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Environmental Health Ecosystem Sustainability: Implication of Electromagnetic Radiation (EMR) Induced Hydrogen Peroxide Formation in the Human Cells

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Abstract

Electromagnetic radiation (EMR) has both ionizable and non-ionizable chemical impact that causes protons and electrons to interact as fields in any surrounding as it travels. This can have negative health effects, such as warming up the body because of polarization and dipolar moment itchy skin eruption. This paper adopted Feynman diagram from quantum electrodynamics as a theoretical model to explain the quantum properties related to the interactions of EMR, in specific the exchanges involving photons and electrons in the 5G electromagnetic carrier signals. The Feynman model depicts electron-positron collisions as mutually annihilating antiparticles that ultimately produce photons. The mutual annihilation resulted in the disappearance of an electron and its antiparticle, producing gamma rays with highest ionizable penetrating power. The process of chemical polarization, also known as ionizing radiation, causes molecules within cells to split apart and create free reactive radicals, which in turn affects the immune system of the body. As a result of the existence of unpaired electrons that occurred from the breaking up of water molecules within the cells, it destabilizes the equilibrium of the charged particles that make up the human deoxyribonucleic acid (DNA). The free radicals will produce hydrogen peroxide compounds, which will start toxic chemical processes inside the cells that can lead to things like fluid accumulation in the lungs (pulmonary edema). Hydrogen peroxide produced from the disintegration of water molecules as a result of EMR is found to facilitate the multistage carcinogenic process, which involves carcinogen activation, oxidative DNA damage, and tumor formation.

Keywords: Telecommunication Infrastructure, Hydrogen Peroxide, Radio Frequency (RF), DNA, Electromagnetic Radiation (EMR), Chemical Polarization, 5G Spectrum Migration

1. Introduction

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As several epistemological studies have shown, there are growing evidences that exposure to radiofrequency electromagnetic field might have harmful biological and chemical impacts on the environmental safety(Verbeek et al., 2021), which have placed the global rollout of the 5G network to a prolonged consideration. A lot of countries have approved guidelines allowing the deployment of 5G infrastructures in the frequency bands that are currently restricted by recommendations for radiofrequency radiation exposure in an effort to encourage sustainability in the environmental ecosystem. A country like Canada has rules governing radiofrequency energy, that authorized health Canada to create exposure standards that are included in the Canadian Health Safety Code 6(Gravel et al., 2023). A major social-economic, and health concern associated with the transition from the current 4G network to the 5G new radio (NR) broadband spectrum is the potential for radiofrequency electromagnetic radiation from the carrier signal frequency base station to have harmful biological and chemical influences on the society wide space. In order to control the exposure of non-ionizing electromagnetic fields on both human and non-human species at the ecosystem level, a new strategy is needed. These electromagnetic fields are utilized in contemporary society and are expanding as a result of the deployment of wireless technology and digital infrastructures. Today, several public health advocacies and environmental activists have acknowledge these electromagnetic fields as potential biologically active environmental contaminants(Davis et al., 2023),(Hens & Hens, 2017).

The electromagnetic fields are non-ionizing low frequency radiation that can come from artificial and natural sources, including telecommunication frequency base stations and powerline transmission(Samaila, Sagagi, & Tampul, 2023). Electrically charged particles permeate the surroundings when substantial electromagnetic fields are present. In anticipation of this, non-ionizing radiation has been divided into four groups corresponding to the quantity of electric energy that each group consists of: microwave radiation, optical radiation, radio frequency radiation from ultra-low frequency fields, and static electric-magnetic fields(Ugochukwu Okwudili Matthew, Kazaure, & Okochi, 2022). The worldwide deployment of the 5G network has refined the transfer from the existing 4G LTE network service infrastructures to the 5G new radio (NR) broadband spectrum. Because of this, there are now serious concerns about radiofrequency electromagnetic radiation from the carrier signal base transmission that affect the environmental health ecosystem sustainability. Powerline transmission and telecommunication frequency base stations are examples of man-made technological sources that emit low frequency, non-ionizing radiation, which causes the electromagnetic field (EMF) to circulate electric current throughout the surrounding area. In addition to infrared, ultraviolet, gamma, and x-rays, radiative elements, radio frequency waves, and microwaves are the sources of electromagnetic radiation. As one might anticipate, non-ionizing radiation is divided into four categories based on the quantum of electric energy that each type of radiation possesses by nature: ultra-low frequency fields, microwave radiation, optical radiation, and static electric-magnetic fields are sources of radio frequency radiation (Georgiou et al., 2022).

