REDSHIFT PERIODICITIES, THE GALAXY-QUASAR CONNECTION

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Abstract.

The Lehto-Tifft redshift quantization model is used to predict the redshift distribution for certain classes of quasars, and for galaxies in the neighborhood of $z = 0.5$. In the Lehto-Tifft model the redshift is presumed to arise from time dependent decay from an origin at the Planck scale; the decay process is a form of period doubling. Looking back in time reveals earlier stages of the process where redshifts should correspond to predictable fractions of the speed of light. Quasar redshift peaks are shown to correspond to the earliest simple fractions of c as predicted by the model. The sharp peaks present in deep field galaxy redshifts surveys are then shown to correspond to later stages in such a decay process. Highly discordant redshift associations are expected to occur and shown to be present in the deep field surveys. Peaks in redshift distributions appear to represent the spectrum of possible states at various stage of the decay process rather than physical structures.

1. Introduction

Modern cosmology presumes to understand the cosmic redshift as a simple continuous Doppler-like effect caused by expansion of the Universe. In fact there is considerable evidence indicating that the redshift consists of, or is dominated by, an unexplained effect intrinsic to galaxies and quasars. In this paper we discuss and relate three lines of such evidence including evidence for characteristic peaks in the redshift distribution of quasars, the issue of associations between objects with widely discordant redshifts, and redshift quantization associated with normal galaxies.

Nonuniformities in the quasar redshift distribution, most notably peaks near z of 0.30, 0.60, 0.96, 1.41, 1.96, and 0.061 and its multiples, have been discussed since the 60s (see Burbidge and Napier, 2001). The issue of association between objects with very different redshifts also dates from that period (Burbidge and Sargent, 1970), as does redshift quantization in normal galaxies (Tifft, 1976). Figure 1 illustrates the quantized differential redshift distribution found for double galaxies (Tifft and Cocke, 1989); Figure 2 shows characteristic redshift periods found globally (Tifft, 1996) using concepts which predict specific values.

Understanding the relationship between different facets of the intrinsic redshift requires familiarity with the predictive framework of redshift quantization developed using local galaxies. Work prior to 1992 employed empirical periodic intervals studied differentially or globally within a galactic center rest frame. Important independent confirmation work was carried out in the 90s by Guthrie and Napier (1991), and has been continued by Napier (W. Napier, this conference). In 1992 emphasis shifted to the cosmic background rest frame, and in 1993 Ari Lehto, a Finnish physicist, suggested a mechanism for predicting periodicities. Subsequent testing, (Tifft, 1996, 1997), confirmed and extended concepts leading to the current Lehto-Tifft quantization model. The underlying concept, described in the Astrophysical Journal (Tifft, 1996), follows:

Lehto was originally motivated to describe properties of fundamental particles from first principles. Begin with the Planck units, the Planck energy, time, mass and light speed. These units can be related to the Planck time or frequency as defined by the fundamental constants h, c, and G. Observable properties of particles (and redshifts) are then presumed to be generated by a *decay* process beginning at the Planck scale. Lehto proposed that the Planck units decay by a period doubling process, an action doubling process in factors of 2, a process well known in decay of systems toward chaos. If this was the case present day fundamental properties of matter and energy should relate to the Planck units by simple powers of 2. When Lehto explored this idea he found what appeared to be ratios involving cube-root powers of 2. Lehto suggested that doubling could be occurring in a 3-dimensional or 3-parameter space which is perceived as 1-dimensional through the action of a cube-root transformation.

2. The Lehto-Tifft Equations

Lehto's initial form for permitted redshift intervals (periods) follows immediately from the above statement.

$$P = c2^{-N/3}, \qquad 1$$

where N is an integer ≥ 0. A form applicable to particle physics replaces c with the Planck mass or energy. It is relevant here to reflect for a moment on the significance of the equation. The equation is a general form of Kepler's third law where, in ordinary space, a spatial distance relates to the 2/3 power of a time interval. Such a relation is a unique property of 3-d spaces. The existence of such a pattern involving only temporal terms raises the possibility that temporal/frequency/energy space is actually 3-dimensional. If such a 3-d temporal space was flowing relative to 3-d spatial space the flow speed would by definition be the speed of light, a constant. Time would be reduced to 1-d by aberration and generate our perceived 4-space. The model automatically provides constancy of c and preserves special relativity. Temporal space must be quantized since it involves a stepwise decay process from fixed units. Space and flowing time (dynamical 4-spaces) are not so restricted. Quantum and continuous physics can co-exist. We will not pursue such a 3-d temporal cosmology here, but it is useful to introduce the concept. This paper depends on the empirical fact that redshift data are consistent with such a periodicity equation, regardless of its interpretation. In fact it is now possible to explicitly derive the Lehto-Tifft equations. This will be reported in a subsequent paper since it occurred subsequent to the Cardiff conference where this paper was presented.

