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A Fuzzy Approach to Interactions between Atomic Particles And Electromagnetic Waves

By

A.M. Salama*

Abstract:

It is revised here some previously accepted definitions regarding interactions between atomic particles and electromagnetic waves. It was found that such definitions were not offering plausible explanations for newly discovered phenomena as Kerr effect, duality property of atoms, colored charges and other related phenomena. Hence, we followed a fuzzy approach to postulate new definitions for electromagnetic waves, electrons, charges and magnetism that may lead to a better understanding of such discovered phenomena.
An interesting experiment was elaborated in this investigation to prove the trueness of the postulated definitions. The found results of such experiment and the results of Faraday's discovery with dielectrics as well as the analogy between heat flow, electric current and magnetic flux affirm the logic of the postulated definitions. The introduced approach offers more plausible explanations of many phenomena in the field of electromagnetism and atomic particles. The postulated definitions have led also to valuable scientific-conclusions in this field.

Keywords:

Fuzzy logic, Fuzzy sets, Duality property, corpuscle, Electromagnetic wave.

* South Valley University

1. Introduction:

No one has actually seen the structure of any atom or realize the assumed nature of the electrons or electromagnetic waves. Similarly, no one can precisely define the physics or nature of the charge, charged particles, magnetic flux or magnet's poles. However, the available definitions or the presumed concepts for defining these items have led actually to plausible explanations of many other related phenomena and to good jobs in the corresponding scientific and engineering fields [1]. But, such definitions are unable to offer similar plausible explanations for the newly discovered phenomena in the field of atomic particles and electromagnetism as Kerr effect [2], the particle-wave duality as introduced by the Quantum theory [3], the discovered antiparticles and the colored charges [4]. Accordingly, it can be stated that the available definitions in this field have only a limited degree of certainty or preciseness. Hence, such previous definitions can be considered as fuzzy concepts according to stated principles of fuzzy logic [5]. The term fuzzy, as introduced in literatures, means something that is stemmed from experience or logic but has a limited certainty. The acceptance of any fuzzy concept is tested by its effectiveness in offering plausible explanations of the concerned phenomena [5].

However, the third law, as developed by Walther Nernst during the years 1906-1912 and referred to as Nernst's theorem or Nernst's postulate, states that the entropy of a system at zero absolute-temperature is a well-defined constant. This is because a system at zero temperature exists in its ground state, so that its entropy is determined only by the degeneracy of the ground state [6]. In other words, any system or particle at a temperature more than zero may be considered as an energized system or particle.

In the presented article, it is assigned for each particle, as an energized particle, two degrees of memberships to two distinct-fuzzy sets; a set of mass-particles and a set of energy or electromagnetic waves.

So, as such particle holds a membership to a system of mass-particles, it may behave as a mass-particle. Similarly, as it holds a conjugate membership to electromagnetic waves, so, it may behave also as electromagnetic waves. This postulated concept interprets the stated wave-particle duality for light and particles, [4], through a fuzzy approach.

In this investigation, we discuss also the similarity of the flow patterns of heat, electric charges and magnetic flux and the analogy of the laws characterizing their quantization [7]. Such similarity and analogy lead to postulate, in a fuzzy discipline, new concepts that consider the electric charge and the magnetic flux as special categories of energy or electromagnetic waves. So, if any particle will be energized by such category of electromagnetic waves, it will act as a positively or a negatively charged particle or it may act as a magnetic pole. The results of such fuzzy approach succeed to eliminate many ambiguities in the field of electromagnetism and to offer more plausible

explanations for the discovered Kerr effect, colored charges, antiparticles and others. The "trueness" of the postulated concepts is affirmed also by the results of Faraday's discovery with dielectrics and the found results of a simple experiment performed in this investigation. However, the relation between the Joule, the Coulomb and the Tesla as units for measurement of energy, charge and magnetic flux should be a subject of future studies. Similarly, the quantization rules that might govern or categorize reforming of electromagnetic waves into charges or magnetic flux should be also investigated.

2. The Atom:

In his Nobel lecture [3], Cornell stated that the atom can be regarded as quantum-mechanical wave-packets that have a spatial extent on the order of thermal de Broglie wavelengths. However, such statement indicates that the postulated structure of the atom by Bohr's model or the previously postulated quantum model does not offer an ascertained hypothesis. Unfortunately, no one has actually seen such atomic structure to be sure of the truth of any proposition regarding the structure of atoms. But we may believe some truth of Bohr's proposition since it explains much we know about physics and chemistry of atomic interactions. As examples of what Bohr's model implies in chemistry is the periodic table which reflects the arrangement of electrons in the atom and describes the chemical reaction as an exchange of electrons between various atoms to fill the outermost shell of the atom. In physics, such model implies also a logical explanation of radioactivity, nuclear reactors and nuclear bombs [7].