In order to support essential infrastructure maintenance, including the deployment of digital healthcare, the connecting of smart devices to the Internet of Things (IoT), and the management of medical IoT, the current article concentrated on the creation of 5G electromagnetic

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spectrum infrastructure as synthetic natural resources. Nevertheless, the deployment of a singly 5G spectrum infrastructure on an exceedingly narrow bandwidth constrained by the applied ultra-high frequency stability exceeding 25gigahertz results in non-ionizable radiation which signifies electrons and protons acting together as fields that can have harmful effects on public health, such as heating the body surface as a result of positively charged ion distorting the electron cloud of a negatively charged ion, which disturbs the equilibrium of the charged particles in human deoxyribonucleic acid (DNA) and creates highly reactive free radicals from the presence of unpaired electrons that arise from broken water molecules(Geesink & Meijer, 2017). Inside the cells, dangerous chemical processes will be triggered by the free radicals creation of hydrogen peroxide molecules. The production of hydrogen peroxide molecules by free radicals will trigger detrimental chemical processes within cells, leading to the accumulation of fluid in the lungs known as pulmonary edema(Bezerra et al., 2023). To provide the reader with easy flow, the present work is organized into introduction, objectives of the study, literature review, research methodology, discussion of research findings and finally conclusion.

2. Objective of the study

i. To establish that substantial exposure to radiofrequency electromagnetic radiation induce the circulation of current in the human body which in effect will produce hydrogen peroxide compounds, a consequential toxic chemical processes inside the cells, resulting in fluid buildup in the lungs called pulmonary edema.

ii. To establish that a positively charged ions will deform the negatively charged ionic electron cloud in order to produce non-ionizing chemical effects through polarization from the electromagnetic field radiation inducement , inherent in the 5G radiofrequency.

iii. To establish that there were enough energy in the ionizable electromagnetic radiation to push one or more constrained electrons from an atom or molecule into an orbit with a higher energy. Boundless electrons released from the chemically defined semi-conductor cause ions and free radicals to be produced inside living cells. These particles collide with the organic chemical complex molecular structure of DNA, which ultimately results in the death of cells.

3. Literature Review

So many studies in environmental epidemiology shows that the majority of human body molecules display modest electromagnetic field interactions in the low radio frequency and extremely high electromagnetic frequency radiation ranges(Okechukwu, 2020). The absorption of electromagnetic field energy is one such interaction that can encourage tissue warming since higher temperatures are produced by the induction of an electromagnetic field at bigger field intensities(Nieuwenhuijsen, Paustenbach, & Duarte-Davidson, 2006). Biological consequences could include burns, chemical polarization (Ugochukwu O Matthew & Kazaure, 2021),(Ugochukwu Okwudili Matthew et al., 2022), and muscle relaxation as induced by a diathermy device in medical surgery(Liu & Liu, 2018). As a significant step in maintaining the

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sustainability of the natural ecosystem, numerous countries and regulatory organizations, such as the International Commission on Non-Ionizing Radiation Protection(ICNIRP), have set safety limits to checkmate electromagnetic field exposures to a non-thermal intensity (Jazuli S Kazaure, Matthew, Okafor, & Okey, 2021),(Jazuli Sanusi Kazaure & Matthew, 2021). It has been demonstrated that the non-thermal impacts of EMR affect a biological organism's systems, causing organic processes to alter the bodies regular functioning, including the immunological system, endocrine, sexual, and nervous systems, to be disrupted(Azab, Khalat, Ebrahim, & Albasha, 2018),(Samarth, Kumar, Matsumoto, & Manda, 2020). A growing percentage of the world's population is currently exposed to radiofrequency electromagnetic radiation, which has led to a number of distinct methods explaining these and multiple mechanisms explaining the numerous occurrences that have been recorded. With the advent of new technological advancements and applications following the broad use of mobile phone technology in the late 1990s and early 2000s, several individuals, governments, and professionals have expressed worry about the potential repercussions this escalation may have on public health and environmental ecosystem sustainability(Verbeek et al., 2021). When exposed to magnetic fields, especially pulsed magnetic fields, numerous behavioral impacts have been documented at varying intensities as low field magnetic stimulation has been used to heal non-union fractures and depressive contingencies(Sangle, Parab, Gujare, Dhatrak, & Deshmukh, 2023). This suggests that the particular pulseform used plays a significant role in the behavioral effect observed. Studies have shown that standing balance and pain perception can be changed by exposing the entire body to a pulsed magnetic field(Venugobal et al., 2023).