Equation 1 is rewritten to distinguish cube-root doubling 'families'

$$P = c2^{-N/3} = c2^{-\frac{3D+L}{3}}. \qquad 2$$

D is the number of doublings, and $L = 0$ to 2 specifies which root is involved. Equation 2 accounts for most redshift periods, however, the complete set of observed periods requires a second cube root operation to yield nine ninth-root families distinguished by an index T.

$$P = c2^{-N/9} = c2^{-\frac{9D+T}{9}}. \qquad 3$$

Equation 3 completely and uniquely describes all presently observed redshift periodicities (Tifft, 1996, 1997). T values do not occur randomly. Pure doubling, $T = L = 0$, is dominant, followed by the 'Keplerian' $T = 6$ ($L = 2$) value. Odd T values shifted by 1 from these values ($T = 1, 5, 7$) are present but less common, while the even values ($T = 2, 4, 8$) are rare or absent. Which T family is involved appears to relate to galaxy morphology (Tifft, 1997). Equation 3 appears to be necessary to describe structure found in the redshift distribution of local galaxies. Deeper in space, at high redshift, the $T = 0$ family becomes increasingly dominant. As noted in the previous paragraph, the origin of the Lehto-Tifft equations is now believed to be known, including why particular T values are preferred. This will be reported in a subsequent paper.

A second basic relationship is required to assess redshift quantization. Redshift intervals dilate with distance due to relativistic and geometric effects. Such effects must be removed to evaluate underlying quantization. In classical cosmology geometry, or 'curvature', is described by a 'deceleration' parameter q_o. The Hubble 'constant' is a function of time, $H = H(t) = f(z, q_o)$ where $q_o = 1/2$ corresponds to Euclidian geometry. Such a relationship must exist in any cosmology. q_o need not be uniquely associated with gravitation but $H(t)$ will be described much the same way. The removal of z-dependent distortion in the redshift is referred to as the 'cosmological' correction.

The cosmological correction was first investigated by Tifft and Cocke (1984) for application in global quantization studies. A correction assuming that redshift intervals dilate in proportion to $\sqrt{H(t)}$ was shown (Tifft, 1996) to linearize quantization in galaxy redshifts to well beyond 10,000 km/s if q_o is set exactly equal to 1/2. In this paper no significant deviation in the form of the correction is seen out to $z = 1$ or 2. The relationship is derived using the classical $H(t)$ formulation to find an expression for redshift intervals as a function of z and q_o which is then integrated in a Taylor expansion about $q_o = 1/2$. For q_o exactly equal to 1/2 the integration gives a closed relationship between z(observed) and z(Lehto-Tifft).

$$z_{obs} = \left[\frac{z(LT)}{4} + 1\right]^4 - 1 \qquad z(LT) = 4[(1 + z_{obs})^{1/4} - 1]. \qquad 4$$

This form empirically fits all data examined (Tifft, 1996, 1997). Current tests therefore use Equation 4 to convert observed redshifts to $z(LT)$ for quantization evaluation.

Equation 4 is consistent with the 3-d temporal concept previously mentioned. In such a model energy is associated with temporal volumes which vary as t^3. If photon redshifts relate to energy density, which varies as volumes evolve, the rate of change will be perceived as H. Volume will evolve as t^2 so H should depend on t^2 and redshift intervals vary as $\sqrt{H(t)}$ as observed.

3. Looking Back In Time

In the Lehto-Tifft model redshifts evolve through a systematic doubling decay process, now quite advanced, to yield the small redshift intervals observed locally. Looking back in time should reveal earlier decay stages. High redshift data should be increasingly structured and consistent with predictable early doublings and mixing. Are redshifts associated with early levels related to the peaks in the quasar redshift distribution? Table 1 shows that there is a very close agreement. The table is constructed by converting the earliest doublings and mixings, basic fractions of c, to observed values using Equation 4, to compare with the quasar peaks. The quasar redshift distribution is indeed consistent with predicted early redshifts generated in a universe evolving in a doubling decay process. Peak locations also match an empirical logarithmic series described by Karlsson (1977).

