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Quantized Redshifts – New Physics or Old Muddle?

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Abstract.
The HI redshift distribution of nearby spiral galaxies has been studied to test long-running but generally ignored claims that extragalactic redshifts are periodic or 'quantized'. The existence of the phenomenon is confirmed at an extremely high confidence level, the quantization appearing in the galactocentric frame of reference. It is proposed that the energy density of the vacuum is a local, oscillating quantity associated with large masses such as spiral galaxies. A variety of 'anomalies' should then be detectable in massive galaxies, associated with their redshifts, their ambient gravitational lensing and their dynamics.

1. Introduction

Over the past ~25 years the perceived need for 'new physics' in interpreting exotic extragalactic phenomena, long espoused by Ambartsumian, has largely receded. Although a wide variety of extragalactic redshift anomalies continues to be reported in the literature, primarily by Arp and Tifft (but also by others), these are generally ignored, or ascribed to coincidence, *post hoc* statistics or whatever. Of the 'anomalous redshift' claims, that of quantization is perhaps the least credible: thus Tifft (1976) claimed that the redshifts of galaxies in the Coma cluster are preferentially offset from each other in multiples of ~72 km/sec, Tifft & Cocke (1984) claimed that wide-profile spiral galaxies distributed over the sky have a galactocentric periodicity ~36.2 km/sec and so on.

However quantization of redshifts, while the least credible of the 'discordant' claims, is also the most testable: adequate numbers of new high-precision 21 cm data have become available since its original formulation. Thus beginning about ten years ago, the author and his colleague Dr Guthrie embarked on a programme of testing the claims (Napier et al. 1989, Guthrie & Napier 1990, 1992, 1996). To carry through this programme, we used rigorous statistical procedures and made extensive use of synthetic datasets as controls. We found that extragalactic redshifts are quantized along the claimed lines. Monte Carlo simulations yield very high formal confidence levels for the phenomenon, but here I simply present it as a straightforward observational result.

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2. The Local Supercluster Galaxies

Estimates of rotation speed V_c at the Sun's distance vary widely with, for example, Feast & Whitelock (1997) deriving $V_c = 231 \pm 15$ km/sec from Hipparcos observations of Cepheids, Merrifield (1992) obtaining 200±10 km/sec from HI kinematics, Metzger et al. finding 237±12 km/sec from Cepheid kinematics, and so on. Sackett (1997), reviewing the subject, concludes that $V_c = 210 \pm 25$ km/sec. Adjusting for the local solar motion relative to the LSR, a middle-of-the road estimate for the solar galactocentric motion is

$$\mathbf{V}_\odot = (V_\odot, l_\odot, b_\odot) = (220\,\mathrm{km/sec},\ 90^\circ,\ 0^\circ)$$

to within ±30 km/sec or so and a few degrees. The Virgo cluster is the nearest rich cluster of galaxies, which had not been used by Tifft in the formulation of the quantized redshifts hypothesis, and so is a natural choice for testing it. Fig. 1 shows the differential redshift distribution of 48 bright spiral galaxies in the Virgo cluster, in pairs, corrected for the above solar motion. A periodicity of ~71 km/sec is clearly observed (Napier & Guthrie 1997) as against ~72 km/sec expected for a dense cluster. The criteria for selecting these galaxies are discussed by Guthrie & Napier (1991); in essence all bright Virgo spirals, with precisely determined HI redshifts and avoiding the core region, were employed.

In Fig. 2 the redshift differences in pairs of 97 nearby, bright spirals within the Local Supercluster are likewise plotted, again in the galactocentric frame of reference. These were selected from the catalogue by Bottinelli et al. (1990) for their precision ($\sigma \leq 3$ km/sec), rejecting those which had been employed by Tifft and colleagues in formulating the quantization hypothesis. Once more, a periodicity is clearly seen, this time one of ~37.5 km/sec as against ~36.2 km/sec expected. Fifty galaxies in this sample of 97 belong to groups and associations, and the periodicity was found to be strongest in the differential redshifts of the 50 galaxies in these groups. To test this, a further sample of LSC spirals was taken from data obtained with the 300-foot Greenbank telescope by Tifft and Cocke over the period 1984–1988. Of 117 'new' spirals with signal to noise ratio >10, thirty belonged to catalogued groups and associations of galaxies (Fouqué et al. 1992). These showed the same quantization, adding to the strength of the periodic signal.

