

ELECTROMAGNETIC RADIATIONS FROM COMMON ELECTRONIC DEVICES AND ITS IMPLICATION ON HUMAN HEALTH

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Electromagnetic Radiations (EMR); SAR Value; Ionizing radiations; Non-ionizing radiations

Abstract:

Humans are always surrounded by some form of the radiations or energy. These radiations depending on their type can cause implications to the human body in one or the other way. These are classified on the basis of their ionization strength, frequencies and a lot many factors. Appropriate and correct measure need to be taken so that there is least damage from the electromagnetic radiations. This paper expresses the concern regarding the implications that EMR can have on our human body.

I. INTRODUCTION TO ELECTROMAGNETIC RADIATION:

In quantum physics, an EMR is defined as the waves of electromagnetic field, that can propagate or radiate through the space (vacuum), thereby carrying electromagnetic radiant energy. The EMR can consists of different radiations such as Microwaves, Infrared, Visible light, Ultraviolet rays or even X-Rays [1]. The electromagnetic radiations consist of electromagnetic waves, synchronized by the oscillations of electric and magnetic fields propagating at the speed of light in vacuum [1]. Usually the EMR is associated with those EM waves that can propagate freely by discontinuing the influence of the moving charges that are responsible for their production. Under Quantum Theory of Electromagnetism, EMR consists of photons, which are the elementary particles and are responsible for all electromagnetic interactions. The quantum effects are responsible for providing additional sources such as the transition or jumping of electrons to lower energy levels in atoms or even black-body radiations.

Types of EMR:

The electromagnetic radiations can be categorized in two different ways, namely- the Ionizing Radiations and the Non-Ionizing Radiations.

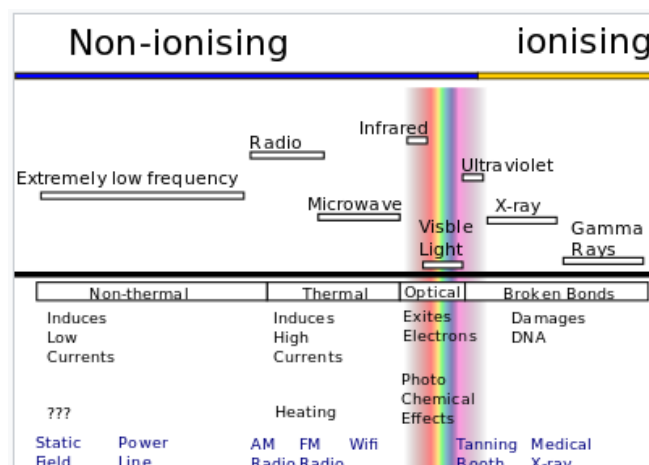


Fig 1: Pictorial Difference between Types of Radiation

Ionizing Radiations:

The ionizing radiations are those radiations which can knock-out electrons from their respective atom shells. They are also known to cause structural damage to DNA of the humans, which could ultimately lead to very severe implications on human health as well as ruin our future generations. These radiations are emitted mostly by the higher frequency EM waves including the X-rays, Gamma rays and even Ultraviolet (UV) rays.

Non-ionizing Radiations:

The non-ionizing radiations are those EMR which are too weak for causing any damage to the humans and in comparison with the ionizing radiations they are completely safe. These type of radiations are usually exhibited by the lower frequency EM waves such as the Microwaves, Visible light.

Ionizing Radiations vs Non-ionizing Radiations:

The differences between ionizing and non-ionizing radiations are listed below-

#	Ionizing Radiations	Non-ionizing Radiations
1	The ionizing radiations are caused by the electromagnetic waves having higher frequency in the Electromagnetic spectrum.	The non-ionizing radiations are caused by the electromagnetic waves possessing lower frequency in the electromagnetic spectrum
2	These radiations have the capability to knock off electrons from their respective atomic shells.	These radiations are too weak to knock out any electron from its atomic shell
3	They can cause severe health implications such as structural damage to the human DNA	These can't cause damages to greater extent, but its advisable to keep ourselves safe from the prolonged exposure of even this type of radiations
4	They are emitted by X-Rays, Gamma Rays, Ultraviolet Rays (UV Rays)	They are emitted by Visible light, microwaves etc.