A growing number of people are becoming aware of the possible health risks associated with microwave/radiofrequency (MW/RF) energies due to the proliferation of telecommunications equipment and installations that possess this capability(C. L. Russell, 2018). Ionic excitation and ionization are two techniques that allow the carrier signal of the 5G network installation to deposit its quantum energy when it travels through a semi-conductor and chemically polarizable material. Non-ionizing radiation is the term used to describe a wide range of hazardous substances, chemicals, and biological agents when the activation of an electron that is chemically bound to a higher electron shell without its ejection is required to deposit enough energy into a chemically defined semi-conductor(Petrinec, 2018). The energy of the ionizable electromagnetic radiation was high enough to push one or more atoms or molecules bounded electrons into an orbit with more energy(Vollmer, 2021). The chemically defined semi-conductor releases bounded electrons, which causes ions and free radicals to be produced inside living cells. These collisions with the organic chemical complex molecular structure of DNA, causes ionic disassociation of organic chemical compounds which ultimately results in cell death(Bag, Burman, & Bhowmik, 2023). The idea that photons are particles that carry both energy and velocity can serve as a convenient way to describe the particle qualities of electromagnetic waves and comprehend the attenuation of electromagnetic radiation in materials. This wave–particle duality applies not just to electromagnetic waves, or photons, but also to the constituent components of matter, like electrons, which are also considered waves. This leads to corresponding explanations in terms of quantum mechanics for the microscopic makeup of matter, which includes atoms, molecules, and

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nuclei(Balzanelli et al., 2022). Understanding their structure is necessary in order to comprehend both the creation of electromagnetic radiation and how it interacts with matter. Depending on its frequency, electromagnetic radiation behaves differently from one another and interacts with matter in different ways. Higher frequencies are linked to higher energy photons and have shorter wavelengths than lower frequencies do.

Table 1: Differentiating different behaviors and interactions with matter according to energy of electromagnetic radiation classes.

Name	Class	Division	Energy
Extremely low frequency	ELF	Radio Waves	Non-Ionizing
Super low frequency	SLF	Radio Waves	Non-Ionizing
Ultra-low frequency	ULF	Radio Waves	Non-ionizing
Voice frequency	VF	Radio waves	Non-Ionizing
Very low frequency	VLF	Radio waves	Non-Ionizing
Low frequency (radio)	LF	Radio waves	Non-Ionizing
Medium frequency	MF	Radio waves	Non-Ionizing
High frequency	HF	Radio waves	Non-Ionizing
Very high frequency	VHF	Radio waves	Non-Ionizing
Ultrahigh frequency	UHF	Microwaves	Non-Ionizing
Super-high frequency	SHF	Microwaves	Non-Ionizing
Extremely high frequency	EHF	Microwaves	Non-Ionizing
Far-infrared	FIR	Infrared	Non-Ionizing
Mid-infrared	MIR	Infrared	Non-Ionizing
Near-infrared	NIR	Infrared	Non-Ionizing
Visible light	NUV	Ultraviolet	Non-Ionizing
Near-ultraviolet	NUV	Ultraviolet	Non-Ionizing
Extreme-ultraviolet	EUV	ultraviolet	Ionizing
Soft X-Rays	SX	X-ray	Ionizing
Hard X-rays	HX	X-ray	Ionizing
Gamma rays	Γ	Gamma rays	Ionizing

Source: Nigeria Communication Commission (NCC): Deployment of Fifth Generation (5G) Mobile Technology in Nigeria, August, 2020

