Arp's Computation of Inherent QSO Redshifts

From Appendix B in *the Electric Sky*

(Revised 12/11/09)

Halton Arp has concluded that an object's total redshift value is a combination of its ***intrinsic*** redshift factor and its ***velocity*** redshift factors. If a quasar's intrinsic redshift value is, say, 0.3, and its total velocity redshift is 0.06, then the total redshift factor that will be measured in light coming from this object is given by (1+0.3)(1+0.06) = 1.378.

In other words, for this example, the object's light is redshifted 30% due to its youth and then that light is shifted another 6% due to its velocity. The total is not the sum (36%) but rather 37.8%. The wavelength of any given line in this object's spectrum will be multiplied by 1.378 as compared to the wavelength of that line when it is measured in the laboratory. The *total* multiplying factor $(1+ z_t)$ is made up of two multiplicative factors.

$$\left(1+ z_t\right) = \left(1+ z_i\right)\left(1+ z_v\right) \qquad (1)$$

where z_i is called the "***intrinsic*** redshift of the object" and z_v is the total "redshift due to ***velocity***" of the object.

The intrinsic redshift z values of quasars seem to be quantized.[1] That is to say, those calculated values are tightly grouped around a series of discrete values.

The existence of any such quantization is sufficient to falsify the idea that redshift is ***only*** an indicator of recessional speed (and therefore distance). Redshift quantization means (under the redshift equals distance interpretation) that quasars must lie in several concentric shells, with Earth at the center of the entire arrangement. Copernicus discovered a long time ago that Earth is not at the center of anything. That is why astronomers are now frantically attempting to disprove the occurance of any quantization in the data.

So, recently a group of astronomers,[2] having analyzed a large number of observed high redshift QSO values, announced that they could find no such quantization effect. But the ***raw*** (observed) redshift values of all the known quasars is not what is quantized. It is the quasars' ***intrinsic*** redshift z values[3] that are.

There are three components of a QSO's overall redshift value. The calculation necessary to identify each of these is done as follows:

Identify a pair of quasars, q_1 and q_2, one on either side of a parent galaxy, G. The redshift of quasar q_1 is due to three causes:

1. The intrinsic redshift of this quasar itself. This is the quantity that we want to determine (this is the value that is quantized). Arp maintains it is a function of the object's age.
2. The entire family: G, q_1, and q_2 are moving through space together. This velocity of the entire family defines the "reference frame" of the family.
3. The relative velocity of the quasar, with respect to the parent galaxy, within its reference frame, in the direction of the line of sight.

The last two (velocity dependent) components must be removed from the raw measured redshift value for each quasar in order to arrive at the intrinsic value of its redshift. The calculation proceeds as follows:

1. If the parent galaxy itself has a significant redshift due to velocity, that component must be removed from all QSOs associated with that galaxy. So, first find and remove the redshift value caused by the velocity of the parent galaxy along the line of sight.
2. Find and remove the redshift component caused by the relative velocity of each quasar with respect to the parent galaxy within this reference frame.

Numerical Example

Dr. Arp gives[4] an example of a parent galaxy UM 341 and several pairs of apparently associated quasars. In this case the parent galaxy has a redshift of $z_G = 0.399$ and one of the associated pairs of QSOs have $z_1 = 0.718$ and $z_2 = 0.879$. Using equation 1:

$$\frac{(1+z_1)}{(1+z_G)} = (1+z_{1G}),$$

we find $1.718 / 1.399 = 1.228$

and $1.879 / 1.399 = 1.343,$

giving the two partially corrected quasar redshift values $z_{1G} = 0.228$ and $z_{2G} = 0.343$. Arp calls these values the "quasar redshifts after they have been transposed to the reference frame of their parent galaxy." The effect of the motion of the entire family has been removed.

Unless the quasars are moving away from their parent galaxy in a direction that is exactly orthogonal to our line of sight, one will be approaching us somewhat, and one will be moving away. Thus, within the frame of reference of the parent galaxy, the quasars' ***velocity*** redshift component values will appear equal in magnitude but opposite in sign. Their intrinsic redshift values are identical to each other. Their transposed (to the reference frame) values of total redshift are z_{1G} and z_{2G} respectively. In general, from equation (1) we have

$$(1+z_i)(1+z_v) = (1+z_{1G})$$

and

$$(1+z_i)(1-z_v) = (1+z_{2G})$$

Expanding each of these expressions yields

$$1+z_i+z_v+z_iz_v = (1+z_{1G})$$

and

$$1+z_i-z_v-z_iz_v = (1+z_{2G}).$$

Adding these yields:

$$2+2z_i = 2+z_{1G}+z_{2G}$$

or

$$z_i = \frac{z_{1G}+z_{2G}}{2}. \qquad (2)$$

Thus we see that the intrinsic redshift value of a pair of symmetrically placed quasars is simply the arithmetic mean of their individual transposed redshift values.

So in the present example, the transposed quasar redshift values as determined above are $z_{1G} = 0.228$ and $z_{2G} = 0.343$. Assuming both have identical intrinsic redshift components, we calculate this value via expression 2:

$$z_i = (0.228+0.343)/2 = 0.2855.$$

Note that this calculated intrinsic redshift value, 0.2855, is only Δ = - 0.0145 (~5%) from one of the quantum levels, 0.300.

This is the calculation astronomers who are critical of Arp's ideas refuse to perform. They simply look at the entire collection of raw quasar redshift values and joyfully report finding no quantizations. They do not want to admit that pairs of QSOs are associated with parent galaxies. But, identifying such pairs is the first step in the calculation. We cannot just lump all raw quasar data together and then look for quantizations in that data.

For completeness in the present example, the redshift component for each quasar due to its motion relative to its parent galaxy can be calculated via equation (1), as follows:

$$\frac{(1+z_{1G})}{(1+z_{i1})} = (1+z_{v1}),$$

$$1.228 / 1.2855 = 0.955$$

which yields

$$z_{v1} = 0.955 - 1 = -0.045$$

and

$$\frac{(1+z_{2G})}{(1+z_{i2})} = (1+z_{v2}),$$

$$1.343 / 1.2855 = 1.045$$

which yields

$$z_{v2} = 1.045 - 1 = +0.045$$

The quasar with the negative relative velocity redshift value (q_1 in this example) is moving away from its parent toward us and the one with positive relative velocity redshift is receding (each at 4.5% of the speed of light with respect to the parent galaxy).

Lastly, we observe that the reference frame redshift value (of the parent galaxy), $z = 0.399$, is also only $\Delta = 0.099$ different from one of the quantum levels, 0.3. If, indeed the actual *intrinsic* redshift of the central galaxy is exactly 0.3, a calculation similar to the above indicates it is receding from us at:

$$\frac{1.399}{1.30} = 1.076$$

or 7.6% of the speed of light, 22,800 km/sec.

Notice that Arp's calculation results in actual real velocity magnitudes (0.45*c*) that are much reduced from the values typically stated for QSOs (0.718*c* and 0.879*c* in the present example).

D.E. Scott, 12/11/09

[1] QSO redshifts cluster at $z = 0.061, 0.30, 0.60, 0.91, 1.41, 1.96, \ldots$ such that $(1+z_2)/(1+z_1) = 1.23$. This general relationship among these quantization levels was discovered by K.G. Karlsson in 1971.
[2] Hawkins, Maddox, and Merrifield (M.N.R.A.S. 336, L13, 2002).
[3] To make this calculation, we first must identify a pair of quasars symmetrically positioned on either side of a parent galaxy and measure the redshift of each.
[4] *Ibid* pp 58-60.