13 **On Discrete Euclidean space**

*Sydney Ernest Grimm**

5 December 2021

The paper is the thirteenth post of the blog "Discrete Euclidean Space" at https://www.conceptualframework.nl. The post is the continuation of the description of the consequences of the transfer of quanta with the constant velocity of the speed of light.

Linear motion

The units of discrete space have identical basic properties but this is not what phenomenological reality shows us. For example a light bulb can emit electromagnetic waves in every direction and this seems impossible if space itself has a structure.

The image below shows the light bulb, the concentric circles of electromagnetic waves (red), the direction of the electromagnetic waves (blue lines) and the schematic representation of discrete space (black lined squares). It is clear, this cannot be reality because the quanta transfer of the electromagnetic waves originates from the units of discrete space.

The only sensible explanation is that the proposed "zitterbewegung" at the smallest scale size of reality is real. It is comparable with the jittery motion of the pixels of the mouse pointer on the screen of an LCD display.

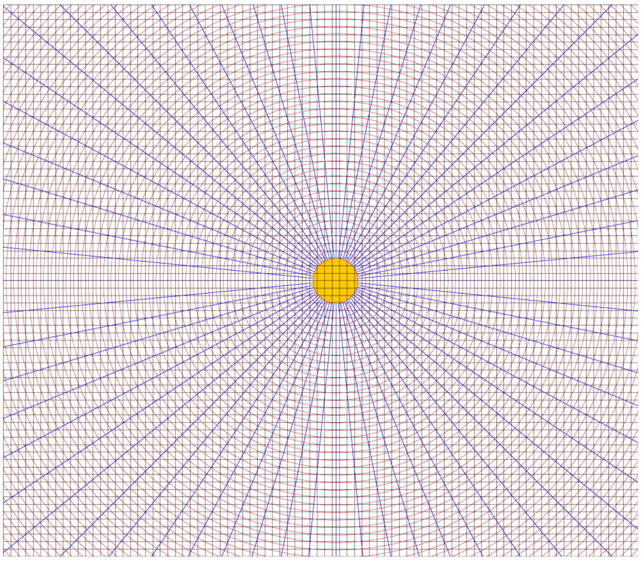

figure 1

The consequence is that the position and direction of every change in vacuum space is not determined by linear motion but by the non-locality of our universe (post **04**). However, if the transfer of quanta in vacuum space is independent from the emitter of the electromagnetic radiation, why is it impossible to measure the absolute motion of an object in relation to the structure of discrete space?

The Doppler effect

If an electromagnetic wave with the frequency ν = x is emitted in the direction of the motion of the emitter the frequency will increase (blue shift). But if the same electromagnetic wave is emitted in the opposite direction by the emitter the frequency will decrease (red shift). Figure 2 shows the emission in both directions in a schematic way.

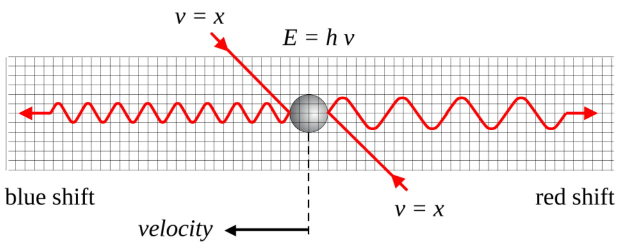

figure 2

The size of the amplitudes of the electromagnetic wave is determined by the wave length of the electromagnetic wave.[1] That means that the amplitudes of linear waves have the same *shape*, no matter if the waves have the same frequency or not.

If a hypothetical emitter is in rest in relation to the structure of discrete space there is no blue shift or red shift of the emitted electromagnetic waves. In other words, the blue shift and the red shift of electromagnetic radiation is the result of the motion of the emitter. Increasing the velocity of the emitter will increase the blue shift and red shift of the radiated electromagnetic waves.

The speed of light is a constant thus the emitted radiation by an emitter in rest – in relation to discrete space – is like an expanding sphere. An imaginary sphere that expands with the speed of light.

If an emitter is not in rest in relation to discrete space the velocity of the emitter influences the frequency of the emitted electromagnetic waves. Just because all the quanta transfer in the universe is synchronized.

The consequence is that every amplitude of the emitted electromagnetic wave by the emitter is like an imaginary sphere at the position in space where the amplitude was released by the emitter. Figure 3 shows the concept.