Evidence abound that electromagnetic radiation, electric currents, and the electromagnetic fields that exist within the brain are all space-traveling, mutually-sustaining waves that leave behind quantum energy on bodies they come into touch with(Bond, 2023). When electrically charged particles interact and apply force to other charged particles, electromagnetic waves are created. Matter is able to absorb the energy, momentum, and angular momentum of the particle that created the waves through interaction. Radiation affects chemical and biological materials differently, depending on its frequency and intensity. The exchange of electromagnetic radiation between semiconductors is a fundamental idea in Max Planck's theory of the energy of the electromagnetic field(Pascale, Giteau, & Papadakis, 2023). This covers the quantization of electromagnetic radiation in relation to the radio waves as well as electromagnetic force carriers. Many topical epidemiologic studies have revealed that living in environments exposed to extremely low frequency (ELF) electromagnetic fields may lead to the development of certain health issues, such as cancer, depression, and miscarriages (Abkhezr et al., 2023). These studies contend that ELF exposure affects the equilibrium of chemical and molecular nomenclature of human cells. Based on the various findings from the current investigation into the deployment of 5G spectrum infrastructure, it was found that the singly installed 5G network deployment on exceptionally narrow bandwidth ultra-high frequency beyond 25gigahert will produce non-ionizable, nonvisible light includes electromagnetic radiation, microwaves, infrared light,

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ultraviolet light, X-rays, and gamma rays, all of which are invisible to humans. that is classified as electromagnetic frequency radiation (protons and electrons acting together as fields) responsible of harmful health effects, such as warming up of the human body surface through separation of electric charges, resulting in the formation of a molecule with a positively and negatively charged end and an electric dipole moment, which will upset the equilibrium of the charged particles in human DNA. Due to the unpaired electrons that are created when water molecules break, the chemical induction of the cell's water molecules will cause the generation of extremely reactive free radicals(Kıran, Otlu, & Karabulut, 2023). The free radicals will produce hydrogen peroxide compounds, which will start toxic chemical processes inside the cells that can lead to things like fluid accumulation in the lungs known as pulmonary edema.

According to (Hu, Dubin, Kurland, Ma, & Roush, 1995), Hydrogen peroxide produces oxygen free radicals, which are implicated in the multistage carcinogenic process through processes such as tumor development, oxidative DNA damage, and carcinogen activation. The authors associated the modification of DNA repair activities as a potential mechanism of hydrogen peroxide in carcinogenesis in their work. Human peripheral mononuclear leukocytes' ability to repair damaged DNA caused by N-methyl-N'-nitro-N-nitrosoguanidine was markedly reduced when they were pre-exposed to hydrogen peroxide, which in effect quantifies the spontaneous DNA synthesis that took place(Tort, 2000). According to the authors, after adjusting for within and between-subject variabilities, the results of multivariate general linear models demonstrated that hydrogen peroxide significantly hindered DNA repair in a dose-dependent manner. The basic hypothesis of this work is that, while oxygen free radicals can oxidatively damage DNA(Sadiq, 2023), they can also inhibit many enzymes involved in DNA repair, hence blocking DNA repair processes out of the equation altogether. This could ultimately cause a build-up of mutations in significant target genes that would otherwise result in cancer. Protein thiols and glutathione, which are required for enzyme functions including DNA repair, can be oxidized in cells when exposed to hydrogen peroxide(Sanookpan et al., 2023).

In terms of the distribution of electromagnetic radiation, an increased frequency and wavelength comes an increase in photon energy, a measure of how electromagnetic radiation impacts chemical compounds and biological organisms as the charged wave particles travels(Ulloa, Santiago, & Rueda, 2019). One way to conceptualize electromagnetic radiation is as a stream of massless particles, or photons, moving at the speed of light in a wave-like pattern. A specific quantity of energy is contained in each photon. The kind of radiation is determined by the energy contained in photons, which are dependent on the radiation's power and frequency (Sinaga, Handayani, Hutagalung, Rifandha, & Lubis, 2023). While X-rays, visible light , ultraviolet, and gamma-rays have the highest energies of all photon types, radio waves contain low energy photons when compared with microwave and infrared photons.

