RADIO-QUIET QSOs IN THE REGION OF HERCULES CLUSTER OF GALAXIES

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Nous présentons le début d'une recherche de QSO, calmes en radio, dans la région de l'amas d'Hercule.

We have begun a search for radio-quiet QSOs in two adjacent areas of the sky, using the 4-m telescope at Kitt Peak National Observatory. We have also undertaken a program of spectrophotometric observation of the candidate QSOs. It is very desirable to update the estimate of numbers of radio-quiet QSOs, relative to radio-emitting objects, especially for samples with other optical selection criteria besides color. It is also of interest to extend the estimates to fainter optical magnitudes, and to examine the redshift distribution of these objects. This program uses a technique similar to that described by Malcolm Smith in this colloquium, but it is complementary in that we reach a fainter limiting magnitude over a more limited area of the sky.

Two areas are being searched in our program, each covering about one square degree. One area is centered on the Hercules cluster of galaxies at 1603+1754 (1950), and the second is a strip about 10 min of R.A. east of the cluster center and outside the boundaries of the supercluster containing Abell 2147 and 2151 (Hercules) and 2152. The Hercules cluster region was selected because it is known to contain many faint blue objects.

The original instrument used for the search was developed by Hoag; it consists of a combination grating and thin prism giving a dispersion of about 2400 Å mm^{-1}, placed at the prime focus of the 4-m telescope. Kodak IIIa-J plates were used, giving a coverage of λλ3100-5200 Å and reaching, in good seeing, a limit of B = 20 to 21. A new system has now been developed by Hoag, using Kodak 127-04 plates and giving a dispersion of about 1500 Å mm^{-1} over λλ3100-7100 Å, to a limit of about B = 19.5 to 20. The strongest emission line visible in spectra of QSOs is Lyα, and in this search it should appear in the range $1.7 < z < 3.3$ on the IIIa-J plates and to considerably greater than $z = 4$ on the 127-04 plates.

We have found 16 candidate QSOs with $1.7 < z < 3.3$ in the Hercules cluster field and 11 candidates $2.0 < z < 2.7$ in the comparison field off the

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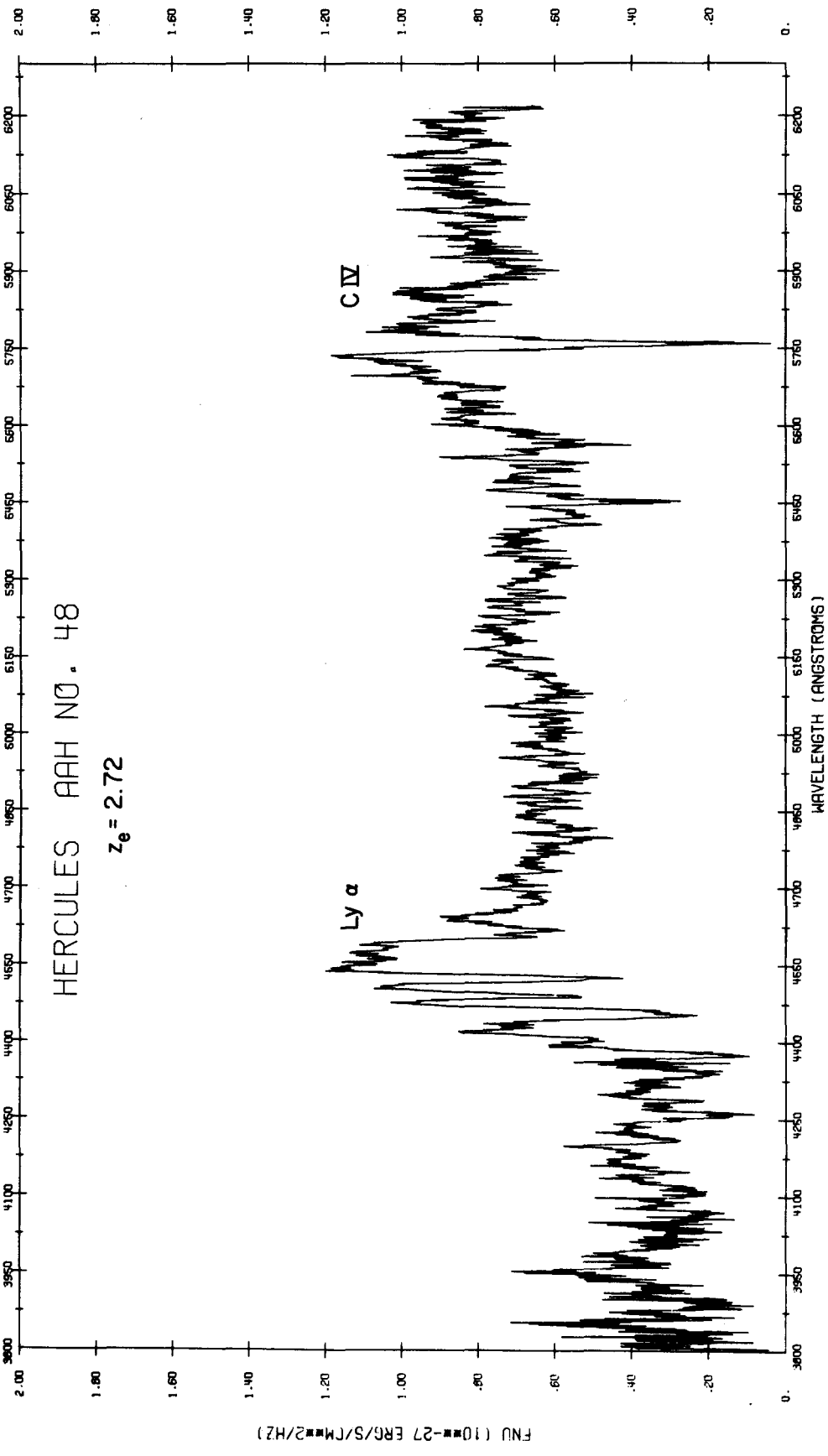

