Let me show you how easy it is to misinterpret mathematics.

**AN ANALYSIS OF THE ENERGY- MOMENTUM 4 VECTOR EQUATION
AND THE MASSLESS PARTICLE**

Einstein gives the mass of radiation (the photon) as m = E/c^2. Actually he used "L" for E. He may have done this to distinguish the energy of radiation from the energy of ponderous bodies. They are different.

What he said was when a body absorbs radiation with no increase in velocity, it gains in mass by L/c^2. This can only be construed to mean the mass came from the radiation (photon).

The energy of the photon is given as E = pc = h nu.

Then there is the misinterpretation of the energy-momentum 4 vector equation.

This equation is nothing more or less than the combination of Einstein's equations for the energy and momentum of moving *bodies* -- "bodies" -- as in ponderous mass, not radiation.

This misinterpretation of the equation, E^2 = (mc^2)^2 + (pc)^2 is as follows:

"If we set the m in the right hand first term to zero, then we get for the photon E = pc which we know is true. This shows that the mass of the photon is zero."

WRONG.

What it does show is that the photon has zero rest mass but does have mass in flight.

The first term is the square of mc^2. In case one forgets, mc^2 is REST energy -- and the m is REST mass.

So what the proposer should be saying is that the photon has no REST MASS but does have in flight mass contained in (pc).

His statement should be altered to say:

"If we set the m in the right hand first term to zero, then we get for the photon E = pc which we know is true. This shows that the REST mass of the photon is zero while the $(pc)^2$ is the square of the energy and momentum in flight. Thus it has mass in flight."

And this is what the equation is saying.

Let us note that the E in this equation is TOTAL Energy which is rest energy (mc^2) + kinetic energy.

This is true for all ponderous bodies — but is NOT true for photons as the photon has no rest energy or mass.

Put another way: mc^2 is REST energy — but the photon is never at rest, so it has no rest energy.

In his first paper of 1905 Einstein developed an equation for the energy of a moving ponderous body: E = (gamma -1) mc^2. This is its KINETIC energy.

In his second paper of the same year he developed the mass of radiation:
m = L/c^2 from which we can write the energy of radiation as L = mc^2.

We can consider it no accident that he chose E for ponderous bodies and L for radiation (photons). We note that each has its own separate form.

The ponderous bodies have the form (gamma − 1) mc^2 and photons the form mc^2.

We note that whereas ponderous bodies have kinetic energy they also have rest energy — and their total energy is the combination of the two.

However, the photon has only kinetic energy (and momentum) because when at rest it is absorbed, and has no rest energy or mass. It only has mass when in flight — and that is its only energy (and momentum).

Therefore, setting mc^2 to zero is proper since the photon has no rest energy or mass BUT THIS HAS NO EFFECT ON pc which contains mass, i.e., the mass of the photon. To conclude that since the photon has no rest mass, it has NO mass is gross error.

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