The Mathematics of New Constants in $L=mc^2$

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Abstract

This article explores a novel conceptual interpretation of Albert Einstein's famous equation, $L=mc^2$, by introducing a series of new constants, denoted as k_n. By reworking Einstein's original formulation involving luminosity L and its relation to mass and energy, a previously overlooked constant relationship emerges. The primary focus is on redefining and simplifying the understanding of thermal radiation processes.

I introduce the constant k_1 as a relationship between heat flow (T^4) and mass (m), offering insights into the interplay between mass and temperature on a quadratic scale. Further, the relationship between the Stefan-Boltzmann constant, σ, and these new constants is investigated, leading to an alternative formulation of this constant that simplifies its thermodynamic definition.

By introducing k_2 I offer alternative expressions for heat radiation and mass loss, as well as a novel definition of temperature that directly links mass, the speed of light (c), and temperature. This application challenges the traditional understanding and provides new insights into the interplay of these fundamental physical quantities.

My analysis shows that this new approach not only simplifies the understanding of existing constant relationships but also offers a more direct link to thermodynamic principles. This research opens avenues for a deeper understanding of energy, mass, and temperature in the realm of physics.

Calculating the Unseen Constants in L=mc²

The small investigation below stems only from Einstein´s famous conclusion *"If a body gives off the energy L in the form of radiation, its mass diminishes by L/c2."* [1]

When Einstein wrote about radiation with the energy L, it stands for luminosity, $A\sigma T^4$, so that $A\sigma T^4/c^2 = m$. Per unit surface area, dA, we then have $\sigma T^4 = mc^2$. It appears like there´s a constant relationship here that has been overlooked.

I´m going to make a couple of constants below and these constants will have notation k_n.

Since $\sigma T^4 = mc^2$ it means that:

$$k_1 = \frac{m}{T^4} = \frac{\sigma}{c^2} = 6.30914242 * 10^{-25} kg/K^4 \tag{1}$$

And a maximum of:

$$\frac{1}{k_1} = \frac{T^4}{m} = \frac{c^2}{\sigma} = 1.58500147 * 10^{24} K^4/kg \tag{2}$$

The definition of the Stefan-Boltzmann constant:

$$\sigma = \frac{2\pi^5 k^4}{15c^2h^3} = \frac{\pi^2 k^4}{60\hbar^3 c^2} = 5.67037442 * 10^{-8} W/m^2/K^4$$

The Stefan-Boltzmann constant included in full:

$$\frac{T^4}{m} = \frac{c^2}{2\pi^5 k^4/15c^2h^3} = \frac{c^4 15h^3}{2\pi^5 k^4} = \frac{c^4 60\hbar^3}{\pi^2 k^4} \tag{3}$$

$\sigma T^4 = mc^2$ can now be expressed as:

$$T^4 2\pi^5 k^4 = mc^4 15h^3 \tag{4}$$

With Planck´s reduced constant:

$$T^4 \pi^2 k^4 = mc^4 60\hbar^3 \tag{5}$$

$T^4 = mc^4$ looks interesting in contrast to $\sigma T^4 = mc^2$ so I reduce the other components into another constant:

$$k_2 = \frac{T^4}{mc^4} = \frac{15h^3}{2\pi^5 k^4} = \frac{60\hbar^3}{\pi^2 k^4} = 1.9622162 * 10^{-10} K^4/kg/m^4/s^4 \tag{6}$$

Now we get another alternative expression for heat emission and mass loss:

$$T^4 = mc^4 k_2 \tag{7}$$

From that we get a relationship between heat, mass, and c in four dimensions:

$$\frac{T^4}{c^4} = mk_2 \tag{8}$$

$$\frac{T^3}{c^3} = mk_2^{3/4} \tag{9}$$

$$\frac{T^2}{c^2} = mk_2^{1/2} \tag{10}$$

$$\frac{T}{c} = mk_2^{1/4} \tag{11}$$

This leads to the alternative definition of temperature, directly connecting temperature to mass and c:

$$T = mk_2{}^{1/4}\, c \tag{12}$$

Redefining the Stefan-Boltzmann constant

The standard definition: $\sigma = \frac{2\pi^5 k^4}{15c^2h^3} = \frac{\pi^2 k^4}{60\hbar^3 c^2} = \; 5.67037442 * 10^{-8} W/m^2/K^4$

New definition: $\sigma = \frac{m}{T^4}c^2 = k_1 c^2 = 5.67037442 * 10^{-8} kg * m^2/s^2/K^4$ (13)

The standard definition is complex, derived from Planck´s law, but here we instead get a simple thermodynamic definition. Equation (2) when multiplied with c^2 gives us joule per K^4 from much fewer components.

References

1.Einstein, A. (1905); Ist die Trägheit eines Körpers von seinem Energieinhalt abhängig? Annalen der Physik, 323(13), 639-641.