Mass is not what you think

Thomas H. Weight*
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We clarify critical misunderstandings in physics by showing that mass is not a scalar constant and by reminding readers that momentum is a vector.

I. INTRODUCTION

The well known proof that photons have zero mass combines the Energy-Momentum relation with Special Relativity. This proof has two errors which we clarify in this paper.

Momentum is not treated as a vector being one error. Momentum is mass times velocity and velocity is well known to be a vector. If we align the momentum of a particle with the z-axis, then the energy-momentum relation in equation (1) is only valid in one direction: namely the direction of the z-axis. In order to determine the impact of the momentum vector in another direction, this momentum vector has to be projected onto that direction.

$$m^2c^4 = E^2 - \vec{P}^2c^2 \tag{1}$$

Another error is treating mass as a scalar constant. The current outdated understanding of mass is a hangover from pre-special relativity. The current definition of mass is:

Old Definition: Mass is a property of matter.

Someone could pick up a rock and easily conclude that mass is a scalar constant. We propose a "new" definition of mass.

New Definition: Mass is the property of a gravitational field that expresses the strength of that gravitational field.

II. APPLY A LORENTZ TRANSFORM

The energy-momentum relation as discussed in Dirac[1] combined with Special Relativity (SR) provides the perfect tool for our investigation. We assume the momentum of a particle is along the z-axis which is only possible because momentum is a vector. Since the Energy-Momentum relation is compatible with SR, we can rotate this relation by an angle θ as shown in figure (1). In anticipation of our results, we express mass by the symbol

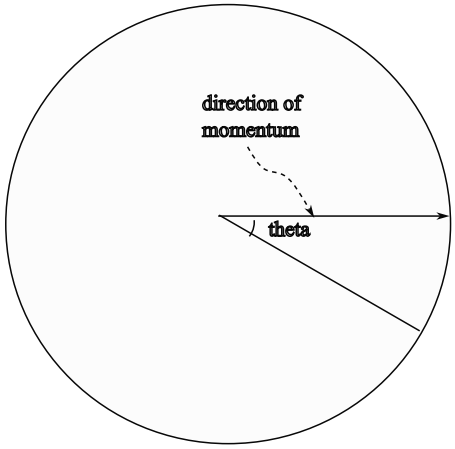

FIG. 1. The angle from momentum axis.

m(θ) showing mass is a function of this angle θ in equation (3). We use the simple Lorentzian transformation as shown is equation (2) where we take the angle θ to the momentum axis as shown in figure (1).

$$\Lambda = \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & cos(\theta) & sin(\theta) \\ 0 & 0 & -sin(\theta) & cos(\theta) \end{pmatrix} \tag{2}$$

We apply the transform Λ, and along the new z' axis we get equation (3).

$$m(\theta)^2c^4 = E^2 - cos(\theta)^2\vec{P}^2c^2 \tag{3}$$

We see from equation (3) that mass is not a simple scalar but a function of the angle θ. If mass were a constant then the derivative of m(θ) with respect to θ would equal zero which it clearly is not.

The whole argument that photons have no mass falls apart since proving mass is zero in one axis does not prove mass is zero in any other axis. We conjecture that photons do have mass.

Photons are clearly weakly interacting massive particles (WIMPs). Tully, Fischer and Renzo will not be surprised to discover that photons are a strong candidate for Dark Matter.

* Tech4THW@gmail.com

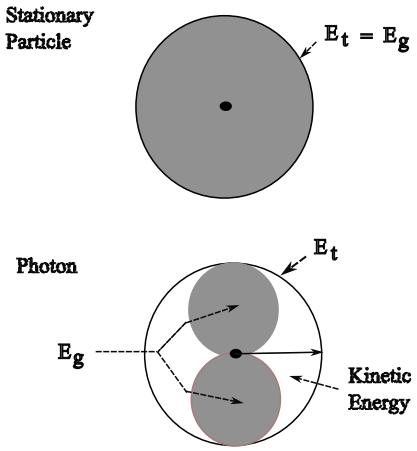

FIG. 2. The Effects of Momentum on Gravitational Fields.

III. HOW MOMENTUM ADVERSELY EFFECTS A GRAVTATIONAL ENERGY FIELD

The gravitational energy field of a stationary particle (i.e. zero momentum) as shown in equation (4) radiates evenly in all directions as shown in the top of figure(2).

$$m(\theta)^2 c^4 = E^2 \tag{4}$$

In the extreme case of a photon, the gravity field can not propagate faster than the particle. The result is a pinching effect, where the propagation of the gravity field is radiating around the plane of rotation of the photon as seen in the bottom of figure(2).

We see that momentum (in some sense) blocks gravity which shows that photons interact weaker than full gravity. We conjecture that mass should be defined as a property of gravity rather than as a property of matter.

It might be a good time to revisit the old masters (in this case H.A.Lorentz[2] and W. Wien[3]). We know that photons are made of elecro-magnetic fields and we know they have mass and gravity. It might be time to resurrect the conjecture that gravity is an electro-magnetic field. This interaction between gravity and momentum strongly susgests that Newtonian Dynamics are a result of gravity and electro-magnetism.

IV. CONCLUSIONS

In this paper, we have shown that the Dirac energy-momentum relation is only vaid in one dimension when we take into account the fact that momentum is a vector. We have also shown that mass is not a scalar constant but a function of the angle θ from the momentum vector.

V. BIBLIOGRAPHY

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[3] W. Wein, Ueber die Moeglichkeit einer elektromagnetischer Begruendung der Mechanik, 11 Decenber 1900