

Fundamental to Electromagnetic Waves

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ABSTRACT

Electromagnetic waves pass through any type of mediums like solid-liquid-gaseous materials, air and space. Electromagnetic waves are manufactured from the beam of electrons passing through electric and magnetic fields acting perpendicular to each other. It moves in the air with the speed of light and having frequency very low range (3 Hz) to very high range (10^{24} Hz). It comprises with electromagnetic spectrum under different frequencies arranging in increasing range such as radio waves, microwaves, infrared radiation, visible light waves, ultraviolet radiation, X-rays, gamma rays etc. Maxwell invented mathematical formulas regarding electric and magnetic field for the propagation of electromagnetic waves. Conception of electromagnetic waves is proposed that they consist of photons which are massless and chargeless particle. In this paper, it is invented that electromagnetic waves are bunch of free electrons moving with the velocity of light having very huge (infinity) mass penetrating all type of materials, air and space. Exposure of electromagnetic waves is causing environmental pollution and health hazards to living creatures including human and tree kingdoms at the maximum extent.

KEYWORDS: *Electromagnetic waves, Frequency spectrum, Photons, Free electrons, Electron's rest mass, Electron's mass moving at the speed of light, Attraction time duration of paper pieces by the positive static electricity charged glass rod, Attraction time duration of paper pieces by the negative static electricity charged ebonite or plastic rod, environmental pollution.*

I. INTRODUCTION

There is no sound in space, because there are no molecules in space to transmit (carry) the sound waves. Electromagnetic waves are not like sound waves, since they do not need molecules to travel. It is observed that electromagnetic waves can travel through air, solid objects and space. Astronauts on space-walks use radio waves to communicate. Radio waves are a type of electromagnetic waves.

Electromagnetic waves are framed when an electric field couples with a magnetic field. Magnetic and electric fields of an electromagnetic wave are perpendicular to each other and to the direction of the electromagnetic wave. Radio waves, television waves, microwaves, X-Rays, visible light waves are all examples of electromagnetic waves [1]-[6]. They only differ from each other in wavelength or

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frequency. Wavelength is the distance between one wave crest to the next and the frequency is the number of wavelengths repeated in a second.

The smaller the wavelength (higher the frequency), the higher the energy, e.g., a brick wall blocks visible light wavelengths, but more energetic X-rays (having higher frequency and smaller wavelength) can pass through the brick walls. It is said that electromagnetic waves are "blocked" by certain materials like water, buildings, lead etc., i.e., wavelengths of energy are "absorbed" by objects. The atmosphere also absorbs some wavelengths of electromagnetic waves while to pass through. Production of electromagnetic waves by the electric and the magnetic fields are shown in Fig. 1.

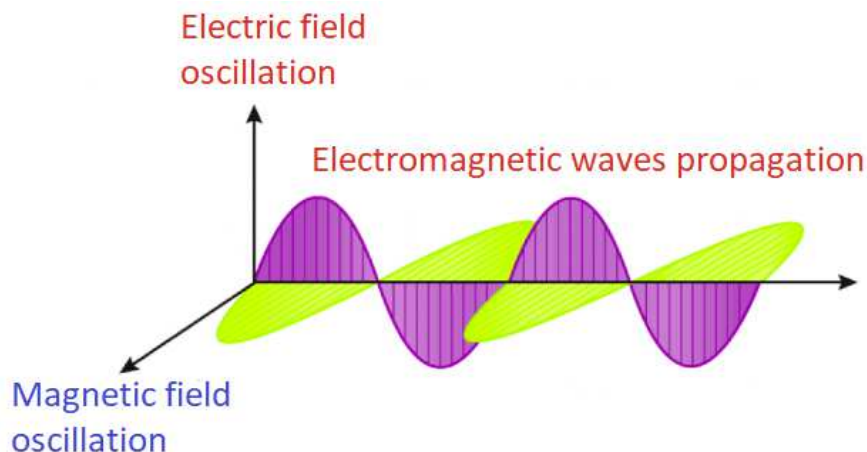


Fig 1 Production of Electromagnetic Waves by the Electric and the Magnetic field oscillations.