According to the mentioned conclusions due to Cornell [3], it is not logic to assume that all atoms are consistent with the Bohr's model. So, following a fuzzy approach as cited in the fuzzy logic literatures [5], we may express such conclusion in the following fuzzy postulate the following proposition, P_1, as follows:

There is only a subset of atoms which is strictly consistent with the Bohr's model.

Such postulated proposition can be expressed by the following equation that is written in fuzzy logic notations [4]:

$$T\{Bo\} = \mu_B\{At\} \qquad (1)$$

This equation reads, according to fuzzy logic literatures [5], the trueness that any atom will belong to the Bohr's model, denoted by T(Bo), is equal to the degree of membership μ_B of any atom in the whole set of atoms {At} to the subset that belong to the Bohr's model denoted as {Bo}.

3. Atomic Particles:

The electron is considered, according to the traditional books of physics [7], as one of the atomic particles. However, strictly speaking, the term *particle* is something of a misnomer where the objects studied by particle physics obey the principles of quantum mechanics as they exhibit a wave-particle duality, i.e. displaying particle-like behavior under certain experimental conditions and wave-like behavior in others [7]. Theoretically, they are described neither as waves nor as particles, but as state vectors in an abstract Hilbert space [8]. So, we may consider, as previously introduced, any particle, such as electrons, photons or atoms, as "an energized particles" which may display the properties of "mass particles" and of "energy or a wave-like". We may express this duality in a rather simple way by stating a fuzzy proposition that defines two fuzzy sets; a fuzzy set of mass-particles denoted by the symbol {M} and another fuzzy set of energy or of electromagnetic waves denoted by the symbol {E}. The term "fuzzy" is added here because such approach is stated by a postulate of limited certainty. According to the principles of quantum physics [7], there aren't pure sets of mass-less energy or energy-less particles. Finally, we may postulate a proposition that expresses the discovered wave-particle duality as follows, P_2:

Each energized particle, according to its masse, may be assigned two degrees of memberships; a membership to a fuzzy set of mass-particles and simultaneously a degree of membership to another fuzzy set of energy or electromagnetic waves.

In fuzzy notations; we denote the degree of membership of any particle to the fuzzy set of mass-particles as μ_M and the degree of its conjugate membership to the fuzzy set of electromagnetic waves or energy as μ_E. So, the stated postulate assigns the duality property to any particle in terms of its degrees of membership μ_M and μ_E. Accordingly, the photon may behave as a mass-particle or as an electromagnetic wave and the atom may behave as a mass-particle and electromagnetic waves in the same way. So, this postulate is fitting the wave particle duality as introduced by de Broglie waves [7] and the results found by Cornell in his experiment on atoms [4].

According to the quantum theory, such memberships may be restricted to some quantization rules which can be imagined in Fig. 1. Such diagram assigns two membership degrees μ_M and μ_E to any energized particle according to its mass and its conjugate energy. Such diagram follows a similar reasoning or logic as found by Cornell in his common generic phase diagram that define transition-boundaries between the Non-Bose Einstein Condensation and the Bose Einstein Condensation in all atoms [4].

Figure (1): *Corpuscle's member ship to two fuzzy sets of mass and energy*

4.Electromagnetic waves:

According to definitions of the electromagnetic waves, after Maxwell, it is formed of two orthogonal-sinusoidal waves or components, Fig. 2. Those components are an electric wave of electric amplitude of intensity E in the vertical plane and a magnetic wave of a magnetic amplitude or strength B in the horizontal plane. The two waves are in phase. It is stated also that the total energy of the photon equals (h . υ) [7]. Such energy may be considered as a sum of magnetic and electric energies which are imparted by the two components of electromagnetic waves. Fuzzily, we may consider the electromagnetic waves as a simultaneous flow of two energies; electric and magnetic energies. Such postulate is stated as follows, P_3:

The areas under the lines of the oscillating electric and magnetic components of electromagnetic waves, vertical and horizontal areas in Fig. 2, are representing the electric and magnetic energies imparted by the electromagnetic waves. The absolute sum of both energies is the total energy imparted by such wave (i.e. = h . υ).

According to this proposition, the area bounded between the oscillating electric potential E and the time's axis is expressing the electric energy imparted by the electromagnetic wave. Similarly, the area bounded in the upper or positive part of the oscillation is corresponding to an electric energy of a positive potential. While the area in the negative or lower part of the oscillation is corresponding to the electric energy of negative potential. So, in normal or neutral electromagnetic waves (Fig.2), integrating the total area along the electric wave component will lead to an electric energy of zero potential. Similarly, integrating the total area along the magnetic component will result into magnetic energy of zero-magnetic potential. As postulated, the sum of the absolute values of the bounded areas should equal (h . υ) It is the energy of a photon.

