COSMOLOGICAL IMPLICATION OF THE EMISSION LINE REDSHIFT DISTRIBUTION OF QUASARS*

Y.Y.Zhou[1], Y.Gao[1], Z.G.Deng[2] and H.J.Dai[3]

[1] Centre for Astrophysics, Univ. of Science & Technology of China,Hefei, Anhui,China
[2] Dept. of Physics, Chinese Academy of Sciences, Beijing, China
[3] Dept. of Physics, Harbin Inst. of Technology, Harbin, China

The peaks and dips in the quasar redshift distribution seem to be incompatible with the cosmological principle. This lays the cosmological redshift hypothesis under suspicion and censure, and has been considered by some investigators as a manifestation of the intrinsic nature of quasar's redshift. So it is worthwhile studying whether the redshift distribution of quasars could be explained in the framework of cosmological redshift. As we know, this distribution is affected not only by the possible physical origin of redshift but also by the selection effects in the observations (Zhou, Deng, Zhou 1983). From this we have the redshift distribution function

$$f(z) = P(z)R(z),$$

where $P(z)$ is the real distribution function which depends on the evolutionary properties of quasars and the space-time structure of the Universe, and $R(z)$ is the factor caused by the selection effect in the line identification.

For the standard model of the universe with $\Lambda = 0$, we have

$$P(z) = \int_{\tilde{L}(z)}^{\infty} \frac{4\pi c^3}{H_o^3} \frac{[zq_o+(q_o-1)(-1+\sqrt{2zq_o+1})]^2}{q_o^4 (1+z)^6 (1+2zq_o)^{1/2}} n(z,L)dL ,$$

where $n(z,L)$ is Schmidt-Green function of quasar evolution and $\tilde{L}(z)$ satisfies

$$z = q_o \sqrt{\tilde{L}(z)/L_o} +(1-q_o)[-1+(1+2\sqrt{\tilde{L}(z)/L_o})^2],$$

where $L_o = 4\pi \ell c^2/H_o^2$, and ℓ is the flux corresponding the limit apparent magnitude in the observation. According to our previous paper (Zhou, Deng, Dai 1985) $R(z)$ is

$$R(z) = \sum_i R_i(z) + \sum_{i<j}\sum R_{ij}(z) + \sum_{i<j<k}\sum\sum R_{ijk}(z) + \dots ,$$

and

$$R_i(z) = \frac{N_i}{N} \frac{S[(1+z)\lambda_{oi}]}{\int P(z)S[(1+z)\lambda_{oi}]dz}$$

* Discussion on p.514

G. Swarup and V. K. Kapahi (eds.), Quasars, 497–498.

$$R_{ij}(z) = \frac{N_{ij}}{N} \frac{S[(1+z)\lambda_{oi}]S[(1+z)\lambda_{oj}]}{\int P(z)S[(1+z)\lambda_{oi}]S[(1+z)\lambda_{oj}]dz} \quad , \text{ etc.}$$

where N_i , N_{ij} , ... are the numbers of quasars identified by the ith line, the ith and jth lines, ... in the sample, respectively, and N is the total number of quasars. $S(\lambda)$ is the total normalized response function. For the αth subsample, which has the common optical measurement window $\lambda_{min}^{(\alpha)} - \lambda_{max}^{(\alpha)}$, from some observational results we assume that

$$S^{(\alpha)}(\lambda) = \begin{cases} A^{(\alpha)}(\lambda-\lambda_{min}^{(\alpha)})/250, & \lambda-\lambda_{min}^{(\alpha)} \leq 250 \text{ Å}, \\ A^{(\alpha)}, & \lambda-\lambda_{min}^{(\alpha)} > 250 \text{ Å}, \lambda_{max}^{(\alpha)} - \lambda > 250 \text{ Å} \\ A^{(\alpha)}(\lambda_{max}^{(\alpha)} - \lambda)/250, & \lambda_{max}^{(\alpha)} - \lambda \leq 250 \text{ Å} \\ 0, & \lambda < \lambda_{min}^{(\alpha)}, \lambda > \lambda_{max}^{(\alpha)} \end{cases}$$

Comparing the calculational redshift distribution histograms with the observational historgram, we come to the following conclusions.

1. The selection effect in redshift identification plays a decisive role in the appearance of peaks and dips in the redshift distribution.

2. For 349 quasars which were discovered by object prism or grating prism technique alone, the calculational distribution histograms are almost as same as the observational one. The four peaks near to z = 0.4, 1.0, 1.4, 2.0 in the distribution appear in the calculational histograms and the correlation coefficients are larger than 0.95 (Fig.1).

3. For 653 quasars which were discovered by the positional method or colour technique, most of the peaks and dips are near to those in the calculational histogram (Fig.2). If we take the limit apparent magnitude $m=20^m$, the correlation coefficients between the observational and calculational histograms are 0.92 for $q_o=0.5$ and 0.89 for $q_o=0.1$. Through χ^2-test we confirm that under the significance level $\alpha=0.001$ the calculational redshift distributions belong to the parent population determined by the observed distribution.

4. To determine q_o by means of the redshift distribution of quasars is a new tentative method, but not a sensitive one. The result for $q_o=0.5$ may better explain the observational redshift distribution than that for $q_o=0.1$. This may put some restrictions on dark matter and a more exact value of q_o will be determined in our further calculations.

REFERENCES

Schmidt, M. and Green, R.F. 1983 Ap. J. 269 352
Zhou, Y.Y., Deng, Z.G. and Zhou, Z.L. 1983 Ap. S. S. 97 63
Zhou, Y.Y., Deng, Z.G. and Dai, H.J. 1985 Ap. S. S. 112 93