Base unit for other base units

One specific frequency has been selected as the primary standard from which SI base units are derived. The basic unit of time, the second, has been redefined as the duration of exactly 9,192,631,770 periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the caesium-133 atom (^{133}Cs).

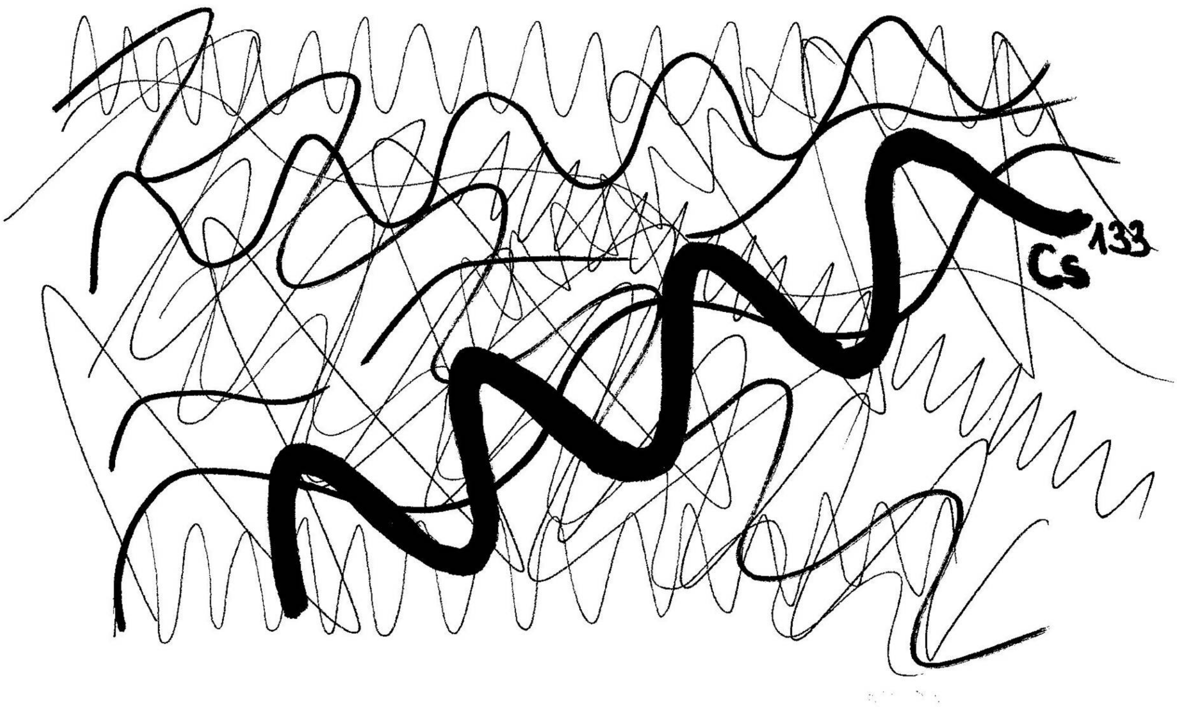

Fig. 1 – Model of space within the Universe as a quantum field crowded with oscillating waves

Two main numbers of periods are used to define base units. The first of them is for time and the other one is for distance.

The base unit for other base units is one second, defined as exactly 9,192,631,770 periods. One period therefore lasts the inverse value of this number, 1/9,192,631 770, which is 1.087 827… $\times 10^{-10}$ sec.

The next base unit, the metre, is defined as the distance travelled by light in exactly 1/299,792,458 of a second. One metre then corresponds to 1/299,792,458 × 9,192,631,770, which equals 30.663 318… periods (approximately). One period therefore corresponds to a distance of 1/30.663 318… m (= 0.032 612 m).

Let us express the speed of light in periods exactly according to the definitions:

$$v = s/t = 1/299{,}792{,}458 \times 9{,}192{,}631{,}770 \,/\, 9{,}192{,}631{,}770 = 1 \text{ (exactly)}$$

We can thus define the speed of light as being exactly 1. But what does the number one mean in this case? It is merely a dimensionless number. Objects, of course, travel at speeds much smaller than 1. Their speeds can all be expressed as unitless fractions of c.