Figure (2): *Normal electromagnetic waves (with a zero-mean potential)*

5.Electric Charges:

Electrons are considered as negatively charged particles with a known mass and a known negative charge. According to Bohr's model, it is revolving in an orbit around a positive nucleus in the atom. If the atom looses one of its electrons, i.e. of its negatively charged particles, it will be a positively charged ion. And if the atom gains an electron, it will be a negatively charged ion. By such concept, we were able to explain the formation of compounds from the atoms of elements. It is stated also that the flow of an electric current is due to the flow of free electrons in a conductor. Assuming the truth of such propositions, scientists were able to explain and set the laws governing the electric circuits in many engineering applications.

However, such concepts fail to define the charge's nature. Is it a form of energy or of mass? Mass and energy are the only known distinct natures involved in every thing of our universe. The primary form of energy may be considered as electromagnetic waves which are emitted from the sun and warming up our universe. Considering the analogy between energy as heat and electric charges, we find that both are quantized [7] and both are crossing the boundaries due to potential differences, i.e. due to thermal and the electric potentials. So, we may assume that the charged particles are like the hot particles or as energized particles by a special form of energy. Accordingly, the charge may be considered as a modified form of energy or electromagnetic waves. So, it is logic to postulate the existence of a category or a fuzzy set of electromagnetic waves which energize particles to be of positively or of negatively charged.

Such proposition may be supported by discoveries as Kerr effect [9] where an electric field is found to influence the light or the electromagnetic waves. Similarly, the behavior of photons as negatively charged particles [7] and the emerging definitions of the positive light [8] indicate an analogy between electromagnetic waves or energy and electric charges.

According to Postulate P_3, the electromagnetic wave is considered to represent two flows of energies into two orthogonal planes. However, both components are considered

to be oscillating about a zero mean-value. Such assumption is not absolutely correct or proved by any means. As an approach to realize the postulated existence of a category or a fuzzy set of electromagnetic waves that may energize particles to be positively or negatively charged, we may assume that the existence of waves that have a shifted or drifted position of the mean value of its oscillating electric component. So, we can define the electric charge by the following fuzzy proposition, P_4:

According to some quantization rules, the electric component of specially categorized electromagnetic waves may be oscillating about a drifted mean. Such drift may be in the positive or the negative directions, i.e. the mean value of the oscillating E component may have a positive or a negative potential (ΔE). *So, if the bounded electric energy by the oscillating E component has a positive-mean potential, it will resemble or define energy of positive electric mean. Similarly, if the bounded electric energy has a negative-mean potential, it resembles energy of negative mean. So, if any particle will be energized by such forms of energy, it will act as a positive or a negative charge.*

According to this postulate, the defined charges are actually particles energized by a special category of electromagnetic waves. Such proposition can be imagined graphically by considering the waves in Fig.3 and Fig.4 which represent flow of electromagnetic waves having electric components with shifted means. The shift of the mean value of the electric potential of such electromagnetic waves may be situated according to some quantization rules influenced the holding particles or other physical parameters. The governing quantization mechanism in these cases should be a subject of further studies. We may denote the drift of the electric component as (ΔE) that defines the value of the shift of mean of the electric component of such modified electromagnetic waves with respect to a zero reference line. Fig. 3 shows such modified electromagnetic waves whose electric component has a positively shifted mean or waves oscillating around a line of a positive potential marked as (+ΔE). So, its oscillation in the positive direction, E^+, is larger than its oscillation in the negative direction, E^-. Hence, the area under the upper part of the wave, or in the positive section of the wave, is larger than the area under the lower part of the wave, or the negative area of the wave. So, the area bounded by the complete electric component of one complete electromagnetic wave sums up energy of a positive potential. So, it may be considered according to the fuzzy postulate P_4, a positive charge has a definite positive potential (+ΔE). Similarly, Fig. 4 shows a negatively drifted electric component of the electromagnetic wave whose area's integration indicates also energy of a negative potential (- ΔE). So, a wave of such form resembles, in a fuzzy logic interpretation, a negative charge. So, proposition P_4 postulates a definition for the electric charge as a form of energy with an assigned value of an adopted electric potentials (+/_ΔE).

So, proposition P_4 adds actually new fuzzy sets or subsets of electromagnetic waves. Such sets may be postulated by the following corollary:

Electromagnetic waves may have a specified degree of membership to one of the

following fuzzily categorized sets: {X}, {Y_1} and {Y_2}. There corresponds for each of those fuzzy sets a certain position of the mean value of its oscillating electrical wave-component with respect to a zero reference line. Such electromagnetic waves may energize the particles with positive, negative or neutral charges (as thermal energy).