Table 1: Ionizing radiations v/s non-ionizing radiations

The following diagram shows the pictorial difference between the ionizing and non-ionizing radiations. From the diagram also, it can be seen that non-ionizing radiations comprise of lower frequencies and on the contrary, the ionizing radiations are obtained from the higher frequencies in the electromagnetic spectrum.[3]

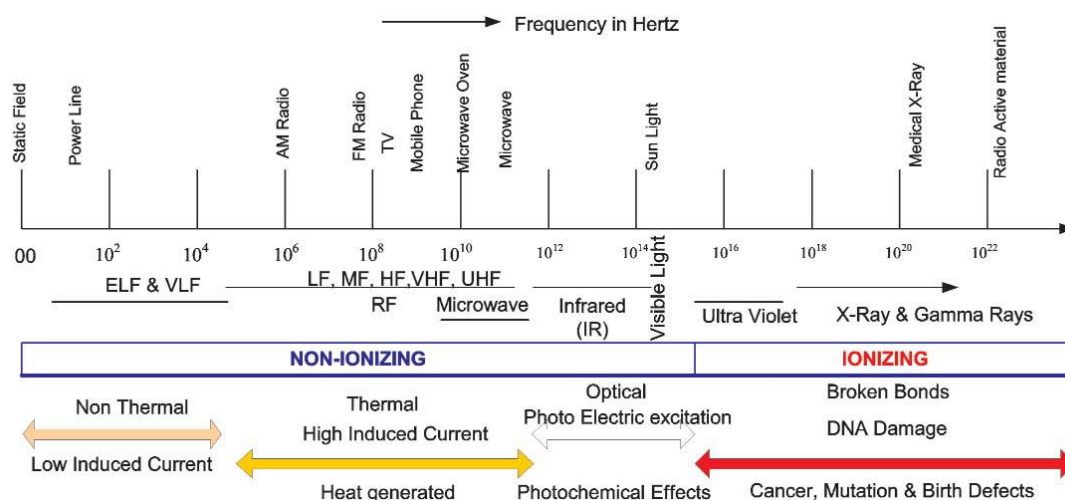


Fig 2: The Electromagnetic Spectrum

II. SPECIFIC ABSORPTION RATE (SAR):

It is the measure of the rate at which energy is absorbed by the human body when it's exposed to a radio frequency electromagnetic field. It can also be defined as absorption of other forms of energy by the tissues such as ultrasounds. It is usually averaged either over the entire body, or a small sample, i.e. either 1g or 10g of tissues in the body. [2] It is measured in Watts/kilograms (W/kg)

The formulae for determining the SAR value of an electromagnetic field is-

$$\text{SAR} = \frac{1}{V} \int_{\text{sample}} \frac{\sigma(\mathbf{r})|\mathbf{E}(\mathbf{r})|^2}{\rho(\mathbf{r})} d\mathbf{r}$$

Where,

σ is the sample electrical conductivity

\mathbf{E} is the RMS Electric field

ρ is the sample density

V is the volume of sample

The SAR Value of some of the common phones being used in India are-

Model	SAR Level	Model	SAR Level	Model	SAR Level
Apple iPhone 6 Plus	1.16	Apple iPhone 4s	1.19	Samsung Galaxy S6	1.25
Apple iPhone 6	1.14	Apple iPhone 4 (GSM)	1.11	Samsung Galaxy S5	1.47
Apple iPhone 5	1.18	Apple iPhone 4 (CDMA)	0.87	Samsung Galaxy S4	1.18
Apple iPhone 5c	1.18	Apple iPhone 3 GS	0.67	Samsung Galaxy S3	0.82

Table 2: SAR Values for common phones in India

The maximum permissible value of SAR in India is 1.6 W/kg and this value is done by the smartphone manufacturers and then sold to the market. Any smartphone that exceeds this prescribed value of SAR is not allowed to sell their phone in India. In India, a government owned laboratory named Telecommunication Engineering Center, calculates this value (SAR Value) by randomly choosing a smartphone produced by the manufacturer and thereby providing data back to the manufacturer [3].

Some of the smartphones having the lowest SAR values are listed below-

1. Samsung Galaxy Note 2; SAR Value = 0.17
2. Samsung Galaxy S3; SAR Value = 0.34
3. HTC One Max; SAR Value = 0.50 [3]

III. ELECTROMAGNETIC RADIATIONS FROM ELECTRICAL DEVICES:

i. Electromagnetic Radiations from Computers-

The electromagnetic radiations emitted from computer or PCs is of the type of Extremely Low Frequency or ELF Electromagnetic Radiations. This type of low frequency radiation is also emitted from the power lines [4]. A computer user who is unaware of the implications of the electromagnetic radiations is prone two types of radiations, namely the ELF Electromagnetic Radiations that are emitted by the user and also the microwave radiations that are emitted from the nearby devices. The field strength of these radiations when taken individually, but upon taking them together they can cause serious damage to human health.