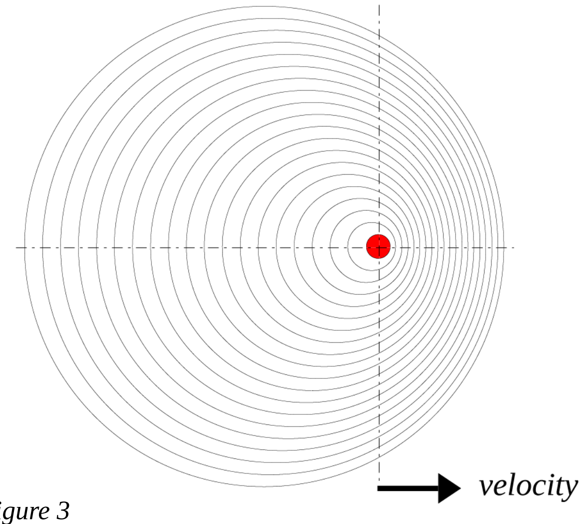

figure 3

The image above shows the Doppler effect by the motion of an emitter. If the emitter is in rest in relation to discrete space the amplitudes of the electromagnetic waves are like concentric circles (spheres). In other words, the blue shift and red shift of the electromagnetic radiation of an emitter represents the motion of the emitter in relation to the structure of discrete space.

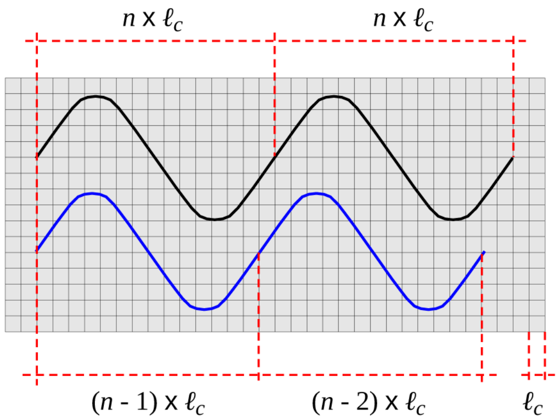

figure 4

The frequency (v) of an electromagnetic wave is directly related to the wave length (λ). The formula is known as the Planck-Einstein relation:

$$E = hv = \frac{hc}{\lambda} \qquad [h = \text{Planck's constant}]$$

In phenomenological physics the wave length is just a length without any relation to the metric of discrete space. But if we use the concept of discrete space the wave length is equal to a number of adjacent units of discrete space. The metric of discrete space – the average size of 1 unit of discrete space – is $\ell_c \approx 0{,}5 \times 10^{-15}$ m. In other words, I can express the wave length of an electromagnetic wave with the help of the metric of discrete space, the minimal length scale.[2] Now the wave length is a multiple (n) of the minimal length scale (ℓ_c).

$$E = hv = \frac{hc}{n\ell_c}$$

Figure 4 shows in a schematic way the wave length of an emitter in rest (black) and also the blue shifted wave length if the emitter is in motion. It is clear that the absolute velocity of the emitter can be determined if we know the wave length of the emitter in absolute rest.

Figure 3 shows that the frequency of the blue shift (v_{blue}) and the frequency of the red shift (v_{red}) together determine the frequency of the electromagnetic wave if the emitter is in absolute rest (v_{rest}):

$$\frac{v_{blue} + v_{red}}{2} = v_{rest} \qquad [1]$$

Measuring absolute motion

If I want to simulate an emitter to compare the amplitudes of the emitted blue shift and red shift of electromagnetic waves I have to create opposite conditions in relation to figure 3. See the setup in figure 5.

The experiment in figure 5 include 2 frequency generators, an amplitude comparator and 2 coax cables. The frequency generators have the same frequency thus the amplitude comparator can detect the direction and the velocity of the motion of the equipment in relation to the structure of discrete space if I rotate the equipment in every direction (the comparator is the point of rotation).

If the direction of the motion of the equipment is in line with the absolute motion the difference between the frequencies of the blue shift and the red shift of the electromagnetic waves is maximal. Figure 6 shows the setup and the Doppler effect by both frequency generators.