Table 1

Quasar Redshift Peaks

z(LT)	D=2	z(obs)	z(peak)
c/16		0.064	0.061
c/8		0.131	
c/4	1/4 c	0.274	0.30
c/2	2/4 c	0.601	0.60
	3/4 c	0.989	0.96
c	4/4 c	1.441	1.41
	5/4 c	1.968	1.95

The issue of specific distinct peaks in the quasar redshift distribution is in dispute, however it is unlikely that the match in Table 1 would occur if the peaks were simply random fluctuations. It seems quite likely that the distribution depends upon the type of quasar involved. Burbidge (1980) and Burbidge and Napier in Hoyle, Burbidge and Narlikar (2000) indicate that peaks are clear when quasars which are strong radio sources are involved. This is illustrated in Figure 3, where quasars known in 1977, virtually all radio sources, are shown and in Figure 4 which shows the complete set of 3c quasar radio sources. The figures also indicate other most likely T states permitted in the Lehto-Tifft model. The gaps associate quite clearly with the absent or least likely T states. Burbidge and Napier (2001) also associate the peaks with quasars close to low redshift galaxies, however other recent studies based upon large optically selected samples do not confirm the effect (Hawkins et al 2002). This may not be surprising since the early samples contained more radio selected objects. In the Lehto-Tifft model the peak redshifts represent unique potentially active stages. Subsequent smaller scale decay toward lower redshifts may move objects out of the active stage and smear out the distribution. We will specifically illustrate this idea using high redshift galaxies, presumed to be evolutionary products of quasars, later in this paper. Whether or not an excess of quasars near galaxies indicates physical association remains an open question, but association and periodicity need not be directly related.

Burbidge and Napier (2001) also invoke a new category of quasars, close associations. They claim that such a sample of redshifts, which includes a significant number with $z > 2.5$, extends the Karlsson (1977) $\log(1+z)$ periodicity to higher redshifts. In fact the number of higher redshifts is quite small and the distribution rather noisy. The redshifts are also well described in the Lehto-Tifft model. Above $z(LT) = 1$ the Lehto-Tifft model proceeds by frequency mixing which should yield the well known sharp drop in redshift frequency at high z. Specific z values are predictable and appear to match the associated quasar redshifts very well. Close associations in quasars seem to be analogous to close binary galaxy systems where the quantized pattern shown in Figure 1 was found. Further details discussing matches to high redshift values will be presented in a subsequent paper.

To further investigate the association of radio emission with the quasar peaks we extended a study by Arp et.al. (1990) based upon quasars selected by radio flux. Their study found the Karlsson peaks in a study of several specific fields. Figure 5 shows, with filled symbols, the distribution found in a south galactic hemisphere field. With the assistance of N. Jobson and L. Lippiello the sample was augmented (open symbols) using the Veron-Cetty and Veron (1996) quasar catalog. The sample was then extended to the entire south hemisphere south of the initial field to yield Figure 6. A peaked distribution related to the Karlsson and specific Lehto-Tifft predictions persists. We note the gaps where rare or absent T values fall, and a possible association with $T = 1$ and perhaps $T = 6$ values not predicted in any other model.

Finally, to extend studies to possible lower redshift peaks, especially the $c/8$ peak predicted to fall at $z(obs) = 0.131$, N. Jobson extended the quasar and active galaxy redshift distribution to low redshifts using the Veron-Cetty and Veron (1996) catalog. The sample was limited to objects with three significant figures in the redshift value to eliminate many rough or preliminary values listed. Figure 7 shows that the $c/8$ peak is apparently present. This peak is the x2 multiple of the $c/16$ peak at $z = 0.06$ consistent with both the Karlsson and Lehto-Tifft model. The $c/8$ peak is not directly predicted by Karlsson, however, Burbidge has noted several multiples of the 0.06 period, compatible with the Lehto-Tifft model. Figure 8 shows the Schmidt and Green (1983) bright quasar sample which also shows small concentrations at the $c/8$ and $c/16$ locations. These results at low redshift are intended only to show broad consistency. The overall pattern becomes very complex at high doubling numbers (Tifft 1996, 1997). We will therefore now turn to much simpler early doubling patterns predicted to be present *for galaxies* at high redshift