However, time does not flow at the speed of light, so, time is equivalent to distance. Actually, from this angle, distance is indistinguishable from time. The particles of light are called photons. In a vacuum, photons travel only at a constant speed (= 1). They cannot be accelerated or decelerated (in a vacuum). It is also impossible to stop photons. They have no rest mass and the only way how to change their energy (mass) is by changing their wavelength. Particles having non-zero mass, by contrast, only move at speeds much smaller than the speed of light. In this regard, particles such as electrons, protons and neutrons hugely differ from photons.

Example:

Consider a material object moving at the speed of 1 m/s. Measuring the distance it travels within one second or the time it takes for it to travel one metre in periods of ^{133}Cs yields the following:

(1) To travel one metre, the object travels for 9,192,692,770 periods of ^{133}C, and
(2) in one second it travels a distance of corresponding to 30.663 … periods of ^{133}Cs.

Over the duration of nearly nine billion periods, the object has travelled a distance corresponding to only thirty periods. This is a huge difference.

How to explain this difference between time and distance? Let us consider the model of the probabilistic appearance of shapes called peaks, excited inside a quantum field full of vacuum fluctuations. We call such peaks particles.

There are two basic forms of particles: bosons and fermions.

Bosons, such as photons or gluons, and fermions, such as electrons, protons and neutrons. The distribution of fermions (in atoms) is given by the Pauli exclusion principle.

In a vacuum, bosons (e.g. photons) travel only at a constant speed. There is no difference between time and distance. We cannot accelerate or decelerate photons. We cannot stop photons, either. The only way how to add energy to them or take it away is by changing their wavelength.

This is, however, not the case with fermions. **Fermions can be accelerated and decelerated, just like electrons.** Their energy depends directly on their speed. This is where the big difference between time and distance resides. It has to do with rest mass. But if we look closer at an electron or proton, we can see no rest state, but only changing excitations of a quantum field. There is no rest state at all. The rest state exists only in our imagination, or perhaps it is better to say that it is our approximation.

If we look closely, we can see particles as excitations of a quantum field full of fluctuations. After that there are probabilistic areas of appearance of peaks which arising in space full of chaotic shapes in a field of quantum fluctuations. Every peak gravitationally attracts other peaks. However, such peaks disappear after a while. New ones then appear nearly in the same place appear only to disappear again, and so on. Some peaks, such as bosons (e.g. photons), travel in **some direction like waves (**electromagnetism**) whereas others, like fermions (e.g. electrons and protons, not to mention gluons and quarks), appear to be mostly stationary (disregarding e.g. Brownian motion). They appear to be bound.**

The speed of light (and other waves, including gravitational waves) is tightly connected to the process of the appearance and disappearance of peaks (shapes). In other words, the basic characteristic of every quantum field is a repeating cycle of creation (appearance) and annihilation (disappearance) in an always changing, ‘bubbling’ quantum field. This is pure randomness. **It seems very strange how stable particles like electrons can exist in such peculiar random circumstances. It is, however, even more perplexing that there are even much more complicated structures such as hydrocarbons and organisms.**

So, what is the purpose of this article? It reminds me that time, spatial dimensions and mass all stem from a specific frequency. One specific frequency has been selected as the primary standard for space, for time, for mass, for density and for other base and derived units of the SI system. In other words, it is possible to reduce all base units to that frequency. All the beauty of nature appears to be given by three elementary particles whose nature seems wholly probabilistic because they are mere excitations of quantum foam full of vacuum fluctuations.

Everything what exists in the Universe is given by different and changing frequencies of waves. Some waves are travelling, like photons (electromagnetic waves), and some are bound (imagine standing waves), like matter in all its forms. **Every wave is different from any other even though they exist in discrete packets of travelling or standing waves** – keep in mind the Planck constant – there is also a probabilistic range in its value.