Suggestion for Unifying Two Types of Quantized Redshift of Astronomical Bodies

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This paper shows how the large quantization for quasar redshifts and the much smaller quantization for galaxy redshifts can be explained by similar mechanisms. If the redshift of quasars is attributed to a change in the electron mass, then the allowable masses for an electron obey a simple formula. If the proton masses obey the same formula, then they can cause a change in the reduced mass of the electron, causing a redshift quantization which is in excellent agreement with observation.

The most widely accepted explanation of the cosmological red shift is that it is due to the redshifted object receding from the observer. Because redshift generally decreases with luminosity, it is also generally concluded that the more distant an object, the more rapidly it is receding. Recently, the simplicity of these assumptions has been challenged by claims that the redshifts of stellar objects are quantized, or can have only certain values. Complicating the matter still further is the fact that two distinct types of quantization have been proposed. Arp (1987) and Arp *et al.* (1990) contend that quasar redshifts are clustered around $z = 0.30$, 0.60, 0.96, 1.41, and 1.96. Tifft (1988) and others suggest that, for closer bodies, there is a quantum of red shift that is approximately 72, 36 or 24 $\mathrm{km\,s^{-1}}$. More recently, Guthrie and Napier (1991) calculated the power spectrum of the redshifts of 89 nearby spiral galaxies. They found the principal peak to be at 37.4 $\mathrm{km\,s^{-1}}$.

Much of the research that attempts to explain this involves mechanisms that would have the redshifted object receding only at discrete intervals. A minority of the literature offers explanations that allow the electron to have several discrete values for its mass (Arp *et al.* 1990, Arp 1991, Narlikar and Arp in press). This paper shows that a slight modification of the latter theory can simultaneously explain both types of redshift.

If the permissible values for the mass of an electron are chosen to explain the redshifts of the quasars, a rather simple relationship ensues. Any of the allowable masses for the electron can be obtained by multiplying the next heavier allowable mass by the same factor. If we then assume that hadrons have similar allowable masses that can be related by the same constant, we then have another mechanism that can affect redshift. A change in the mass of the nucleus will change the reduced mass of its electron, causing an apparent redshift. This effect can produce Guthrie and Napier's value for redshift quantization.

Quasar redshifts and electron mass

Defining the redshift, z, as

$$z=\frac{\lambda_k-\lambda_o}{\lambda_o}=\left(\frac{c+v}{c-v}\right)^{1/2}-1 \tag{1}$$

where λ_o is the original wavelength, λ_k is the redshifted wavelength, c is the velocity of light, and v would be the velocity if the redshift were caused by a recessional velocity. If v/c is small, then (1) can be expanded, and

$$z=\frac{v}{c} \tag{2}$$

To calculate redshift in terms of the electron's mass, we will look at the spectrum of a hydrogen atom

$$E_{ij}=\frac{hc}{\lambda_{ij}}=\frac{e^4m}{4\epsilon_o^2h^2}\left(\frac{1}{j^2}-\frac{1}{i^2}\right) \tag{3}$$

where E_{ij} is the energy of the photon, h is Planck's constant, ϵ_o^2 is the permittivity of free space, e is the electron's charge, m is the mass of the electron, and i and j are integers denoting the energy levels of the electron. Solving (3) for wavelength we get

$$\lambda_o=hc\frac{4\epsilon_o^2h^2/e^4m_o}{1/j^2-1/i^2} \tag{4}$$

and

$$\lambda_k=hc\frac{4\epsilon_o^2h^2/e^4m_k}{1/j^2-1/i^2} \tag{5}$$

where m_o is the original mass of the electron and m_k is the alternate mass. Dividing equation (4) by equation (5) we get

$$\frac{\lambda_o}{\lambda_k}=\frac{m_k}{m_o} \tag{6}$$

Substituting equations (4) and (5) in equation (1), we get

$$z_k=\frac{\lambda_k-\lambda_o}{\lambda_o}=\frac{m_o-m_k}{m_k}=\frac{m_o}{m_k}-1,\ k=1,2,3,4,5 \tag{7}$$

It should be noted that if m_k is less than m_o, a redshift is produced.