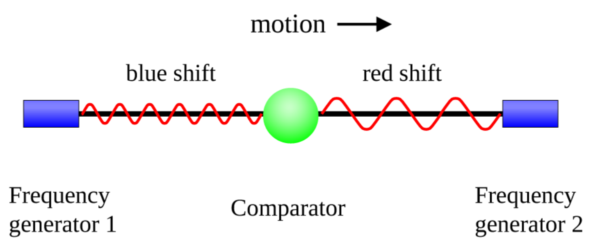

figure 5

The idea to measure the absolute motion of an object – actually the solar system – with the help of 2 frequency generators and an amplitude comparator was published in

2019 by Anna Edwards[3] although the described measurement was not meant to measure the Doppler effect of both frequency generators.

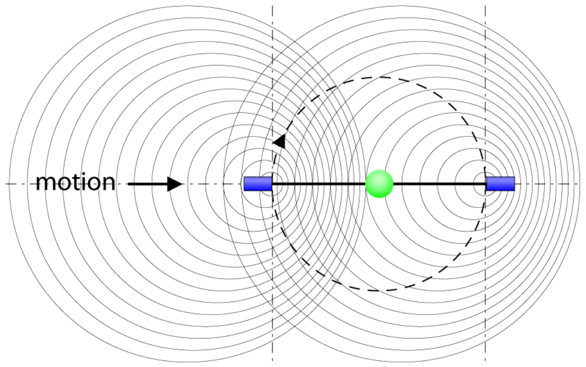

figure 6

The velocity of the free electrons – supplied by both frequency generators – is not equal to the speed of light (c). One can argue that there must be a correction – an input constant or a variable – if I want to calculate the absolute velocity with the help of the outcome of the measurement in figure 6.

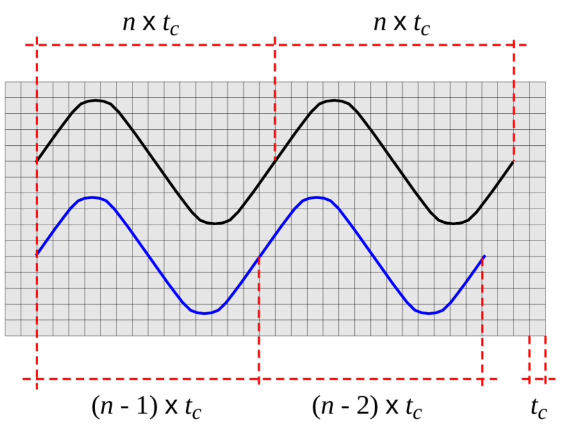

figure 7

The image above is figure 4 but I have changed the text to visualize the following explanation (ℓ_c => t_c).

The difference between the amplitudes of an electromagnetic wave with the speed of light (c) and the amplitudes super positioned on an electric current by free electrons is time. Because the linear pass on of a quantum from one face to the opposite face of 1 unit of discrete space is a constant: ≈ 6 x 10^{-23} second.

We express the frequency of an electromagnetic wave with the help of the speed of light (c) and the wave length (λ):

$$v = \frac{c}{\lambda} \quad \text{or:} \quad v = \frac{c}{n\ell_c}$$

But the speed of light divided by the minimal length scale (c / ℓ_c) is the constant of time (t_c). That is why it doesn't matter if the super positioned frequency of the frequency generators has the speed of light or not. Because figure 7 shows that the difference between the frequency in rest (black) and the blue shifted frequency is equal to a difference in the individual duration of both wave lengths.

The calculated frequency in rest [1] is independent from the velocity of the emitted radiation, although the frequency of the super positioned amplitudes of both frequency generators must be identical.

Therefore the maximal difference between v_{rest} and v_{blue} will determine the absolute linear velocity of the motion of the object. Because we know the calibrated frequency and the wave length of the super positioned amplitudes of both frequency generators. However, the higher the generated frequency the more accurate the absolute velocity of the measurement equipment/laboratory.

References:

1. Montie, E., Cosman, E., 't Hooft, G. *et al.* *"Observation of the optical analogue of quantized conductance of a point contact"*. *Nature* 350, 594–595 (1991) https://doi.org/10.1038/350594a0
2. Sabine Hossenfelder (2013). "*Minimal length scale scenarios for quantum gravity.*" Living Reviews in Relativity, January 2013. DOI: 10.12942/lrr-2013-2. https://arxiv.org/pdf/1203.6169.pdf
3. Anna Edwards (June 2019), "*The absolute meaning of motion to the optical path*". Results in Physics 14 (2019) pages 102410 https://www.sciencedirect.com/science/article/pii/S2211379719317024