Electromagnetic waves and cancer

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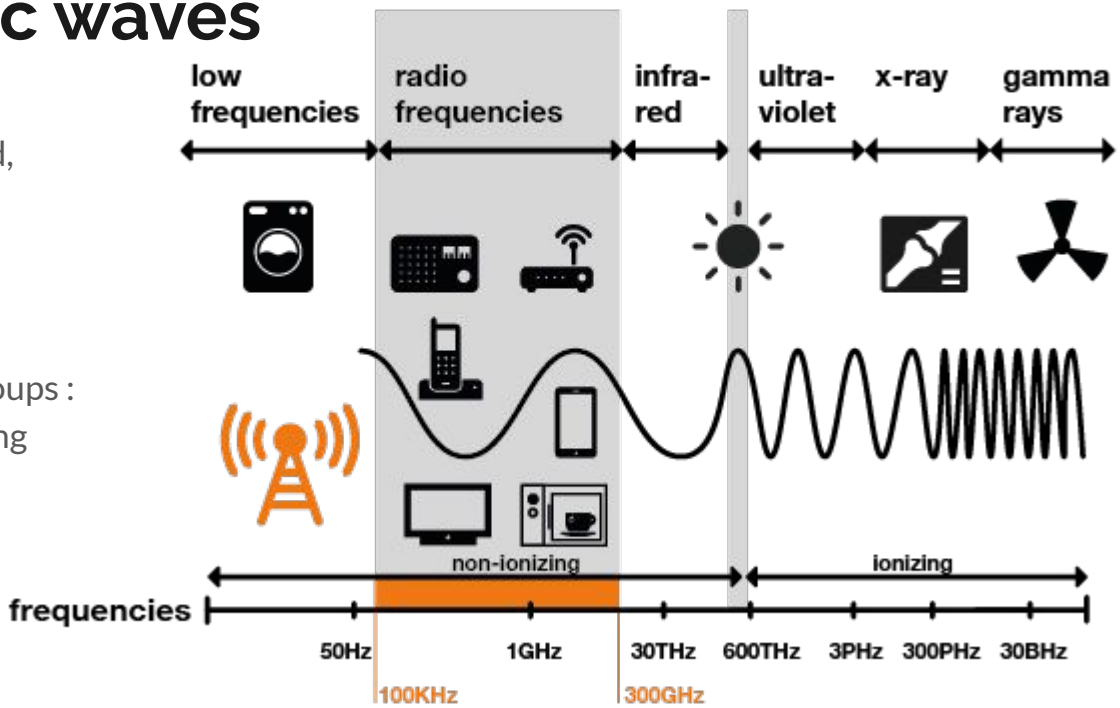
Electromagnetic waves

Waves of the electromagnetic field, propagating through space, and carrying electromagnetic radiant energy.

EM waves can be classified in 2 groups : Ionizing radiations and Non-ionizing radiations.

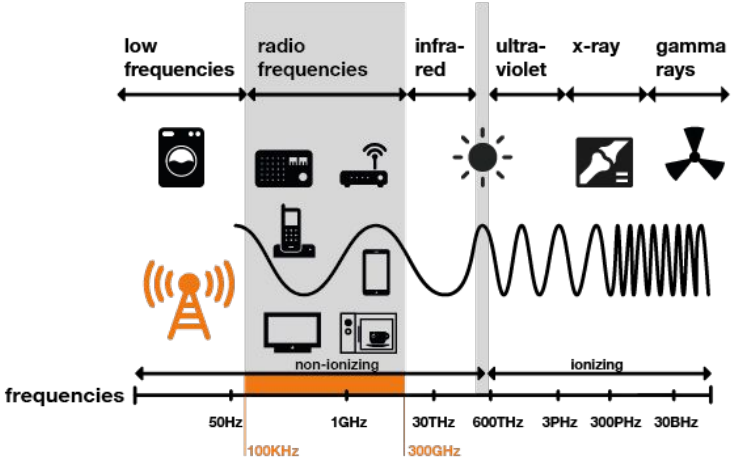


Electromagnetic waves

Ionizing radiations are extremely high frequency, X-rays and gamma rays. These have enough photon energy to produce ionization by breaking the atomic bonds that hold molecules together.

Non-ionizing radiations doesn't have enough photon energy to break these atomic bonds. These are IR radiation, as well as radiofrequency and microwaves.

Example that is interesting for us : radio waves, with a frequency between 100 KHz and 300 GHz.



Health and EM waves

Along with the widespread use of technological products in daily life, the biological effects of electromagnetic waves started to be discussed. Particularly concerning the radiofrequency waves, looking at the dramatically increasing number of mobile phones users rise significant concerns due to its potential damage on people exposed by radiofrequency waves.

