A SURVEY OF ULTRAVIOLET-EXCESS QUASAR CANDIDATES IN A LARGE FIELD AROUND NGC 450

Paper n° 4

J.P. Swings(1), H. Arp(2), J. Surdej*(1), A. Henry(1) and E. Gosset(1)

(1) Institut d'Astrophysique, Université de Liège;

(2) Mount Wilson and Las Campanas Observatories, Carnegie Institution of Washington.

* Chercheur Qualifié au Fonds National de la Recherche Scientifique (Belgium).

Abstract : Preliminary results of a search for QSO candidates in a 25 square degree field around NGC 450 are presented.

In order to further investigate the distribution, space density, and luminosity of quasars near to as well as far from bright galaxies, a large field area (≃ 25 deg.^{2}) centered around NGC 450 was searched for ultraviolet excess objects. On the basis of a single U/B dual image photographic plate obtained with the Palomar 48-inch Schmidt telescope, a homogeneous sample of 96 QSO candidates was selected; 57 were subsequently observed spectroscopically with the following instruments :

- Palomar 5-m Hale telescope with the photon counting or 2D double spectrographs;
- E.S.O. 3.6-m telescope with an image dissector scanner;
- Las Campanas 2.2-m Irénée Dupont telescope with a "Shectograph".

The 57 candidates included 6 fairly bright and very blue objects : 1 turned out to be a QSO, the other 5 being stars.Of the remaining 51, 37 are quasars, 2 are possible quasars, 10 are stars, 1 is probably a star, and 1 is a galaxy.

In addition to the 96 first choice candidates, there exists a set of about 200 ultraviolet excess objects that need confirmation on the basis of a second U/B exposure. A statistical analysis of the quasar candidates (cluster analysis, proximity, location on plate, etc...) is presently in progress.

Figure 1 plots the number of quasars in the field centered around NGC 450 and in three adjacent fields versus their continuum level at ≃ 5000 Å, as seen on spectrophotometric scans : the "limiting V(5000 Å) magnitude" is thus found to be around 19.75. No UBV photometry has been performed yet, because of bad weather conditions on La Silla in September 1982.

"Quasars and Gravitational Lenses"; 24th Liège Astrophysical Colloquium, Institut d'Astrophysique, June 1983.

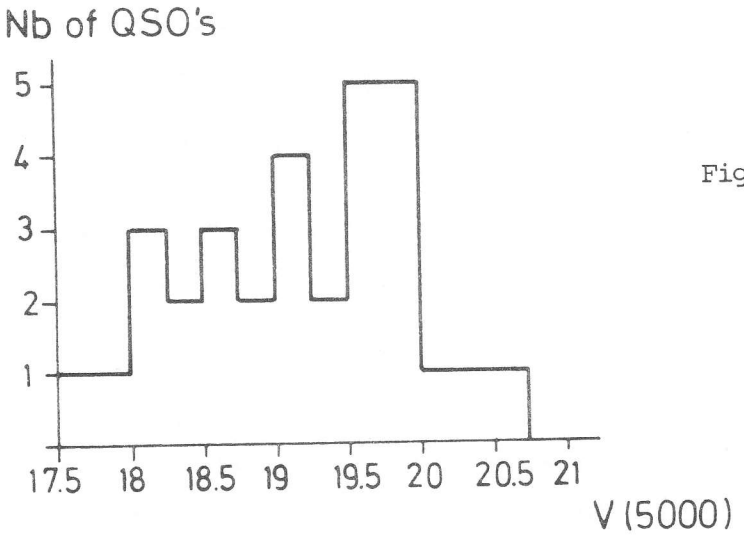

Figure 1 : Limiting magnitude estimate for the available Palomar Schmidt dual exposures (bins of 0.25 mag.)

Figure 2 illustrates for the 96 first choice candidates in the 25 deg.^{2} field, the location of the confirmed quasars, of the stars, and of the remaining spectroscopically unobserved candidates. Two groups are worth briefly describing :

a) the trio of quasars near the S. limit of the plate have the following redshifts : 1.448, 2.104 and 1.169, the latter two objects being separated by only 27 arcsec (the position accuracy is of order 1 arcsec on the digitized blink comparator used for the measurements). A spectroscopic study at higher resolution is planned at the M.M.T. for these two objects in collaboration with P. Shaver and G. Robertson,

b) the quintet near the W. edge contains the very interesting pair of quasars Q 0107-025 AB (z=0.96) to which a contribution is devoted (Surdej et al, 1983, these proceedings).

