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Nearby and Distant Galaxies: A Brief Note

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In our previous communications, we defined nearby galaxies as those whose cosmological redshift (or just simply redshift), z_G, is from 0.001 to 0.1 (or $0.001 \leq z_G \leq 0.1$) and distant galaxies with $z_G > 0.1$ [1-3], emphasizing that there is no sharp boundary between them. This definition needs some further explanation.

The redshift of nearby galaxies is approximately defined (in wavelength) by the following equation

$$z_G = (\lambda_G - \lambda)/\lambda \quad \ldots (1)$$

where λ is the wavelength of light emitted by nearby galaxies and λ_G is its wavelength measured by an Earth's observer.

If the recessional speed of nearby galaxies υ is much smaller than the speed of light c (= 2.99792×10^5 km sec^{-1})[1] then this speed is defined based on the non-relativistic Doppler effect by the following equation

$$\upsilon = cz_G \quad \ldots (2)$$

In this case, recessional speed is the product of redshift, z_G, multiplied by the speed of light c.

The starting point of numerous papers related to the recessional speed of nearby galaxies is the Hubble's law equation based on the assumption that $\upsilon = cz_G << c$. This equation states that

$$\upsilon = cz_G = H_0D_G \ldots (3)$$[2]

H_0 is Hubble's constant and D_G is the proper distance (hereinafter distance). This equation is based on two assumptions: (a) speed is the only cause of redshift of nearby galaxies (see https://www.loop-doctor.nl/hubble-and-humason-measured-redshift) and (b) their peculiar motion is negligible and this is highly likely for most of these galaxies.

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[1] I. e., $\upsilon = z_Gc << c$.

[2] Of course, the equations (1) - (3) can only be used when the recessional speed $\upsilon << c$ (in particular, when $\upsilon \leq$ 0.1 c) at higher υ, equations must be derived based on the Special theory of relativity.

A good approximation for $\upsilon = cz_G << c$ is $\upsilon = cz_G \leq 0.1c$ or briefly $z_G \leq 0.1$ [1]. Let us now find the distance range of "megamaser" galaxies. Plugging $z_G \leq 0.1$ into eqn. (3) and after a bit of algebra we have

$$D_G \leq 0.1c/H_0 \quad \ldots (4).$$

We know that c/H_0 is Hubble's distance which is equal to about 13.8 Gly. Hence, nearby galaxies are those on distance $D_G \leq 1.38$ Gly and distant galaxies are with $D_G > 1.38$ Gly. Taking into account the above-defined low limit for z_G (≥ 0.001), we propose the following distance range for nearby galaxies: 0.0138 Gly $\leq D_G \leq$ 1.38 Gly.

The upper limit for nearby galaxies[3], $z_G \leq 0.1$, defined above is based on eqn. (4). On the other hand, their lower limit is arbitrarily defined on the basis that the maximum peculiar speed[4] of about 300 km sec^{-1} or 0.001c. (See the definition given above).

A problem that has received little attention despite its importance is the fact that we do not know the recessional/peculiar speeds of any of nearby galaxies at all (for example, see https://www.loop-doctor.nl/hubble-and-humason-measured-redshift/). Moreover, we do not even know their distance except for six so-called "megamaser" galaxies (1). The distance of these galaxies ranges from 23.7 Mly[5] to 447 Mly [1, and references therein]. Therefore, all of them are nearby galaxies.

References

[1] P. I. Premović, *Distant galaxies in the non-expanding (Euclidean) Universe: the light speed redshift.* The General Science Journal, December 2021.
[2] P. I. Premović, *The redshift of light emitted by nearby and distant galaxies in the observable Universe*. The General Science Journal, December 2021.
[3] P. I. Premović, *The photon quantum of energy of the observable Universe*. The General Science Journal, December 2021.

[3] Or the lower limit for distant galaxies.
[4] In general, peculiar speed = $\upsilon - D_G H_0/c$.
[5] The peculiar motion is not negligible only for this galaxy [1].