https://www.biorxiv.org/content/early/2016/05/26/055699

Meta-analysis is the statistical procedure for combining data from multiple studies. When the treatment effect (or effect size) is consistent from one study to the next, **meta-analysis** can be used to identify this common effect

An electromagnetic field (also EMF or EM field) is a physical field produced by electrically charged objects. It affects the behavior of charged objects in the vicinity of the field.

Static E and M fields and static EM fields[edit]

Main articles: electrostatics, magnetostatics, and magnetism

When an EM field (see electromagnetic tensor) is not varying in time, it may be seen as a purely electrical field or a purely magnetic field, or a mixture of both. However the general case of a static EM field with both electric and magnetic components present, is the case that appears to most observers. Observers who see only an electric or magnetic field component of a static EM field, have the other (electric or magnetic) component suppressed, due to the special case of the immobile state of the charges that produce the EM field in that case. In such cases the other component becomes manifest in other observer frames.
A consequence of this, is that any case that seems to consist of a "pure" static electric or magnetic field, can be converted to an EM field, with both E and M components present, by simply moving the observer into a frame of reference which is moving with regard to the frame in which only the "pure" electric or magnetic field appears. That is, a pure static electric field will show the familiar magnetic field associated with a current, in any frame of reference where the charge moves. Likewise, any new motion of a charge in a region that seemed previously to contain only a magnetic field, will show that the space now contains an electric field as well, which will be found to produces an additional Lorentz force upon the moving charge.
Thus, electrostatics, as well as magnetism and magnetostatics, are now seen as studies of the static EM field when a particular frame has been selected to suppress the other type of field, and since an EM field with both electric and magnetic will appear in any other frame, these "simpler" effects are merely the observer's. The "applications" of all such non-time varying (static) fields are discussed in the main articles linked in this section.

1. UT

ABBREVIATION

Universal Time.

The direction of the field lines indicates
the direction of the electric force at any point. The density or spacing of the lines corresponds to the
intensity of the field. Figure 2-3 shows the electric field that exists between two equal and opposite
electric charges. Electric field intensity is measured in units of volts per meter (V/m). One thousand volts
per meter is a kilovolt per meter (kV/m). Field intensities are sometimes referred to as “field values” or simply as “fields”.

Figure

There are several different units used to describe magnetic fields. The proper unit of magnetic field intensity is the Ampere per meter (analogous to the V/m for electric fields). Often, magnetic field strength is indicated by **a** related quantity called the magnetic flux density which is the number of field lines that cross a unit of surface area. The unit of magnetic flux density that is encountered most often in the power-frequency literature is the gauss (G). Sometimes, the magnetic flux density is given in tesla (T).
There are 10,000 gauss in each tesla. For fields in air or in biological tissues, the magnetic flux density in gauss is l/80th of the magnetic field intensity in A/m. The gauss and tesla are large units. Sixty hertz magnetic fields are commonly reported in thousandths of a gauss or milligauss (mG). Note: 1000 microteslas/1 ~~Tesla~~ x 1 ~~Tesla/~~10000 gauss = 0.1 uTesla / gauss

Electric and magnetic fields produced by power lines and other sources can be either measured using a "field meter" or calculated given information on voltage and current. For transmission lines, such
calculations can be quite accurate. Published reports describing fields from various sources are listed in

Table 2-1.

In an independent set of experiments, Blackman and coworkers also observed a change in calcium efflux, although it was an increase rather than decrease, with a complex pattern of several "windows". The frequency ranges they examined were 1-30 Hz and 45-105 Hz , and the intensity range, 1 to 70 V/m. [Blackman 82, Blackman 85a, Blackman 85b] Figure 3-1 summarizes the ELF frequency and intensity combinations found to cause changes in calcium-ion efflux from chick brain tissue in vitro. [Blackman 85a] For example, the figure shows that in