All the electromagnetic waves travel at a speed of 3×10^8 meters/second which is the speed of light. All the electromagnetic waves travel with the speed of light in medium or free space, they don't need any material medium to travel as required by other mechanical waves like sound wave, water wave and electrical wave.

When electromagnetic waves travel through space, it does not lose energy to a medium. When they strike matter, they lose energy, they may be reflected or refracted or diffracted or absorbed by the matter and converted to other forms of energy like heat, electricity etc.

II. ELECTROMAGNETIC WAVES CHARACTERISTICS

An electromagnetic wave is produced when an electrically charged particle vibrates. A vibrating charged particle causes the electric field surrounding it to vibrate as well. A vibrating electric field, in turn, creates perpendicularly a vibrating magnetic field. Again a vibrating magnetic field is applied on the charged particle which also creates perpendicularly a vibrating electric field. These two types of vibrating fields (electric and magnetic fields) acting perpendicularly (at right angles) combine to create an electromagnetic wave which travels perpendicular to the both fields. Therefore, an electromagnetic wave is a transverse wave. They are deflected neither by the electric field nor by the magnetic field. However, they are capable of showing interference or diffraction [1]-[6].

Electromagnetic waves are split into a range of frequencies (wavelengths), this is known as the electromagnetic spectrum in increasing frequency like radio waves, microwaves, infrared radiation, visible light waves, ultraviolet radiation, X-rays, gamma rays, shown in Table 1.

Table 1 Electromagnetic Spectrum

Name of the Spectrum	Wavelength	Frequency
Radio waves	100 Mm – 1 m	3 Hz – 300 MHz
Microwaves	1 m – 1 mm	300 MHz – 300 GHz
Infrared Radiation	1 mm – 750 nm	300 GHz – 400 THz
Visible Light	750 nm – 400 nm	400 THz – 800 THz
Ultraviolet Radiation	400 nm – 1 nm	10^{15} Hz – 10^{17} Hz
X-Rays	1 nm – 1 pm	10^{17} Hz – 10^{20} Hz
Gamma Rays	1 pm – 0.0001 pm	10^{20} Hz – 10^{24} Hz

This is clearly explained by Max Planck and Albert Einstein's Modern Quantum Theory such as electromagnetic waves consist of photon particles (as they assumed) and the energy (E) possessed by the waves or photon particles are calculated [1]-[3]. Photon is a massless and charge less elementary particle having particle and wave properties both as per their assumptions. If the energy of each photon is E ;

Then, $E = hf$ (1)

where h is called Planck's Constant, $h = 6.626 \times 10^{-34}$ joule-second; f or ν is the linear frequency of the electromagnetic waves. If velocity of electromagnetic waves is c and λ be the wavelength, we know, $f\lambda = c$, then $f = c/\lambda$,

Therefore, $E = hf = hc/\lambda$ (2)

Velocity of electromagnetic waves, c is equal to the velocity of light,

Hence, $c = 2.9979 \times 10^8$ meters/second or 1,86,000 miles/second.

Therefore, it is seen that if frequency of the electromagnetic waves is high, it will possess more energy, and thus it will penetrate the atoms, i.e., living and non-living body with more energy or power. It is already proved by Albert Einstein in Photoelectric Effect (earned Nobel Prize in 1921 for this) that when high frequency electromagnetic waves consisting of photon particles fall any atoms (metallic or non-metallic), the photons will release electrons from the atoms, called photoelectrons, cause current generation or current flow through the circuit.

Actually, the assumption of electromagnetic waves as photons like massless and charge less particle is not correct; if a photon is massless, then its energy (potential and kinetic both) becomes zero, i.e., the photon cannot strike with certain energy. Therefore, the photons are nothing except free electrons which have very less mass in rest (stationary) condition, i.e., 9×10^{-31} kg and infinity or huge mass in free stage when moving with the speed of light. Hence, electromagnetic waves are free electrons having very huge (infinity) mass comparing to its volume (radius of an electron, $r = 2.82 \times 10^{-15}$ m), and negative charge moving with the speed of light.

