ANOMALOUS REDSHIFTS
AND THE VARIABLE MASS HYPOTHESIS

JAYANT V. NARLIKAR
Inter-University Centre for Astronomy and Astrophysics
Post Bag 4
Ganeshkhind, Pune 411 007, India

Abstract. There are several observations of extragalactic objects that do not appear to be consistent with the cosmological hypothesis that their redshifts arise from the expansion of the universe. These phenomena are looked at in a spacetime framework that is wider in its scope than general relativity. This framework directly incorporates the Machian notion of inertia and is conformally invariant. The consequence of this approach is that the mass of a particle may not stay constant. Two alternative viewpoints are presented to explain how large redshifts could arise from emission of radiation by particles of low masses.

1. Introduction

The velocity distance relation first announced by Hubble (1929) set the theme for the present mainstream of cosmological models. These models have the universe expanding, i.e., its typical distance scale $S$, separating two extragalactic objects, increases with the cosmic epoch $t$. If a typical extragalactic object, say, a galaxy $G$ emitted light at epoch $t$, which is received by us today at epoch $t_0$, the object would exhibit a redshift $z$ given by

$$1 + z = \frac{S(t_0)}{S(t_1)}.$$  \hspace{2cm} (1)

Thus, if $S(t)$ has been steadily expanding, the ratio $1 + z$ will be larger, the farther back in time ($t_1$) we go into. Since this would also increase $(t_0 - t_1)$ and hence the distance $D$ of the object, we have a relation of the type.
\[ z = f(D), \]  
(2)

with \( f(D) \) increasing with \( D \). The form of \( f(D) \) is determined by the specific model chosen. For small \( D \), this relation takes the linear form

\[ z = \frac{DH}{c}, \]  
(3)

where \( H \) is the Hubble constant, and \( c \) the speed of light.

This result does appear to hold, in the form (3) for nearby galaxies and (2) for distant ones. The latter has several sources of errors and uncertainties and so we cannot as yet fix the form of \( f(D) \) with any degree of confidence. For first ranked cluster members, however, \( f(D) \) does seem to provide a good fit with modest scatter (Kristian, et al 1978).

This has generated a confidence that the rule (2) applies to all extra-galactic redshifts. This paradigm is often called the cosmological hypothesis. Nevertheless, there are, by now several claims by observers and theoreticians that there are situations where this paradigm does not apply. Redshifts of such objects are often referred to as anomalous redshifts, i.e., redshifts that don’t fit into the cosmological hypothesis. We begin with a brief review of the field (see for details Arp 1987, Narlikar 1989).

2. Examples of Anomalous Redshifts

2.1. THE REDSHIFT MAGNITUDE RELATION FOR QSOS:

Astronomers estimate distances by using apparent magnitudes. The method works provided they are looking at a class of objects which are standard candles, i.e., objects of a fixed absolute luminosity. This seems to be the case for galaxies of elliptical type that dominate a cluster, which is the reason why the relation (2) gets verified in a redshift \((z) - \text{magnitude} (m)\) diagram. For the quasi-stellar objects, however, the \((z - m)\) diagram is a typical scatter diagram. This had been first pointed by Hoyle and Burbidge (1966) three decades ago when there were only about 100 QSOs known. Today with more than 7000 QSOs plotted on the \(z - m\) diagram there is no trend discernable: certainly, there is no prima-facie correlation between \(m\) and \(z\) as predicted by the cosmological hypothesis.

2.2. QUASAR-GALAXY ASSOCIATION:

There are examples of pairs of quasars and galaxies separated by small angular deviation on the sky. Given the magnitude of the quasar we can estimate the surface density of such (or brighter) quasars on the sky. From these data we may estimate the probability of a galaxy being found within