The composition of photons and negative mass

Tong Wang

The composition of photons and negative mass

Tong Wang*

Abstract

From the implications of special relativity, we know photons are massless. However, we have also observed light being bent by the gravity of large bodies. To reconcile these two contradicting facts, here we propose a new composition of a photon involving the idea of negative mass—a physics concept mentioned in the context of matter propulsion—to answer the present paradox of light. In short, this alternative configuration solves the puzzle because as a combination of mass and negative mass, a photon can have zero net inertial mass, yet simultaneously, exhibit positive passive gravitational mass. Furthermore, the novel photon structure has implications on the magnitude of energy possessed by the photon. It also determines the photon crest-to-crest wavelength.

Introduction

Throughout the history of science, light and its properties have been investigated by numerous scientists from a variety of fields and for a variety of purposes. Its makeup has received much attention, and is now understood in great detail. Originally, Newton conceived that light was made up of ordinary particles, and thus each particle consisted of mass. Later in history, Young discovered empirically that a photon actually behaved like a wave. Maxwell, in the 19th century, independently speculated that light was an electromagnetic wave. Finally, half a century later, Einstein proposed that a photon in fact was a particle-like energy bundle with a discrete energy. In his seminal article[1], Einstein proposed a relationship between mass and energy, transcribed below:

(1) $E\sqrt{(1 - v^2/c^2)} = mc^2$

It is argued that if a particle with a positive quantity of mass moves at the speed of light *c*, then the expression inside the radical on the left side of the equation $(1 - v^2/c^2)$ is zero. We know the particle's energy E is finite, so the left side of the equation will equal zero. Therefore, the right side of the equation (mc^2) must equal zero as well. Because the speed of light *c* is finite, the particle's mass must be zero. For a particle consisting of only mass the conclusion must then be that its mass is zero, and therefore what we consider to be massless. However, if we consider the proposal that the makeup of a photon consists of both mass and negative mass[2,3,4], then it is possible that the *net* mass on the right side of the equation is still zero, and also that the photon is in all other respects still considered massless.

Attributes of Negative Mass

Some fundamental attributes of negative mass which will be important in later arguments are as follows:

Attribute 1: Negative mass repels mass or negative mass.

Attribute 2: Mass attracts mass or negative mass.

Attribute 3: Negative mass generates a field similar to the field generated by mass. The repulsion field strength (force), upon a test mass, abides by the inverse-square law.

Attribute 4: A plural quantity of negative mass is unstable if no other forces bind them together. A single unit of negative mass is stable.

Configuration of a Photon

Assuming the smallest unit of negative mass (will be referred to a Yinon in this article) exists, then a photon can have a new configuration composed of a unit mass and a Yinon. The magnitude of the sign of mass and the Yinon must be equal (an analogy is the fact that magnitude of the electrical charge of an electron exactly equals to that of a proton), and the mass and the Yinon are spatially separated by distance *d*. This configuration can maintain a stable intrinsic distance *d* because the pair will move together in the same direction—from the Yinon to the mass—and at the same velocity.

Figure 1 shows a photon consisting of a Yinon and a mass. The Yinon applies a repulsion force to the mass while the mass applies an attraction force to the Yinon.

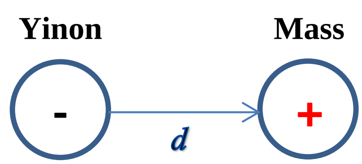

Fig.1 Configuration of a photon

If one considers the pair as a whole, the pair does not exhibit net inertial mass (in other words, it is observed as massless) because the unit of ordinary mass and the Yinon cancel each other out exactly in terms of their inertial masses. The pair's active gravitational mass is likewise zero because the gravitational fields of the mass and the Yinon cancel each other out. However, due to the fact that mass attracts *both* ordinary and negative mass (*Attribute 2*), the pair's passive gravitational mass is positive. We observe this property when light is bent by large astronomical bodies.

A New Way to Determine the Wavelength of a Photon

Let a photon A have an equal quantity of mass and a Yinon, called *m*. Assuming the distance between its mass and its Yinon is *d*1, then the repulsion force from its Yinon to its mass is F = $G_d \bullet m \bullet \frac{m}{d1^2}$ according to Newton's gravitational law, where G_d is the gravitational constant for small distances. G_d may be different than G if the small distance causes the gravitational constant to vary. The acceleration of the photon is $a = G_d \bullet \frac{m}{d1^2}$.

If we consider after the first full cycle of its associated wave a photon has reached its maximum speed at *c*, then the time transpired from a photon's creation to its maximum speed is $\frac{l1}{c}$, where *l*1 is the wavelength of the photon A.

Hence we get equation:
(2) $G_d \bullet \frac{m}{d1^2} \bullet \frac{l1}{c} = c$

Let *d*2 be the distance between the mass and the Yinon of a photon B, and *l*2 be its wavelength. Similarly:
(3) $G_d \bullet \frac{m}{d2^2} \bullet \frac{l2}{c} = c$

By dividing equation (2) by equation (3), we produce the following ration:
(4) $\frac{l1}{l2} = \frac{d1^2}{d2^2}$

This new equation (4) shows that the ratio between two wavelengths of lights is equal to the ratio of the squares of the intrinsic distances between the mass and the Yinon of their photons. Furthermore, from the energy-wavelength equation (transcribed below):
(5) $E = h \bullet \frac{c}{l}$ where E is the energy a photon carries

We can deduce the relationship:
(6) $E_1 \bullet d1^2 = E_2 \bullet d2^2$
We can see the smaller the intrinsic distance *d*, the more energy E a photon has.

According to the theory of special relativity[5], a photon cannot exceed the speed of light, so the photon will maintain the speed of light after it reaches *c*.

Behaviors of a Photon

Since the magnitude of the sign of mass and a Yinon must be equal, photon A has neither gravitational attraction nor repulsion on an external object. It hence has zero net active gravitational mass. Let *d* denote the intrinsic distance between the mass and the Yinon inside the photon A. Let another photon B be placed at a distance *ab* from the photon A. If *ab* >> *d* then there is no gravitational attraction or repulsion between A and B. Therefore the two photons A and B are in a stable state. They do not collapse into or move away from each other.

Because mass attracts both ordinary and negative mass, the mass-Yinon combination will possess passive gravitational mass. Therefore, a beam of light can therefore be bent by the gravity of heavy astronomical bodies.

The shorter the intrinsic distance *d* between the mass and the Yinon in a photon, the lesser the disturbance on the stability of the pair of mass and a Yinon. Therefore, a photon with a shorter wavelength is less impacted by other photons. In other words, a photon with a shorter wavelength behaves more particle-like than wave-like.

If a photon's intrinsic distance is changed beyond a certain value, then its light cannot maintain a valid physical wavelength. Therefore, in this case, the light disappears.

References

1. Einstein, A. "Does the inertia of a body depend upon its energy-content?". *Annalen der Physik* **18**: 639-641 (1905).
2. Luttinger, J. M. "On "Negative" mass in the theory of gravitation". *Awards for Essays on Gravitation*. Gravity Research Foundation (1951).
3. Bondi, H. "Negative Mass in General Relativity". *Reviews of Modern Physics*. **29** (3): 423 (1957).
4. Forward, R. L. "Negative matter propulsion". *Journal of Propulsion and Power* **6**: 28. doi:10.2514/3.23219 (1990).
5. Einstein, A. "On the electrodynamics of moving bodies". *Annalen der Physik* **17**:891 (1905).