Photon structure and behavior
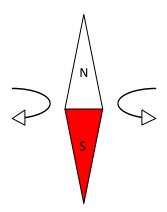
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One of possibilities for that why like charges repel and opposite charges attract was a photon possessing negative and positive two poles that with an up or down spin frequency – any integer -- offers a fresh insight into photon energies.

Key words: Photon structure, charge repel-attract, force lines, spin frequency

1. Introduction

Light is wave[1] or particle[2]? Now the argument is explained to display wave–particle duality in uncertainty principle of morden physical theories. While in here prefers particle to wave that light not only is made of particles -- photons[3-7], but also they could own two opposing charge poles that gave rise to charge r-a (repel-attract) property; what is more, it accompanying a spin can offer an easier sketch on an origin of electromagnetic frequency (Fig. 1).

Fig. 1: Photon image and spin

A neutral photon (boson) seems like a compass or a fermionic dyon having both positive (+, N: north pole and norton – north particle) and negative (–, S: south pole and souton – south particle) charges that around its NS axis could emerge two spin (not only ± 1, but also any integer as frequency) directions.

2. Suppositions and discussions

2.1. Photon structure

This photon image came from a problem that like charges repel each other and opposite charges mutually attract, which was often in my mind for a few decades. Why it is so that has no a deeper explanation on it up to now, to the best of my knowledge. Here a consideration is that either electric or magnetic field is made up of lines of force[8] and the lines consist of photons; if these photons own an intrinsic configuration that occurs a N-S pair analogous to an electron-positron one -- but smaller, a fermionic dyon or skyrmion[9-12] and unable to be broken almost in any condition, which likely was anisotropic, oscillating and deformable (Fig. 1), and then line them (looking like string)[13-16] able to create charge r-a phenomena (Fig. 2A-B).

However, it is surprised that when I skim a paper "*A Photon is a Magnetic Dipole*" and its references[17-18] on viXra in Aug. 3, 2021, which is nearly comparable to my and stimulated me ahead of time to write this paper. For he used electromagnetic r-a phenomena to elucidate double-slit experiment I agree partly, since lattice materials of double-slit, and others we unclear, might be involved.
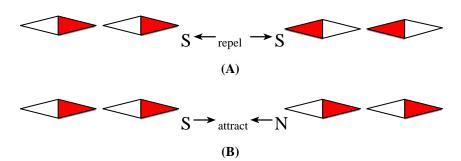
Fig. 2: Force line r-a occurrence of two magnets

(A)

(B)

(A) Nose to tail photons corresponds to Faraday's illuminating a magnetic
curve or line of force, no matter on magnetic or electric fields, subsequently
displays like (negative) charges repulsion.
(B) Opposing (negative and positive) charges attraction.

2.2. Photon spin and energy

A photon energy is generally related to atomic or nuclear energy levels when a transition is from excited to ground state that are potential energies and their pictures a bit was unphysical (see also an elegant tangible nuclear model of 1-118 elements and their different isotopes)[19], which the energy span is from radio waves to gamma rays (~ 10^{-9} – 10^6 eV or ~ 10^6 – 10^{20} Nz). A problem is that when a photon has been emitted afterward it became a free photon that how to express its kinetic energy?

To express real meaning of a photon energy, a promising way is to assume that its frequency could roughly be regarded as another expression of its spin that was variable (any integer, approximately equal to its angular momentum plus its orbital angular momentum in modern

physical concept), and exhibited a certain direction known as left-handed and right-handed, a spin photon probably linking to a spin of our universe and as a consequence lead to an asymmetric world that matter is more much than antimatter[20], or up and down that a photon has two possible polarization states[21]. That is

$$E = hc/\lambda = hv = hf,$$

giving

$$f = s_f,$$

so

$$E = hs_f$$

where are: E, photon energy; h, planck constant; c, light speed; λ, wavelength; f / v, frequency; and s_f, spin frequency. Obviously, it is accessible to understand photon energies (Fig. 1).

