Physics & Astronomy International Journal

Conceptual paper

Open Access

The effect of gravitational field on photon frequency: a fresh look at the photon

Abstract

The purpose of this paper is to present a new description of the photon. The photon is postulated to be a rotating dipole, consisting of two masses, one with a positive charge and the other a negative charge. This conceptualization of the photon permits a parsimonious explanation of both the wave and particle properties of light while providing a straightforward hypothesis for the increased red shift associated with the early stages of the universe. In addition, if measurements could be made of the red shift associated with photons being drawn into a black hole, such measurements might aid in estimating the strength of the associated gravitational gradient.

Keywords: photon, rotating dipole, gravitational gradient, red shift

Volume 6 Issue 1 - 2022

Robert L. Kosson, D. Sc.
Aerospace Engineer, Gurmman Aerospace Corporation, USA (Retired)

Correspondence: Robert L. Kosson, c/o David S. Kosson, Department of Psychology, Rosalind Franklin University of Medicine and Science, 3333 Green Bay Road, North Chicago, IL USA 60064, Fax 847-578-8761, 847-578-8765, Email david.kosson@rosalindfranklin.edu

Received: September 30, 2021 | **Published:** March 09, 2022

The effect of gravitational field on photon frequency: a fresh look at the photon

The purpose of this paper is to present a new description of the photon. Light is usually described as a stream of photons, each of which has both particle and wave characteristics. The frequency of the light is a property of the emitting molecule and is affected by the speed of the emitting molecule relative to the observer.

Astronomers note a red shift in the frequency of light, which they attribute entirely to the movement of the emitting molecule away from the observer, and which cosmologists have associated with the expansion of the universe.[1-3] They have also noted an increased red shift in observations of the early universe, which has often been attributed to an increase in the rate at which the universe is expanding. Several explanations of this phenomenon posit additional field forces.

A simpler explanation is provided by a new conceptualization of the photon as a rotating dipole, consisting of two masses, one with a positive charge and the other a negative charge. In a gravitational field, there will be a difference in the forces of attraction on each of the two masses, which will cause an increase in the red shift without the need to postulate additional forces. To provide some background, photons are absorbed or shed by electrons as they adjust their orbit in response to changes in the forces of their parent atoms. Their energy and angular momentum are set by the change in quantum number of the shedding electron. The time required for a photon to make a complete revolution (i.e., the frequency of the photon) is related to the circumferential distance and diameter of the revolution.

The conventional view of the photon allows us to explain many of the properties of electromagnetic radiation. However, the increased red shift observed in early stages of the universe is generally ascribed to increased forces of acceleration on the emitting atoms. Although a variety of mechanisms have been postulated to explain the increased red shift, there is not yet an agreement as to the nature of these.[4]

What is frequently overlooked is that, when an electron emits a photon in adjusting its orbit, it transfers to it not only energy but also angular momentum. To account for the effect of the angular momentum, the photon can be conceptualized as essentially a small spinning electromagnetic vortex. This may be most easily pictured as an electromagnetic doubleton or dipole with two equal masses, opposite electrical charges, and sufficient electrostatic and electrodynamic forces to balance the centrifugal effect. Because the masses are revolving at electromagnetic speed, the time for a revolution is determined by the diameter of the circle.

This conceptualization is easiest to understand if you consider a frame of reference fixed with respect to the photon. Using Einstein's equation relating mass and energy, each end has an apparent mass equal to half the mass of the photon.

The angular momentum is important because the length of the dipole is set by the rotational angular momentum given up by the shedding electron. All gravitational fields have gradients. The component of the gravitational field coincident with the spin plane of the photon exerts a slightly different force on each end of the dipole during each half-spin of the photon, increasing the length of the dipole. This effect is monotonic and is linearly related to the strength of the gravitational gradient. Since the speeds of the ends of the dipole are fixed at electromagnetic velocity, any increase in dipole length results in a decrease in dipole frequency. This change in frequency is generally small at current levels of gravity in our expanded universe, but the red shift due to gravitational gradients would have been much larger in the early evolution of the universe.

This conceptualization can explain the increased red shift noted in observations of the early universe. From this perspective, there is no need to posit additional forces of acceleration or other mechanisms. From this perspective, the increased red shift results from the greater difference in the length of the dipole when photons are released in stronger gravitational fields.

This conceptualization may also be helpful to astronomers studying black holes. The magnitude of the red shift may be related to the strong gravitational gradient associated with a black hole. If measurements could be made of the red shift associated with photons being drawn into a black hole, such measurements should be useful in estimating the corresponding gravitational gradient. For example, the estimates of the masses of the "standard candles', type 1A supernovae can be used to evaluate their gravitational fields and their effects on the photon red shift.

Conclusion

The current hypothesis presents a precise physical description of the photon. It is noted that this description is consistent with the classical findings on photons using wave and particle models of the photon, as well as early observations of minor displacements in the location of photons passing near stars.[5] It also helps to explain the increased red shifts seen in observations of the early universe and more recent phenomena emerging from studies of black holes. It is proposed that the availability of a precise physical model of the photon will prove useful to physicists who seek an improved understanding of a variety of phenomena related to light.

Note: Dr. Robert Kosson passed away in October of 2021.

References

1. Hubble E. A relation between distance and radial velocity among extra-galactic nebulae. *Proceedings of the National Academy of Science of the United States of America*. 1929;15(3):168–173.
2. Huggins W. Further observations on the spectra of some of the stars and nebulae, with an attempt to determine therefrom whether these bodies are moving towards or from the earth, also observations on the spectra of the sun and of comet II. Philosophical Transactions of the Royal Society of London, 1868;158.
3. LeMaitre AG. A homogenous universe of constant mass and growing radius accounting for the radial velocity of extragalactic nebulae. *Monthly Notices of the Royal Astronomical Society*. 1931;91(5):483–490.
4. Marmet L. On the Interpretation of Red-Shifts: A Quantitative Comparison of Red-Shift Mechanisms. 2013.
5. Chwolson O. Über eine mögliche Form fiktiver Doppelsterne [On a possible form of fictitious double stars]. *Astronomische Nachrichten.* 1924;221:329–330.

Citation: Kosson RL. The effect of gravitational field on photon frequency: a fresh look at the photon. *Phys Astron Int J.* 2022;6(1):28–29.
DOI: 10.15406/paij.2022.06.00246