This corollary defines three fuzzy sets or categories of electromagnetic waves; a fuzzy set having energy of neutral or zero electrical potential, another fuzzy set having positively shifted mean values of its electrical potentials (+ΔE) and a fuzzy set having negatively shifted mean values (-ΔE). The word fuzzy should be introduced here because such drift are fuzzily stated to find a physical explanation for an ambiguous concepts. Such concepts should be tested to discover its "trueness", i.e. if they are true or false concepts. According to the previous postulate; the fuzzy set of normal electromagnetic waves is denoted as {X}, the fuzzy set of positive mean potential is denoted as {Y_1} and the last fuzzy set of negative mean potential is denoted as {Y_2}.

According to postulates P_2 and P4, the electron may be defined as an energized particle that has a degree of membership to a fuzzy set of mass particles {M} and another degree of membership to a modified fuzzy set of electromagnetic waves of the category{Y_1}. Proton can be also defined as an energized particle of a higher degree of membership to a fuzzy set of mass particles {M} and a lower degree of membership to a modified fuzzy set of electromagnetic waves of the category{Y_2}. By such line of logic, the electromagnetic waves that energize the electron with a negative charge induce an equal but opposite drift in the E component of the electromagnetic waves that energize the nucleus. So, the nucleus will be positively charged and the atom will be a neutral particle. Such conclusion fit the neutral nature of atoms.

Figure (3): *Electromagnetic waves belonging to the fuzzy set {$Y_{1'}$}*

Figure (4): *Electromagnetic waves belonging to the fuzzy set {Y_2}*

In a similar way, we may define the photon in general as an energized particle of a low degree of membership to the fuzzy set of mass particles μ_M (since $m_{ph} = h \upsilon / c^2$), and a high degree of a conjugate membership to any of the fuzzy sets of energy or electromagnetic waves of the categories {X}, {Y_1} or {Y_2} that can be denoted as μ_{pX}, μ_{pY1} or μ_{pY2}. So, photons may behave as an energized particle of neutral, positive or negative charges according to the category of its conjugate electromagnetic waves. So, the postulated memberships offer logical reasoning or more plausible explanations for the behavior of some photons as charged particles [7] and also to the found polarization of photons [8]. Such attained understanding that removes the ambiguities of such phenomena improves the trueness of the stated postulates.

According to the proposition P_4, we may state the following corollary:

The charge can be considered as a category of electromagnetic waves that possess a potential of the value (ΔE).

This corollary assigns, as postulated, a definite adopted potential ΔE for each charge or charged particle. So, the total electric potential of flowing charged particles or charges can be expressed mathematically as the sum of the drifts of its charges. Such conclusion may be stated as follows:

$$E = \Sigma (\Delta E_i) \qquad (2)$$

According to definitions of the electromagnetic waves, after Maxwell, it is formed of two orthogonal-sinusoidal waves or components, Fig. 2. Those components are an electric wave of electric amplitude of intensity E in the vertical plane and a magnetic wave of a magnetic amplitude or strength B in the horizontal plane. The two waves are in phase. It is stated also that the total energy of the photon equals (h . υ) [7]. Such energy may be considered as a sum of magnetic and electric energies which are

imparted by the two components of electromagnetic waves. Fuzzily, we may consider the electromagnetic waves as a simultaneous flow of two energies; electric and magnetic energies. Such postulate is stated as follows, P_3:

$$E \alpha Q / A \qquad (3)$$

The constant of proportionality in equation (2) depends on the value of the mean's shift (ΔE) in the fuzzy sets $\{Y_1\}$ or $\{Y_2\}$. In other words, it is representing the potential of the electromagnetic waves that energize the particle with negative or positive charges. The value of such potential or shift may also offer a plausible explanation of the so called fractional charges, 2/3 and -1/3, [8] which may be explained as different categories of electromagnetic waves of different quantized shifts or drifts (ΔE). So such particles have different degrees of membership μ_M, μ_X, μ_{Y1}, and μ_{Y2} and differ also in the quantized drifts of its energizing waves. Such conclusion may also offer plausible explanations for the so called color-charged particles as the quarks and gluons [8]. Such particles, as electrically-charged particles, interact by changing their memberships by accepting or loosing electromagnetic waves of different drifts of its potential (ΔE). So, the color may refer to different quantized magnitudes of the drift ΔE of the particle's conjugate electromagnetic waves. Different values of potential's drift (ΔE) and the degrees of membership (μ_{Y1} or μ_{Y2}) of any corpuscle may be combined simultaneously according to certain quantized rules to categorize such charged particles into weak, normal and strong charged particles of negative or positive charges which are denoted as W^+ , W^- , Z or named as quarks, gluons, etc. [8]. In symbols:

$$\Delta E_{weak} \neq \Delta E_{normal} \neq \Delta E_{strong} \neq \Delta E_Z \neq \Delta E_W \qquad (4)$$

$$\mu_{Y(weak)} \neq \mu_{Y(normal)} \neq \mu_{Y(strong)} \neq \mu_{Y(Z)} \neq \mu_{Y(W)} \qquad (5)$$