Some electromagnetic waves are far from harmless, their dangerousness depends on their frequency: the higher the frequency, the more energy the wave is rich in and therefore deeply absorbed by the tissue.

Health and RF waves

RF waves : From 100 kHz to 300 GHz.

These waves have biological effects. The biological phenomena generated by EMFs depend on the wave/matter interaction at the frequency under consideration. Some effects are well established :

- Up to a frequency of 100 kHz, EMF induce currents that can lead to the **stimulation of excitable tissues** (nervous system and muscles),
- Above 10 MHz, EMFs induce **heating in the tissues** (thermal effect, by orientation of water molecules),

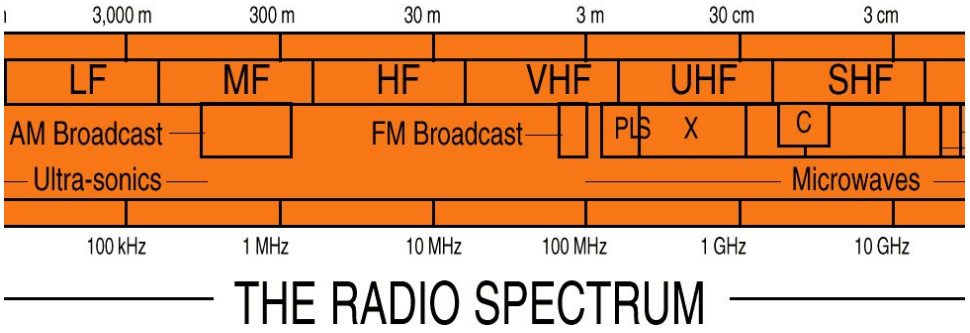
Other possible effects of EMFs are still the subject of scientific debate, such as **genotoxicity**, the **risk of cancer,** effects on **cell multiplication**, changes in the permeability of the blood-brain barrier, enzymatic and hormonal disturbances.

RF, high frequencies ?

As we see, effect on health are already visible at 100 KHz - 10 MHz, and radio frequency are up to 300 GHz.

We will distinct 2 différents type of radio frequencies :

- Radio Frequency IDentification, RFID.
- Radio Frequencies.



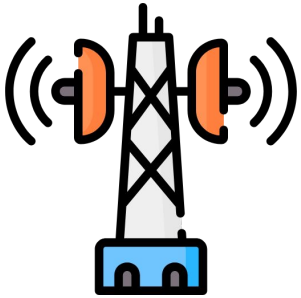
Radio Frequency IDentification

Use of radio waves to identify, without contact, an object (which can be a person), bearing a radio tag. The tag have an antenna associated with an electronic chip that enable them to receive and respond to radio waves emitted by a reading terminal.

Some applications are already widely used in everyday life: animal identification, public transport tickets, traceability of goods. There are 4 frequency bands used, low frequencies (125 kHz), high frequency (13,56MHz) which is the most common one in the industry, Ultra High Frequency (around 900MHz depending on the country)) and Super high frequency (microwaves) (5.8 GHz).

In most cases, only the terminal are emitting a radio frequency and the tags are passive devices using only the energy of the radio wave emitted by the terminal. The studies do not allow to establish any health risk linked to the explosion of these waves, the exposure being very low for the majority of person. However, a professional exposure can be more dangerous for people.

Radio Frequencies

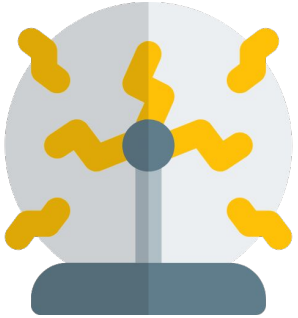


Mainly used by the smartphones and base stations. Mobile phone remains by far the main mode of exposure to radiofrequency fields, particularly in comparison with the exposure generated by base stations.

The increase in the use of mobile phones combined (+25% from 2017 to 2019) with the general increase in frequencies for communications (3g, 4g, and now 5g) is raising concerns about the effects of these waves, which are increasingly 'strong' and present in our environment.

Currently, smartphones are using high frequencies that can penetrate up to 1 cm into exposed tissues.

Radio Frequencies - Studies ?



All the studies that have been carried out lead to the conclusion that in the current state, the waves do not seem to have any particular effect on health in a conventional environment, and these studies also show that our levels of exposure to Radio Frequencies are all below the regulatory exposure limit values.

But…

The studies also warn that there is probably still not enough of a hold, given the recent democratisation of high frequencies.
Studies also warn that sustained exposure to these waves could (slightly) increase the chance of developing gliomas (Tumor that starts in glial cells of the brain of the spine), and therefore EM waves has been classified as ‘possibly carcinogenic’ for humans in 2011 by the IARC.

