ALTERNATIVE COSMOLOGIES

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The hot big bang models with inflation (in some form or other) being the favourite amongst the cosmologists, the development of alternative models has been confined to very few workers. Nevertheless, the HST measurements of Hubble's constant, and their implications for the age of the universe, underscored the need to think beyond the standard model. Ostriker and Steinhardt (1995) for example have concluded that the present data favour a low matter density model ($\Omega_m < 1$) with a non-zero cosmological constant ($\Omega_\Lambda > 0$). The latter, however cannot exceed 0.75, if the data on gravitationally lensed sources is taken into account. A similar conclusion is drawn by Bagla et al (1996) who have also taken into consideration the constraints from structure formation, deuterium abundance,the data on high redshift objects, cluster abundance, etc. These authors find that even with the allowances made for observational errors, the window of available parameters for the conventional big bang models is uncomfortably small if not non-existent. A detailed study by Viana and Liddle (1996) has discussed implications for flat and open cosmological models using the data on cluster abundance, COBE, galaxy correlation function, etc.

Meanwhile theoreticians working on the particle physics-cosmology frontier have been looking at cosmological models based on string theory. Gasperini and Veneziano (1993) discuss possible non-singular models with a *pre- big bang* phase of accelerated evolution. Cosmological implications of dynamical supersymmetry breaking such as big bang nucleosynthesis, are discussed by Banks et al (1994). Brustein and Veneziano (1994) discuss the long standing graceful exit problem within the string cosmology. The answer is still non-definitive. The vanishing of the cosmological constant in the post-inflation era continues to occupy the astro-particle theorists.

Amongst alternative to dark matter in cosmology the idea discussed most in recent times is modified nonrelativistic dynamics (MOND). Milgrom (1994) has reviewed the status of MOND theories both from a theoretical point of view as well as observations of the flat rotation curves of spirals.

To what extent the universe has fractal dimension has been reviewed by S. Borgani (1996) who finds that the universe behaves like a self-similar structure at small scales, where fractality is generated dynamically by non-linear gravitational clustering while preserving large scale homogeneity. Souriau (1994) and his coworkers have attempted to understand structure on the scale of 100 Mpc as due to a primordial symmetry breaking giving stratification.

Evidence which cannot be explained by the conventional cosmological redshifts continues to come forth. Arp (1994), for example has analysed the ROSAT pictures to claim physical association between Cen A and NGC 5090. Burbidge (1995) has measured the redshifts of two x-ray QSOs from the ROSAT PSPC data aligned within 36 arcsec across the nucleus of NGC 4258 and finds them to be 0.398 and 0.653 respectively. Pietsch et al (1994) who had carried out the first study of the data had concluded "...If the connection of these sources with the galaxy is real they may be bipolar ejecta from the nucleus."

It is becoming increasingly difficult to ignore these associations as chance projection effects, which they have to be if the redshifts follow Hubble's law. Likewise, the earlier findings of small scale periodicities in the redshift distributions of galaxies by Tifft, reviewed by him recently (1995), appear to hold up under stringent statistical tests. For example, Napier and Guthrie (1993) have shown that a periodicity of 37.5 km/s is seen to a high level of significance in the local supercluster. These observations may pose a stiff challenge to any cosmological theory, standard or otherwise.

An alternative cosmology using the conventional redshift but without a singularity is the quasi-steady state cosmology proposed by Hoyle et al and developed in several papers (e.g.,1994 a,b, 1995). It offers an alternative interpretation of the microwave background, abundances of light nuclei and dark matter while claiming consistency with the data on ages of globular clusters, optical and radio surveys of discrete sources. This cosmology also predicts the existence of a modest fraction of low-blueshift objects.

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