technology (5G)	18
IV Resources (draft)	19
Identifying research gaps	20
10 Literature data (draft)	21
10.1 Soviet research	21
11 Open data (draft)	22
12 EMF research around the world (draft edition)	23
References	24

Preface

The best book for scientific ideas, including generating new ideas and bringing ideas to life – within the field of biological and health effects of electromagnetic fields (EMF).

This is a collection of theories and hypotheses related to the study of biological and health effects of non-ionizing radiation.

The book is an open science project started in 2024 and is work in progress. A final edition may take years to complete. Scientists and authors familiar with the topic can contribute and will be credited for any contribution. If you want to contribute, you can simply submit additions and revisions at the book's [GitHub repository](#). Currently, I serve as the editor, but that may be changed if more experienced authors decide to contribute.

The book at this page will remain free. The book is licensed under [CC BY-NC-ND 4.0](#). Potentially, additional paperback, hard copy or e-book editions can be made available for sale at a future point in time.

The aim of the book is to be a comprehensive list of the theories and hypotheses related to non-ionizing radiation that can be used for researchers and others who want to familiar themselves with the topic; look up potential frameworks to interpret findings; or explore research gaps and possible new research questions and methods.

The aim is not to discuss specific research findings, but rather to provide a scope of theories. However, relevant scientific references for each theory should be included. But to support the progress of the development of this book, such lists may most often not be exhaustive, meaning that a theory may be included with one reference initially that is not necessarily the most updated and correct reference.

It is also not the aim that theories or hypotheses included should have been proven to be correct (or scientifically speaking, not haven been falsified). Theories that are speculative, or even wrong, may also be included, and the reader should be aware this. The reason for this is that ideas that have not yet been researched may have extra value in that they may point to research gaps, and theories that have proven wrong may prohibit other researchers to waste their effort following that same path.

1 Introduction (draft)

Electromagnetic fields are ...

Part I

Characteristics (draft)

Characteristics of electromagnetic fields and radiation

2 Nomenclature (draft)

Part II

Effects (draft)

3 Thermal theories (draft)

4 Non-thermal theories (draft)

4.1 The interaction with specific biological components

4.1.1 Melanin

4.2 The Zeeman effect (Chiabrera et al. 2000)

4.3 The Rouleaux Effect

4.4 Microbiome

A hypothesis about how the microbiome can be affected by exposure to anthropogenic electromagnetic fields and create health effects, may first have been presented in a conference abstract in 2022, for a conference in Sogn og Fjordane in Norway (Manzetti 2022)

5 Ionizing radiation theories (draft)

6 Specific diseases

6.1 Cardiovascular disease

6.1.1 Blood pressure

Cell phone calls, and thus radiofrequency radiation, may be related to the development of high *blood-pressure* (hypertension) , according to a large study using data from the UK Biobank (Ye et al. 2023). Radiation exposure can be assumed to be strongly affected by cell phone usage. Confounding factors and other explanatory models can always exist. Mecanistic models for how a blood pressure increase can happen due to radiofrequency radiation, is a topic for future studies, – and such studies will increase the confidence in the findings from epidemiological studies on cell phone usage or similar exposure, and blood pressure.

6.2 Cancer

7 Psychological theories (draft)

Part III

Exposure assessment

...

8 Real world measurements (draft)

8.1 5G exposure

2022:

- Columbia, SC, USA (Koppel and Hardell 2022)

2024:

- Stockholm, Sweden, 2024 (Hardell and Koppel 2024)

9 Exposure in general

9.1 Fifth generation mobile phone technology (5G)

Non-user exposure:

A 2023 study performed measurements “near two 5G New Radio (NR) base stations, one with an Advanced Antenna System (AAS) capable of **beamforming** and the other a traditional microcell.” (emphasizement/bold part added)(Aerts et al. 2023).

They found that exposure was in general lower for non-users than for users, but that “for the non-user, the difference lies in whether they are in a beam or not” and that when there are many users around the base station exposure can generally increase for the non-user.

Part IV

Resources (draft)

In this part of the book, various resources that can aid in research on electromagnetic fields. The various chapters holds resources such as information on literature databases, open data and scientific communities around the world.

Identifying research gaps

If you are interested in conducting new research on EMFs, the table below with *the seven research gaps* from Miles (2017) may aid you. What research gap *type* do you find to be the most important within EMF science?