4. The Galaxy-Quasar Connection

To preserve sharp quantization of redshift and the Hubble law, as observed, objects must evolve by cascading down through a series of specific redshift states. We have suggested that the principal peaks in the quasar redshift distribution represent an active stage relating to the earliest doublings and mixings associated with decay from the Planck unit c. In such a model subsequent decay can be expected to produce less active quasars and ordinary galaxies distributed in a redshift 'spectrum' between the primary peaks. Since the spectrum of states is far advanced locally the obvious place to look for such a process is at high redshift. Decay from the first doubling, $c/2$ associated with the $z = 0.6$ quasar peak, may be expected to be especially clear. We would expect the redshift spectrum to show a strong $T = 0$ dominance, multi-periodic 'phased' decay products, and discordant redshift associations where physically related objects have decayed into different but related states. Local decay has proceeded into the $D = 12$ to 16 range, but at $z = .5$ we would expect to see periods in the $D = 4$ to 9 range corresponding to $c/16$ - $c/512$ (20,000+ to 500 km/s).

To test this hypothesis we turn to the excellent accurate redshift surveys recently done in and around the Hubble deep field (HDF) and a southern deep field (SDF) by Cohen et al (1996, 1999, 2000). Figure 9, adopted from Cohen et al (2000), shows the overdensity redshift spectrum for the HDF region. The sharp spikes are classically interpreted as remarkably low velocity dispersion clouds or 'walls' in a developing 'cell' structure. The smooth broad curve shows the heavily smoothed overall galaxy density distribution. The general distribution shows peaks displaced below $z = .6$ and $z = .96$ consistent with being evolved remnants of early $c/2$ and $3c/4$ doublings. To investigate this we examined the redshift pattern in intervals immediately below $c/2$ and around $c/4$.

The first study, done in 1997, utilized the original HDF region study by Cohen et al (1996). A redshift frequency diagram is shown in Figure 10. Predicted locations are shown for the simplest fractions of c expected to fall in the interval, including $T = 1$ and 6 values. Peaks are present very close to predicted locations, especially three strong peaks directly below $c/2$ associated with $c/16$ and $c/32$ intervals. Figure 11 shows how precise the fit to these three peaks is. Redshift 'phase' at the $c/16$ period (the decimal part of $cz(LT)$ divided by $c/16$) concentrates strongly at 0.5 (odd $c/32$ values) and less strongly at 0.0 ($c/16$ values). Redshift values appeared to be periodic and phased as predicted. Further analysis requires a larger sample, which became available with the publication of a general catalog of HDF data by Cohen et al (2000).

Figure 12 shows the redshift distribution for the complete HDF catalog in the interval immediately below the $c/2$ location. The three primary concentrations and finer structures are apparent. Figure 13 shows that the lower two main peaks and certain satellite peaks are offset slightly from $c/32$ or $c/16$ locations. The offsets are consistent with higher fractions of c and increase in complexity with decreasing redshift. Further, the fractions involved are all *odd* fractions. We will see additional examples of such patterns later. This is the signature of a decay process which has proceeded to a specific doubling level but not beyond, $c/32$ for the main distribution with offsets up to $c/512$ in this case. Small offsets near the simpler fractions can be expected from frequency mixing during a decay process if a range of doublings exists at any time. Alternatively there may be some detailed finer structure within the primary doubling process. In either case even fractions correspond to earlier doubling levels (i.e. $2/512 = 1/256$) which may have already decayed ($1/256 \rightarrow 1/512$) or were not generated. The most prominent example of a missing higher state is the $c/2$ state itself which we associate with a much earlier quasar era. The distance to any particular aggregate of galaxies seems to take us back to a time period when decay had proceeded only so far, to the $D = 5$ or $c/32$ level for the main peaks in this HDF example. This is a normal lookback expectation, however D not redshift measures lookback time; redshift may distribute over a range of *specific* levels at a given distance.

Just as we see that the small offsets above the $c/32$ peaks correspond to the first few odd offsets of higher doublings, so too the offsets of the triple pattern below the $c/2$ location correspond to offsets of 1/32. 1/16, and 3/32 of c. The smallest offsets (1/32 and 1/512) are fit very accurately in both cases. We will see other examples of this. The states closest to the simple fractions appear to be the most persistent, while the simple fractions themselves are usually absent or infrequent above the highest doubling present.