The ELF radiations account for a numerous number of major and minor health complications in human health. Interference in sleep, cancer and Alzheimer's disease are some of the health complications that are caused by these types of radiations. If pregnant women are prolonged exposed to the ELF, the risk of miscarriage and birth defects are increased significantly [4].

ii. Electromagnetic Radiations from Laptops:

There are three types of radiations that are emitted from the laptops, namely- Low Frequency Electromagnetic Radiation, Radio Frequency Radiation and Heat Radiations. All the three radiations are a threat to human health. This type of radiation is similar to the radiations emitted from cellphones, television and microwave ovens, but the radiation from laptops is dangerous because as the name says "laptop", its placed on the laps of the users who are using it.

All these three radiations can cause damage to the vital organs, skin and muscles [4]. Such type of radiations can cause reactions in the body and also there are chances of development of skin rashes, muscles soreness and infertility. High levels of radiations can cause fatigue, dizziness and also different types of cancer. Upon direct expose to the laps, these radiations are responsible for serious health issues such as damage to the cells and DNA.

iii. Electromagnetic Radiations from Television:

The radiation emitted from the television sets are of the type Low frequency Electromagnetic Radiations. EMR released from the television is mainly due to the CRT or Cathode Ray Tubes, producing an EMR upto 20 milligauss when placed at a distance of 30cm and when the television set is placed at 1.5m, then the radiation level reaches over 1 milligauss. The radiations from the television sets are known to cause damage to the human eye. With the introduction of new technology TVs such as LED and LCD, they are responsible for emission of higher levels of radiations when compared to the CRTs. They are still preferred despite this threat level of radiations.

iv. Electromagnetic Radiations from Mobile Phones:

The radiations emitted from the mobile phones lie in the range of microwaves. They also emit radio frequency energy, which is a non-ionizing electromagnetic radiation and can be absorbed by the tissues if they are held close. There are several factors on which the emission of radiofrequency depends for mobile phones. Some of the factors are enlisted below-

- a. Technology of the phone
- b. Distance between the phone antenna and the user
- c. User' distance from the cell tower
- d. Extent of use of the device
- e. Type of the usage done

The radiations from the mobile phone can cause burning and tingling sensation in the scalp [4][5]. Other effects of mobile phone usage include dizziness, fatigues, lack of sleep and concentration. There are also chances of hearing disorders, memory loss, cataracts, increase in heart rate and several health issues, which're definitely not suitable for any user.

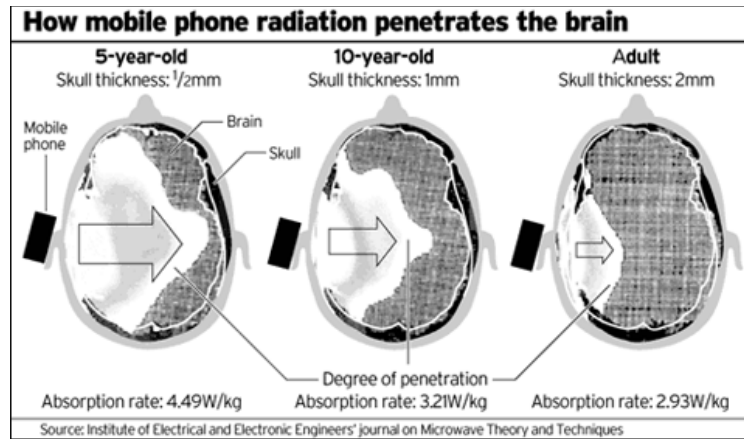


Figure 3: Radiations from mobile penetrates the brain

Conclusion:

The electromagnetic radiations are emitted by all the devices. There are certain levels defined for their usage and one should try to use these devices upto the defined levels and minimize the health threats. Exceeding the prescribed levels would cause several health ailments and implications. Following the right methods would definitely help in protecting from the threats possessed by these electromagnetic radiations. It is impossible to achieve zero radiations but their levels can be minimized.

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