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Table 2: Photon energies at different frequencies displayed in the electromagnetic spectrum

Class	Frequency	Wavelength	Energy
ELF	3 Hz	100 Mm	12.4 feV
SLF	30 Hz	10 Mm	124 feV
VF/ULF	300 Hz	1 Mm	1.24 peV
VLF	3 KHz	100 km	12.4 peV
LF	30 KHz	10 km	124 peV
MF	300 KHz	1 km	1.24 neV
HF	3 MHz	100 m	12.4 neV
VHF	30 MHz	10 m	124 neV
UHF	300 MHz	1m	1.24 ueV
SHF	3 GHz	1 dm	12.4 ueV
EHF	30 GHz	1cm	124 ueV
FIR	300 GHz	1 mm	1.24 meV
MIR	3 THz	100 um	12.4 meV
NIR	30 THz	10 um	124 meV
Visible light	300 THz	1 um	12.4 eV
NUV	3 PHz	100 nm	124 eV
EUV	30 PHz	1 nm	1.24 keV
SX	3 EHz	100 pm	12.4 keV
HX	30 EHz	10 pm	124 keV
Γ	300 EHz	1 pm	1.24 MeV

Source: Nigeria Communication Commission (NCC): Deployment of Fifth Generation (5G) Mobile Technology in Nigeria, August, 2020

Regarding Tables 1 and 2, every nation has laws that must be followed in order to modulate the electromagnetic spectrum emissions that radiofrequency transmitters produce. The laws, known as "Type-Approvals" and "conformance testing" are acknowledged as being dynamically implemented globally to satisfy the prerequisites for installation on the radio receiver equipment that is able to transmit radio frequency signals and subsist within the globally acceptable unhazardous bounds for the citizens of the nation(Alazab Elkhouly et al., 2019).

4. Biomedical Consequences of Electromagnetic Frequency Radiation on Human Body

While radio/microwave frequencies (10 MHz - 300 GHz) emitted by radio antennas and wireless networks, as well as extremely low frequency (ELF) electric and magnetic fields (0 to 300 Hz) generated by power lines, have been extensively studied for their effects on health(Bonato, Chiaramello, Parazzini, Gajšek, & Ravazzani, 2023), much less research has been done on the intermediate range and ultra-high frequencies(UHF) . It has been challenging to establish the direct effects of low power radiofrequency electromagnetism on human health, and the only known instances of radiofrequency electromagnetic fields posing a threat to life are from high power sources that are capable of producing sizable thermal effects and medical equipment like pacemakers and other electronic implants. In order to learn more about how electromagnetic fields affect tumor growth, apoptosis, and cell metabolism, numerous studies have been carried out using these fields(Barati et al., 2021). As depicted in Figure 1, exceeding 20 GHz for ultra-high frequencies will cause the same extreme low frequency powerline transmission effects, such as a warning up of the body tissues due to an indirect chemical change induced through atomic bond disruption by electromagnetic field induction during the polarization process, since the human body is by nature a semi-conductor (dipolar) in its existential theory (Hosseinabadi, Khanjani,

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Mirzaii, Norouzi, & Atashi, 2019), refer to **Table 1,** on the assumption that both ELF and UHF belong to non-ionizable EMR.

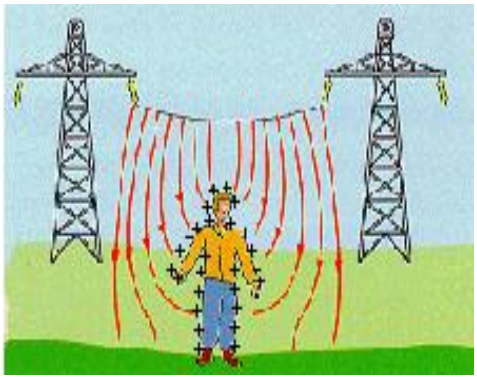

Figure 1: Similar to installing a 5G network at UHF >= 20 GHz, ELF Powerline Transmission poses a health risk.