As noted above, a common decay level of galaxies for the three $c/32$ peaks suggests a common spatial (distance) association despite the wide redshift spread. To test this we looked at the correlation between galaxy position and redshift peak membership. Figure 14 is a plot of galaxy positions with $0.46 < z < 0.6$ for a rectangular region in the HDF extended study. Symbols distinguish the three dominant redshift peaks and objects that are in between. The sample is cut at a uniform magnitude to account for deeper sampling in the central HDF although this affects few galaxies in the range of z involved. Galaxies appear to be clumped. At the distance associated with $c/2$ 1 Mpc has an angular scale of about 100 arc seconds. The larger boxes in Figure 14 therefore correspond with typical galaxy group sizes locally (although the two scales in the figure are different). We see that what looks like spatial clumps are composites of the three redshift peaks. We further see numerous pairings of galaxies from different peaks. One is shown with a small box in Figure 14.

To assess the significance of the discordant associations D. Christlein carried out Monte Carlo evaluations of the angular separation distribution between pairs which combine different redshift peaks. The number of pairs between specific peaks, in ranges of separation, were counted for the observed distribution and compared with 1000 samples generated by random wrapped displacements in RA and Dec of the objects in one peak relative to the other. Block displacements were used to preserve any real clumpy structure. Figure 15 shows the result for associations between the two extreme peaks separated by 25000 km/s in redshift, and for associations with objects which are not in the peaks. The peaks which phase together show a clear excess of associations for both close pairs and groupings. Objects which do not phase together do not show significant associations. Figures 16 and 17 show the result of comparisons between adjacent peaks which have redshift differences in the 12000-13000 km/s range. Again we find clear evidence for physical association of galaxies widely discordant in redshift which phase together in periods corresponding to simple fractions of the speed of light.

5. Extensions To Lower Redshift

To further investigate the deep field work we examined extensions to lower redshift. Figure 18 shows three prominent narrow redshift peaks in the $0.2 < z < 0.46$ interval below the region previously discussed. Many other redshifts distribute throughout the interval but the pattern is not random. Figure 19 examines *phase* relationships using the $c/16$ period. The three prominent peaks are well isolated but appreciably enhanced. The peaks have been significantly reinforced by addition of points at different redshifts which phase together as seen previously in the region below $z = .6$. Figure 20 shows the $c/16$ couplings for the three peaks. The 17 points in the $z = .457$ peak, which falls at phase 0.312, are enhanced by 11 points from $z = 0.376$, 0.298, and 0.224 to generate a sharp clear peak. The other peaks are also enhanced. The $c/16$ period pervades the region. Except for the linearity correction from Equation 4, relatively small at low z, this period is essentially a phase shifted version of the $z = 0.06$ period noted previously by Burbidge (1968).

What is new is the appearance of several phase shifted versions within which one particular cycle is especially enhanced. The phase diagram in Figure 19 shows that the peaks associate with specific eights, 5/8 and 3/4, or sixteenths, 5/16, of the $c/16$ cycle. There may be small offsets below the simple fractions but more precise z values will be required to examine any detailed substructure. An overall periodicity of 8×16 ($c/128$) will superimpose the two upper phase peaks and weaker peaks at phase 7/8 and 1/8 which associate with $c/16$ periods matching redshifts at $z = 0.421$ and 0.441. The phase 0.312 family of redshifts is one doubling higher in the $c/256$ series. Formulae describing $z(LT)$ for the three phase peaks are $(16n+5)/256$, $n = 3-6$, and $(8n+5)/128$ or $(4n+3)/64$ for $n = 3-5$. These are consistent with forms expected if doubling decay occurs for values offset from simpler primary fractions by mixing.

As noted in the region just below $c/2$, only odd fractions of intervals are present. The 2/8, 4/8 and 8/8 fractions are missing. As noted above this is consistent with a decay sequence displayed in distance. The galaxies in Figure 19 are at doubling level $D = 8$ ($8 \times 16 = 128 = 2^8$). Even fractions reduce to smaller D values which may have existed earlier and have subsequently decayed if they formed at all. They should not be found in a cloud associated with a distance corresponding to $D = 8$. The odd-integer characteristic of the patterns is a strong confirmation that a time dependent doubling decay model has produced the structure.

