

An Analysis of the Claim That Light Possesses Mass: A Rebuttal to Mandlbaur

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Abstract

This paper critically evaluates the claims presented in the document “A Mathematical Proof That Light Has Mass” by John H. Mandlbaur (2022). We demonstrate that the author’s conclusion is fundamentally flawed on two distinct levels. Mathematically, the argument conflates an undefined algebraic operation (division by zero) with physical impossibility, ignoring the well-defined limit of acceleration as mass approaches zero. Physically, the argument misapplies classical Newtonian mechanics to a relativistic entity, bypassing the established frameworks of Special and General Relativity which accurately describe massless particles.

1 Introduction

In the brief paper “A Mathematical Proof That Light Has Mass,” Mandlbaur (2022) posits that it is mathematically impossible for light to have zero rest mass. The author characterizes the scientific consensus that light is massless as an “unsupported assumption” and a “logical fallacy.” By analyzing the interaction between Newton’s Second Law of Motion and Newton’s Law of Universal Gravitation, Mandlbaur claims that assigning a mass of zero to light results in an impossible mathematical contradiction. This paper deconstructs that proof to show why the underlying assumptions and algebraic operations are incorrect.

2 Analysis of Mandlbaur’s Proof

Mandlbaur begins by equating two foundational principles of classical mechanics: Newton’s Second Law ($F = ma$, where m is inertial mass) and Newton’s Law of Universal Gravitation ($F = G \frac{Mm}{r^2}$, where m is gravitational mass).

Assuming the weak equivalence principle holds (inertial mass equals gravitational mass), setting these forces equal yields:

$$ma = G \frac{Mm}{r^2} \tag{1}$$

The author’s argument proceeds by assuming light has no mass ($m = 0$). Substituting zero into both sides results in the identity $0 = 0$. Mandlbaur then asserts that attempting to solve for acceleration (a) by isolating it requires dividing by zero. Characterizing this division by zero as an “unrealistic possibility,” the author concludes that the initial assumption ($m = 0$) must be false, meaning light must possess mass.

3 Discussion and Refutation

The author’s argument fails due to a fundamental misunderstanding of both mathematical limits and modern physical frameworks.

3.1 Mathematical Misinterpretation of Division by Zero

Within the classical framework, Mandlbaur incorrectly interprets algebraic indeterminacy as a physical constraint. For any massive particle ($m > 0$), the mass term cancels out, yielding an acceleration that is entirely independent of the object's mass:

$$a = G \frac{M}{r^2} \quad (2)$$

This mass-independence is the hallmark of the Equivalence Principle. If we approach the scenario mathematically by taking the limit as mass approaches zero, the acceleration remains perfectly well-defined:

$$\lim_{m \rightarrow 0} a = G \frac{M}{r^2} \quad (3)$$

When $m = 0$ is substituted directly into the initial equality $ma = G \frac{Mm}{r^2}$, yielding $0 = 0$, dividing both sides by zero to solve for a results in the indeterminate form $a = \frac{0}{0}$. An indeterminate form simply signifies that this specific algebraic rearrangement cannot yield a unique solution. It is a known boundary of arithmetic division, not a physical proof that a particle cannot exist without mass.

3.2 Inapplicability of Classical Mechanics to Light

More fatally, Mandlbaur commits a category error by applying classical Newtonian equations to light. The equations $F = ma$ and $F = G \frac{Mm}{r^2}$ describe the behavior of massive bodies at non-relativistic speeds. They do not govern photons.

In the framework of Special Relativity, the relationship between energy (E), momentum (p), and invariant rest mass (m_0) is given by:

$$E^2 = (pc)^2 + (m_0c^2)^2 \quad (4)$$

For a photon, the invariant rest mass is exactly zero ($m_0 = 0$), reducing the equation to $E = pc$. Light possesses both energy and momentum, but no rest mass.

Furthermore, the interaction of light with gravity is governed by Einstein's General Relativity, not Newtonian gravitation. In General Relativity, gravity is the curvature of spacetime induced by mass and energy. Massless particles travel along the straightest possible paths (null geodesics) through this curved spacetime. This modern framework accurately predicts and measures phenomena such as gravitational lensing and the Shapiro time delay without ever assigning rest mass to photons.

4 Conclusion

Mandlbaur's claim that light must possess mass is built upon the misapplication of classical mechanics to a relativistic domain and a mischaracterization of mathematical limits. The failure of Newtonian equations to algebraically resolve acceleration for a zero-mass particle highlights the boundaries of classical arithmetic, not a fundamental property of light. Modern physics, governed by Special and General Relativity, elegantly and consistently describes the behavior of massless photons in a vacuum.

References

- Mandlbaur, J. H. (2022). *A Mathematical Proof That Light Has Mass*. ResearchGate. https://www.researchgate.net/publication/363585512_Mathematical_proof_that_light_has_mass