Whenever electromagnetic waves exist in a medium with matter, their wavelength is decreased. Wavelengths of electromagnetic radiation, whatever medium they are traveling through, are usually quoted in terms of the vacuum wavelength, although this is not always explicitly stated.

III. ELECTROMAGNETIC WAVES THEORY

With the publication of "A Dynamical theory of the Electromagnetic Field" in 1865, James Clerk Maxwell (Scotland, U.K.) demonstrated that electric and magnetic field travels through space as waves moving at the speed of light. Maxwell's equations encompass the major laws of electricity and magnetism [1]-[6].

The four Maxwell equations are on electromagnetic theory corresponding that D is the electric flux density coulombs/sq. meter, ρ (rho) is the electric charge density coulombs/cubic meter, B is the magnetic flux density weber/sq. meter, E is the electric field intensity volt/meter, H is the magnetic field intensity amperes/meter, J is the electric current density ampere/sq. meter, and they are expressed below:

$$(i) \operatorname{div} D = \rho \quad (ii) \operatorname{div} B = 0 \quad (iii) \operatorname{curl} E = -\frac{\partial B}{\partial t} \quad (iv) \operatorname{curl} H = \frac{\partial D}{\partial t} + J$$

Constitutive relations are- $D = \epsilon E, B = \mu H, J = \sigma E$.

Where ϵ is the permittivity, μ is the permeability of the material and σ is the conductivity of the material.

Vacuum behaves like a perfect linear "material" without additional polarization and magnetization.

The compact way of writing these equations in the meter-kilogram-second (mks) system is in terms of the vector analysis operators divergence (div) and curl, i.e., in partial differential equations form. The equations describe how the electric field can create a magnetic field and vice-versa. Here Maxwell established relations between the electric field intensity (E) and the magnetic flux density (B); the magnetic field intensity (H) and the electric flux density (D).

IV. PRODUCTION OF ELECTROMAGNETIC WAVES

Electromagnetic waves travel through empty space or through insulating materials, but they cannot travel through conducting materials, although they can travel along their surfaces. When alternating current flows through a wire (i.e., electric charges are accelerated), it produces lesser amount of electromagnetic waves. The frequency of the electromagnetic waves created by this way equals to the frequency of the alternating current.

The inverse effect also happens, if an electromagnetic wave strikes a wire (i.e., receiving antenna), it induces an alternating current of the same frequency in the wire. This is how the receiving antennas of a radio or television sets work [4]-[6]. Thus, an antenna is the most efficient when its length is of the order of the wavelength of the electromagnetic waves emitted or received. For TV transmission, electromagnetic waves having wavelengths of the order of one meter, which is also the size of a typical TV antenna.

Therefore, electromagnetic radiation is produced whenever a charged particle, such as an electron changes its velocity, i.e., whenever it is accelerated or retarded (decelerated).

The generation of electromagnetic radiation into two categories is below:

1. Systems or processes that produce radiation covering a broad continuous spectrum of frequencies, e.g., the Sun with its continuous spectrum.
2. Those that emit (and absorb) radiation of discrete frequencies that are characteristics of particular systems, e.g., a radio transmitter or receiver tuned to one frequency.

Because any change in motion is an acceleration or deceleration (retardation), circulating currents of electrons produce electromagnetic radiation. When these circulating electrons move at relativistic speeds (i.e., approaching the speed of light), then the brightness of the radiation increases enormously. This radiation was first observed at the General Electric Company in 1947 in an electron synchrotron which is a type of particle accelerator that forces relativistic electrons into circular orbits by using powerful magnetic fields.

Electromagnetic waves consist of wavelengths range from 10^{-16} m to 100 Mm which corresponds to frequencies from 3×10^{24} Hz to 3 Hz. All the energy from the Sun that reaches the earth arrives as solar radiation, part of a large collection of energy called the electromagnetic radiation spectrum. Solar radiations are composed with electromagnetic radiation like visible light, ultraviolet light, infrared radiation, radio waves, X-rays and gamma rays. Radiation is one way to transfer heat energy. Every object or matter is continually radiating electromagnetic waves unless its temperature is at absolute zero.