The fact that only odd multiples of a given D level are to be expected within a given cloud of objects may be related to the absence of even T values in the Lehto-Tifft doubling equation for redshift families, or more precisely the absence of T values which are direct powers of two, 2, 4, and 8. Six divides only once to the odd value of 3. It is 1, 5, 7, with 6, and sometimes 3 T values that are seen in addition to the pure $T = 0$ doubling sequence. (As noted earlier, the origin of the Lehto-Tifft equations and the generation of particular T values within a doubling process now appears to be understood and will be published separately.)

The final step in the examination of the lower redshift sample involves looking at spatial associations. Figure 21 shows the spatial location of galaxies in the $0.2 < z < 0.46$ range using superimposed symbols to identify objects connected by the $c/16$ period incorporating the $z = 0.457$ peak. Clumping appears to be present, on a larger angular scale as expected from the lower redshifts involved. The concentration in the northeast part of the figure and the general contrast between the east and west halves also suggest physical associations of discordant redshift values; a much larger sample will be required to properly test this possibility in the lower redshift range.

6. The Southern Deep Field

To test the findings associated with the HDF investigations we looked at an independent SDF study by Cohen et.al. (1999). Figure 22 shows the redshift distribution in the $0.3 < z < 0.6$ range. There is a striking periodicity at $c/64$ and $c/32$ aligned with predicted $T = 0$ redshift states as indicated. A phase diagram in Figure 23, constructed for the $c/32$ period, shows a strong concentration around 0.5 (odd $c/64$ states) and a weaker concentration around 0.0 ($c/32$ states). This pattern is expected for objects at or approaching the $D = 6$ ($c/64$) doubling level. The pattern is remarkably consistent with expectations. The phase distribution around 0.5 may contain a spatially dependent stepped pattern at still higher fractional intervals, as seen in the HDF data, but more accurate data are needed.

A detailed examination suggests that the z range above and below $z = 0.46$ should be separated as was done for the HDF. Above this level the $c/64$ period is very strong with a trace of $c/32$ and perhaps the 7/16 state. The smaller fractions show the largest offsets. As noted in the HDF the state adjacent to the empty $c/2$ state is strong and accurately matched. Our model suggests this is a single aggregate at a distance corresponding to $D = 6$ decay, closer than the similar HDF association in the $D = 4$ to 5 range.

The lower redshift region may represent more than one aggregate. The $c/64$ states are barely represented while the $c/32$ states are stronger. The 5/16 level is present and a leading 3/8 state is strong. The 3/8 state is the first eighth state below $c/2$, consistent with the smallest offset being strong and well fit. This may associate it with a higher doubling pattern. Figure 22 shows a possible $T = 6$ state also in the $c/8$ pattern at 5/8. The 5/8 state is empty but the state 1/64 below it is populated. The range of D involved suggests that the pattern could represent more than one structure, much as spectral lines from different multiplets overlap. The objects below the 3/8 state associate primarily with the $D = 5$ level since few occupy the $D = 6$ level. If D is associated directly with distance these objects could be more distant than the higher redshift group. Individual redshifts may have little to do with actual distance. Much more study will be required to examine such a picture, map possible structures and understand if and how D levels relate to actual distance. The SDF appears to be consistent with the HDF, showing redshift patterns consistent with large associations at various stages of doubling decay.

7. Summary and Conclusions

In this paper we have used the Lehto-Tifft redshift quantization model to predict the redshift distribution for certain classes of quasars, and for galaxies in the neighborhood of $z = 0.5$. In the Lehto-Tifft model redshift values represent specific decay states from an initial Planck scale value set by the speed of light, c. The decay is presumed to be essentially a period doubling process characterized by an index D which indicates the number of doublings which have occurred. Looking back in time (distance) should encounter earlier stages (smaller D values) for which redshift values are known. We do in fact find that the redshifts are periodic and in phase at periods of $c2^{-x}$ after correction for cosmological distortion associated with the model. The exponent x has a general form $(9D+T)/9$, with only certain T values possible, primarily 0, 6, and 1, as discussed elsewhere. Pure doubling, $T=0$, is normally dominant and at high redshift little else was expected or found.

