TESTING FOR QUANTIZED REDSHIFTS. I. THE PROJECT

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Abstract. A project intended to examine the long-standing claims that extragalactic redshifts are periodic or 'quantized' was initiated some years ago at the Royal Observatory, Edinburgh. The approach taken is outlined, and the main conclusions to date are summarized. The existence of a galactocentric redshift quantization is confirmed at a high confidence level.

1. Introduction

Persistent claims have been made over the last 25 years or so that at least some extragalactic redshifts are non-cosmological in origin. Perhaps the least credible of these claims is that the redshifts of galaxies are periodic or 'quantized', tending to occur at intervals of ~72 km s\(^{-1}\) within binaries, groups and clusters (Tifft 1976, 1977, 1980; Arp & Sulentic 1985; Arp 1987), with a related global redshift periodicity of ~24 or ~36 km s\(^{-1}\) for field galaxies when a suitable correction for the solar motion is made (Tifft & Cocke 1984, hereinafter TC). The quantization claim is extraordinary, and if confirmed would have profound repercussions for cosmology. Given the perceived success of standard paradigms, a correspondingly high standard of proof would be required before the alleged periodicity could be accepted (say at the level where a cosmological model which failed to incorporate it would lack credibility). Testing for the quantization is however a 'clean', well-posed statistical problem, while new high-precision 21 cm redshifts are now available in adequate numbers for confirmation or otherwise of the
claim to be possible. A series of research programmes was therefore initiated at the Royal Observatory, Edinburgh to investigate the issue. Rigorous statistical analysis, utilising power spectrum analysis (PSA), was employed throughout: the pitfalls in the latter, and our means of avoiding them, are described in the companion paper (Paper II). Two pilot studies, involving 48 and 40 high-precision redshifts respectively, yielded positive results, and so were followed by a major analysis involving over 200 spiral galaxies in the Local Supercluster. We summarize herein the progress of this work.

2. The Virgo Cluster

We first examined the distribution of the most accurately measured HI redshifts of galaxies in the region of the nearby Virgo cluster, which had not previously been used in formulating the quantization hypothesis (Guthrie & Napier 1990). We compiled two samples of galaxies within 10° of the central galaxy M87, comprising 112 bright spirals and 77 dwarf irregulars. Their heliocentric redshifts \( c_z \) are \(<3000 \text{ km s}^{-1} \) (the upper limit for the cluster) and have stated accuracies of \( \pm 10 \text{ km s}^{-1} \) or better.

We first tested each sample for the existence of a redshift periodicity somewhere in the range 70–75 km s\(^{-1}\), in accordance with the original claim made by Tifft (1976). No significant periodicity in this range was found for either sample of heliocentric redshifts. However, when the individual redshifts were corrected for the estimated solar motion with respect to the centroid of the Local Group \([V_\odot=252 \text{ km s}^{-1} \text{ towards } (l_\odot, b_\odot)=(100^\circ, 0^\circ)]\), a possible periodicity of \(~71.3 \text{ km s}^{-1}\) emerged for the sample of 112 spirals. The periodicity appeared to be stronger for the 56 outer spirals at \(5^\circ–10^\circ\) from M87. Accordingly, a sub-sample of 48 spirals in low-density regions of the cluster was compiled from a chart of bright galaxies in the region, the criterion for low density being adjusted to maximize the periodicity signal. Taking account of the number of independent trials involved in testing the period range 70–75 km s\(^{-1}\) and the number of trials used in selecting the optimum criterion for low density, we found that the periodicity (71.1 km s\(^{-1}\)) was significant at a confidence level \(0.997 < \alpha < 0.999\).

Since the Virgo cluster covers only a small area of sky, the differential correction for the solar motion is small and the exact choice of solar vector is not critical. When the apex was varied over the whole sky, it was found that the periodicity appeared most strongly for correcting vectors \((l_\odot, b_\odot)=(98^\circ, 60^\circ)\) and \((101^\circ, -30^\circ)\); the previously adopted apex \((100^\circ, 0^\circ)\) lies on a north–south ridge encompassing these twin peaks (see figure 8 in Guthrie & Napier 1990). The significance of the peaks was assessed by comparison with 60 whole-sky maps constructed for sets of 48 synthetic, random redshifts with the same overall distribution in space and redshift as