A Review of the Cosmological Redshift Argument

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Abstract. Quasars are cosmological objects in which extreme manifestations of violent activities are currently occurring in active galactic nuclei. They have provided us with valuable insights into the large-scale structure of the universe. Quasars are objects with, in most cases, very large redshifts. While most astronomers, however, interpret these large values of quasar redshift according to the Hubble law, there exist isolated cases, as well as detailed studies, indicating that the redshifts of quasars (and even some galaxies) might contain reasonable non-cosmological components. In this paper we have reviewed some of these cases.

Sommaire. Les quasars sont des corps célestes, manifestations d'activités extrêmement violentes au cœur des noyaux actifs de galaxies. Ils nous fournissent une somme importante d'information sur l'Univers aux larges échelles. Les quasars sont des corps présentant pour la plupart un large Redshift. Bien que la majorité des astronomes interprètent les larges valeurs de Redshift des quasars selon la loi de Hubble, il existe néanmoins des cas isolés, ainsi que des études détaillées suggérant que le Redshift des quasars (ainsi que de certaines galaxies) aurait une composante d'origine non cosmologique. Dans cet article, nous passons brièvement en revue certains de ces cas.

Introduction

Doubts on the universal validity of the cosmological hypothesis (CH) are still not fully settled. The CH assumes that the redshift (z) of an extragalactic object completely originated from the expansion of the universe due to the Big Bang, according to the Hubble law,

$$v = H_o D \quad (1)$$

This relationship could be re-expressed in terms of z and the luminosity distance (D) of the source as

$$z = f(DH_o/c) \quad (2)$$

Ideally, evidence in support of the CH should demonstrate the validity of equation (2), in which independent measures of determining D are used. If the CH must have universal validity and applicability in galaxies and quasars, however, then any counter – example where equation (2) does not fit the data disproves it. Granting a leeway to the CH[10] as

$$(1 + z) = (1 + z_C)(1 + z_{NC}), \quad (3)$$

where Z_c, represents the cosmological redshifts and Z_{NC}, the non-cosmological redshifts, then a good counter-example will simply show a value of z_{NC} in equation (3) which is significantly higher than what could be attributed to random velocity Doppler shifts in galactic clusters.

Some Documented Exceptions to the CH: the Tifft Effect

A number of exceptions to the cosmological hypothesis exists, including the Tifft effect. This effect shows that there exists a correlation between the nuclear magnitudes of galaxies in clusters and their differential redshift, Δz, where the values of cΔz apparently bunch up near multiples of 72 km/s. The bunching of Δz implies a bunching of the differential luminosity distance ΔD, which suggests some form of inhomogeneity or discrete quantised structures in the space distribution of galaxies, contrary to the predictions of the CH. This effect has been observed in some galaxy and quasar samples. The Tifft effect has been shown to persist in galaxies even with cΔz values ~ 9 km/s or better[6,4]. In quasars, Burbridge[16] highlighted some observed peaks in the z distribution. Also Hewitt and Burbidge[8], using a sample of ~3000 quasars, demonstrated sharp peaks at z ≅ 0.3, 1.4 and 1.95. A perfect CH would, on the contrary, allow only a uniform distribution of z!

Can Discrepant Redshift Objects be Physically Associated?

The answer is an emphatic "No!". Yet observations seem to answer "Yes" to this question. The idea is to demonstrate that a collection of extragalactic objects with very different z values are physical neighbours, which would be very puzzling if redshifts are to be used ubiquitously as distance indicators. Any genuine proof that different values of z are found at the same D will effectively invalidate the CH. In reality, a number of such cases exist. These are:

(a) In galaxies, Arp and Sulentic[4] have found two pairs of dynamically interacting galaxies with cΔz values of 4459 km/s and 28661 km/s for the galaxies 4030-11 and 4151-46 respectively. These values are clearly too large for the pair members to be physical neighbours.

(b) In galaxy/quasar samples where the brighter galaxies are supposed to be nearby and quasars (with their larger z) are farther away, no correlation between their respective distributions are expected. Yet this has been found in several studies ranging from isolated groups[1,5,13,9] to large populations[7,1,11].

(c) Quasar-quasar associations have also shown this violation of the CH. Using some statistical tests different from equation (2), Burbidge *et al.* (1974) have found two physically related pairs of quasars with very different z values T on 155, 156 and 1548+114a, B.

Summary

The peaks and dips in quasar redshift distribution seem to be incompatible with the CH and lays the cosmological z hypothesis under suspicion and censure. This has been considered by investigators as a manifestation of the non-intrinsic nature of quasar z origin. Zou *et al*[15] (1986) have studied the possibility that the z distribution of quasars could be explained in the framework of cosmological redshift using calculated histograms of z and observational histograms of z data arising from a large sample (653) of quasars. They still found peaks in the z histograms. However, they show that selection effects in the z identification play a decisive role in the appearance of peaks and dips in z distribution.

In conclusion, therefore, we can see that there exists severe theoretical constrains on the quasar models if the CH is still acceptable. Moreover, at cosmological distances the quasars must be very luminous, yet the observed apparent superluminal motions and rapid flux variability in these objects require them to be very compact indeed. However, selection affects might help explain these anomalies.

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