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SPECTROSCOPICALLY CONFIRMED QSOs IN A 1.5 DEG^2 AREA NEAR THE SOUTH GALACTIC POLE

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RESUMEN. Se comunican los resultados preliminares de nuevas observaciones espectroscópicas de candidatos a cuasares (QSOs) en una región de 1,5 grados^2, provenientes de dos búsquedas independientes, una basada en un criterio espectroscópico (Clowes y Savage, 1983-CS) y la otra en un criterio de color (Campusano y Torres, 1983-CT), además de una tercera que empleó placas tomadas con grisma. Estas observaciones espectroscópicas que complementan las ya conocidas, hicieron posible seleccionar todos los QSOs en las muestras de CS y CT. La muestra del grisma reveló la casi totalidad de los QSOs de CS y CT, y la espectroscopía de parte de esta muestra aportó varios QSOs adicionales.

El número total de QSOs con B$\lesssim$19 mag que se confirmaron asciende a ocho. Tres provienen sólo de la muestra CS, dos sólo de la muestra CT, uno pertenece a ambas muestras, y los dos QSOs restantes provienen de la muestra del grisma. La densidad superficial que se infiere para nuestra muestra combinada con B$\lesssim$19 mag es de 5,3 grados^{-2}. Por otro lado, si se considera que 8 es el número total de QSOs en el área, las muestras CS y CT contendrían el 50% y 37% de los QSOs respectivamente.

ABSTRACT. We report on spectroscopic observations of QSO candidates in the 1.5 deg^2 region centered at (00h 53m, -28°03'). The candidates come from Clowes and Savage (CS sample), Campusano and Torres (CT sample) and a grism sample by ourselves. These observations which complement the spectroscopic data of CS, permitted the identification of all the QSOs in the CS and CT samples in the 1.5 deg^2. The grism sample contributed with several additional QSOs. The total number of confirmed QSOs with B$\lesssim$19 mag was eight. Three of them came from the CS sample alone, two from CT alone, one belonged to both samples, and the two remaining ones came from the grism sample. The implied surface density of QSOs is 5.3 deg^{-2}. On the other hand, if the presently known number of QSOs is taken as the total number, we get that the CS sample and the CT sample contain 50% and 37% of them respectively. Finally, it is stressed that coordinated spectroscopic and photometric observations of the many QSO candidates in this area could supply a reasonably complete sample of QSOs.

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I. INTRODUCTION

The detection of QSOs has experienced rapid progress in recent years (see the review by Smith 1983). Possibly the most important one is the arrival of machine-based selection techniques, which should provide the reasonably complete samples necessary to study the luminosity function and evolutionary history of QSOs.

Carefully assembled samples of QSOs which are already available or in preparation might be important benchmarks for the coming machine-surveys if they have combined different selection techniques and if the QSOs have been confirmed by slit spectroscopy. It has been repeteadly stressed that in order to achieve these conditions, it is desirable to concentrate the international survey effort into selected regions of the sky. We argue that one such region should be the one centered at α=00h 53m (1950) δ=-28°03', located in the vicinity of the South Galactic Pole (SGP) (see Campusano and Torres, 1984).

In this contribution we determine the presently known number of spectroscopically confirmed QSOs in a 1.5 deg^2 region centered at the already mentioned coordinates. This region is inside a larger one that have been surveyed independently by spectroscopic and color criteria, and we have also used a number of QSO candidates coming from a grism search we have conducted in the 1.5 deg^2 area. The spectroscopic confirmation of the candidates was taken from the literature when available, otherwise we have done the spectroscopic observations with the 2.5m telescope of Las Campanas Observatory (LCO) or the 4m telescope of Cerro Tololo Inter-American Observatory (CTIO).

Full details of this investigation will be elsewhere.

II. QSOs IN THE 1.5 DEG^2 REGION

A 44 deg^2 area centered at α=00h 53m δ=-28°03' which contains the SGP, has been selected by several workers for visual (Clowes and Savage, 1983 - CS sample; Campusano and Torres, 1983a - CT sample) and automated searchs of QSOs. The visual searchs have been done using different selection techniques (CS - spectroscopic criteria using objective prism; CT - color criteria searching UVX objects), and many of their objects have redshift information derived either from prism plates or slit spectroscopy. On the other hand, among the automated searchs, there is one of UVX objects (Shanks et al., 1983) and others under way which include spectroscopic, color, and variability criteria (Clowes, private communication).

We have analyzed the information available to us corresponding to the QSO - candidates in the central 1.5 deg^2 of the just mentioned region, to identify the presently known QSOs and to compare the relative contribution of the CS and CT samples. In addition to these samples, we have considered a visual search of CTIO 4m grism plates (see Campusano and Torres, 1984) and the high-redshift quasi-stellar-object DHM 0054-284 discovered by a color technique (Shanks, Fong and Boyle, 1983).