Figure 2: The effects of burnt caused by electromagnetic field induction

Establishing the fact in Figure 2, this occurs when a temperature increase modifies one set of conditions, causing a subsequent rise in temperature. When an electromagnetic field interacts with a dielectric, a phenomena known as thermal runaway occurs, which often results in the target overheating severely. The resulting radiation burns are comparable to those caused by microwaves, but they only harm the surface of the skin since smaller millimeter waves are less likely to penetrate the body(Omer, 2021). As long as the beam is operational, the victim's exterior temperature will rise steadily, depending on the recipient's material, the distance from the electromagnetic field transmitter, and the operator's predetermined beam's frequency and power gauge. In a perfect situation, several human experiments took roughly 4seconds to achieve the unbearable heating threshold, as no one could withstand the scourge of the heat for more than 5seconds(Ugochukwu Okwudili Matthew et al., 2022).

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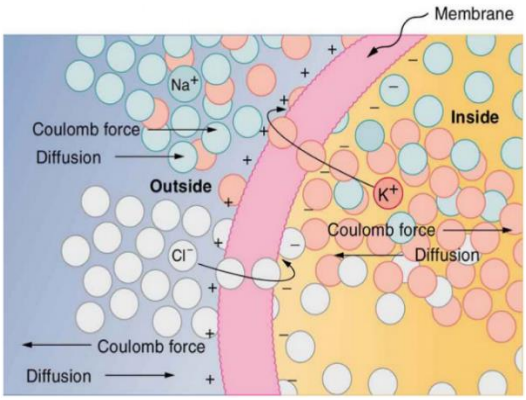

Figure 3: ionic polarization due to applied EMR on the human cells

Refer to **Figure 3,** the electrically charged particles (ions) were present in specific concentrations both inside and outside the human cell's semi-permeable membrane. Potassium (K+) and chloride (Cl-) ions diffuse through the previously mentioned channels until the Coulomb force stops them from transmitting any further. This arrangement results in the concentration of the negatively charged ionic particle layer inside the body and the positively charged ionic particle layer outside, creating a voltage across the body's cell membrane that normally becomes resistive to sodium (Na+) ions. The result of relative dislocations caused by electromagnetic stimulation between positively and negatively charged particles in an ionic crystal is ionic polarization(Dwivedi, 2023). That clarifies the cause of the centers of negatively (-) and positively (+) charged particles shifting, changing the equilibrium and raising the possibility that vibrations of molecules or lattices may have contributed to some of the atom dislocations (F. Russell, 2013),(Zhang, Wang, & Weber, 2023). Ionic crystal elements like sodium chloride (NaCl), potassium chloride (KCl), and lithium bromide (LiBr) polarize spontaneously during this process.

Since the positively charged (+) and negatively charged (-) ions in the human body have dipole moments that balance each other out to maintain equilibrium, net polarization is frequently unachievable in the absence of an external electromagnetic field(Böhm, Mavromatos, Michette, Stracke, & Unger, 2005). However, in practice, external electromagnetic fields are applied to the ions, shifting them, resulting in induced polarization. As an external electromagnetic field was present, **Figure 3** showed how ions could dislocate. An ion produces a net average dipole moment when positively (+) charged particles move with the field and negatively (-) charged particles move against it(Sandhu, 2023). The body cell membranes allow current to flow across them to enter and exit the cell, making them effectively charged capacitors with vital activities linked to the potential difference across the membrane. Chemical elements like calcium, magnesium, sodium, and potassium can produce energy because of the electrical charges called ions that are already present in human bodies. The electromagnetic field's external impulses will shift and alter the electrical body's equilibrium(Bond, 2023).

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5. Research Methodology

This research work adopted Feynman diagram from quantum electrodynamics (QED) as a theoretical model to explain the quantum properties related to the exchanges of EMR, in particular the interfaces linking photons and electrons in electromagnetic carrier signals. The electromagnetic radiation that interacts with semiconductor materials mostly comes from the electromagnetic spectrum which are traveling at the speed of light in a wave-like pattern and carrying an unquestionable quantum of energy in each one. The quantum energy contained in their photons allows for the differentiation of several other forms of radiation. The intersection of three lines on the Feynman diagram, which measure the electron, positron, and photon as the underlying QED particles, represents electromagnetic interactions (Salam, 2018). Chemical reactions, molecular structure orientation, and other electromagnetic phenomena are governed by these relatively long-range interactions, which are created when elementary particles' electric and magnetic fields interact(Riccardi & Martin, 2023). Interactions with an electric or magnetic field can cause a particle or molecule to reorient, changing the internal distribution of electric charges. The Feynman diagram actually illustrated how photons are absorbed and released by electrons or positrons.