this experiment, at 60 Hz, six field intensity values were examined : 25, 30, 35, 40, 42.5 and 45 V/m . These voltage values to the peak-to-peak voltage (abbreviated as V_{PP}) of the field applied during the experiments. In all other experiments the field intensity is expressed in terms of root-mean-square (rms) voltage, as defined in Section 2.2.2. Figure 3-1 also shows the equivalent rms values. The effect appeared only at three of these values, 35, 40 and 42.5 V/m. The lower values of 25 and 30 V/m as well as the higher value of 45 V/m showed no significant difference between the efflux from the exposed and the unexposed halves of the brain. That is, for the frequency of 60 Hz, there is an intensity window between about 35 V/m and 43V/m. There is no effect observed immediately above or below this range of values. Similarly, if the intensity is kept at 42.5 V/m and the effect explored at various frequencies, the effect is seen at several values (15, 45, 60, 75, 90 and 105 V/m) but not at values in between. Further experiments by Blackman et al., showed that the position of frequency and amplitude windows was influenced by the strength and relative orientation of any static magnetic field superimposed on the AC field [Blackman 85 b]. That is, the position of the windows depended on constant or static (not

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27
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I
0
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20 40 60 80 100 120
Frequency, Hz

Figure 3-1: Frequency and intensity windows in the efflux of calcium from chick brain tissue : This figure shows the results of Blackman's experiments on calcium efflux in chick brain exposed to ELF electric fields.' The horizontal axis shows the frequency of the sinusoidal ELF exposure. The left hand vertical axis shows the peak-to peak electric field strength. The right hand vertical axis denotes the root-mean-square field strength (See section 2.2.l for an explanation). The efflux of calcium from one half of the brain exposed in vitro to ELF electric fields **was** found to be significantly higher than from the other half which was not exposed. The graph shows the values of frequency and field intensities for which there was an effect. Dark circles show the presence of an effect and the open circles show values which were examined, but no effect was found. Instead of showing an effect that increased or decreased with increasing or decreasing frequency or intensity, the effect appeared at certain values of frequency and intensity but not at others. For example, note that when the frequency of the applied field is 60 Hz, an effect is seen at 3 values of field, at 35, 40 and 42.5 Vpp/m. When the field is **above** or below this range, such as at 45 V/m or at 30 Vpp/m, there is no effect. So when the "applied frequency is 60 Hz, there is an 'intensity window"

between about 35 and 42.5Vpp/m at which there is an effect. Along similar lines, it can be seen that there **are** "frequency windows" at 15, 45, 60, 75, 90 and 105 Hz when the applied field **value is** kept at 42.5Vpp/m. Similar observations can be made about other values of frequency and field. [Blackman 85a]
AC) magnetic fields present in the labortory setup. In a recent experiment, Bellossi has found that a
replication of the efflux experiment with only static (frequency = O Hz) magnetic fields produces no effect..

[Bellossi 86].

The group at the J.B. Pettis Veterans Hospital at Loma Linda have examined the tumor promotion hypothesis by looking at effects of ELF fields on specific biochemical processes in the cell rather than by looking at the cell growth itself. Their results are described below. They have so far examined : 1. Decreased immune response depicted by the CTLL-1 experiment described in the previous section [Lyle 86], 2. Accelerated growth potential as measured by the increased activity of ornithine decarboxylase (ODC), described below [Cain 86, Byus 86], 3. Loss of the ability of cells to communicate because of the loss of gap junctions, described below [Fletcher 87]. Ornithine decarboxylase (ODC) is present in all cells and is an essential enzyme for cell growth because it helps synthesize biochemical that are necessary for DNA and protein syntheses. Any agents promoting cell growth also increase ODC activity. Examples of biochemical that cause increased ODC activity when administered to cells are : hormones and growth factors in the **case** of normal cells, and tumor promoters such as phorbol esters that promote uncontrolled growth of tumor cells. Hence factors that increase ODC activity can, but do not necessarily, lead to tumors. Highly increased ODC activity has been used as an indicator of malignancy.

Table 3-1: Cellular Level Experiments: Effects and possible significance
A Summary of results described in this section
Possible
Experiment Effects Noted Significance
Calcium efflux from Efflux is dramatically changed.
cell membrane The change occurs only at some
(6 experiments) frequency and intensity values,
but not at others.
Chromosomal Damage
(3 experiments)
DNA Synthesis Rate
(1 experiment)
RNA Translation
(1 experiment)
Cell Response Modifications:
Response to:
A. hormones
(1 experiment)

