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THE LIEGE GRISM SEARCH FOR QUASARS

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ABSTRACT We report on an on-going grism survey in which nine fields, one degree in diameter, have been searched for quasar-candidates. The selection techniques, the different calibrations, as well as the spectroscopic follow-up are briefly described.

INTRODUCTION

Several years ago, we undertook a grism survey for quasars in several small fields. This survey was initially intended to give further evidence for or against the location of quasars in superclusters, in the vicinity of irregular galaxies or near the companions thereof. It was also intended to complement an older ultraviolet excess survey taking place in larger fields (see the status report of Swings *et al.* 1988).

As time was going by, quasar surveys turned out to be of high value and to contain a large amount of crucial information relevant to observational cosmology. It also became clear that a complete survey, whatever the precise meaning of it is, is extremely difficult to perform. We now believe that the necessary path is through the use of several independent selection techniques. The paper reporting on an objective-prism quasar survey in one of our fields (see Gosset *et al.* 1990) is to be considered as such an example.

In the following, we briefly report on the present status of the survey of ours that deals with the grism selection technique.

OBSERVATIONS

Baked IIIaJ plates were exposed at the prime focus of the ESO 3.6m telescope equipped with a triplet corrector adapter and a Hoag type grism. The resulting dispersion in the utilized first order was roughly 1500 Å mm^{-1} , and exposure times were fixed to 20 min. and/or 1 hour. Nine fields (about one degree in diameter, with some vignetting at the western part of the plate) have been covered. The grism fields are situated in regions already investigated by other types of surveys. In particular, we selected

- a field centered on the galaxy NGC450 (U/B excess survey, see the status report by Swings *et al.* 1988);

- a field centered on the galaxy NGC520 (U/B excess survey, as above but also covered by an objective-prism survey, see Gosset *et al.* 1990);

- five fields in selected area ESO no.300 (3^h –40°, U/B excess survey, see Swings *et al.* 1988);

- two fields in selected area ESO no.345 (22^h –40°, one is included in the CTIO 4m survey; see Hoag and Smith 1977 and Osmer 1980).

The plates have been visually scanned several times in a manner as homogeneous as possible in order to search for quasar-candidates; we used an XY machine built for the purpose in Liège.

RESULTS

More than four hundred quasar-candidates have been detected and classified in three groups: the primary candidates represent 35 % of all the candidates and are characterized by the clear presence of, at least, one emission line in their grism spectrum; most of them are certainly quasars. The secondary candidates are 24 % of all the candidates and exhibit a well-marked ultraviolet excess. Finally, the tertiary candidates (41 %) are possible quasars not entering in the two other classes.

The position of each object has been measured on ESO and Palomar Schmidt plates using the ESO Optronix machine. These measurements have been converted to equatorial coordinates thanks to astrometric standards. The precision of the fit is better than one arcsecond in both directions.

Photometry in areas of the different fields has been performed in the U, B, V bands with the Las Campanas 2.5m and ESO 1m telescopes. CCD frames have also been obtained at the Danish 1.5m telescope on La Silla. Therefore, photometric sequences are available in all the fields except the two at 22^h, –40° which have been used as check fields. We considered the comparison with the CTIO survey as a fruitful step. Virtually all the known quasars present in any of the fields have been rediscovered by the present survey. The candidates have been calibrated in magnitude by scanning ESO and/or Palomar survey plates with a conventional microdensitometer.

SPECTROSCOPY

Among the candidates, some 10 to 15 objects were already known as quasars and had a well-determined redshift. They can thus be used in order to calibrate in wavelength the slitless spectra thanks to the presence for each object of a zero order which fixes the wavelength origin in a precise way (by opposition to objective-prism plates, for example). Each slitless spectrum has been scanned with the Liège Grant machine and then calibrated in wavelength. This can be

used to tentatively identify and measure the redshift of the objects (at least, for most of the primary candidates).

A few candidates have already been observed in low resolution spectroscopy. This has been done with the multi-object Optopus system attached to the ESO 3.6m telescope on La Silla. As a very first result, more than 60 newly discovered quasars have been spectroscopically identified. For each of them, we determined the lines and measured the redshifts as well as the equivalent widths.