It is possible to explain the process by which a gamma-ray photon with an energy greater than twice the rest mass energy of an electron (above 1.02 MeV) is build up immediately it travels in the direction of a nucleus, since it is directly converted into an electron-positron pair(Reali, Gilbert, Boleininger, & Dudarev, 2023). Please refer to **Figure 4** for the Feynman diagram, which depicts electron-positron collisions as mutually annihilating antiparticles that ultimately produce photons. Apart from the disintegration of some subatomic particles and the splitting apart of radioactive atomic nuclei, mutual annihilation that resulted in the disappearance of an electron and its antiparticle, a positron also produces gamma rays when two photons are formed. The electron–positron annihilation and the production of dynamic photons result from the collision of an electron (e−) with its antiparticle, a positron (e+).

$$e^- + e^+ \rightarrow \gamma + \gamma.$$

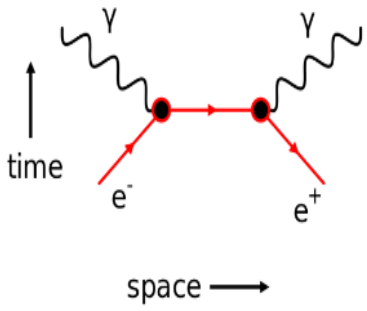

Figure 4: Diagram created by Feynman to illustrate how a positron (e+) annihilates an electron (e−). Two new particles are created when the particle antiparticle pair is destroyed: an antimuon (γ+) and a muon (γ−).

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Because gamma rays are the highest energy photons in the electromagnetic spectrum, each and every one of exceedingly high-energy photons are gamma rays, which essentially explained their passing through properties(Chaudhary & Kumar, 2023),(Karmaker et al., 2021). According to Albert Einstein, each photon transmits energy equal to the frequency of the wave times Planck's constant (E=hf), indicating that light particles, or photons, possess some fundamental quantum energy in relation to their frequency and wavelength(Pearsall & Pearsall, 2020). Since electromagnetic interactions occur where chemistry, biology, and physics combine, an understanding of and mastery over these interactions are necessary for their utilization in technology. Since this energy is created by photon energy in the carrier signal, it can travel through magnetic fields like an endless road as an electric current. An electromagnetic field's photon is a unit of intensity that has an energy that doesn't vary unless it is destroyed(Pearsall & Pearsall, 2020). Unlike electrons, photons can occupy the same space simultaneously if they have the same quantum number, which is equivalent to the same frequency and polarization(Pearsall, 2017). Ionizing radiation causes a positively charged ion in the electron cloud to deform a negatively charged ion, which in turn causes molecules inside cells to dissociate and compromise the immune system of the organism. (Al-Qabandi & Alshammary, 2022) claim that when electromagnetic radiation ionizes the cell wall, it destroys DNA's genetic material and may even cause cell death by changing the way DNA is metabolized inside the cell. About 80% of a cell is made up of water molecules, which can become ionized when they come into contact with electromagnetic radiation(Romanenko, Begley, Harvey, Hool, & Wallace, 2017), causing indirect cell damage. Because unpaired electrons are created when water molecules are broken , the chemical stimulation of the cells' water molecules will promote the generation of extremely reactive free radicals(Juan, Pérez de la Lastra, Plou, & Pérez-Lebeña, 2021).