2.3. Photon mass and charge

This scheme is based on light wave theory that still used wavelength or frequency term. A photon energy, on the other side, perhaps can't completely exclude that might partly result from its mass; however, our world displays a certain shape and size that is made of material. Commonly, an ordinary object kinetic energy is

$$E = mv^2/2,$$

which its energy is proportional to its mass. But in a photon energy

$$E = mc^2,$$

photon speed c is constant in vacuum and mass m is massless. Accordingly, trying to seek a possible means is that a photon may occur an intrinsic mass m, but could increase to nm, $n = 1, 2, 3…$, like Bose-Einstein condensation[22], and a big (multi) photon, even so large as a neutron, a mini black hole[23-24] (somewhat corresponding to a neutrino?), or a black hole (needless to say its photon sphere-circle) [25], that its properties are same as a single photon. This is due to that electron and positron can be annihilated into two photons

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

in free space, or contrary

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

adjacent atomic nuclei, implying that electron-positron pair came mostly from one of nucleons of

the atomic nuclei, and a photon existing mass and charge, no matter more or less, is necessary. Hence, a photon could have mass and charge, and, on the other side, its particle characteristic is more prior than of wave that merely is a show of its mass-charge field.

For a long time an attempt is using photons, which not only is force carrier but also a mere basic particle was assumed that all of others were composite[20], to simulate structures of electron and positron after that to neutron and proton[26], i.e.:

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

Nevertheless a clear map has not been drawn so far, where as an embryonic idea in Fig. 3 shows some possible subparts of these particles, along with they grow to various size shapes that can match partons, or quarks and leptons to some degree.
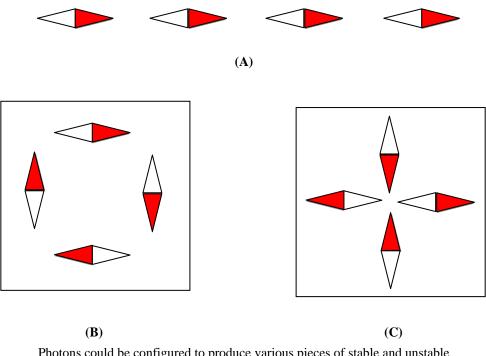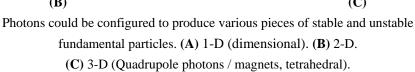
Fig. 3: Photons forming open, closed and quadrupole "strings"

(A)

(B)   (C)

Photons could be configured to produce various pieces of stable and unstable
fundamental particles. **(A)** 1-D (dimensional). **(B)** 2-D.
(C) 3-D (Quadrupole photons / magnets, tetrahedral).

In addition, about mass and charge a topic is their relationship that mass has F_g (gravitational-) and charges have F_r (repelling-) and F_a (attracting-force), noticing that among four fundamental gravitational, electromagnetic, weak and strong forces solely electromagnetic one can occur repelling characteristic, including of proton-proton. Here a guess is that if there is a balance (cross) point, $\sim 10^{-15}$m (i.e. nucleon scale, Fig. 4):

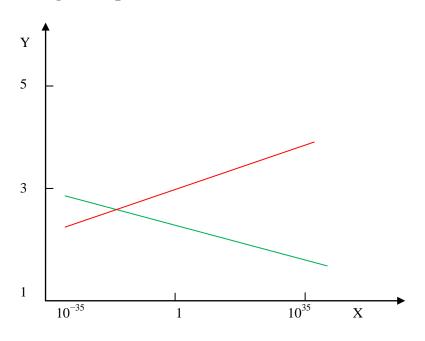$$F_r = F_a,$$

when a distance is larger than this value:

$$F_r < F_a,$$

otherwise reverse. Thus:

$$F_g = F_a - F_r,$$

meaning that gravitational and electromagnetic forces may be identical, which the both might slightly deviate from inverse-square law. In the light of this, so far as to say other three forces are in different scale show of electromagnetic one (Fig. 4). What tending to think a picture of that cosmos is shaped only by photons (bosons, matter) and electromagnetic force (interaction) is too simple to likely? However, it is uncertain that whether some physical laws and constants are invariant, or not.[27-30]