B. Neurotransmitters
(1 experiment)
No chromosomal damage
detectable.
Rate change at low
magnetic field.
New proteins made by
the cell. Rate of transcription
altered.
Modifications in adrenal
and bone tissue and connective
cell response.
to hormones
Phase shifts in
the periodicity of
secretion rhythms
C. immune system Not clear that there
(5 experiments) are significant effects
except in special cases.
Significance not clear
But points up the
possibility that effects
of fields may not be
such that “higher field intensity
is worse than lower”.
Does not cause the
damage that usually
initiates cancer.
Extremely low AC magnetic
fields as small as the
earth’s natural DC field
may affect cell process
rates.
Fields may alter rates
of primary cell processes.
Significance not clear.
Adrenal response shows
intensity windows. Bone tissue
experiment points to membrane
as site of action.
If true in humans, might
have implications for
psychological disorders, such as
chronic depression.
Implications not clear.

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Among the most impressive and concerted set of experiments with animals have been those conducted at the Battelle Pacific Northwest Laboratories in Richland, Washington [Phillips 79] under a rather large project funded primarily by the Department of Energy, and a few smaller projects by Electric Power Research Institute (See Section 8), The first phase of these experiments consisted of extensive screening studies in which animals were examined for all kinds of effects of electric fields at the perceptual, behavioral and physiological levels. This screening was done under fairly high field strengths, much higher than any field that is likely to be encountered even under the right-of-way as it was thought that this would enable a potential effect to be picked up. This argument assumed that exposure to higher fields produce more pronounced effects than that to lower values. The Battelle studies used small animals such as mice, rat and miniature swine to study effects of fields on behavior, physical and motor development and growth, immunology and hematology, and endocrinology. Several of the studies spanned generations. The breadth of these studies, their careful experimental design and interpretation make them the central source of knowledge in this area. This has in large part been due to the excellent team work by experts in the various fields relevant to this area of study such as neurochemistry, stress physiology, psychology, developmental toxicology, electrical engineering and physics and careful integration of the results. Animal studies with sufficient numbers of animals to get statistically significant results, are very expensive and time-consuming. For example, some of the Battelle studies spanned two or three generations of mice and pigs (4-5 years), and involved as many as two hundred rodents in each

study.

Report of Partial findings from the National Toxicology Program Carcinogenesis Studies of Cell Phone Radiofrequency Radiation in

Hsd: Sprague Dawley® SD rats (Whole Body Exposure)

Michael Wyde, Mark Cesta, Chad Blystone, Susan Elmore, Paul Foster, Michelle Hooth, Grace Kissling, David Malarkey, Robert Sills, Matthew Stout, View ORCID ProfileNigel Walker, Kristine Witt, Mary Wolfe, John Bucher
doi: https://doi.org/10.1101/055699

- Abstract
- Info/History
- Metrics
- Preview PDF

ABSTRACT

The US National Toxicology Program (NTP) has carried out extensive rodent toxicology and carcinogenesis studies of radiofrequency radiation (RFR) at frequencies and modulations used in the US telecommunications industry. This report presents partial findings from these studies. The occurrences of two tumor types in male Harlan Sprague Dawley rats exposed to RFR, malignant gliomas in the brain and schwannomas of the heart, were considered of particular interest, and are the subject of this report. The findings in this report were reviewed by expert peer reviewers selected by the NTP and National Institutes of Health (NIH). These reviews and responses to comments are included as appendices to this report, and revisions to the current document have incorporated and addressed these comments. Supplemental information in the form of 4 additional manuscripts has or will soon be submitted for publication. These manuscripts describe in detail the designs and performance of the RFR exposure system, the dosimetry of RFR exposures in rats and mice, the results to a series of pilot studies establishing the ability of the animals to thermoregulate during RFR exposures, and studies of DNA damage. Capstick M, Kuster N, Kühn S, Berdinas-Torres V, Wilson P, Ladbury J, Koepke G, McCormick D, Gauger J, Melnick R. A radio frequency radiation reverberation chamber exposure system for rodents Yijian G, Capstick M, McCormick D, Gauger J, Horn T, Wilson P, Melnick RL and Kuster N. Life time dosimetric assessment for mice and rats exposed to cell phone radiation Wyde ME, Horn TL, Capstick M, Ladbury J, Koepke G, Wilson P, Stout MD, Kuster N, Melnick R, Bucher JR, and McCormick D. Pilot studies of the National Toxicology Program's cell phone radiofrequency radiation reverberation chamber exposure system Smith-Roe SL, Wyde ME, Stout MD, Winters J, Hobbs CA, Shepard KG, Green A, Kissling GE, Tice RR, Bucher JR, Witt KL. Evaluation of the genotoxicity of cell phone radiofrequency radiation in male and female rats and mice following subchronic exposure

Booster Shots - latimes.com, 08 Sep 2016
Technology analysts have been calling Apple's decision to eliminate the earphone jack on its new iPhone 7 a risky business move.

