OBSERVATIONAL EVIDENCES FOR THE EVOLUTION OF THE QUASAR-LUMINOSITY FUNCTION

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ABSTRACT. The results of objective-prism spectrophotometry for a sample of quasar candidates investigated in an area of approximately 100 deg^2 of sky are presented. The selection effects and the collective properties of the sample are discussed in terms of the consequences for the present understanding of the cosmological evolution of the quasar luminosity function.

1. INTRODUCTION

Visual surveys of objective-prism plates from Schmidt telescopes or grism plates from large telescopes are the most successful methods for discovering quasars. This technique has been reviewed by Smith (1978) and Cannon (1987). The properties of these samples are characterized by large numbers of quasars detected per square degree of the sky rather than by the completeness of the samples (Carswell & Smith, 1978 and Clowes, 1981).

The most recent data concerning counts of quasars selected on low dispersion spectral plates have been published by Markarian et al. (1986) showing that the Palomar Survey data (Schmidt and Green, 1983) at the bright end of the number-magnitude-relation (logN - B) for quasars are incomplete at least by a factor of two. At faint magnitudes Afanasjev et al. (1987) using multi-slit techniques at the 6m-telescope of the Academy of Sciences of the USSR found an indication for a high value of the quasar number density in the order of 500 objects up to the magnitude of $m = 23^m$ observing a small area of about 0.014 square degrees in the SA 57 field. The resulting integral number-magnitude-relation shows a moderate slope at magnitudes brighter than $m = 20^m$ and only a slight indication for a flattening thereafter. Thus, the question of the completness of moderate deep quasar surveys has considerable influences on the predictions of the quasar evolution.

The quasar sample investigated in the present paper resulted from a search of objective-prism plates from the Schmidt telescope of the Karl Schwarzschild Observatory Tautenburg at the Centralinstitute for Astrophysics.

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2. SEARCH TECHNIQUE

An area about 100 square degrees in different fields on the sky was visually investigated on low dispersion objective-prism plates of the Tautenburg Schmidt telescope (see Table 1) in order to find peculiar extragalactic objects (Afanasjev et al. 1979).

TABLE I. Details of the objective prism plates

telescope:	134 / 200 / 400 cm Schmidt
prism:	prismatic correcting lens
plate scale:	51.35 arsec mm^{-1}
field of view:	3.3 deg x 3.3 deg
dispersion:	250 Å mm^{-1} at H_γ
limiting magnitude:	$19^m.5$ in B
seeing:	1 to 3 arcsec

The detection criteria for quasars are:

I. presence of emission lines and or
II. uv-excess,

usually used in objective prism surveys. Because of the low signal-to-noise ratio of our spectra, emission lines are detectable only if the contrast against the underlying continuum is high. This indicates the presence of strong selection effects. Additionally to that, large differences in the apparent number density of quasars on different plates are strongly correlated to the plate quality due to the varying observing conditions. This means that the visual survey technique should be supplemented by a quantitative evaluation. At very low spectral resolution of objective-prism spectra, one must take complete advantage of the information stored in the plates in order to give reliable classifications of the objects and to investigate the selection properties of the sample.

3. SPECTROPHOTOMETRY OF LOW DISPERSION OBJECTIVE-PRISM PLATES

The spectrophotometry of objective-prism plates has to include the determination of the wavelength of discernible features in the spectra, the intensity distribution of the continuum and the estimation of the signal-to-noise ratio in the spectra as a function of wavelength. Lorenz et al. (1978) described a procedure to establish a wavelength scale on the plates independent of the brightness or structure of the individual objects. On the basis of this wavelength scale the automatically selected spectra are converted to intensities by a set of characteristic curves as a function of wavelength. In the final step of the primary image processing of individual objective-prism spectra the signal-to-noise ratio is estimated as a function of wavelength using the intensity distribution perpendicular to the direction of the dispersion in the spectra.