The redshift distribution for the combined sample of 80 galaxies is shown in Fig. 3. Clearly, the 37.5 km/sec periodicity is indeed galactocentric, within current uncertainties. The dispersion about the best-fit periodicity (period=37.5 km/sec, phase=0°) is ~8.25 km/sec, but as the data here are redshift differences taken in pairs, the intrinsic mean spread for each galaxy in the sample is $8.25/\sqrt{2} \sim 5.8$ km/sec.

A significant finding of the Guthrie/Napier study was that the strength of the 37.5 km/sec periodicity from galaxies in the real Local Supercluster is vastly in excess of that from synthetic LSCs in which only local quantization was assumed. Thus the ~37.5 km/sec periodicity appears to be global rather than confined to differential redshifts within small groups and clusters; that is, the periodicity in cluster A is locked in phase with that in cluster B even although they may be at opposite ends of the Local Supercluster.

Artefacts in data selection or reduction procedures, or in radio telescopes themselves, seem unable to account for the phenomenon. A formidable problem

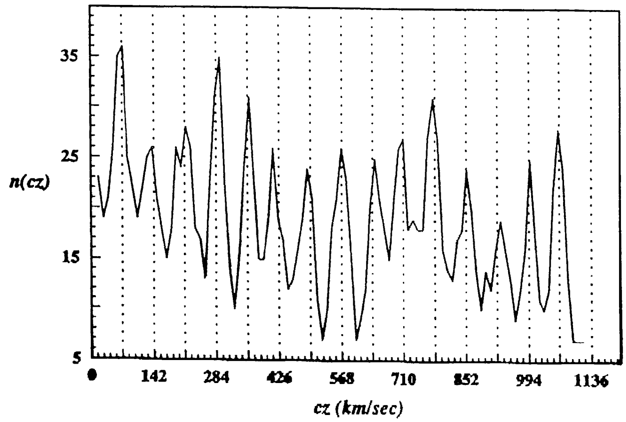

Figure 1. Differential redshifts for 48 bright Virgo spirals, in the galactocentric frame of reference, plotted in bins 11 km/sec wide.

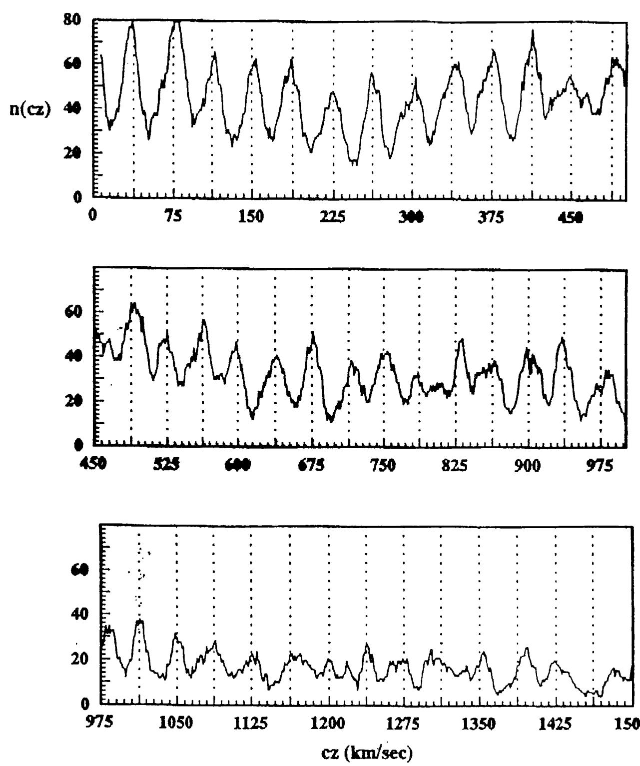

Figure 2. Differential redshifts for 97 bright spirals in the Local Supercluster, in the galactocentric frame of reference.