In other words, different values of potential drifts or values of the amplitude of the energizing electromagnetic waves distinguish the different atomic particles as discovered. So, proposition P_4 and its corollaries offer also a plausible explanation for the existence of such distinguished atomic particles and antiparticles for each of those particles. Antiparticles may be explained as a result of a mutual induction evoked between two similar particles such that they have equal memberships to the mass particles and waves, i.e. equal μ_M and μ_E, with equally and oppositely drifted conjugate electromagnetic waves. So, combining a particle and its anti-particle will result in a neutral particle whose conjugate electromagnetic waves will be of the fuzzy set $\{X\}$. The drift of the E-component in the particle will neutralize the opposite drift in the antiparticle. The result of their combination will result into a particle having the sum of

energies of the two particles but in the form of normal electromagnetic waves, as heat.
As light may behave as a charge of negative and positive potentials, according to P4, it is expectable to find changes in indexes of refraction for light polarized parallel to or perpendicular to the applied electric field. This discovered phenomenon is called Kerr effect [2].
Proposition P_4 may offer also more plausible explanation for charging of clouds. According to the stated propositions, the interaction between the cosmic dust and the solar radiation may create a storm of photons with negatively drifted or positively drifted electric components. Such storm of drifted photons may be absorbed by the water droplets forming the clouds as conjugate electromagnetic waves of definite drift or potential. The accumulation of such waves or charges will lead to a charge of large potential ($= \Sigma (\Delta E)_i$). As long as the accumulation continues, it will create extremely high potential clouds with extremely huge electric energy or charge. When the potential at some parts of such clouds becomes high enough with respect to the ground state of the earth, their charge or electric energy will pass to the earth through the humidity of the air in the form of such electrified electromagnetic waves known as lightning.

6. The Energy Stored In Capacitors:

No one has ever seen the electric current as a flow of electrons in a conductor. However, such proposition satisfies most of the electricians or the physicians. But according to the velocity of flow of the electric current in some conductors and the flow of charge from the clouds to the earth during lightning, it can be regarded in some cases as a flow by the speed of light. So, this affirms proposition P_4 that considers the flow of charges to be a flow of electromagnetic waves with the speed of light. However, the electric current may be regarded also in some cases as a flow of energized particles of a high degree of the membership μ_E and a low degree of the membership μ_M. Hence, such particles may behave as electromagnetic waves flowing with the velocity of light, and having a charge according to the category of electromagnetic waves energizing such particles, i.e. of the category $\{Y_1\}$ or $\{Y_2\}$.

Such proposition may be verified also by considering the case of a charging a capacitor by a battery [7], Figure 5, where current flows from the high potential terminal of the battery to the capacitor plate h and from the capacitor plate l to the battery's lower potential terminal. According to restricted definition of current as a flow of electrons, such definition cannot explain the flow of such electrons through air during the charging process, as the air is a non-conducting medium.

Figure (5): *A capacitor charging circuit*

However, if we consider the photons as energized particles of definite charge, as postulated here, we can find a plausible explanation of the flow of such photons across the capacitor plates or through air during such charging process.
Such logic offers also more plausible explanation for the capacitor storage capacity. The concerned postulates define the charge as a modified form of energy or electromagnetic waves that may energize any particle if it is capable of absorbing such energy. So, if the gab between the two plates of a condenser is filled by air, the capacity of the air to absorb charge as a category of electromagnetic waves is limited due to its low density or absorbing capacity. If it is filled by a dielectric material having a higher density, then it will have a higher capacity to absorb such energy. Such conclusion offer a plausible explanation to the results Faraday's discovery which is expressed by the equation:[2]

$$C = \kappa * C_{air} \qquad (6)$$

Where κ is the dielectric constant of the filling material. Equation (4) expresses the increase in the charge of the capacitor by the factor κ if we insert a dielectric slab in the space between the plates of a condenser. So, if q_i denotes the initial charge of the plates of a capacitor, then the addition of a dielectric material between the plates was found to increase the charge of the capacitor to a final value q_f defined by the equation [2]:

$$q_f = \kappa * q_i \qquad (7)$$

Such increase can be explained more logically according to the stated postulates that it represents the net charge or energy absorbed by the added dielectric slab. Such conclusion is affirmed by the found decrease in the stored energy in the capacitor's circuit [4] which was found as:

$$U_f = U_i / \kappa \qquad (8)$$

From equations (6) & (7), the initial energy in the capacitor circuit decreases by the same ratio of increase charge in the capacitance. So, the energy loss in the capacitor circuit is absorbed as an electric charge in the dielectric material. This is a thermodynamic process that satisfies the principles of conservation of energy, i.e. the first law of thermodynamics. In other word, the energy absorbed in the dielectric slab as a charge is equal to the energy decease in the condenser circuit. Such conclusion is a sufficient proof that the electric charge is a category of energy, or a modified form of electromagnetic waves, as previously postulated. Accordingly, we may describe the electric current by the following proposition P_5:
The flow of current may be considered as a flow of photons or a special category of electromagnetic waves, as the fuzzy sets $\{Y_1\}$ or $\{Y_2\}$.

