On the Observational Discrimination of Friedmann-Lemaître Models

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It is the purpose of this paper to illustrate the interrelation between the problems of the "missing mass", the galactic age and the cosmological constant Λ (or its equivalent quantum vacuum density ρ_V).

The inflationary scenario of the early universe predicts that our present universe should have a very nearly Euclidean metric. If we accept this concept, one would have to discriminate between two rather extreme Euclidean cosmological models:

1) The standard model with $\Lambda = 0$ and a density $\rho_c = 3H_0^2/8\pi G$. There are difficulties if $H_0 \geqslant 50$ km/(s·Mpc) and the galactic age $t_0 \geqslant 14 \cdot 10^9$ years.

2) The Euclidean Friedmann-Lemaître models with $\Lambda > 0$, i.e. $\rho_V = \rho_c - \rho_0$ where ρ_0 is the present matter density, including the nonrelativistic dark matter. Here ρ_V "competes" with the missing mass (see ref. (1)).

We have derived the angular size $\alpha(z)$-redshift relation and the apparent magnitude m(z)-redshift relation based on Friedmann-Lemaître models with positive cosmological constant Λ. In view of the large spread of $\alpha(z)$ curves for different models with $\Lambda > 0$ and $\Lambda = 0$, the measurement of apparent diameters of galaxies up to high redshifts, say $z = 3$, will permit one to discriminate between different Friedmann-Lemaître models provided that size evolution of galaxies can be determined or neglected. On the other hand, the m(z) relations for different models are rather close to each other. We have plotted the QSO data from the Hewitt and Burbidge catalogue (1987) versus the m(z) relation. The strong evolution of intrinsic luminosities of quasars overpowers any discrimination between different models. (For a mathematical description of our models and their relations to observable quantities we refer to our forthcoming paper).

Reference: (1) Blome, H.J and Priester, W. (1985): Astrophys. Space Sci. 117, 327.

J. Audouze et al. (eds.), Large Scale Structures of the Universe, 517.