Coluna Ciência, 19 Jun 2016
O uso de telefone celular causa câncer? Esta é uma pergunta recorrente que sempre volta a agitar os meios de comunicação quando…

Respectful Insolence, 06 Jun 2016
There are certain myths that are frustratingly resistant to evidence, science, and reason. Some of these are basically medical…

Brights - Die Natur des Zweifels, 03 Jun 2016
Last week a new study linking cell phone radiation to cancers in rats had a lot of people wondering: Do I need to start…

Skeptoid, 03 Jun 2016
By now, most people have read something from one or both sides of the story regarding new preliminary data published about cell…

Motherboard RSS Feed, 03 Jun 2016
Last week a new study linking cell phone radiation to cancers in rats had a lot of people wondering: Do I need to start…

HighWire, 01 Jun 2016
Cold Spring Harbor Laboratory's bioRxiv preprint server hit a milestone these last few days with the posting of a preprint on…

Take As Directed, 01 Jun 2016
Texting while driving carries a much greater health risk than any effect of cell phone radiofrequencies. Photo credit: David…

Natural Society, 31 May 2016
Concerns over the potential cancer risk associated with cell phones is nothing new. Scientists and health experts have been…

Ars Technica, 31 May 2016
(credit: kaboompics) Late last week, headlines blared that a new $25 million years-long US government study had finally…

New Scientist - Astrobiology, 31 May 2016
A study in rats suggests high cellphone radiation exposure is linked to tumours, but the experiment can't tell us much about…

Guest Blog, 31 May 2016
The recent preliminary results from a study by the National Toxicology Program have serious limitations and…

NeuroLogica Blog, 30 May 2016
Mother Jones headline declares: "Game-Changing" Study Links Cellphone Radiation to Cancer." NBCNews was similar: A Possible…

Science-Based Medicine, 30 May 2016
The zombie story that cell phones cause cancer has risen from the grave yet again. There are certain myths that are…

Persuasion Blog, 29 May 2016
This research (pdf) is simple. Researchers exposed rats to two specific forms of cell phone radiation from gestation out to 106…

3quarksdaily, 28 May 2016

Dina Fine in Scientific American: Federal scientists released partial findings Friday from a $25-million animal study that…

Bruce's Blog, 28 May 2016
Cell-phone-radiation study finds associated brain and heart tumors in…

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Glioma in rat brain (credit: Samuel Samnick et al./European Journal of Nuclear Medicine) A series of studies over two years…

Booster Shots - latimes.com, 28 May 2016
New results from a closely watched government study show why the World Health Organization has flagged mobile phones as a…

Slashdot, 27 May 2016
An anonymous reader quotes a report from NBC News: A giant U.S. study meant to help decide whether cellphones cause cancer is…

WEBODILE - Your Personal Magazine, 27 May 2016
You are almost definitely slowly killing yourself. Eating poorly, smoking, riding motorcycles, watching "The Bachelor" — they're…

Motherboard RSS Feed, 27 May 2016
Image: Marjan Lazarevski/FlickrSmartphones have become so ubiquitous that they're almost an extension of ourselves. So some new…

scienceofus, 27 May 2016
Here we go again. As you may have already discerned from the panicky headlines exploding across your feed – "Cellphone-Cancer…

The Reference Frame, 27 May 2016
NBC News and others just informed about partial results of some new $25 million U.S. government of health impact of cell phones.

The Incidental Economist, 27 May 2016
Seriously, he's got more game than all of you combined: @aaronecarroll It is not possible for me not to #troll you with this.

Environment | Mother Jones, 27 May 2016
It's the moment we've all been dreading. Initial findings from a massive federal study, released on Thursday, suggest that radio…