Fig. 4: Exponent as a function of distances

This only is conceptual, not precise values. Red and green lines represent repelling and attracting forces, respectively; and distance m is at X axis and exponent n in $F = Gm_1m_2/r^n$ and $F = kq_1q_2/r^n$ is at Y axis that both gravitational and Coulomb constants: G (6.674×10^{-11} m^3 kg^{-1} s^{-2}) and k ((8.988×10^9 N m^2 C^{-2}) would be integrated into a stronger "nuclear" one.

Finally, a difficult problem in next step is that how to estimate a value of a photon mass and charge, and then to construct electron-positron pairs (somewhat similar to a spinor[31-32]) but in a what case uncharged photons (bosons, a fermionic dyon) can form charged particles (fermions), very key, and how many photons (n) need to build an elementary charge (e, electron or positron,

i.e.: e/n, n is not negative integer), which their present rough values are: $m_\gamma \lesssim 10^{-14}$ eV/c^2, $q_\gamma <$ 1×10^{-35} e, respectively[33-35]. A photon charge is near $e/10^{35}$ that a quark only is $e/3$ or $2e/3$? However, perhaps there was a certain ratio of mass and charge that, e.g., 3 photon masses equal to 3 norton plus souton charges:

$$3m_\gamma = 3(q_N + q_S),$$

although net charges of 3 photons are zero that is parallel to a neutron containing proton and electron, implying that a photon mass and charge units might be more fundamental than of other particles. In other words: a photon could sever as two most basic units of mass and charge to some extent, or mass could stand for charge, vice versa that is no difference between them, if possible.

Now discussion has reached photon level, a smallest overt stable particle that unlikely was bigger than an electron we known, that might be an upper limit of that we can do. Namely to find a latent sub-photon particle (N and S, or force particles, e.g. graviton[36] that its mass: $m_g \leq$ 7.7×10^{-23} eV/c^2; relative speaking that gluons, W and Z bosons were too large) getting more information seems impossible, despite need for a deeper reason upon charge r-a character, and others. Will string ($\sim 10^{-35}$m, Planck length) be?

3. Conclusions

Electromagnetic r-a phenomenon existence seems to indicate that a photon not only was a point-like particle, but also had two opposing charge endpoints that can occur up or down spin with a variable frequency, which gave rise to photon energies of large span range ($\sim 1 - 10^{15}$).

References

1. Hooke R (1667). *Micrographia: or some physiological descriptions of minute bodies made by magnifying glasses with observations and inquiries thereupon...* London: Royal Society of London. ISBN 978-0-486-49564-4

2. Newton I (1952) [1730]. *Opticks* (4th ed). Dover, NY: Dover Publications. Book II, Part III, Propositions XII–XX, Queries 25–29. ISBN 978-0-486-60205-9

3. Planck M (1901). *"Ueber das Gesetz der Energieverteilung im Normalspectrum (On the Law of Distribution of Energy in the Normal Spectrum)"*. Annalen der Physik. 4 (3): 553

4. Einstein, A (1905). *"Über einen die Erzeugung und Verwandlung des Lichtes betreffenden heuristischen Gesichtspunkt"* . Annalen der Physik. 17 (6): 132–148

5. Millikan R (1914). *A Direct Determination of "h"*. Phys. Rev. 4 (1): 73–75

6. Lewis G N (1926). *The conservation of photons*, Nature 118, 874-875

7. Compton A H (1923). *"A Quantum Theory of the Scattering of X-Rays by Light Elements"*. Phys. Rev. 21 (5): 483–502

8. Peter D (1999). *The Philosopher's Tree: A Selection of Michael Faraday's Writings*. CRC Press. ISBN 0-7503-0570-3. p. 125

