One Kg

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Abstract

In this paper, we summarize a series of known and less-known things about one Kg.
Key Words: Kg, kilogram, fundamentals.

Things You Know and Did Not Know about One Kg

- 1797: The kilogram mass (kg) was introduced as the standard mass in France. Similar mass standards were adopted in England. The kg is a human-chosen clump of matter. Weight was important for trade and science, for example. It made sense to choose a standardized mass that was not too heavy to carry around, but not so light that it would make the weighing apparatuses inaccurate for the practical purposes back then. The one kg measure fit those requirements very well.
- In 2019, the kg was redefined in terms of the Planck constant using a Watt balance, see [1–3].
- The rest-mass energy of one kg is: $E = mc^2 = 1\ kg \times c^2 = c^2 = 8.99 \times 10^{16} J$, which is approximately 2.5×10^{10} KwH.
- Half of the Schwarzschild radius of one kg is $\frac{1}{2} r_s = \frac{G \times 1\ kg}{c^2} = \frac{G}{c^2} \approx 7.44 \times 10^{-28}$ meters.
- The Compton wavelength of one kg is $\bar{\lambda}_{1kg} = \frac{\hbar}{1kg \times c} = \frac{\hbar}{c} \approx 3.51 \times 10^{-43}$ meters. A one kg mass is a composite mass, so in reality, it does not have a Compton wavelength, but it consists of a massive amount of subatomic particles that do have Compton wavelengths. The Compton wavelength of one kg is a sum of the following elements in the formula $\bar{\lambda}_{1kg} = \frac{1}{\sum_i^n \frac{1}{\bar{\lambda}_i}} \approx 3.51^{-43}$ meters.
- There are about 5.98×10^{26} protons in one kg.
- The mass of one kg corresponds to the mass of about 1.097×10^{30} electrons.
- There are $\frac{c^2}{\hbar} \approx 8.52 \times 10^{50}$ internal collisions between indivisible particles in one kg per second, see [4]. This is equal to the Compton frequency inside one kg per second because we have $f = \frac{c}{\bar{\lambda}} = \frac{c}{\frac{\hbar}{1kg \times c}} = \frac{c^2}{\hbar}$. This also gives us deeper insight on the Planck constant; the Planck constant is linked to one collision relative to the number of collisions in one kg per second. In other words, $\hbar \approx \frac{1}{8.52 \times 10^{50}}$.
- There are $\frac{c^2}{\hbar} \times t_p \approx 45994327$ internal collisions between indivisible particles in one kg per Planck second (Planck time), see [4]. This is equal to the Compton frequency inside one kg per Planck second.
- One kg corresponds to the mass of 45994327 Planck masses $(1/m_p)$.
- One kg has a collision time of $\frac{l_p}{c} \frac{l_p}{\bar{\lambda}_{1kg}} \approx \frac{7.44 \times 10^{-28} m}{c} = 2.48 \times 10^{-36}$ seconds. This is shorter than one Planck second, can only happen for a composite mass, and it is indeed a composite mass. For a better understanding what collision-time is, see [4].
- With a KwH price of 5 cents, the value of the rest-mass energy stored in one kg is 1.25 billon USD. Unfortunately, modern technology is able to extract less than 1% of the energy in matter, and that is from Deuterium type elements. Antimatter an exception, but far from easy to produce in any sizable quanta. However, if we knew a simple way to convert all the rest-mass to energy based on simple calculations from $E = Mc^2$, then that would be the potential value at that energy price. Think about that next time you call a kg dirt for dirt!
- There is a movie about the one kg with title 1001 gram. A creative place to start for more knowledge of the kg.

References

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