Distance-redshift relation in an accelerating universe

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Cosmological redshift is often attributed to an expanding universe, and accelerating expansion to dark energy.

A new interpretation is given with an accelerating universe, which may lead to new models of cosmology.

1. Definitions

The speed of light in vacuum, C, is postulated to be a constant. This hints that our flow of time, dT, is tied to C.

If the time of the universe, t, is different from T, the speed of light of the universe, c, can vary, and $dt \times c = dT \times C$.

To conserve energy, when c changes, photon is postulated to move between different c, so that frequency is conserved.

This suggests that photon rate is conserved.

2. Distance and redshift

Let $n = -0.8$ chosen using the Pantheon+SH0ES data.

Let t drops to zero as time flows.

Assuming c is uniform.

$$c \propto t^n \tag{1}$$

Suppose a photon emitted at $t = a$ is observed at $t = b$.

Redshift and time dilation are

$$(1 + Z) = b^n \div a^n = (a \div b)^{0.8} \tag{2}$$

Comoving distance is

$$D = \int_b^a c\, dt \propto (1 + Z)^{0.25} - 1 \tag{3}$$

Luminosity distance is

$$L = D\,(1 + Z) \tag{4}$$

Distance modulus is

$$\mu = 5 \log_{10}(L) - 5 \tag{5}$$

3. Data

1. Pantheon+SH0ES (2022)
2. Dark Energy Survey Supernova 5YR (2024)
3. Supernova Cosmology Project Union2.1 (2012)

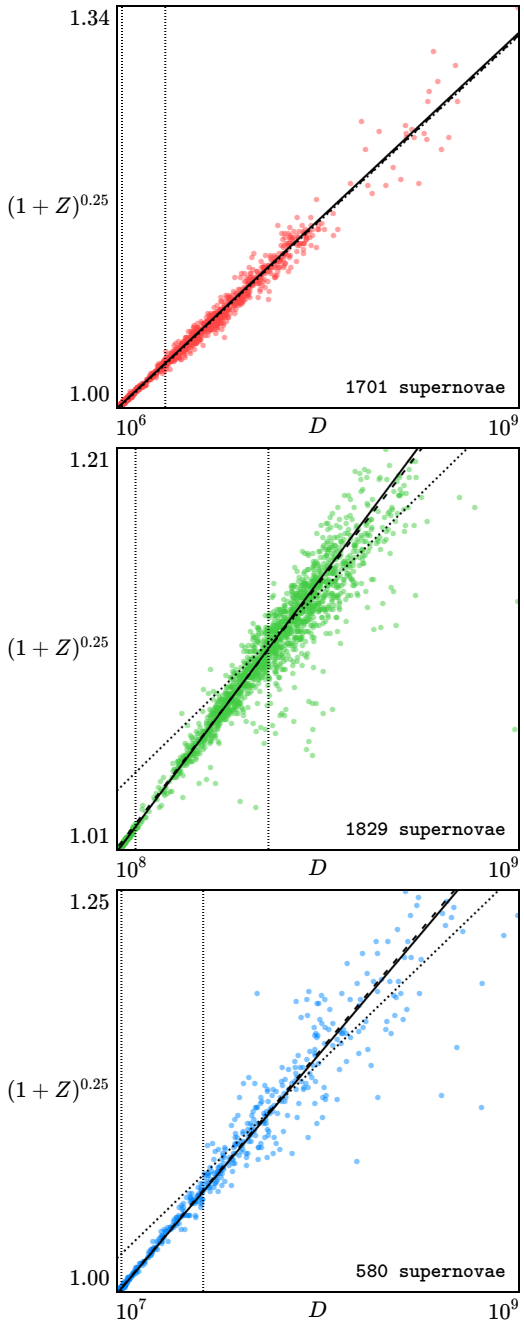

Figure 1. Redshift (zHD) and distance modulus from Pantheon+SH0ES, Dark Energy Survey Supernova 5YR, and Supernova Cosmology Project Union2.1, respectively. Vertical lines divide data into 3 parts: 10%, 40%, and 50%. Solid linear regression line uses 1st, dashed 2nd, dotted 3rd.