Research Gap Type	Definition
Evidence Gap (Contradictory Evidence Gap)	Results from studies allow for conclusions in their own right, but are contradictory when examined from a more abstract point of view [Jacobs, 2011; Müller-Bloch & Kranz, 2014; Miles, 2017].
Knowledge Gap (Knowledge Void Gap)	Desired research findings do not exist [Jacobs, 2011; Müller-Bloch & Kranz, 2014; Miles, 2017].
Practical-Knowledge Gap (Action-Knowledge Conflict Gap)	Professional behavior or practices deviate from research findings or are not covered by research [Jacobs, 2011; Müller-Bloch & Kranz, 2014; Miles, 2017].
Methodological Gap (Method and Research Design Gap)	A variation of research methods is necessary to generate new insights or to avoid distorted findings [Jacobs, 2011; Müller-Bloch & Kranz, 2014; Miles, 2017].
Empirical Gap (Evaluation Void Gap)	Research findings or propositions need to be evaluated or empirically verified [Jacobs, 2011; Müller-Bloch & Kranz, 2014; Miles, 2017].
Theoretical Gap (Theory Application Void Gap)	Theory should be applied to certain research issues to generate new insights. There is lack of theory thus a gap exists [Müller-Bloch & Kranz, 2014; Jacobs, 2011; Müller-Bloch & Kranz, 2014; Miles, 2017].
Population Gap	Research regarding the population that is not adequately represented or under-researched in the evidence base of prior research (e.g., gender, race/ethnicity, age, etc.) [Robinson, et al, 2011].
Sources	Robinson, Saldanha, & McKoy (2011); Müller-Bloch & Kranz, (2015); Miles, (2017).

10 Literature data (draft)

10.1 Soviet research

In the earliest time of EMF science, much research was done in the Soviet Union.

Big portions of this body of research may not be available in literature databases. As a starting point of an exploration of the Soviet research, below is a list of some sources discussing this literature.

- Glaser and Dodge (1976)
- D. I. McRee (1979)
- Donald I. McRee (1980)
- Kositsky, Nizhelska, and Ponezha (2001)
- Kostoff (2019)
- Kostoff (2020)

11 Open data (draft)

12 EMF research around the world (draft edition)

References

- Aerts, Sam, Kenneth Deprez, Leen Verloock, Robert G. Olsen, Luc Martens, Phung Tran, and Wout Joseph. 2023. “RF-EMF Exposure Near 5G NR Small Cells.” *Sensors (Basel, Switzerland)* 23 (6): 3145. <https://doi.org/10.3390/s23063145>.
- Chiabrera, A., B. Bianco, E. Moggia, and J. J. Kaufman. 2000. “Zeeman-Stark Modeling of the RF EMF Interaction with Ligand Binding.” *Bioelectromagnetics* 21 (4): 312–24. [https://doi.org/10.1002/\(sici\)1521-186x\(200005\)21:4%3C312::aid-bem7%3E3.0.co;2-#](https://doi.org/10.1002/(sici)1521-186x(200005)21:4%3C312::aid-bem7%3E3.0.co;2-#).
- Glaser, Zorach R., and Christopher H. Dodge. 1976. “Biomedical Aspects of Radiofrequency and Microwave Radiation: A Review of Selected Soviet, East European, and Western References.” In *Biologic Effects of Electromagnetic Waves: Selected Papers of the USNC/URSI Annual Meeting (Boulder, Colorado, Oct. 20-23, 1975)*, 2–34. HEW Publications (FDA) 77-8010 and 77-8011.
- Hardell, Lennart, and Tarmo Koppel. 2024. “Spots with Extremely High Radi-ofrequency Radiation After Deployment of 5G Base Sta-tions in Stockholm, Sweden.” *Ann Clin Med Case Rep* 14 (4): 1–8.
- Koppel, Tarmo, and Lennart Hardell. 2022. “Measurements of Radiofrequency Electromagnetic Fields, Including 5G, in the City of Columbia, SC, USA.” *World Academy of Sciences Journal* 4 (3): 22. <https://doi.org/10.3892/wasj.2022.157>.
- Kositsky, Nikolai Nikolaevich, Aljona Igorevna Nizhelska, and Grigory Vasil’evich Ponezha. 2001. “Influence of High-Frequency Electromagnetic Radiation at Non-Thermal Intensities on the Human Body.” *No Place To Hide-Newsletter of the Cellular Phone Taskforce Inc* 3 (1): 1–33.
- Kostoff, Ronald N. 2019. “Adverse Effects of Wireless Radiation.”
- . 2020. “The Largest Unethical Medical Experiment in Human History.”
- Manzetti, Sergio. 2022. “On the Potential Underlying Cause of Electromagnetic Field Hypersensitivity: A Connection to the Gut Microbiome.”
- McRee, D. I. 1979. “[Review of Soviet/Eastern European Research on Health Aspects of Microwave Radiation](#).” *Bulletin of the New York Academy of Medicine* 55 (11): 1133–51.
- McRee, Donald I. 1980. “Soviet and Eastern European Research on Biological Effects of Microwave Radiation.” *Proceedings of the IEEE* 68 (1): 84–91.
- Miles, D. Anthony. 2017. “A Taxonomy of Research Gaps: Identifying and Defining the Seven Research Gaps.” In *Doctoral Student Workshop: Finding Research Gaps-Research Methods and Strategies, Dallas, Texas*, 1–15.
- Ye, Ziliang, Yanjun Zhang, Yuanyuan Zhang, Sisi Yang, Mengyi Liu, Qimeng Wu, Chun Zhou, Panpan He, Xiaoqin Gan, and Xianhui Qin. 2023. “Mobile Phone Calls, Genetic Susceptibility, and New-Onset Hypertension: Results from 212 046 UK Biobank Participants.”

European Heart Journal - Digital Health 4 (3): 165–74. <https://doi.org/10.1093/ehjdh/ztad024>.