Molecules or atoms emit radiation when high energy electrons in a high atomic level (higher shell or orbit) fall down to lower energy levels (lower orbit). The energy lost is emitted as electromagnetic waves radiation, e.g., light, infrared, radio waves etc. When energy is absorbed by an atom, it causes the electrons to “jump” up to higher energy levels (higher orbit or shell). Therefore, all atoms (objects) absorb and emit radiation, i.e., electromagnetic waves. When the absorption of energy balances the emission of energy, the temperature of the atoms stays constant. If the absorption of energy is greater than the emission of energy, the temperature of an object rises. If the absorption of energy is less than the emission of energy, the temperature of an object falls.

Electromagnetic radiation is made when an atom absorbs energy. The absorbed energy causes one or more electrons to change their locale within the atom.

When the electron returns to its original position, an electromagnetic wave is produced. Depending on the kind of atom and the amount of energy, this electromagnetic radiation can take the form of heat, light, ultraviolet, or other electromagnetic waves.

There are several ways of causing atoms to absorb energy. One way is to excite the atoms with electrical energy. We do this in neon signs (tubes). The electricity we put through the neon tubes will excite or add energy to the neon atoms. These electrons in these atoms are then in a high energy state. The electrons don't like to be in the high energy state and will fall back down into the low energy state giving off radiation which we see as light.

In electromagnetic waves, energy is transferred through vibrations of electric and magnetic fields. Quantum physics explains that electrons kick up virtual photons (i.e., free electrons), which travel at the speed of light and hit other particles, exchanging energy and momentum. Here virtual photons are free electrons only.

The German physicist Heinrich Hertz was the first to generate and detect certain types of electromagnetic waves in the laboratory in 1887.

An electron in an atom can absorb energy from light or electromagnetic waves (photons, i.e., free electrons) or heat (phonons) only if there is a transition between energy levels that matches the energy carried by the photon or phonon. Photons (free electrons) with correct wavelength can cause an electron to jump from the lower to the higher energy level (shell) by absorbing energy from the incident electromagnetic waves. Electron will not stay at a higher energy level for longer period, it drops from higher to lower energy level emitting a new photon (i.e., free electron) as spontaneous emission, $E_2 - E_1 = \Delta = h\nu$, which is shown in Fig. 2.

Here h is called Planck's Constant, $h = 6.626 \times 10^{-34}$ joule-second; ν or f is the linear frequency of the electromagnetic waves.

