Abstract. An attempt is presented to explain the red shift in terms of a theory based on two postulates: (1) perfect cosmological principle, and (2) postulate of the uniqueness of electromagnetic wavelength measurements.

It is assumed that the space of events is a static space, and the red shift is a consequence of the geometry of that space. In terms of the accepted postulates a theorem has been proved, according to which the luminosity distance $D$ is related to the red shift $\Delta \lambda / \lambda_0$ by

$$D = c T \frac{\Delta \lambda / \lambda_0}{1 + \Delta \lambda / \lambda_0},$$

where $c$ is the light velocity, and $T$, the Hubble constant.

It is shown that this relation is in agreement with astronomical data concerning the red shift and the distribution of galaxies. The hypothesis does not lead to the necessity of accepting any assumptions concerning the creation of matter at the origin of time or a continuous creation of matter, which have been postulated by certain other theories.

1. Introduction

The explanation of the red shift in terms of the Doppler effect taken into account leads to a formulation of the space-time metric in which the line element of space is dependent on time. Thus we obtain the following form of metric, which is usually referred to as Robertson-Walker's metric

$$ds^2 = e^2 dt^2 - R^2(t) \frac{du^2 + u^2 (d\theta^2 + \sin^2 \theta d\phi^2)}{(1 + k/4u^2)^2},$$

where $u = r/r^0$ is dimensionless distance, $k = -1, 0, 1$ is coefficient of the space curvature, and $R(t)$ is scale factor.

As a result of certain additional assumptions, the function $R(t)$ may take different forms. For instance, in the case of de Sitter's metric, we assume that $R(t) = R_0 e^{t/T}$. It is possible, however, to distinguish two particular cases, namely, a case in which the function $R(t)$ has a 'singular point', that is, $R(t) = 0$ for $t \leq t_0$, and a case in which this function is different from zero for all the values of time [2].

The first case leads to the conclusion, which is inconvenient from the point of view of physics laws, that at the moment $t = t_0$ all matter was concentrated at one point of space. The second case, on the other hand, leads to the necessity of postulating a continuous creation of matter [4]. The conceptual difficulty of a birth at the origin of time encountered in several models has thus been replaced in the second case by the
assumption of a continuous creation of matter which may be equally hard to accept [2].

Independently of the inconveniences just mentioned, the difficulty lies also in the necessity of accounting for the physical causes of the expansion of space.

Another explanation of the red shift is the 'aging' of a light ray travelling in space, as a result of which the length of the light wave increases with distance. According to such a hypothesis, in the case of two stars $S_1$ and $S_2$, the monochromatic light emitted from $S_1$ to $S_2$ and reflected back from $S_2$ would have a different frequency at $S_1$. This means, however, that the velocity of light measured locally depends on time, which fact is contradictory with the postulate of invariant velocity of light in the special theory of relativity. The adoption of this interpretation would thus render all the concepts of the theory of relativity meaningless [5].

There is also a tentative interpretation of the red shift as an effect that is not wavelike in nature and is analogous, for instance, to Compton's effect [5]. Since, however, this effect is not accompanied by dispersion, such an interpretation is not acceptable [5]. It is thus to be concluded that all the proposed interpretations of the red shift are unsatisfactory.

The task of the present paper is to show that the red shift may be explained in terms of a specific property of physical space, a property which results from two obvious postulates, namely,

1. postulate of equivalence of stationary frames of reference,
2. postulate of the uniqueness of electromagnetic wave measurements.

The first postulate is a certain interpretation of the 'perfect cosmological postulate', and the second one expresses a quite evident principle of a unique determination of electromagnetic wave length measured by a stationary observer.

As a consequence of accepting these postulates we can prove Theorem 1, according to which the change in the length of the wave coming from a distant source is caused by a change in the metric properties of space as a function of the distance from the observer. By this interpretation, the red shift is interpreted as a consequence of space geometry, and from such a point of view our concept is in a sense similar to the concept of the theory of relativity. Such an interpretation does not yield the contradictions referred to above; for distances $D \ll 10^{23}$ km it is compatible with the theory of relativity and the theory of electromagnetic wave propagation based on Maxwell equations.

2. The Red Shift

Let us consider the following formula, assumed axiomatically, which relates 'the red shift' $\Delta \lambda/\lambda_0$ with the luminosity distance $D$:

$$\Delta \lambda/\lambda_0 = \frac{kD}{1 - kD}; \quad kD < 1,$$

where $k = 1/cT$, $c =$ light velocity, and $T =$ Hubble's constant.

* The orthodox Einsteinian cosmological models do not involve unphysical creation of matter, but such models do not satisfy the 'perfect cosmological postulate' (in the widest sense of the term).