COMPLETE QUASAR SAMPLES AND COMPARATIVE COSMOLOGY

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ABSTRACT. Comprehensive testing of alternative cosmologies on the basis of complete samples of discrete sources is described. Application is made to the comparison of the Friedman and chronometric cosmologies (denoted C1 and C2) using quasar samples. C2 predicts the results of analyses predicated on C1 that represent evolution in the C1 framework, but is itself nonevolutionary, nonparametric, and consistent with observation.

Statistically efficient methods of estimation of luminosity functions and related quantities, making due allowance for the observational cutoff bias, in conjunction with Monte Carlo methods, make possible rigorous objective estimates of the probabilities of the observed discrepancies between theoretical cosmological prediction and empirical measurement, assuming correctness of the theory and fairness of the sample (apart from specified cutoffs). At the same time, the statistical framework makes possible the separation of the question of the conditional distribution of magnitudes at given redshifts, which is unaffected by spectroscopic selection, from the statistically independent question of the spatial distribution, which is extremely sensitive to spectroscopic selection.

Using the BQS and other complete samples treated by Schmidt and Green (1983), parallel systematic analyses were made of C1 and C2 as the basis for equitable comparison. This involved not only direct tests of each cosmology per se, but also tests of the capacity of each cosmology for explanation of the results of analyses predicated on the alternative cosmology. Application to the BQS indicates not only the statistical acceptability of C2 but shows that the deviations from observation of the predictions of C1, representing apparent evolution in the C1 framework, are in statistical agreement with the predictions of C2 for the results of analyses predicated on C1 (Segal and Nicoll, 1986).

Simple theory shows that with suitable frequency-independent pure luminosity and number evolution (LE and NE), C1 will make statistical pre-

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dictions identical to those of C2. Nevertheless, LE does not provide as close a fit to observations as C2 when the evolution is fitted to the data in question, assuming it naturally related to the Friedman lookback time, in the cases of optical and X-ray samples studied by Marshall et al. and Maccacaro et al. Their fitted evolutions are however similar to the difference between the magnitude-redshift laws for C1 and C2. Moreover, at small redshifts (< 0.1), LE models are highly deviant from observed flux-redshift relations, which C2 fit closely; while at large redshifts (> 2.7) they predict many more quasars than are observed in faint samples , while C2 predicts that $N(2.7 < z < 4.7) = (0.1)N(< 2.7)$ consistently with observation. Significantly, quasars appear as 'standard candles' in C2, having a bias-corrected dispersion in absolute magnitude of less than $\frac{1}{2}$ mag. in the range $z > 0.1$ for the BQS, with or without other complete samples reported in loc. cit. (Segal and Nicoll, 1985), and/or samples of Marshall et al., Mitchell et al.; X-ray selected samples of Maccacaro et al. and Margon et al. inclusive of optical data but presumptively incomplete fit correspondingly.

The present comparative results are similar to those from earlier studies of complete homogeneous galaxy samples, which however are quite limited in redshift, in contrast to the cosmic range of this study. Besides its statistical effectiveness in fitting systematic observations on discrete sources, C2 provides wholly natural explanations (devoid of ancillary parameters or scenarios, such as are used in connection with C1) for a variety of anomalies within the framework of C1. Among these are the extreme absolute brightness of quasars, apparent superluminal velocities, the close connection in all but absolute magnitude of Seyfert I AGNs and quasars, the missing mass in galaxy clusters, the failure of the Hubble law in homogeneous complete samples even when allowance is made for possible local perturbations (peculiar velocities, motion of the Galaxy, the Supercluster, small-scale clustering), the isotropy of the microwave and X-ray backgrounds, the flatness of the spectrum of the XRB relative to those of major discrete sources, the absence of evidence for initial fluctuations from which galaxies originated, and looming problems in primeval nucleosynthesis. See Proc. Natl. Acad. Sci. USA **75**, 535; Ap. J. **227**, 15; A. & A. **68**, 353; A. & A. **123**, 151; A. & A. **115**, 398 and **118**, 180; Phys. Rev. **D28**, 2393; submitted and forthcoming studies; and references in the foregoing.

Summarizing regarding evolution, since (a) this is incapable of direct observational substantiation, (b) the deviations from C1 predictions represented as evolution are precisely as predicted by C2, (c) C2 is itself consistent with statistically appropriate observations, and otherwise acceptable (in terms of theoretical economy and explanatory power), I submit that the evolution hypothesis can not properly be considered a truly scientific one.

M. Schmidt and R. F. Green (1983), Ap. J. **269**, 352.
I. E. Segal and J. F. Nicoll (1985), A. & A. **144**, L23.
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