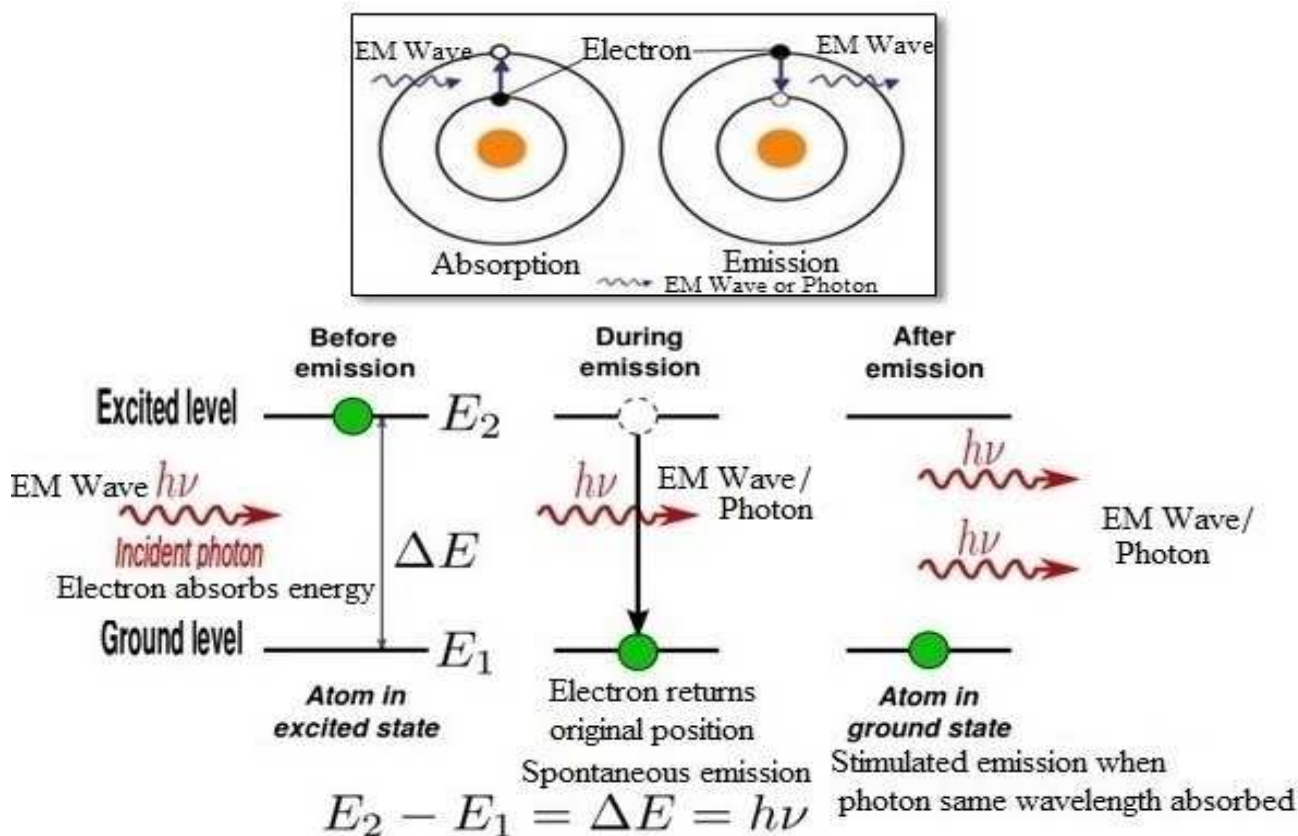


Fig. 2 Electromagnetic waves absorption and emission by an atom or electron.

This phenomenon is a direct physical manifestation of the Heisenberg Uncertainty principle. The emitted photon or electromagnetic wave has random direction, but its wavelength matches the absorption wavelength of the transition. When an electron is excited from one state to that at a higher energy level with energy difference ΔE , it will not stay that way forever.

Eventually, a photon or free electron will be spontaneously created from the vacuum (actually electron is thrown) having energy ΔE . Conserving energy, the electron transitions to a lower energy level which is not occupied, is with transitions to different levels having different time constants. This process is called “spontaneous emission”. Spontaneous emission is a quantum-mechanical effect and a direct physical manifestation of the Heisenberg uncertainty principle in which proposed that the electrons are always changing orbits or positions in an atom. The emitted photon (free electron) has random direction, but its wavelength matches the absorption wavelength of the transition. This is the mechanism of fluorescence and thermal emission.

A photon or free electron with the correct wavelength to be absorbed by a transition can also cause an electron to drop from the higher to the lower level, emitting a new photon or free electron. The emitted photon or free electron exactly matches the original photon (free electron) in wavelength, phase, and direction. This process is called “stimulated emission”.

Electromagnetic waves are generated by several electronic instruments. A Gunn diode, also known as a transferred electron device (TED), is a form of diode, a two-terminal semiconductor electronic component, with negative resistance, used in high-frequency electronics. Electromagnetic waves are generated by Gunn diode, although the Gunn diode is only made by n-type semiconductor doping in different concentrations. In Gunn diode, electrons inside the different n-type layers are oscillated due to positive and negative resistance occurring according to the voltage applied between the terminals of the diode. Therefore, some electrons are skipped out from the semiconductor material of the Gunn diode in air with the same frequency of oscillation which is identified as electromagnetic waves.

Then electromagnetic waves are generated by Klystron and Magnetron instrument. Here, electrons beam from the cathode is oscillated by applying high electric field and high magnetic field at right angles (perpendicularly) to the electric field, as a result some electrons are transmitted or skipped out with the frequency of oscillation as electromagnetic waves.

