Colloques internationaux du C.N.R.S.
N° 263 - L'ÉVOLUTION DES GALAXIES ET SES IMPLICATIONS COSMOLOGIQUES

NON-COSMOLOGICAL REDSHIFTS

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L'introduction de lignes d'univers brisées dans la théorie de la gravitation de Hoyle et Narlikar permet de rendre compte de la création de matière. Cette matière qui se compose de masses inertielles plus petites se manifeste par des décalages spectraux vers le rouge anormaux. Un test basé sur les largeurs de raie est proposé afin de discriminer entre les décalages cosmologiques et les décalages gravitationnels des QSO.

In this colloquium Arp has reported several examples of anomalous redshifts. Two objects in physical proximity have different redshifts in a typical such example. Arp has argued that the higher redshift object in such a pair has the excess (anomalous) redshift and that it is the younger of the two.

It is possible to account for such a scenario within the framework of the conformal theory of gravitation given by Hoyle and Narlikar (1974) by introducing the concept of broken world lines. A world line with a beginning describes the creation of new matter. The basic idea is briefly illustrated below with the example of the Einstein deSitter model.

In this model the line element is given by

$$ds^2 = dt^2 - (3Ht/2)^{4/3}[\, dr^2 - r^2(\, d\Theta^2 + \sin^2\Theta \, d\varphi^2)] \qquad (1)$$

where H is the present value of Hubble's constant and t is the cosmic time. In the conformal theory the field equations are conformally invariant and the space-time can be described by the flat space line element

$$ds^2 = d\tau^2 - dr^2 - r^2(d\theta^2 + \sin^2\theta \, d\varphi^2). \tag{2}$$

Note that the time coordinate is now different. Both $t = 0$ and $\tau = 0$ represent the same epoch. However, in the former case it is the epoch of big bang while in the latter case it corresponds to the vanishing of particle masses. In the latter description the masses change with epoch according to the formula

$$m \alpha \tau^2 \tag{3}$$

and the redshift arises because the radiation from distant masses has longer wavelength.

Now in this framework we introduce the concept of creation of new matter. It can be shown that with suitable mathematical description of the basic inertial interaction, an electron created at a later epoch will have a smaller mass than one created at an earlier epoch. Since the redshift observed at the present epoch is inversely proportional to the mass of the radiating particle, an object composed of younger electrons will show a larger redshift than an object composed of older electrons. This is precisely the situation envisaged by Arp.

In the second part of my talk I want to describe a potential test to distinguish between the cosmological and the gravitational redshift models of QSOs. Suppose all QSOs are identical but are located at different cosmological distances corresponding to their redshifts. Then the width of any specified spectral line will vary according to the formula

$$w \alpha (1+z) \tag{4}$$

Thus a plot of the full width at half maximum intensity (FWHM) for a specified line against (1+z) should be a straight line through the origin. In the gravitational redshift model there is no such simple relation since here the line width depends on the model used.

A preliminary plot of w against (1+z) for the MgII line in the case of 18 southern sources given by Peterson et al (1976), Browne et al (1975) reveals no such trend. However, with more accurate data on line widths for many other QSOs becoming available in future there is hope that this test may be applied to a more homogeneous sample of QSOs.

REFERENCES

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DISCUSSION

H. SMITH: One potential difficulty with the line width test is the extreme dispersion in the physical properties of QSOs, as suggested by your figures. In general when one searches for correlations between physical properties of QSOs even with the good spectrophotometric data becoming available, they do not exist, presumably because of the great differences in the physical conditions from one object to the next.