MORPHOLOGICAL STUDIES AND ENVIRONMENT

Each quasar-candidate has been visually inspected on the grism plates and also on the ESO or Palomar Schmidt survey plates (B and R bands). This additional work has resulted in associating to each object a comment on its morphology (nebulous or not, symmetrical or not, etc...) and on the direct surroundings of the object (isolated, clustered, accompanied by nebula(e), etc...). This information is of high interest, particularly in the framework of a search for new candidates of gravitational lensing effects. It should be pointed out that only a very small fraction of the objects look isolated; most of the candidates have indeed several faint or very faint "companions" (diffuse or not).

THE TWO-DIMENSIONAL DISTRIBUTION OF THE CANDIDATES

The two-dimensional (on the celestial sphere) distribution of the candidates has been investigated for each of the five fields in the ESO selected area no.300. We used the Correlation Function Analysis method. We calculated the autocorrelation of the candidates correcting for the edge effects by computing the exact measure of the domain actually explored when making counts in the annulus centered on each object (see Gosset *et al.* 1988). In order to realize the null-hypothesis of a uniform distribution, we also simulated uniform random populations and computed the mean cross-correlation function between the observed and the synthetic populations. The results for the union of the five fields are given in the accompanying figure 1. Clearly, the observed function is in good agreement with the null-hypothesis except for a tendency to exhibit a clustering for scales up to $0\overset{\circ}{.}05$. This deviation is present in three fields, whereas in the two others an opposite tendency appears. It should also be noted that the deviation disappears when the five fields are piled-up on top of each other. Beyond an angular distance of $0\overset{\circ}{.}03$, the edge effect correction is no longer working properly.

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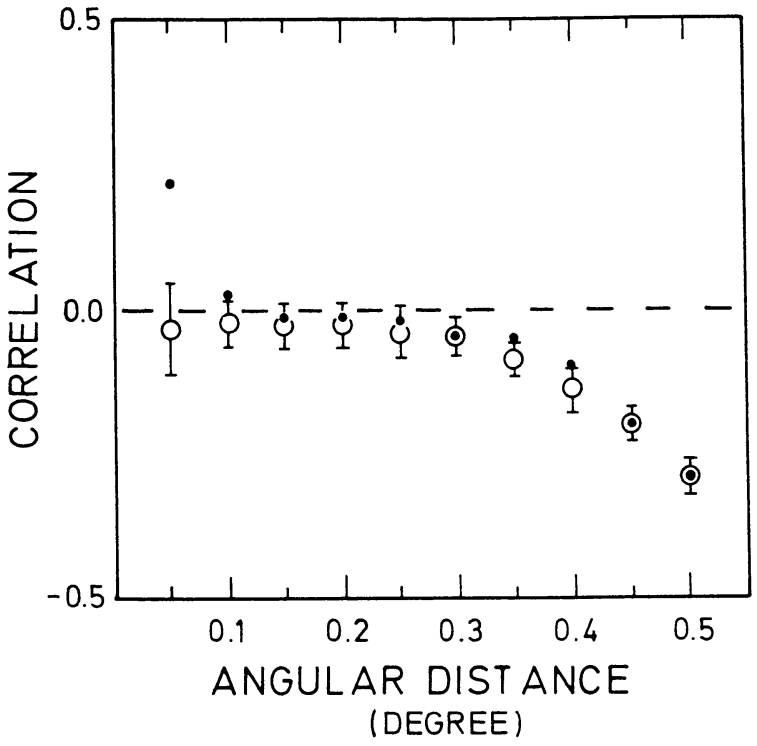

Fig. 1. Observed autocorrelation for the union of the five fields (dots) and expected values with their corresponding standard deviations under the null-hypothesis of uniformity (open circles and associated one sigma error bars)

REFERENCES

Gosset, E., Surdej, J., Swings, J.-P. 1988, in *Proceedings of a Workshop on Optical Surveys for Quasars* , ed. P. S. Osmer, A. C. Porter, R. F. Green and C. B. Foltz, Astron. Soc. Pacific Conference Series 2, p. 281.

Gosset, E., Clowes, R. G., Surdej, J., Swings, J.-P. 1990, *M.N.R.A.S.*, **245**, 71.

Hoag, A. A., Smith, M. G. 1977, *Ap. J.*, **217**, 362.

Osmer, P. S. 1980, *Ap. J. Suppl.*, **42**, 523.

Swings, J.-P., Surdej, J., Gosset, E. 1988, in *Proceedings of a Workshop on Optical Surveys for Quasars* , ed. P. S. Osmer, A. C. Porter, R. F. Green and C. B. Foltz, Astron. Soc. Pacific Conference Series 2, p. 61.