Therefore, we can conclude that electromagnetic waves are only special type of free electrons with the speed of light which comes out from an atom or electron beam by application of high electric field and perpendicularly high magnetic field. Thus these free electrons (electromagnetic waves) are not deflected (neutral) by the electric or the magnetic field.

It is observed that when an electric field is applied, a magnetic field will be automatically exist or evolve which is perpendicular to the electric field, and vice-versa. Therefore, when both the electric field and the magnetic field are acting simultaneously at right angles (perpendicular) to each other, the strengths of the both fields are high enough to oscillate (skip out) electrons releasing from the atoms or electron beam as electromagnetic waves perpendicularly to the both fields.

If an electron moves with a velocity v , its mass $m_1 = m_0 / \sqrt{1 - \frac{v^2}{c^2}}$, where c = velocity of light, m_0 = electron's rest mass; this equation indicates the mass will increase with the increase of its velocity, in this equation the electron's mass increases 1% when velocity increases 15% of velocity of light, if $v = c$, m_1 becomes infinity [2]-[9]. Since electromagnetic waves travel with the speed of light and it consists of free electrons only which have very huge (infinity) mass, therefore these tiny electrons having radius, i.e., $r = 2.82 \times 10^{-15}$ m can penetrate any material. Thus when electromagnetic waves consisting of free electrons are moving inside any material, air and space, its mass is infinity, i.e., huge mass. Due to this characteristic, electromagnetic waves or free electrons can penetrate any type of materials.

V. ELECTROMAGNETIC WAVES ARE FREE ELECTRONS: CONFIRMATORY EXPERIMENT

A solid glass rod and a piece of silk (pure silk cloth) are taken. The glass rod is slightly heated so that outermost electrons of the glass (silicon) atom receive sufficient energy to reach conduction band. Then the warm glass rod is rubbed by silk piece cloth from middle portion to one terminal (end) in one way direction. Small pieces of paper are kept on a table. After rubbing 1-2 minutes, the glass rod is brought near or touching small paper pieces, the paper pieces will be attracted by the glass rod like a magnet. This is happened, because positive static electricity (positive type static electric charge) creates or acquires on the upper layer or periphery of the glass rod. This positive static electric charge on the glass rod will remain indefinite period until it discharges by external opposite sources, i.e., negative type electric charge [7]-[10].

Case I: There are no powerful electromagnetic wave sources near the positive static electricity charged glass rod, i.e., mobile phone, microwave oven, remote control etc. are not switch on or working condition, then the positive type static electricity on the glass rod persists longer duration such as 10-15 minutes depending upon the other remote electromagnetic wave sources such as nearby mobile BTS (Base Transceiver Station or Tower), TV and radio transmission network, electromagnetic wave signals from remote mobile phones and electronic instruments etc. [10]. Gradually the positive static electric charge on the glass rod is neutralized or discharged by the remote sources of electromagnetic waves which is shown in Fig. 3.



Fig 3 Glass rod rubbed by the silk cloth attracts pieces of paper for different duration of times.

Case II: The glass rod is positively static electricity charged by rubbing silk cloth and the glass rod attracts paper pieces. Then strong electromagnetic wave sources like mobile phone or other electromagnetic waves transmitter under switch on condition is brought in front of the glass rod, the glass rod discharges positive static electricity charge immediately, i.e., within one minute, and it no longer attracts the paper pieces. Therefore, the attraction time duration of paper pieces by the positive static electricity charged glass rod is fully dependent on the amount of electromagnetic waves nearby or received by the glass rod, and this attraction time duration is inversely proportional to the amount or power of the nearby electromagnetic wave sources [10].

Case III: When ebonite rod or plastic rod is rubbed with wool, ebonite or plastic rod acquires negative static electricity charge and wool acquires positive static electricity charge in same amount. This negative static electricity charge on the ebonite or plastic rod attracts paper pieces also. When electromagnetic wave sources like mobile phone, remote control etc. in switch on or working condition are brought in front of the negative static electricity charged ebonite or plastic rod, they do not affect the negative static electric charge of the ebonite or plastic rod, and the ebonite or plastic rod attracts the paper pieces till discharged its negative static electric charge in same time as in normal condition [10].