4. PROPERTIES OF THE SAMPLE

For the investigation of the selection effects we used a subsample of quasars found by means of the Ly_α emission lines in the spectra. Fig. 1 shows the observed differential quasar counts versus B-magnitudes for the 27 suspected Ly_α quasars in the sample. The presence of selection effects is strongly indicated by the turnover at m = $18^{m}.5$. The same effect is evident in the redshift distribution, which is shown in Fig. 2 for 18 of the 27 quasars that are confirmed at higher resolution.

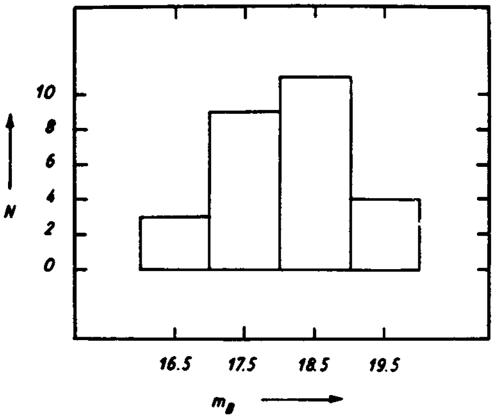

Figure 1. Number of the suspected Ly_α-quasars in the Tautenburg sample as a function of B-magnitude.

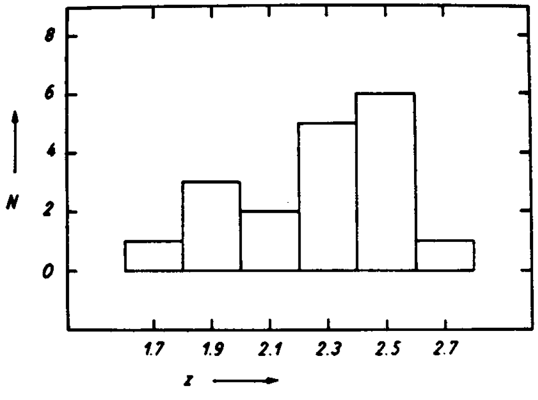

Figure 2. Redshift distribution of confirmed Ly_α-quasars in the Tautenburg sample.

Using the signal-to-noise ratio data of the objective-prism plate for a particular detected quasar and the emission-line properties measured

7. CONCLUSIONS

The strong selection biases in objective prism surveys are present even in moderate deep surveys. A detailed investigation of the luminosity function requires a careful estimation of the area sampled in the L - z plane on the basis of the selection properties of the sample.

The indicated consequences concerning the evolution of the luminosity function at large redshifts require deeper surveys for faint objects (see Afanasjev et al. 1986).

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REFERENCES

Afanasjev, V. L., Dodonov, C. N., Lorenz, H. and Terebish, V. Yu.: 1987, This conference.
Afanasjev, V. L., Karachentsev, I. D., Lipovetsky, V. A. and Lorenz, H.: 1979, Astron. Nachr., 300, 77.
Cannon, R. D.: 1987, This conference.
Carswell, R. F. and Smith, M. G.: 1978, Mon. Not. R. astr. Soc., 185, 381.
Clowes, R. G.: 1981, Mon. Not. R. astr. Soc., 197, 731.
Hazard, C. and McMahon, R.: 1985, Nature, 314, 238.
Lorenz, H., Lange, M., Richter, G. M. and Stoll, D.: 1978, Astrophysical Letters, 19, 117.
Markarian, B. E., Erastova, L. K., Lipovetsky, V. A., Stepanian, J. A. and Schapovalova, A. I.: 1986, Astrofizika, in press.
Peacock, J. A.: 1985, Mon. Not. R. astr. Soc., 217, 601.
Petrosian, V.: 1973, Astrophys. J., 183, 359.
Schmidt, M. and Green, R. F.: 1983, Astrophys. J. 269, 352.
Smith, M. G.: 1978, Vistas Astr., 22, 321.

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