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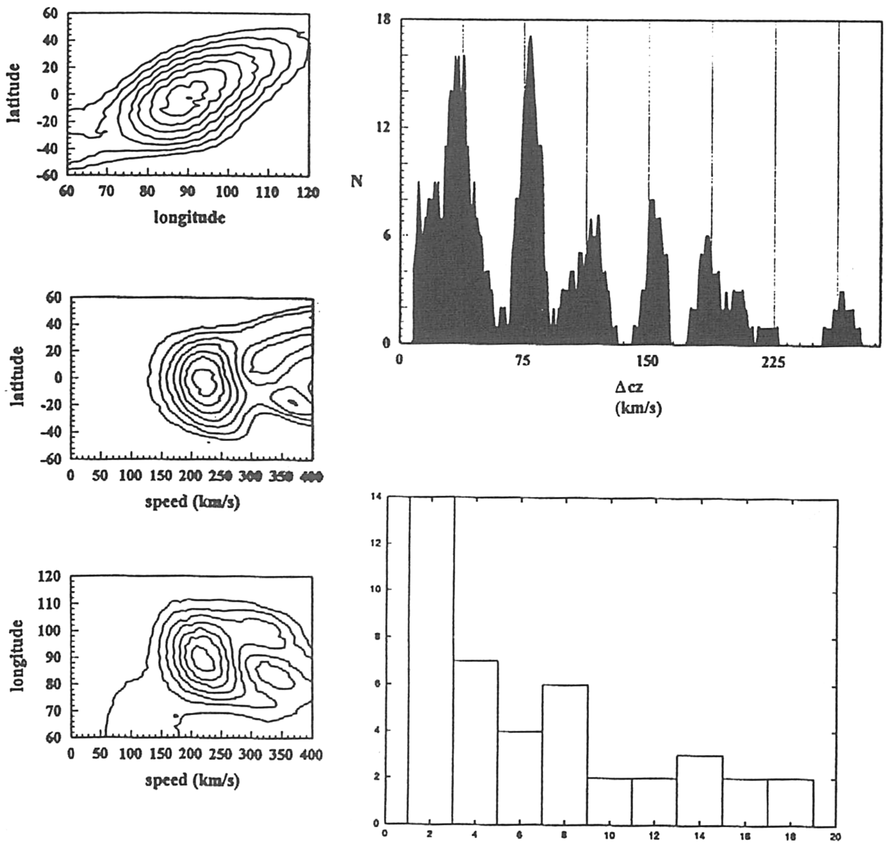

Figure 3. *Left-hand column.* Signal strength as a function of solar velocity. The signal peaks at about $V_{\odot}$ =220 km/sec, $l_{\odot} = 90°$, $b_{\odot} = 0°$. *Top right.* The peak signal (periodicity ~38 km/sec). *Bottom right.* Distribution of residuals.

for any artefact theory is the galactocentric nature of the phenomenon: somehow the bug in the software, or in the telescope, must know the solar velocity around the Galaxy, and indeed have anticipated the best estimates recently obtained from Hipparcos, Cepheid and HI data. The quantization is readily detectable in individual datasets from Jodrell Bank, Greenbank 140 and 300 foot, Effelsberg, Arecibo, Westerhout and other telescopes.

3. Discussion and conclusions

The main conclusion is that extragalactic redshifts are strongly quantized. The intensely galactocentric nature of the phenomenon suggests that any underlying 'oscillating physics' should likewise be galactocentric; this presumably applies also to other massive galaxies (*cf* Schunck 1998). At a phenomenological level,

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one might envisage that the energy density of the vacuum, rather than being constant throughout space and time, is a local, complex variable centred on large concentrations of mass. Anthropocentric observers, adopting a constant local clock rate, would then observe extragalactic clock rates varying cyclically, with corresponding oscillations in extragalactic redshifts. Even more adventurously, a locally decaying vacuum would, to such observers, yield an apparent cosmological expansion satisfying the time dilation and Tolman surface brightness tests for expansion. This cyclic relation between local and cosmological proper times might also manifest itself through anomalous 'wiggles' in $H\alpha$ rotation curves (Schunck 1998), discretized galactic dynamics (Roscoe, this volume) and discordant redshifts between adjacent objects (Arp, this volume).

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