The constant relationships between heat, temperature and mass

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Abstract

A closer look at the mass-energy equivalence reveals details of constant relationships between heat, temperature and mass. Not only does heat emission(T^4) have a constant relationship to mass via the speed of light, but temperature does as well.

Results

Quote from "Does the inertia of a body dependupon its energy-content?":

"If a body gives off the energy L in the form of radiation, its mass diminishes by L/c2."

The relationship between thermal radiation and mass is according to Einstein $L = mc^2$, where $L= \sigma T^4$. There are several constant relationships here that appears to have been overlooked.

Since $L = \sigma T^4$, it means that:

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

The definition of the Stefan-Boltzmann constant:

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

When including it in its entirety, we can now see that:

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

Where:

Planck´s constant $h = 6.62607015 \times 10^{-34} J/Hz$

Boltzmann´s constant $k = 1.380649 * 10^{-23} J/K$

Planck´s reduced constant $\hbar = 1.054571817 * 10^{-34} J/s$.

Which leads to:

$$T^4 2\pi^5 k^4 = mc^4 15h^3 \quad (3)$$

And with Planck´s reduced constant:

$$T^4 \pi^2 k^4 = mc^4 60\hbar^3 \quad (4)$$

Now we can reduce it to a constant relationship to mass for both T^4 and temperature.

Here I´ll use k=konstant.

$$k_1 = \frac{T^4}{mc^4} = \frac{15h^3}{2\pi^5 k^4} = \frac{60\hbar^3}{\pi^2 k^4} = 1.9622162 * 10^{-10} K^4/kg/m^4/s^4 \quad (5)$$

Instead of $L = mc^2$ we now have:

$T^4 = mc^4 k_1$ (6)

where $c^4 k_1 = 1.58500147 * 10^{24} K^4/kg$. (7)

Then, with the fourth root of k_1, we get another constant:

$k_2 = \sqrt[4]{k_1} = 3.742714625 * 10^{-3} K/kg/m/s$ (8)

And now we can get a constant relationship also between temperature and mass:

$T = mck_2$ (9)

References

e_mc2.pdf (fourmilab.ch)