Attraction time duration of paper pieces by the negative static electricity charged ebonite or plastic rod does not depend on the nearby electromagnetic wave sources. Hence, the electromagnetic waves cannot discharge or neutralize the negative static electric charge on the ebonite or plastic rod. Therefore, electromagnetic waves comprise with free electrons only.

VI. ENVIRONMENTAL POLLUTION CREATED BY ELECTROMAGNETIC WAVES

This super high frequency electromagnetic waves transmitted by electronics equipment like microwave oven, satellite system and antenna, 4G, 5G and higher generation mobile communications system (Mobile Exchange like BTS, BSC, MSC etc., Mobile Instrument or Phone) in MHz to GHz range radiating in different paths (multiple paths) by MIMO (Multiple-Input-Multiple-Output) antennas have ailing (sick) effect on animals, birds, human health including trees [11]-[14]. This high frequency electromagnetic (EM) waves gradually decrease human, animal's and tree's body immunity (resistance) and causes severe illness, even death. It is observed that the most of the small birds and insects pass away from the nature due to the high frequency intensified electromagnetic waves. Trees are not able to produce fruits as per standard, e.g., coconut tree, orange tree, wheat tree etc. If human body immunity and lungs activity are checked especially in city and suburban area people, then it will be clearer about the effect of high frequency electromagnetic wave signals from different sources. Therefore, it is seen that if frequency of the electromagnetic waves is high, it will possess more energy, and thus it will penetrate the atoms, i.e., living body with more energy or power.

The electromagnetic interference (EMI) or pollution from electronic devices causes malfunctioning of neighboring sensitive devices and negative impact (harmful effects) on animal life and environment. Therefore, the exposure of electromagnetic waves are minimized by shielding of electromagnetic waves (radio frequency) by different shielding materials like carbon materials and their composites, lead, water etc. Low level exposures of electromagnetic waves cause headaches, anxiety, depression, nausea, fatigue, electromagnetic hypersensitivity, skin symptoms, nerve disorder, loss of libido (sexual desire) and suicide; while higher level exposure of electromagnetic waves cause damage to the DNA inside a living cell, i.e., cancer [13]-[14].

The World Health Organization (WHO) began a research effort in 1996 to study the health effects from the ever-increasing exposure of electromagnetic waves (EMI) to the people from diverse range of electromagnetic waves transmission sources [13]. In 2011, the WHO and International Agency for Research on Cancer (IARC) has classified electromagnetic fields as possibly carcinogenic to humans, based on an increased risk for glioma, a malignant type of brain cancer, associated with mobile phone use. In the United States, non-ionizing radiation (below ultra-violet level) is regulated in the Radiation Control for Health and Safety Act of 1968 and the Occupational Safety and Health Act of 1970. International Commission on Non Ionizing Radiation Protection (ICNIRP) with WHO declared in 1998 that electromagnetic waves in non-ionizing state (0-300 GHz) do not produce any known adverse health effect, although huge number of research papers (more than 5000) focus different health problems and environment pollution created by electromagnetic waves exposure in air.

Specific Absorption Rate (SAR) in respect of mobile handsets is prescribed by ICNIRP maximum limit as 2 watt/kg averaged over 10 gm human tissue in 2008, in the frequency range of 10 MHz to 10 GHz. It is revised as 1.6 watt/kg averaged over a mass of 1 gram human tissue in 2013 (also applicable in India) [13]. There are so many organizations worldwide to look after and control the electromagnetic waves causing pollution, such as, International Commission on Non Ionizing Radiation Protection (ICNIRP), International Agency for Research

on Cancer (IARC), United Nations Environment Programme (UNEP), International Labour Organization (ILO), International Telecommunications Union (ITU), European Commission (EC), International Electro-technical Commission (IEC) and North Atlantic Treaty Organization (NATO) etc., but no strict guidelines and rules for minimizing the exposure of electromagnetic waves are framed so far.

