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A Critical Examination of the Applicability of $E=mc^2$ to Massless Particles

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Abstract
Limitation of Einstein's formula of energy.

The well-known formula
$E=mc^2$, developed by Albert Einstein, establishes a fundamental relationship between energy (E) and mass (m), where c represents the speed of light. This principle, which states that energy is equivalent to mass multiplied by the square of the speed of light, forms a cornerstone of modern physics. However, a critical analysis of its application to particles without mass, such as photons, reveals a potential limitation of the formula.

The argument is based on the foundational components of the equation. The formula is expressed as:
Energy=Mass × Speed of Light^2 The speed
of light, represented by
c, is a constant value of approximately 299,792,458 meters per second.

The central point of contention arises when this formula is applied to a photon, a particle of light. Photons are considered to be massless, meaning their mass is zero. When the mass of a photon is substituted into the equation, the calculation is as follows:

$Energy=0\times(299,792,458m/s)^2$

According to the rules of mathematics, any number multiplied by zero results in zero. Therefore, the outcome of this calculation is:

Energy=0

This result suggests that if a photon's mass is zero, its energy must also be zero. However, this conclusion is in direct contradiction with the established understanding that photons possess light energy. This discrepancy leads to the assertion that the famous formula

E=mc2 is not universally applicable and fails to account for the energy of a photon. The theory thus proposes that the formula has limitations and is not a comprehensive model for all forms of energy, particularly for those associated with massless particles.