7. Magnetism:

As the energy is quantized, it was found also that the magnetic flux is quantized [7], where the quantum flux is defined by the following equation:

$$\Phi_{qu} = h / 2*e \qquad (9)$$

Such relation relates the quantum flux (Φ_{qu}) to the photon's energy by the Planck's constant (h) and to the electric charge by the electron's charge (e). So, it forms a scientific base for a further fuzzy proposition that may consider the magnetic flux of a similar nature as the energy or electromagnetic waves. Similarly, using magnetic expansions to attain extremely low temperatures, [7] sustains the proposed postulate that regards the magnetic flux as a form of energy. So, the area bounded by the magnetic component of electromagnetic waves, i.e. the area between the oscillating magnetic strength B and the time axis, may offer also a fuzzy approach to define the magnetic energy imparted by electromagnetic waves. Following a similar line of logical reasoning as that followed in defining the electric charge in proposition P_3, we may postulate a new proposition (P_6) that offers a more generalized fuzzy-approach for defining the electric charges and the magnetic flux as categories of electromagnetic waves.

Electromagnetic waves may be found in three different categories defined by the following fuzzy sets: {X}, {Y_1}, {Y_2} and {Z}. There corresponds for each of those fuzzy sets a specific value of the mean of its oscillating electrical wave-component or its magnetic wave- component with respect to reference zero potential- lines.
The trueness of such fuzzy proposition is sustained also by the analogy or the similarity of flow patterns of heat through a conductor from a high temperature point to a low temperature point, the magnetic flux of a bar magnet indicated by the iron fillings and the field electric field lines for two separated-equal but opposite electric-charges [1]. The proposition P_5 adds new categories or fuzzy sets to the previously defined fuzzy sets of

electromagnetic waves. The new fuzzy set, *{Z}* is defining the magnetic flux as another category of electromagnetic waves. The mean value of the oscillating magnetic component of such category of electromagnetic waves, the horizontal component of the wave, has a magnetic strength (ΔB) that corresponds to its drift with respect to a zero potential line, as shown in Fig.6.

According to proposition P_3, the area under the line representing the oscillating magnetic wave indicates the magnetic energy imparted by such electromagnetic wave. So, we may define the magnetic flux by following a similar fuzzy approach as that considered in defining the electric charge. So, proposition P_6 may read:

Magnetic flux is a form of energy that may be resembled by the net algebraic sum of the areas bounded by an oscillating magnetic-component of an electromagnetic wave of the fuzzy set {Z}. Such flux possesses a definite strength ΔB that corresponds to the drift of the mean value of its oscillating magnetic-component with respect to a zero potential-line. This strength, or drift, may depend on specific quantization rules tied to the interactions between the membership's degrees μ_M and μ_E *in atoms of specially latticed elements (as ferromagnetic materials).*

The previous proposition postulates the nature of a magnetic flux as magnetically drifted electromagnetic waves, i.e. a special category of electromagnetic waves with a drifted B-mean. As a corollary for proposition or postulate P_6 , we may state such conclusion as follows:

The magnetic flux is a form of energy flow which adopts a specific value of magnetic potential.

According to the second law of thermodynamic, heat is adopting a thermal potential that governs its flow from high to low temperatures [7]. Hence, by analogy between heat, charge and magnetic flux as different forms of energy, the charge and magnetic flux should have as postulated analogous potentials. This analogy proves the trueness of postulates P_4 , P_6 and their corollaries.

So, the magnetic flux may be considered as a bundle of drifted electromagnetic waves when it is crossing a definite area. The total magnetic strength of the flowing drifted electromagnetic waves will be the sum of the drifts of the flowing waves. This may be expressed as:

$$B = \Sigma(\Delta B)_i \qquad (10)$$

So, increasing the magnetic flux per unit area will lead to increasing the strength of the magnetic field produced by such magnetic flux. This result can be expressed by the following equation:

$$E \ \alpha \ Q/A \qquad (11)$$

If we compare equation (10), as found from the postulated logical reasoning in the proposition P_5, with the following law as found in physics-literatures [7] through experimentation and measurement:

$$B = \Phi / A \qquad (12)$$

Such comparison will lead to a conclusion that the coefficient of proportionality in equation (8) is 1. This conclusion and coincidence of the both equations prove that that the magnetic flux has an adopted magnetic potential as have been concluded from postulate P_6.