United Nations Conventions on Climate Change 21st meeting at Paris (COP 21) led to a new international climate agreement in 2015, applicable to all countries, aiming to keep global warming at 1.5°C - 2°C, in accordance with the recommendations of the Intergovernmental Panel on Climate Change (IPCC). It was adopted by 196 Parties (Countries) at COP 21 in Paris and force on November 2016. To achieve this, the Paris Agreement stipulates that all countries shall review their contributions to reducing greenhouse gas emissions every five years. The emission or exposure of electromagnetic waves also cause the rise of environment temperature and pollution, but minimization for the exposure of electromagnetic waves are not yet focused or implemented in the world [13]-[14].

It is already proved by Albert Einstein in Photoelectric Effect that when high frequency electromagnetic waves consisting of photon particles fall any atoms (metallic or non-metallic), the photons will release electrons from the atoms, called photoelectrons, cause current generation or current flow through the circuit [11]-[12]. Therefore, the continuous exposure of high frequency electromagnetic waves to human, animal and trees body by electromagnetic wave signals generate photoelectrons in the atoms or molecules of human, animal and trees body causing current flow which effectively diminishes the body immunity, and hence several diseases will attack the body. This current is having very small value (few milliamperes), because matured human body has an internal resistance 500 ~ 700 ohms and dry skin resistance 1000 ~ 1,00,000 ohms. Generally the resistance of big size animal and tree body is having more than that of human one. Moreover, electromagnetic waves are absorbed by water particles. Human and animal adult bodies content about 60% water, some amount of electromagnetic waves are soaked up by the body's water particles, as a result the absorbed electromagnetic energy will increase the body temperature which evaporates the water particles at a faster rate; Hence water-electrolyte imbalance produces headache, fatigue and dehydration etc. Therefore, the continuous exposure in electromagnetic waves causes damage to heart, lungs, kidney, brain and all other organs of the human and animal body, turning to less immunity as a whole. It is already observed that those persons, working in high frequency electromagnetic waves zone like mobile exchange (MSC, BSC, BTS etc.), satellite earth station, radar system etc., are suffering from respiratory problems like bronchitis, asthma, pneumonia, tuberculosis etc. frequently, and they are prone to attack by the other severe diseases like diabetics, heart problem, blood pressure, kidney problem, cancer, and Covid-19 etc. This is happening because of the high frequency electromagnetic waves diminishing their immunity power completely.

Therefore, a trade off must be maintained for use of the range of frequency (electromagnetic spectrum) in GHz, the number of antennas in MIMO system, the number of trans-receivers (BTSS) in a locality, the data speed, bandwidth, and use of electromagnetic waves as minimum as possible. Therefore, our precaution from the diseases (including Covid-19) is to minimize the exposure of electromagnetic waves.

This can be done by restricting the number of electronic equipment transmitting electromagnetic waves in air, mobile exchange systems (hence mobile SIMs), and the use of mobile phones by keeping switch off condition maximum time in a day and switch on condition call or message duration time only (communications have to be made by the help of email, sms, whatsapp, missed call etc.); so that human and animal body's and tree's immunity boosts up and safe guards from all diseases.

VII. CONCLUSION

Electromagnetic waves are used to do huge works in our daily life from communications to medical, food cooking to entertainment and so on. At the same time it causes environmental pollution and health problems to living creatures with slow killing ability. By the above confirmatory experiment, it is proved that electromagnetic waves are high speed (with the velocity of light) free electrons only, which are randomly moving in materials, air and space. Positive type static electricity on the glass rod periphery is immediately discharged by the electromagnetic waves due to composed by electrons only. Hence, the discharging rate of the positive static electricity on the glass rod depends on the availability of free electrons from the nearby electromagnetic waves, i.e., power of the nearby electromagnetic wave sources. On the other hand, electromagnetic waves have no effect on discharging of the negative type static electricity induced on the periphery of ebonite rod or plastic rod when rubbed with wool.

Again electromagnetic waves are gradually decreasing its power by propagating distance through materials and air, because free electrons are absorbed by the materials and water. The exposure of electromagnetic waves have extreme health effect on living creatures including human one and create environmental pollution with global warming to the world and space.

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