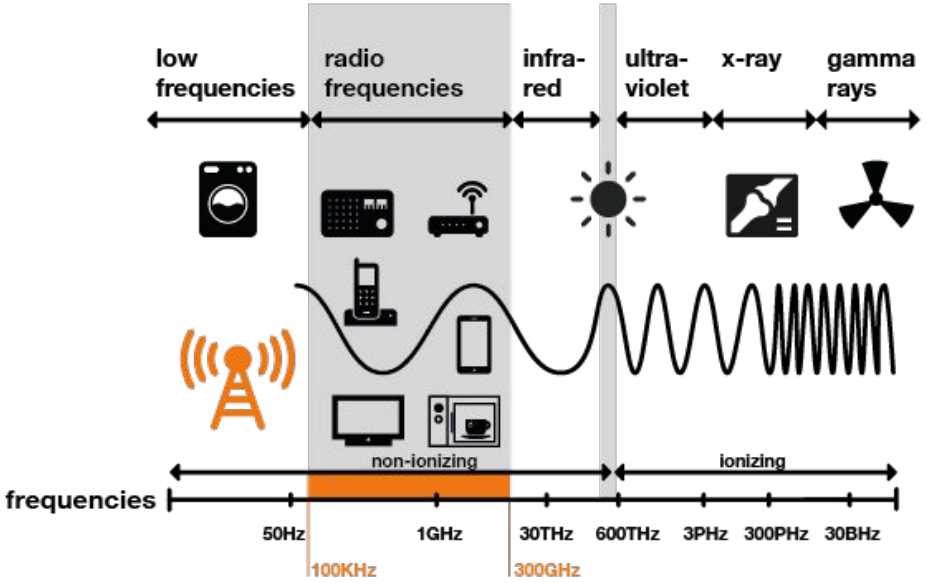
Radio Frequencies - 5G

With the recent deployment of 5G and the greater frequency it uses than 4G, can it be more risky?

4G frequencies : 700, 800 et 900 MHz, 1800, 2100 et 2600 MHz
5G frequencies : Between 700MHz and 26GHz, with the classic band at 3.5GHz.

Although no studies are currently available regarding the dangerousness of 5G waves, however, based on previous studies and current exposure levels, they are not expected to be dangerous under normal conditions either.
In addition, exposure will be reduced because 5G base stations will direct the 5G signal to the destination device, and not in all directions like the stations of previous generations.
However, harmlessness has not been proven either, and caution should be exercised until studies have been carried out on a large scale.

What about other electromagnetic waves ?



Ultraviolet waves

We get exposed to this type of EM wave from the sun.

Around 30 PetaHz (Peta = 10^15).

Getting too much sun exposure can be harmful, but in moderation, sun exposure is beneficial.

Beneficial effects :

- Vitamin D production from body.
- Skin well being (UV are used to treat psoriasis, eczema, ...etc)

Harmful effects :

- Skin damage (sunburn, skin cancer)
- Eye damage (eye being the most sensitive to lower UV band)

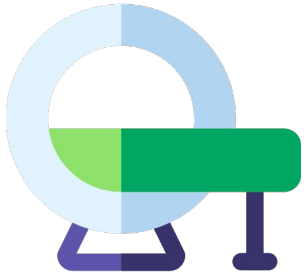
Ultraviolet waves

Protection from harmful damage : sunscreen.

Not everyone is equal when it comes to the dangers of UV rays: as UV rays affect the skin, higher melanin levels are less sensitive to UV rays.

So, this range of EM waves are both beneficial for us and harmful. And we can protect ourselves from the harmful effects.

EM waves and medicine : Medical Imaging



Two categories of EM waves used in medical imaging.

- X-rays, frequency range : 300 PetaHz - 30 ExaHz
- Gamma rays : > 30 ExaHz

These 2 categories of waves are classified as “Ionizing waves”, which can break atomic bond between molecules. These are capable of the most severe types of molecular damage, which can happen in biology to any type of biomolecule, including mutation and cancer, and often at great depths below the skin, since the higher end of the X-ray spectrum, and all of the gamma ray spectrum, penetrate matter.

Note : Peta = 10^15 / Exa = 10 ^18

EM waves and medicine : Medical Imaging

Great danger for the organism, implementation of protection, called radioprotection. The protection of people from harmful effects of exposure to ionizing radiation, and the means for achieving this

Two main measures for human protection :

- Dosimeter usage, to monitor and control the radiation level.
- Usage of shielding material, such as lead and barium sulfate.

-> We know how to protect ourselves from these harmful waves.

Conclusion

RF waves : Under normal conditions, no danger, even with 5G

UV waves : Beneficial or Dangerous, depending on the exposure level

X-ray, gamma : Dangerous, require protection

As the frequencies increase, the danger appears, however, we know how to protect ourselves at all levels.
About RF waves and 5G, even if it has not been proven that it is not dangerous, we will be able to protect ourselves if it has an effect on our health.