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Special Relativity, Nearby Galaxy and Its Local Universe

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In the following note, we will focus only on nearby galaxies[1] and leave distant galaxies, local galaxies and all other natural and artificial astronomical objects.

Premović [2, 3] has shown that the clock on the nearby or distant galaxy would run slower than an identical clock on Earth. In other words, the farther away a galaxy is, the slower its time flow. This is an example of a phenomenon called cosmological time dilation (or cosmic time dilation)[2].

Let us first define the term "true speed" of a nearby galaxy. We mean by it, simply the average speed of this galaxy through space relative to the present-day Earth unrelated to the Universe expansion. The true speed of a nearby galaxy is probably far less than the speed of light (about 3×10^8 m sec^{-1}).[3] In further consideration, we will assume that the true speed of all nearby galaxies is about the same.

We will now consider a nearby galaxy moving at a true speed v. The Special relativity formula that relates its times is the following

$$t = t_0/1/\sqrt{(1- v^2/c^2)} \quad \dots (1)$$

where t is the time measured on this galaxy, t_0 is the time measured on Earth and $1/\sqrt{(1- v^2/c^2)}$ is the Lorentz/Einstein γ factor. (In relativity, subscript 0 usually denotes a stationary frame of reference). This equation tells us that the time of the nearby galaxy runs slower than on Earth, although their true speed is far less than the speed of light.

The time difference between Earth T_0 and the nearby galaxy T is

$$\Delta T = T_0 - T \quad \dots (2)$$

[1] We define nearby galaxies as those galaxies whose redshift z is from 0.001 to 0.1 (or $0.001 \leq z \leq 0.1$) and distant galaxies are those having $z > 0.1$. Of course, there is no sharp boundary between nearby and distant galaxies [1].

[2] I was not aware of that term until the evening of February 9, 2022, when, by a happy coincidence, I came across it while wandering with Google's "Advanced Search".

[3] We reason that possible time dilation caused by the recession (?) is negligible compared to the time dilation of Special relativity.

Thus, each nearby galaxy exists in the very near past in respect to the Earth and the Earth exists in the very near future in respect to this galaxy and *vice versa*. We propose that nearby galaxies exist (or are) in their universe (or in our Universe of the very near past) which we will call a local universe.[4] The Earth also exists in its local universe (in the current Universe, in the present-time Universe). Before the present time, the Earth existed in our Universe of the past.

The immediate consequence is that all nearby galaxies are, concerning time, in different local universes with respect to the current Universe. None of these galaxies existed/exists in our Universe but in their local universe. (We are not even sure if a particular nearby galaxy still exists at all). As there is a finite number of nearby galaxies there is a finite of local universes.[5] Each of these local universes is characterized by its local time, with its expansion rate and its electromagnetic radiation that moves at the speed of light independent of their time and place.
The Big Bang cosmology of the expanding Universe states that nearby galaxies[6] at different cosmic times have different cosmic positions to the Earth. Following this cosmology, we pointed out that no galaxy was born at the same cosmic time as Earth (about 4.55 Gy ago or after) but at a different distance from our planet [1]. In other words, no nearby galaxy can be formed for the last 4.55 Gy. It is possible to overcome this paradox by our hypothesis of a local universe of nearby galaxies.

Eqns. (1)/(2) imply that a nearby galaxy is in its local universe even if its true speed is much (or even infinitely?) less than the speed of light. We can consider that this galaxy is in the same cosmic time as the Earth. This is shown on the space (position or distance) time diagram, Fig. 1. So, the nearby galaxy can be born at the seemingly same cosmic time as Earth, but not necessarily in the same position.

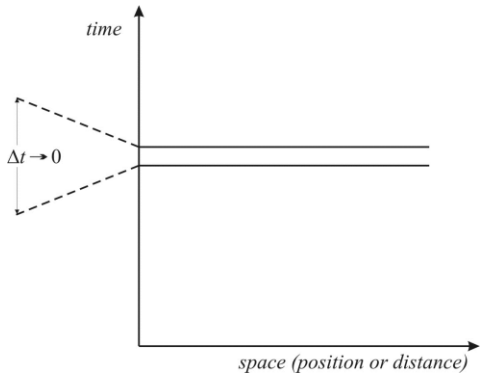

Fig. 1. The spacetime diagram for the nearby galaxies with time dilation $\Delta t \rightarrow 0$ (see text).

[4] This proposal can be extended to the planets in our Solar system.
[5] This could be interpreted as one of the possible versions of the Multiverse theory.
[6] Of course, with its local universe.

Now the intriguing question arises how can a nearby galaxy be observed by radio, infrared, optical, ultraviolet, x-ray and gamma-ray telescopes? As we pointed out in our previous communication [3], any electromagnetic radiation, particularly light, can overcome the time (past/future) barrier between the galaxy's local universe and our Universe. Thanks to this property of the light, we can measure its redshift. This light also gives us the impression that they are part of the present-time Universe. Light (or any electromagnetic radiation) travels between the local universe of a nearby galaxy in a normal way. It covers a distance D between these two for the light travel time $\tau = D/c$.

Finally, according to eqns. (1)/(2) and Fig. 1, a nearby galaxy can be born or exists at the seemingly same cosmic time as the Earth but seemingly be at the same cosmic position as the Earth. But there is no such galaxy.

References

[1] P. I. Premović**,** *Nearby and distant galaxies: a brief note*. The General Science Journal.
[2] P. I. Premović, *A simple way to show space-time expansion*. The General Science Journal.
[3] P. I. Premović, *The oddity of cosmological time dilation*. The General Science Journal.
[4] P. I. Premović, *A nearby or distant galaxy cannot and will not be created while the Earth exists*? The General Science Journal.