We find that peaks in the quasar distribution at $z = 0.061$, 0.3, 0.6, 0.96, 1.41, and 1.95 correspond very closely to Lehto-Tifft predictions corresponding to 1/16, 1/4, 1/2, 3/4, 1.0, and 5/4 of c (0.064, 0.274, 0.601, 0.989, 1.441, and 1.968). These peaks appear to associate with an active stage where radio emission or other indications of activity are apparent. The doubling level associated with this stage of quasar activity is $D = 0$ to 4, with $T = 0$ dominant and perhaps some traces of $T = 1$ and 6 which are believed to be the next most likely values.

We find that galaxy redshifts in the Hubble Deep Field, and a similar field in the southern galactic hemisphere, concentrate sharply at higher fractional values of c displaced below the primary quasar peak at $z = 0.6$. Close to the $z = 0.6$ peak doublings range around $D = 4$ to 8 and increase further at lower z as expected. A fine structure at still higher fractions of c is present. The patterns of D present are consistent with doubling evolution to decreasing D values as a function of increasing lookback. A series of phase shifted $c/16$ periodicities is especially prominent around z of 0.4.

Galaxies which are periodically phased, but in different sharp redshift peaks, appear to be strongly spatially associated as both pairs and small groups. The objects in specific associations have similar D values but may distribute over a wide redshift range corresponding to periodically spaced redshifts at a given D level. The redshift pattern appears to be a 'spectrum' of related redshifts associated with individual large galaxy clouds which have evolved to different D levels. Monte Carlo evaluations of the discordant redshift patterns around $z = 0.5$ in the HDF show strong physical associations between redshift peaks which differ by 12,000 and 25,000 km/s ($c/32$ and $c/16$).

We conclude that more extended studies using precise redshifts, especially near $z = 0.5$ below the $z = 0.6$ active quasar peak, can provide critical, perhaps definitive, information relating to the nature of the redshift. This window corresponds to the region directly below the first doubling ($c/2$) where strong $T = 0$ states at low doubling levels are predicted to be prominent. Photometric redshifts are not accurate enough for such a test. Equivalent local studies require much higher resolution since doubling appears to have proceeded to $D = 16$ or beyond. Precise 21-cm redshifts or equivalent are required for most local work on quantization.

This conference is being held in honor of Fred Hoyle, a man who unhesitatingly pursued new and exciting ideas, generally well ahead of many of the scientific views of his time. I am pleased to have known such a man, and have attempted to follow his path by using this opportunity to present some new ideas here that just might help us better understand the cosmos that Fred so loved. Preprints of this paper, related future publications, and links to most previous publications by the author can be accessed on the internet at http://SASTPC.org

References

Arp, H., Bi, H.G., Chu, Y., & Zhu, X.: 1990, A&A, **239**, 33

Burbidge, E. M., & Sargent, W.: 1970, in *Nuclei of Galaxies*, ed. D. O'Connel (North Holland) p. 351

Burbidge, G: 1968, ApJ, **154**, L41

Burbidge, G: 1980, Texas Symp. Proc. Ann. New York Acad. of Sci.

Burbidge, G, & Napier, W. M.: 2001, AJ, **121**, 21

Cohen, J. G., et.al.: 1996, ApJ, **471**, L5

Cohen, J. G., et.al.: 1999, ApJS, **120**, 171

Cohen, J. G., et.al.: 2000, ApJ, **538**, 29

Guthrie, B. N. G., & Napier, W. M.: 1991, MNRAS, **253**, 533

Hawkins, E., Maddox, S. J., & Merrifield, M. R.: 2002, MNRAS (in press)

Hoyle, F., Burbidge, G., & Narlikar, J. V.,: in *A Different Approach to Cosmology* (Cambridge) p. 332

Karlsson, K. G.: 1977, A&A, **58**, 237

Napier, W. M.: in this conference

Schmidt, M., & Green, R. F.: 1983, ApJ, **269**, 352

Tifft, W. G.: 1976, ApJ, **206**, 18

Tifft, W. G.: 1996, ApJ, **468**, 491

Tifft, W. G.: 1997, ApJ, **485**, 465

Tifft, W. G. & Cocke, W. J.: 1984, ApJ, **287**, 492

Tifft, W. G. & Cocke, W. J.: 1989, ApJ, **336**, 128

Veron-Cetty, M. P. & Veron, P.: 1996, *A Catalog of Quasars and Active Galaxies* (ESO Scientific Report – electronic form)