Figure 1: The spectrum of Hercules AAH No. 48 obtained with the Lick Observatory IDS on the 3-m telescope.

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cluster. Spectroscopic observations of these candidates have been made at Lick Observatory using the Wampler-Robinson image-dissector scanner (IDS) on the 3-m telescope and at Kitt Peak National Observatory using the 4-m Ritchey-Chrétien spectrograph. So far 8 of the sixteen cluster candidates have been confirmed as QSOs. One of these (AAH No. 14, z = 1.77) is probably associated with the radio source 1603+17W5 detected at 21 cm by Jaffe and Perola (1975) in their survey of rich clusters.

Since our sample extends to a fainter magnitude limit and is heavily weighted toward strong emission-line QSOs at high redshift, it is difficult to compare our results with the familiar number density, 1-3 per square degree brighter than B = 19.7, from Sandage and Luyten (1967). However, if proper correction is made for our incompleteness at low z and we note that the QSOs in our sample are not in general blue, then it is probable that the density of QSOs on the sky inferred from our sample will be significantly in excess of previous estimates.

Of the confirmed QSOs in the cluster field, two objects for which we have IDS observations have particularly interesting spectra, showing very strong and deep absorption features. A moderate resolution scan of Hercules AAH No. 48 is shown in Figure 1. The strong absorption lines seen in Lyα and C IV λ1549 were apparent at lower resolution and have broken up into narrower, deeper features at higher resolution. These lines, and those in AAH No. 2, are among the strongest we know in any high-redshift QSOs. We also obtained observations of the stellar object in the emission knots associated with IC 1182. Stockton (1972) noted this object as having a continuous spectrum, however our results (confirmed by Tarenghi, private communication) show it to be a galactic star.

This observational program is continuing and we plan to search these areas carefully for all candidate QSOs, and to obtain spectroscopic observations with the best possible resolution. The absorption-line objects will be studied in detail. It is probable that they will show multiple redshifts, as is common in high-redshift QSOs.

REFERENCES

Jaffe, W. J. and Perola, G. C.: 1975, Astron. & Astrophys. Suppl. 21, 137.

Sandage, A. and Luyten, W. J.: 1967, Ap. J. 148, 767.

Stockton, A. N.: 1972, Ap. J. 173, 247.

DISCUSSION

V. RUBIN: Do you see absorption in the QSO spectra at the velocity of the Hercules cluster?

M. BURBIDGE: No. One would only expect to see Ca II and K and the D lines since the cluster redshift is not large. We have not yet studied the absorption lines in detail nor made sufficiently accurate wavelength measurements to attempt identifications.

J.E. GUNN: How do the numbers of QSOs you find at these faint magnitudes compare with Schmidt's predictions?

M. BURBIDGE: I do not know. We have not attempted to carry out this analysis until the survey data are more complete.

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