Short Research Communications :

CENTRAL REDSHIFTS FROM STATIC MASSIVE SPHERES

P. K. Das and J. V. Narlikar

Tata Institute of Fundamental Research, Bombay 400 005

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Static massive spheres with isotropic pressure have been considered in general relativity by Bondi (1964). It is seen that different physical restrictions in well defined inner (core) and outer (envelope) zones of the sphere put upper limits on the values of gravitational redshift from the surface (z_s). [See table below]. For physically plausible models (e.g. the density nowhere less than three times the pressure in the core and adiabatic stability in the envelope), z_s does not exceed 0.62.

Hoyle and Fowler (1967) have suggested a cluster model of QSOs wherein the observed large redshifts are thought to be gravitational, originating in a compact source at the centre. Although theoretical models predicting arbitrarily large values of central redshift (z_c) are known (e.g. Schwarzschild's interior solution giving $z_c \rightarrow \infty$), they are not based on realistic equations of state. We have calculated values of z_c for the various models considered by Bondi. The preliminary results are tabulated below. It can be seen that the z_c values are significantly larger than the corresponding z_s values. In particular, for the model cited above, z_c=2.85.

The observed redshift of a QSO can be partly cosmological and partly gravitational. If gravitational redshifts as high as 2.85 can occur, the cosmological part(even for a redshift as high as 3.4, e.g. for the QSO identified with OH 471) need not be more than 0.14. Also, if the upper limit to the cosmological part of z is taken to be as that observed in galaxies ($z \leqslant 0.46$) the upper limit for the combined redshift should be around 4.7.

Table of z_s and z_c

(ρ= energy density, p= pressure)

Equation of State		Redshift	
Core	Envelope	z_s	z_c
$p \geqslant 0$	Thin mass shell	5.77	∞
$\rho = p$	ρ=const	1.13	10.56
$\rho = 3p$	ρ=const	0.66	2.72
$\rho = 3p$	adiabatic stability ($dp = d\rho$)	0.62	2.85

References :

Bondi, H. 1964, *Proc. Roy. Soc. London,* **A 282,** 303.

Hoyle F., and Fowler, W. A. 1967, *Nature,* **213,** 373.