Arp (1987) has suggested that quasar redshifts show a fit with the following relationship,

$$\frac{1+z_{k+1}}{1+z_k}=\text{constant} \tag{8}$$

where the constant is chosen to fit a group of quasars. It can vary from group to group because there can be a Doppler redshift in addition to the intrinsic redshifts. For the redshifts listed above the constant is 1.23. It should be noted that equation (8) is essentially the result of fitting five points, and care should be taken in extrapolating any equations derived with it.

Substituting equation (7) in equation (8) and rearranging we get

$$m_k=m_o[1.23]^{-k}\ldots\ldots k=1,2,3,4,5 \tag{9}$$

The simplicity of the relationship should be reason for cautious optimism. If an electron can have the masses described above, then the quasar redshift quantization can be explained.

Galaxy redshifts and proton mass

Next we will look at the implications of the proton obeying the same mass relationship. While the proton mass does not affect the emission spectrum directly, it can affect the reduced mass of the electron, and that is what really appears in equation (3). While this may only be true for the hydrogen atom, it should be noted that almost all redshift measurements are done with various hydrogen lines.

The reduced mass is given by

$$\mu=\frac{m_e m_p}{m_e+m_p} \tag{10}$$

where m_e is the electron mass and m_p is the proton mass. If we substitute a relationship like equation (9) for only proton mass in equation (10) and rearrange, we get

$$\begin{aligned}\frac{\mu_o}{\mu_k}&=1+\frac{(1.23)^k-1}{m_p/m_e+1}\\&=1+\frac{(1.23)^k-1}{1837.12}\end{aligned} \tag{11}$$

The left side of equation (11) is the ratio of the reduced electron masses, which is substituted for the ratio of the electron masses in equation (7), yielding

$$z=\frac{(1.23)^k-1}{1837.12} \tag{12}$$

Substituting (2) in (12) and solving for v, we have

$$v = \frac{c\left(\left[1.23\right]^k - 1\right)}{1837.12} \quad (13)$$
$$= 37.5,\ 83.7,\ 140.5,\ 210.3,\ 296.3,\ etc.\ \mathrm{km\,s^{-1}}$$

Comparison of results

Napier and Guthrie's result, 37.4 $\mathrm{km\,s^{-1}}$, and the one calculated here, 37.5 $\mathrm{km\,s^{-1}}$, agree to about one part in four hundred, which speaks for itself.

A comparison of our results to Tifft's 72 $\mathrm{km\,s^{-1}}$ periodicity is beyond the scope of this paper. One of the authors (Kokus) intends to evaluate both quantizations for the local galaxy cluster in the near future.

A possible test

This mechanism predicts different redshifts for different elements, and one of the authors (Kokus) plans to survey and evaluate the literature on the subject in a future paper. For the present, suffice to say that such an effect has been observed by Tifft (1976) in data taken by Rubin and Ford (1971) for the galaxy M31. For certain parts of the galaxy, the hydrogen lines were blueshifted between 85 and 90 $\mathrm{km\,s^{-1}}$ more than the nitrogen lines. This is roughly equivalent to 86 $\mathrm{km\,s^{-1}}$, the blueshift of M31 relative to the Milky Way (Arp 1986). While such anecdotal evidence is far from conclusive, it definitely warrants closer examination.

Summary

The authors do not intend the mechanism described in this paper to be a final theory describing redshift quantization, and we do not mean to imply that this is the origin of all galaxy redshifts. Our intention is to suggest an avenue for research into the problem that is presently being ignored, namely, the possibility that galaxy redshift quantization could be the result of discrete changes in the nuclear mass. The mechanism may prove to be incorrect, and if it is, there is then an even more tantalizing question: Why are the two quantizations so simply connected by the ratio of the proton and electron masses?

Note: These calculations were originally done in December 1991. There was no effort to publish them at the time, because galaxy quantization was considered to be 72 $\mathrm{km\,s^{-1}}$. It was not until we belatedly learned of Napier and Guthrie's results that we realized the potential importance of our calculations.

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