Figure (6): *Electromagnetic waves belonging to the fuzzy set {Z}*

8.Permanent Magnets and Ferro-magnetism

According to proposition P_2 and the results of Cornell's experiment [3], atoms can be considered as energized particles that holds two degrees of membership to the two previously mentioned fuzzy sets {M} and {E}. So, if an atom's conjugate-electromagnetic waves are belonging to the fuzzy set {Z}, this material is a ferromagnetic material and it will act as a magnet which is the case of permanent magnets or artificial magnets. So, the strength of the magnetic field of such material may be determined by the value of the magnetic drift of its energizing waves. However, the classical explanation that relates the magnetism of iron atoms to special spinning electrons is not so convenient and it fails to explain why other materials haven't such spinning motion as iron. It is more logic to postulate that the permanent magnet has a permanent capability to reform its absorbed electromagnetic waves into electromagnetic waves of the category {Z}, i.e. it imposes a drift in the oscillating magnetic component of its energizing electromagnetic waves. Then it emits such energy as a magnetic flux. In case of ferromagnetic materials, they have a special property to be energized by such magnetic flux or they are able to absorb such drifted waves. However, such ferromagnetic materials may gain the property of reforming the normal electromagnetic

waves into a magnetic flux if it is activated by special treatment as magnetizing by a permanent magnet or the influence of an electric field [7]. In this case it will gain the properties of magnets.

The electric charges were defined by proposition P_4 as fuzzy sets of electromagnetic waves $\{Y_1\}$ and $\{Y_2\}$, i.e. with positive or negative drifts of the electric components of such electromagnetic waves. Similarly, it may be postulated drift of the magnetic component in both directions too.

The postulated proposition may offer also a plausible explanation for the loss of magnetism in ferromagnetic materials at high temperatures. Such phenomena may be explained, according to the propositions (2) and (6) as follows: The atoms of the ferromagnetic materials have a limited membership μ_E that limits the quantity of its conjugate electromagnetic waves. If the band-gab of such ferromagnetic materials is limited to specified quantity of conjugate electromagnetic waves, heating the magnet will replace such waves by normal electromagnetic waves of different frequencies or wave lengths. So, the magnet will loose its ability to emit magnetic flux but it will emit normal heat similar to the absorbed waves. Is such explanation representing a further approach to the trueness of the postulated concepts?

9. Kerr Electro and Magneto-Otical Effects

Many experiments were designed to detect small changes in polarization of light that occur due to the influence of electrical fields or magnetic fields. Such influence on the polarization state of optical radiation is found as it passes through a transparent medium [9]. Under such influence of the applied field, the material becomes birefringent, with different indexes of refraction for light polarized parallel to or perpendicular to the applied field. The difference in index of refraction, Δn, depends on the wave length of the incident light and the amplitude of applied field. . This difference in index of refraction causes the material to act like a wave-plate when light is incident on it in a direction perpendicular to the field. Such confusion between the light and the electric or magnetic fields is better explained according to the postulate P_6. According to this proposition, the photons of light are considered as energized particle whose conjugate energy may be of the modified categories {Y} or {Z}. Such modification of the waves may be imposed due to the applied magnetic and electric fields. So, the applied field and the restricting slabs influence the light to behave as electric charges or magnetic flux according to postulates (4) and (6).

10. Experimental Proof of "Trueness" of Stated Postulates:

The success of the introduced definitions to find plausible explanations of some discovered phenomena represents a step to accept the "trueness" of such definitions. Faraday's discovery may represent, as previously explained, a sufficient experimental proof that the electric charges are modified categories of electromagnetic waves. However, it is also necessary to carry out a laboratory experiment to investigate the nature of the magnetic as a modified form of energy or electromagnetic waves.
A permanent magnet is immersed in water inside an insulated metal or glass flask. Near the flask is placed an iron ball of polished surface which is free to move under the attraction of the magnet along an inclined smooth glass plane. Fig. 7 shows such simple test-rig. The temperature of the water was measured by a digital thermometer connected to a data logger. As the magnet is performing a work to pull the ball up the glass plane, the water temperature was found to decrease. By applying the first law of thermodynamics on such closed system [7], so, we get the following equation:

$$\underline{C} * d(t) = m * g * s * \sin \varphi \qquad (13)$$

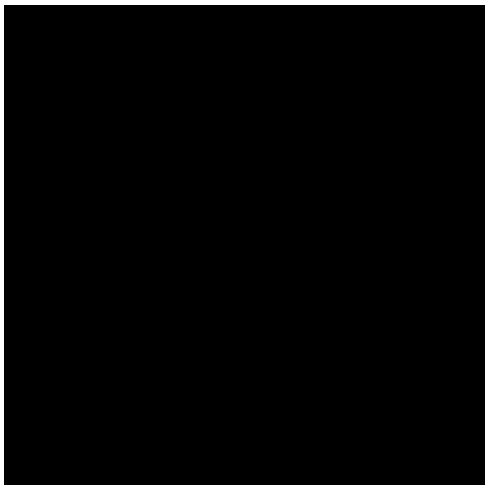

Figure (7): *Measurement of energy balance parameters during magnet's attraction.*

