

Conservation of Energy and Momentum of Quasi Particles

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ABSTRACT

The author through this brief communication wishes to publicize his findings of a differential form of conservation of energy and momentum of quasi particles. The contents of the paper are a repeat with some new thoughts and an application in the theory of the expanding Universe.

Keywords: Conservation, Energy, Momentum, Quasi particles.

SHORT COMMUNICATION

Quasi particles are named so because they exhibit wave-particle duality. Electrons and Photons are two examples of quasi particles. As a particle, the differential form of conservation of energy and momentum is given by the equation:

$$\frac{dE}{E} = \frac{dp}{p} = \frac{dm}{m} \quad (1).$$

Here, dE , dp and dm are differential energy, momentum and mass of the particle in a material, and E , p , and m are the energy momentum and mass of the free particle. As a wave, the differential form of conservation of energy and momentum is given as:

$$\frac{dE}{E} = \frac{dp}{p} = -\frac{d\lambda}{\lambda} \quad (2).$$

Here, dE , dp and $d\lambda$ are the differential energy, momentum and wavelength of the particle as wave, and E , p , and λ are the energy, momentum and wavelength of the particle as a wave. Notice that the same symbol is used for energy and momentum for both the particle and wave but their formulas are different as described in the references [1-2] below. For a wave, if one takes the example of Raman scattering in a material of blue light into green light, then the total energy will be conserved although the 16.5% change in energy of the blue photons will go in increasing the vibrational energy of the molecules of the material from which it is scattered [1]. A mathematical relation between a particle and a wave can be expressed as [2]:

$$\frac{dm}{m} = -\frac{d\lambda}{\lambda} \quad (3).$$

That is, the percentage change in the mass of the particle is equal to the percentage change in the wavelength of the particle as a wave. These are, of course, equal to the percentage change in energy and momentum of the particle and wave. The relative change in wavelength finds

application in the Big Bang theory of the expanding Universe where it is defined as the red shift in the 'tired light' model of the expanding universe [3].

CONCLUSION

The main conclusion through the process of reductionism is that the particle and wave are mathematically related. The percentage change in the mass of the particle is equal to the percentage change in the wavelength of the particle as a wave.

References

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