For our statistics we accept only QSO's conformed through slit spectroscopy. Several of the CS objects in the 1.5 deg^2 area have been observed at low resolution with the AAT, while the rest were observed, always at low resolution, by Campusano and Zamorano in LCO. With respect to the CT objects in the region, Campusano and Zamorano also completed spectroscopic observations for all of them at LCO. Finally, concerning the grism objects, a few of them-which did not coincide with the CS or CT sample - were observed at low resolution with the CTIO 4m telescope.

III. THE IMPLIED SURFACE DENSITIES

For the comparison between the CS, CT and grism sample in the defined areas we considered first the objects with B$\lesssim$19. Four QSOs came from the CS sample, three from the CT sample, while the grism sample not only revealed most of the CS and CT QSOs, but added two additional ones. Taking into account that there is only one QSO in common between the CS and CT samples, this information implies that the number of presently known QSO to B$\sim$19 mag, is eight, corresponding to a surface density of 5.3 deg^{-2}. This value compares well

with the density of UV excess QSO with B$\lesssim$19.20 given by Marshall et al. (1983) for the Braccesi et al. (1980) faint sample, 5.8 $\pm$ 1.8 deg^{-2}, which is assumed to be reasonably complete. We will not estimate the completeness of our derived sample of QSOs to B$\lesssim$19 mag, but it is interesting to note this rough agreement between data coming from the vicinity of the two galactic poles.

If we consider the presently known number of QSOs (8) for B$\lesssim$19 in the small SGP area to be representative of the total number, we get that the CS sample contained one-half of the QSOs, while the CT sample included 37% of them; taking the CS and CT together we get a sample that contains 75% of the assumed total. These percentages represent, of course, upper limits for the completeness of the samples discussed.

A second step in the comparison of the CS, CT and grism samples was performed extending the magnitude limit to B$\lesssim$19.9 mag. Although we know that the incompleteness of the CT sample is extremely high at this magnitude range and ignore the completeness of the other two samples, we obtained an interesting estimate. Remembering that only a fraction of the grism QSO candidates have been observed to B$\lesssim$19.9 mag, we obtained 5 additional QSOs from the CS sample, 1 QSO from the CT sample and 3 QSOs from the grism sample. Therefore, including DHM 054-284 with z=3.61, we got a total of 18 known QSOs in the small SGP region to B$\lesssim$19.9 mag - 50% of them being included in the combined CS and CT sample - corresponding to a surface density of 12 deg^{-2}. One point of reference that can be employed for comparison with this surface density is the expected number of UVX - QSOs at B$\lesssim$19.9 (Véron & Véron, 1982), which is 22 deg^{-2}. It is not surprising to conclude that possibly there is a large incompleteness in our derived sample to B$\lesssim$19.9.

Finally, in addition to the preliminary estimates of the QSO surface density in the area under study, we briefly considered their distribution. Dividing the region in two equal sub-areas, we obtained for our derived sample with B$\lesssim$19, surface densities of 3 and 8 deg^{-2}; and for the other, very incomplete sample with B$\lesssim$19.9, we got values of 9 and 15 deg^{-2} in the same sub-areas. The physical significance of this apparent non-uniformity should be clarified in the future.

IV. CONCLUSIONS

The conclusions we can derive at present are:

1. The 1.5 deg^2 region centered at α 00h 53m δ -28°03' is shown to be promising to build a sample of QSOs, where several surveys of QSOs using different techniques already exist, or are underway. Therefore a highly complete sample of faint QSOs could be formed if the efforts of various investigators are coordinated to perform the slit spectroscopy of all the QSO - candidates that survive after the inspection of their slitless spectra, and assigning precise magnitudes to the QSOs through the set up of reliable photometric standards.

2. Using two surveys of QSO candidates, the CS (slitless spectra), CT (color) and partially the CTIO-4m grism sample, in addition to supplementary slit-spectroscopy conducted at LCO and CTIO, it is shown that the number of presently known QSOs in the area to B$\gtrsim$19 mag is eight. Three of them come from the CS sample alone, two from the CT alone, one belongs to both samples, and the two remaining ones come from the grism sample.

3. The QSO surface density of our derived sample to B$\gtrsim$19 mag, 5.3 deg^{-2}, compares well with the value found by Marshall et al. (1983) in a QSO sample near the North Galactic Pole.

4. If the presently known number of QSOs to B$\gtrsim$19 mag (8) is considered to be representative of the total number in the area, we get that the CS sample contains 1/2 of the QSOs and the CT sample includes 37% of them.

5. The number of presently known QSOs in the small SGP area to B$\gtrsim$19.9 is found to be 18 - 1/2 of them being included in the combined CS and CT sample -, which implies a surface density of 12 deg^{-2}. This value is about 1/2 of the expected one (Véron and Véron, 1982), so a large incompleteness is possibly present in our sample derived to B$\gtrsim$19.9 mag.

6. Eye inspection of the distribution of the QSOs suggests an interesting non-uniformity. No physical significance can be attached to it at this moment.

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