

THE CTIO OBJECTIVE-PRISM SURVEY AND SIT VIDICON OBSERVATIONS OF SOUTHERN QUASARS. PATRICK S. OSMER AND MALCOLM G. SMITH. CERRO TOLOLO INTER-AMERICAN OBSERVATORY*. LA SERENA, CHILE.

Nous avons étudié des quasars de grand décalage spectral avec deux nouvelles techniques : l'utilisation de plaques obtenues avec un prisme objectif de faible dispersion pour la découverte des quasars par la détection de $L\alpha$ en émission, puis un tube vidicon SIT pour la spectrophotométrie des raies d'émission. Sur les 45 candidats observés jusqu'à présent, 24 ont des décalages spectraux compris entre 1.9 et 2.5 et 9 entre 2.5 et 3.1. Deux nouveaux quasars de magnitude 16 et de $z \sim 2.2$ ont été découverts. Nous comparons la distribution des intensités et des largeurs des raies d'émission observées avec les modèles de photoionisation. Un des principaux résultats du programme du prisme objectif sera d'améliorer la détermination de la densité spatiale des quasars de $z > 2.5$.

We describe the application of two new techniques to the study of quasars. The first makes use of low-dispersion objective-prism plates to discover high-redshift quasars (Smith 1975). The $L\alpha$ emission can be seen directly on the spectrograms. The second involves a two-dimensional SIT vidicon tube for spectrophotometry at medium resolution of the emission

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lines (Ingerson, Lasker, and Osmer, 1976). To date, we have observed 45 candidates from the Curtis Schmidt survey with the vidicon system on the 1.5 m telescope and confirmed 33 as quasars with $1.9 < z < 3.1$. 9 of the 33 have $2.5 < z < 3.1$. The objective-prism technique is capable of producing a complete sample of quasars brighter than magnitude 18 with little or no bias in the redshift distribution in the range $1.9 < z < 3.1$, unlike multicolor methods, which have been inefficient for discovering quasars with $z > 2.5$. The present rate of discovery is about 1 high redshift quasar per 5 deg^2 to magnitude $18\frac{1}{2}$.

Objects of special interest in the present sample include two new 16th magnitude quasars with $z \sim 2.2$. Q1101-264, the brightest quasar yet found in the survey, is one of the two or three most luminous quasars known. It does not have a rich spectrum of absorption lines. Q1246-057 has a strong, broad (5000 km s^{-1}) absorption system blue-shifted by 15000 km s^{-1} with respect to the emission lines and a moderately rich spectrum of narrow absorption lines.

We have made a systematic study of the emission-line spectra in high-redshift quasars from spectrophotometry with the SIT vidicon for 21 of the newly discovered quasars and 8 quasars previously identified with radio sources. The data consist of measures of the intensities, widths, and equivalent widths of $\text{L}\alpha$ and $\text{C IV } \lambda 1549$, the intensity ratios $\text{O VI } \lambda 1034/\text{L}\alpha$, $\text{NV } \lambda 1240/\text{L}\alpha$, $\text{C IV}/\text{L}\alpha$, $\text{Si IV} + \text{O IV }] \lambda 1400/\text{L}\alpha$, and $\text{He II } \lambda 1640/\text{L}\alpha$ and the continuum flux. The empirical results are (1) the objective prism technique does not produce a sample biased toward strong-lined quasars, for the newly discovered quasars have spectroscopic properties similar to those of the radio-selected quasars; (2) the luminosity in the C IV line increases in proportion with the continuum and the equivalent width is constant with luminosity; (3) the equivalent width of $\text{L}\alpha$ is lower in the more luminous objects; and (4) although the $\text{NV}/\text{L}\alpha$ ratio varies conspicuously from object to object, the spectra show no patterns which make a classification scheme possible.

Comparison of the line ratios with the photoionization models of MacAlpine (1972) shows good agreement between theory and observation for

the O VI/L α and C IV/L α values. There is no need for an under-abundance of helium according to the observed and predicted values of the He II/L α ratio. The NV line, which is intermediate in excitation and ionization between the C IV and O VI lines, is observed to be too strong by a factor of about 5, which could be interpreted as an abundance effect. However, the Si IV+O IV] feature is also too strong by a similar amount. These discrepancies plus the fact that the L α equivalent widths are consistently too low by a factor of about 5 raise questions about the suitability of the models for detailed analyses.

We believe that one of the most important uses of the objective-prism survey will be the determination of the redshift-magnitude distribution for high-redshift quasars, especially those with $z > 2.5$. Our main observational effort will be to build up the necessary complete sample to establish the space density of quasars with $z > 2.5$. The data obtained to date are inconclusive. On the one hand the preliminary estimates of the frequency of quasars with $2.5 < z < 3.1$ appear consistent with Schmidt's (1970) conclusion that the density of quasars does not increase for $z > 2.5$. On the other hand the statistics for the most luminous quasars in the present and (probably biased) sample suggest the opposite. The conflict provides strong motivation for obtaining a complete, unbiased sample from the survey.

REFERENCES

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DISCUSSION

M. ROWAN-ROBINSON: Have you looked at V/V_m for your optically selected QSOs?

P.S. OSMER: We have not calculated V/V_m for our sample and should caution that the sample is not unbiased. Our main effort at present is directed to obtaining a sufficiently large sample to be able to do statistical studies. We have, of course, looked at what the present data say about the space density of quasars with $z > 2.5$. As the text describes, the results are not yet clear.

H.E. SMITH: I'm intrigued by the high redshift QSO you have without absorption features. What is its redshift and do you have high resolution spectra that go very far below Lyman α emission?

P.S. OSMER: The redshift is 2.14. The image tube spectrogram we have does not extend very far below the Ly α emission. It at least confirms the scarcity of absorption features noted from the SIT vidicon data.