9. Schwinger J (1969). *A Magnetic Model of Matter*. Science. 165 (3895): 757–761

10. Witten E (1979). *"Dyons of Charge eθ/2π"*. Phys. Lett. B. 86 (3–4): 283–287

11. Skyrme T (1962). *A unified field theory of mesons and baryons*. Nuclear Physics. 31: 556–569

12. Usama A, Henk S (2001). *Skyrmions in a ferromagnetic Bose–Einstein condensate*. Nature. 411 (6840): 918–20

13. Zeeya M (2011). *"Collaborative physics: string theory finds a bench mate"*. Nature. 478 (7369): 302–304

14. Lisa R, Raman S (1999). *An alternative to compactification*. Phys. Rev. Lett. 83 (23): 4690–4693

15. Ashoke S (1994). *Strong-weak coupling duality in four-dimensional string theory*. International Journal of Modern Physics A. 9 (21): 3707–3750

16. Chris H, Paul T (1995). *Unity of superstring dualities*. Nuclear Physics B. 4381 (1): 109–137

17. Rajpal K L (2021). *A Photon is a Magnetic Dipole,* viXra 2105.0017

18. Evans M W (1992). *The Elementary Static Magnetic Field of the Photon*, Physica B 182, 227-236

19. Mao J (2017). *The Periodic Table Possible Coincided with an Unfolded Shape of Atomic Nuclei.* Applied Physics Research 9 (6):47

20. Mao J (2021). *Cosmic Background,* European Journal of Applied Physics, 3(1), 67-70

21. Schwartz M D (2014). *Quantum Field Theory and the Standard Model*. Cambridge University Press. p. 66. ISBN 978-1-107-03473-0

22. Anderson M H et al. (1995). *"Observation of Bose–Einstein Condensation in a Dilute Atomic Vapor"*. Science. 269 (5221): 198–201

23. Hawking S W (1971). *"Gravitationally collapsed objects of very low mass"*. Monthly Notices of the Royal Astronomical Society. 152: 75

24. Treder H J (1985). *"The planckions as largest elementary particles and as smallest test bodies"* . Foundations of Physics. Springer. 15 (2): 161–166

25. Claes R C (1997). *Using the Uncharged Kerr Black Hole as a Gravitational Mirror*. General Relativity and Gravitation. 29 (4): 445–454

26. Miller G A (2007). *Charge Densities of the Neutron and Proton*. Phys. Rev. Lett. 99 (11): 112001

27. Dirac P A M (1938). *"A New Basis for Cosmology"*. Proceedings of the Royal Society A. 165 (921): 199–208

28. Teller T (1948). *On the change of physical constants*. Phys. Rev. 73 (7): 801–802

29. Michael D (2002). *Trialogue on the number of fundamental constants*. Journal of High Energy Physics. 2002 (3): 023

30. Uzan J P (2003). *The fundamental constants and their variation, Observational status and theoretical motivations*. Reviews of Modern Physics. 75 (2): 403

31. Oknin´ski A (2021). *On spin-charge separation*, viXra 2107.0178

32. Czajka P et al. (2021). *Oscillations of the thermal conductivity in the spin-liquid state of α-$RuCl_3$*, Nature Physics 17, 915–919

33. Amsler C et al. (2008). *"Review of Particle Physics: Gauge and Higgs bosons"* Phys. Lett. B. 667 (1): 1

34. Kobychev V V, Popov S B (2005). *Constraints on the photon charge from observations of extragalactic sources*. Astronomy Letters. 31 (3): 147–151

35. Williams E, Faller J, Hill H (1971). *New Experimental Test of Coulomb's Law: A Laboratory Upper Limit on the Photon Rest Mass*. Phys. Rev. Lett. 26 (12): 721

36. Abbott B P et al. (2017). *GW170104: Observation of a 50-Solar-Mass Binary Black Hole Coalescence at Redshift 0.2*. Phys. Rev. Lett. 118 (22): 221101