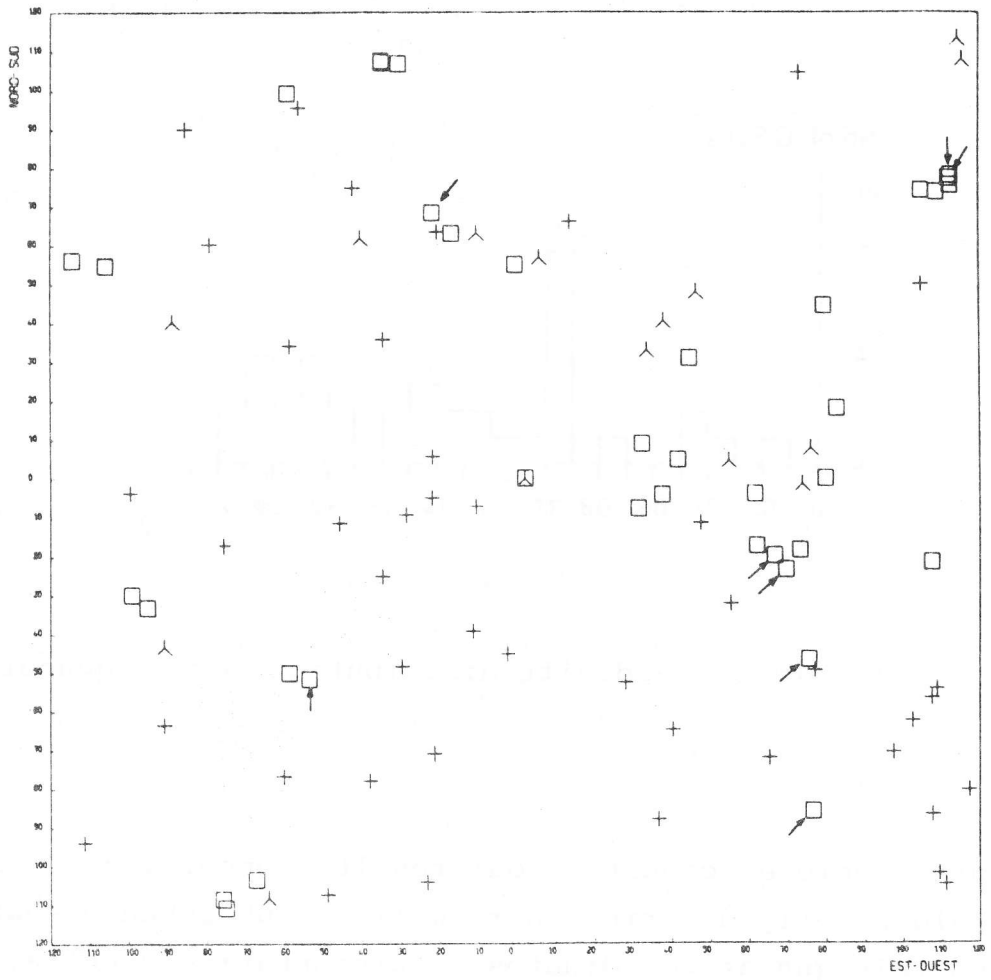

Figure 2 : Distribution of quasars (squares), stars, and spectroscopically unobserved candidates (+). Arrows indicate quasars with $0.9 \leq z \leq 1.0$. Field is 5 x 5 degrees.

Figure 3 shows the redshift distribution of the 38 quasars in the field of fig.2 : a marked concentration of values of z exists between 0.9 and 1.0, and is seen for 8 objects out of 38 (probability of chance coincidence $\simeq 3 \times 10^{-4}$). The corresponding objects are indicated with an arrow in fig.2. Similar results do appear in the surrounding fields as well. The question of evolution and of quasar formation at a cosmic time of $0.9 \leq z \leq 1.0$ in this particular direction in the sky will be worth examining in more detail.

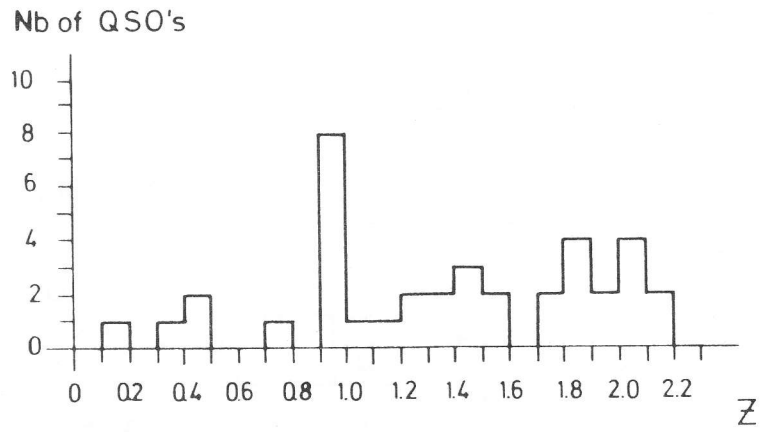

Figure 3 : Redshift distribution for 38 quasars.