Where C_F is the flask's heat capacity, n is the number of attracted balls along the inclined surface per minute, m_b is the mass of the iron balls, g is the acceleration gravity, s is the displacement of the iron ball along the inclined smooth plate φ is the angle of inclination of the smooth plate and Δt is the rate of temperature increase per minute. In an experimental study with the following data: thermal capacity of the flask = 1.26 kJ/ deg , mass of each iron ball = 0.3 kg: , number of attracted balls along the inclined surface per minute = 42 balls , the displacement moved by each ball along the inclined surface s = 20 cm and the angle of surface inclination φ = 30 deg. The found results of temperature decrease in the held experiment are shown in Fig. 8 (10) and are compared to the theoretical results from Equation (10). Such decrease in water

temperature is due to the decrease in the flask internal energy (including the internal energies of water, magnet and walls of the flask) which is transferred to the magnet as a substitute to its emitted magnetic flux. So, the magnetic flux emitted by the magnet, as postulated, is a categorized form of energy or electromagnetic waves. The difference found between the theoretical and experimental results in Fig. 8 is due to the heat and frictional losses.

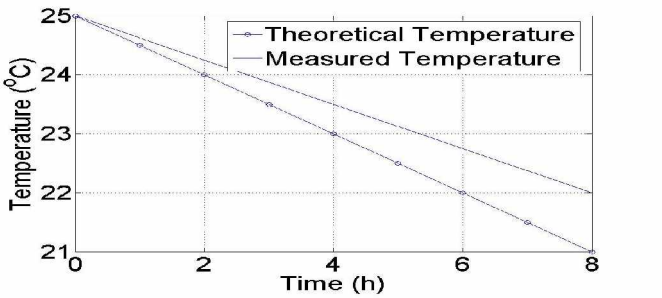

Figure (8): *Experimental and theoretical results recording decrease of water temperature during iron-ball's attraction by a magnet.*

According to this experiment, we may state a scientific conclusion or discovery which affirms the trueness of the stated postulates. Such postulate assigns permanent magnets with the capability of reforming electromagnetic waves into magnetic flux. Such conclusion defines experimentally and logically the way of substituting the magnetic flux emerged from permanent magnets or ferromagnetic materials. Such conclusion proves that the continuous emission of the magnetic flux or energy from the permanent magnets is continuously absorbed from its internal energy. Such decrease of internal energy can be substituted by absorbing an equal amount of energy from surroundings. So, as postulated, permanent magnets are capable of reforming such electromagnetic waves into magnetic flux with a magnetic potential or a drift (Δ B).

11. Conclusions:

According to the third law of thermodynamics, any particle may be considered as an energized particle. Such consideration is interpreted in a fuzzy concept that adopts the discovered wave mass duality. Each particle is considered to have two degrees of membership to two systems; a mass-system and an energy-system. Reviewing the similarity and analogy between heat, electric charges and magnetic flux, new concepts that consider the electric charge and the magnetic flux as special categories of energy or electromagnetic waves of adopted potentials were postulated. The "trueness" of such postulates was proved by the results of Faraday's discovery in capacitor charging and

the results of a new experiment that was done in this investigation. As the postulated concepts lead to plausible explanations of the concerned phenomena in the field of atomic particles and electromagnetic waves, the trueness of such concepts is cleared.
Such postulates lead also to interesting scientific conclusions concerning the permanent magnets, the colored charges, the Kerr effect the loss of magnetism due to heating, the anti-particles, the charged clouds, etc.

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Nomenclatures:

Δ	Mean Drift of the line of oscillation of electromagnetic waves.
ϕ	Magnetic flux
φ	Angle of inclination of the sliding plane
κ	Dielectric constant
μ	Degree of membership of a set to a fuzzy system
A	Area
At	Atom
B	Strength of magnetic field
Bo	Bohr's model of atoms
C	Capacitance
$\underline{C}$	Heat capacity
d	Difference
E	Electric potential
e	Electron charge
g	Gravity acceleration
h	Planck's constant
m	Mass of the balls
N	Number of balls attracted per minute
s	Distance traveled by the balls along the inclined surface
t	Temperature
{X}	A fuzzy set of normal electromagnetic waves
{Y}	A fuzzy set of a category of electromagnetic waves having an electric potential
{Z}	A fuzzy set of a category of electromagnetic waves having a magnetic potential