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The mass of light and other “massless” particles

This note will give a chuckle to any physicist that reads it. For this note, forget about a Higgs Field, or similar field, and the imputation of mass to “massless” particles.

The way the idea of a “massless” particle is used once confused me and sometimes still does. I wish physicists would think up better terms for particles that have mass even when they are at rest relative to us versus particles (or other entities) that must move and that have mass only as part of their moving.

For want of better terms, I use the term “particle” for an entity that has energy while it is moving, that must move relative to us as observer, and that has mass as a result of the energy it has while moving.

I understand a particle that has mass even when it is not moving relative to us. I understand a particle that would have zero mass if we took away all mass due to its energy, including kinetic and potential energy, such as a photon. I think some, but not all, messenger particles are like this if we can abstract them away from residence in a field that gives them energy. But, of those particles, as far as I can tell, none do exist without moving or being somehow caught up in a field. So it makes no sense to speak of their (non-) mass if they were not moving or not caught up in a field, in the same way we can talk about the mass of a (relatively) motionless electron. If we took away the mass due to energy of a photon, then it would not even exist, so it makes no sense to say something that does not exist is “massless”. If we never experience the particle except when it is moving, then its “energy mass” is a part of its identity, so it has mass. If it has energy, then it has mass. A photon has mass because of its energy.

Talking of a “massless particle” is only confusing, at least to me.

I am not sure about neutrinos. Because kinds of neutrino can modulate between each other, apparently neutrinos should have some mass apart from the mass they get from energy. Even if they don’t, they still have mass as a result of their energy.

It seems more interesting, and urgent, to me, to figure out why some particles do have mass when they are not moving relative to us. What is the mass of an electron or a quark? The equations for converting energy to mass, or vice versa, are clear enough; but it is still not clear what mass is before it converts to energy, or what energy becomes after it converts to mass.

An example of my confusion: I am never sure if the mass-due-to-energy of photons, neutrinos, and other so-called “massless” particles is figured into cosmology when cosmologists calculate the total mass of the universe, a part of the universe, or a galaxy. They need to be clear what-all goes into their calculations. I am not accusing anybody of anything, and I am not expecting to find a vast overlooked source of mass. I am not explaining dark matter or dark energy. I just wish cosmologists would be clear about what they report when they report.

Given that we evolved on a physical Earth and use chemical reactions as the basis for our understanding of physics, it is natural to think of a particle apart from the energy it has, and to think of energy as added to the particle when the particle moves or when it is moved to have greater potential energy. Fine. But it is not too hard to abstract away from that to only the energy moving around. Sometimes we can escape our evolved mind sets. We can get away from the idea that a bundle of energy needs a particle to attach to, and the particle has to exist apart from any attached energy. It is a little hard to imagine such a bundle of energy as a kind of particle, but thinking that way is part of the imagination that many of us picked up as kids. We don't need to think of the photon as a "massless particle" if we can think of it as a moving bundle of energy with some implied mass as a result of the energy – and nothing else. When the energy goes away, the "particle" goes away, and that is that.

I am not sure if there is a question here but comments are welcome.