A more complete account of our results concerning the survey of the field briefly described here will be published elsewhere : it will contain quasar coordinates, representative spectra, line identifications, data on line strengths, redshifts, etc...
It should be mentioned here that fields around NGC 5334, NGC 520, PKS 0054-0006, and in the α=3hr., δ=-40° area are also being examined by the same authors.

Part of this research was supported by NATO grant n° 111/81.

DISCUSSION (PAPERS 2-4)

T. SHANKS - How did you select the candidates around NGC450 for spectroscopic observation ?

J.P. SWINGS - We first selected the candidates located in groups; then, among the randomly distributed ones, we chose the brightest objects and / or those having the strongest UV excess.

R. WEYMANN - Do you feel that use of continuum magnitudes derived from objective prism data (especially with IIIa-F plates) provide as much information as V-R pairs of direct plates ?

R.G. CLOWES - Continuum magnitudes are sensible because of the specification of the selection effects. The errors seem to be quite small - see Clowes and Savage 1983. COSMOS can be used in another mode to provide V,R magnitudes if required.

D. WALSH - In the early stages of selecting QSOs from objective prism plates, the effect of seeing was thought to be an important factor. Does your technique overcome this ?

R.G. CLOWES - The seeing is a parameter that is included in the translation of the selection criteria into the physical selection effects. It is certainly an important factor and only plates with excellent seeing are worth processing. Everything can be quantified.

H. ARP - Some of the unobserved candidates in the field you showed are fainter than 20 mag. If you made a cut off brighter than 20 most of the candidates in the field would have been observed.

B. MARGON - One of the exciting implications of the log N/log S curve that you display is that if this curve does not flatten at B=21, then faint QSOs cannot be X-ray sources similar to brighter ones, as the observed intensity of the diffuse X-ray background would be exceeded. The log N/log S curve is a quite elegant and model-independent proof of this.

D. KOO - How does your totally "quantitative" method eliminate stars, especially M dwarfs ?

R.G. CLOWES - The ADQ samples inevitably contain unwanted "junk" - exactly aligned overlaps, for example. There is no bias introduced by visually rejecting certain "junk". Other objects either remain or are omitted according to new selection limits.

H. MARSHALL - Measurements of the surface density of confirmed UV excess quasars in the 13h. +36° faint Braccesi region give 20±3 per sq. deg. with B < 19.8. Extrapolating the steep N(< B) relation gives about 30 per sq. deg. at B=20. This result is consistent with those results of Hawkins but not Swings.

J.W. SULENTIC - J. Lorre + myself have studied the problem of automated quasar detection on CTIO grism plates. We conclude that crowding of images is an almost insurmountable problem requiring visual clarification. Thus derived QSO densities will be difficult to compare from plate to plate especially when the fields are at different galactic latitudes.
Question : Have any comparisons been made between visual and automated surveys of the same plate ?

R.G. CLOWES - Overlapped spectra are lost, presumably at random. The use of second prism plates with the dispersion rotated by 90° minimises such losses. The effect is not serious at high galactic latitudes and can be easily estimated from the image density. Comparisons have been made in the SGP field. AQD finds ∿ 50-100 % more plausible quasar candidates than the visual search.

P.S. OSMER - The crowding problem is worse on grism plates than objective prism plates because of the zero order images in the former.

D.L. JAUNCEY - When using N(M) statistics please use differential counts, particularly when looking for any changes in N(M) with flux density, as the use of integral counts is statistically incorrect.

P.S. OSMER - How many of your candidate quasars have been confirmed by follow up spectroscopy ?

R.G. CLOWES - None yet. An application for AAT time is presently in the allocation system. However many of the new candidates are quite bright and strong-lined, and include a BAL quasar. This fact illustrates my point that the visual searches are not really worth the effort.

D. WILLS - Since you require your candidates to vary by more than 0.3 mag, what effect does this have on your number-magnitude counts ? That is, at which epoch(s) does the object have to be < 21 mag ?

M. HAWKINS - The magnitude at minimum is used. This prevents an artificial turnover in the counts near the sample limit.

H. ARP - In discussing densities per sq. deg. to a limiting magnitude one must distinguish between broad band and continuum magnitudes. The latter are about 1/2 mag. fainter at 20th mag. The survey Swings discussed used continuum magnitudes.

H. MARSHALL - We use broad-band photometric blue magnitudes. No correction for lines is included. The photometric system was calibrated with CCD observations.