The potential for free radicals to trigger toxic chemical reactions in cells that lead to pulmonary edema that leads to a build-up of fluid in the lungs has made them more significant in the realms of biology and medicine(G Martemucci et al., 2022). The modifications in the chemical composition will really drive the cells to undergo numerous structural changes, which may result in malfunction or even cell death. Many different endogenous and exogenous factors are responsible for their genesis. The mitochondria, a sensitive source of reactive oxygen species (ROS) in the majority of mammalian cells, are the primary organ implicated in the creation of endogenous ROS during cell activity(Murphy, 2009). In addition to being crucial for redox communication from the organelle to the rest of the cell, this ROS generation plays a role in mitochondrial damage in a variety of diseases. A surplus of free radicals may cause damage to proteins, lipids, nucleic acids, and other macromolecules. This leads to the destruction of tissue in a number of chronic and degenerative diseases. With reference to **Figure 3,** any molecule having an unpaired electron in an atomic orbital that is able to exist on its own is referred to as a free radical. Most radicals have some characteristics in common because they have an unpaired electron. Numerous radicals exhibit instability and strong reactivity, acting as reductants or oxidants because they have the ability to either give or receive electrons from other molecules(Lobo, Patil, Phatak, & Chandra, 2010). In various disease situations, the most significant oxygen-containing free radicals include the following: hydrogen peroxide,

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hypochlorite, hydroxyl radical, superoxide anion radical, oxygen singlet, peroxynitrite and nitric oxide radical, radical(Cardoso, Gonçalves, & Davis, 2023).

6. Discussion of research Findings

With reference to **Figure 4,** the body may produce unusually large levels of free radicals as a result of exposure to ionizing radiation and environmental contaminants(Siama et al., 2019). When ionizing radiation hits an atom or molecule in a cell and one electron is lost, a free radical might result. Through the production of extremely high levels of free radicals, ionizing radiation causes cell death. Free radicals can also be abundant in the environment or be stimulated to proliferate in the body's cells by toxins(Sadiq, 2023). Numerous metabolic processes including the tricarboxylic acid cycle, fatty acid oxidation, the urea cycle, amino acid metabolism, and hemoglobin synthesis are made more difficult by reactive oxygen source production in the mitochondria(Murphy, 2009). This causes oxidative damage to mitochondrial proteins, membranes, and DNA. These metabolic processes are essential for the regular functioning of most cells. The body naturally produces free radicals, which are vital to many regular cellular functions. Free radicals, however, can be harmful to the body at high concentrations and harm all of the main parts of cells, such as DNA, proteins, and cell membranes(Giovanni Martemucci et al., 2022). Cancer and other illnesses may arise as a result of the harm free radicals do to cells, particularly the harm they do to DNA(Mustafa, 2023).

7. Conclusion

The electromagnetic frequency radiation has a non-ionizable impact that causes protons and electrons to interact as fields in any surrounding. This can have negative health effects, such as heating up the body through polarization and dipolar moment urtication. About 80% of a cell is made up of water molecules, which can become ionized when they come into contact with electromagnetic radiation, causing indirect cell damages. Because unpaired electrons are created when water molecules are broken, the chemical stimulation of the cells' water molecules will promote the generation of extremely reactive free radicals. As a result of the existence of unpaired electrons that occurred from the breaking up of water molecules within the cells, destabilizes the equilibrium of the charged particles that make up human deoxyribonucleic acid (DNA). In the circumstance of reperfusion injury, the generation of reactive oxygen source within the mitochondria induces the mitochondrial permeability transition pore , making the inner membrane accessible to tiny molecules. Thus, it is not surprising that a variety of illnesses are influenced by mitochondrial oxidative damage. In addition, mitochondrial reactive oxygen source have the potential to behave as a modifiable redox signal, impacting many activities in the mitochondria, cytosol, and nucleus in a reversible manner.

However, at large quantities, free radicals can be toxic to the body and damage all of the major components of cells, including DNA, proteins, and cell membranes. Free radicals

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have the ability to harm cells, particularly DNA, which can result in the emergence of cancer and other diseases. The free radical will produce hydrogen peroxide compounds, which will start toxic chemical processes inside the cells that can lead to things like fluid accumulation in the lungs (pulmonary edema). This study has established that the multistage carcinogenic process, which includes carcinogen activation, oxidative DNA damage, and tumor growth, is aided by hydrogen peroxide created during the breakdown of water molecules as a result of electromagnetic frequency radiation.

8. Conflict of interest

There is no conflict of interest regarding this publication. The research was supported by U&J Digital Consult Limited, an IT and Educational Consulting Firm based in Nigeria.

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