

THE CERRO EL ROBLE SAMPLE OF FAINT ULTRAVIOLET EXCESS OBJECTS IN THE SOUTH GALACTIC POLE

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ABSTRACT

The idea to develop selected regions of the sky for extragalactic research in the Galactic Polar areas is emphasized. One such region, centered at  $\alpha=00^{\text{h}} 53^{\text{m}}$  (1950)  $\delta=-28^{\circ}03'$ , has been examined by several authors for surveys of QSO candidates. We have also searched  $44\text{-deg}^2$  of this region, containing the South Galactic Pole (SGP), for relative ultraviolet excess objects (UVXs) in 5 partially overlapping fields of the 70/100 cm Maksutov telescope of Cerro El Roble. The search was found to be extremely incomplete at  $B>19$  mag, while the completeness for  $B \lesssim 19$  was estimated to be approximately 30% in non overlapping regions and 50% in overlapping regions. Only the central overlapping region was used for the comparison of the surface densities of different UVX samples. The surface density in this region is  $7.2 \text{ UVX/deg}^2$  at  $B \sim 19$  mag and approximately a factor 2 larger than the one found by Savage and Bolton (1979) in two  $25 \text{ deg}^2$  fields near the SGP. In addition, our surface density value is a factor  $3/2$  larger than the density found by Braccisi, Formigini and Gandolfi (1970) near the North Galactic Pole. Twenty-seven new QSOs have been already identified in our UVX sample from spectroscopic data collected on the Las Campanas 2.5 meter telescope. A statistical test applied to the surface distribution of our UVXs in the central  $25 \text{ deg}^2$  region, gave a slight suggestion of non-uniformity.

I. INTRODUCTION

It is well known that the regions of the sky which are at high galactic latitudes ( $|b| \sim 90^{\circ}$ ) are privileged, over other directions, for the observation of extragalactic objects due to the advantage of low obscuration and low star density; among them, the regions containing the Galactic Poles are specially noteworthy. On the other hand, it is also

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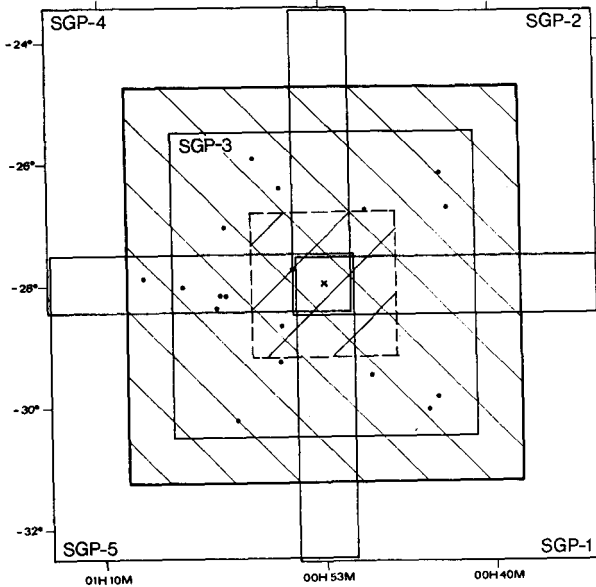


Figure 1. The approximate positions of the five  $5^\circ \times 5^\circ$  Maksutov fields employed for the search of UVX objects are shown in this schematic ( $\alpha, \delta$ ) diagram where hatching denotes a  $44 - \text{deg}^2$  area. The closed dots represent the UVX objects selected in more than one field. Grism plates for the central  $1.4 \text{ deg}^2$  region, shown with crossed hatching, have been obtained with the 4 meter CTIO telescope.

well known the convenience of defining some selected areas on the sky, where a large variety of independent investigations can be concentrated. Survey works must be carried out first in order to set samples of objects in given regions, and it is desirable to include all available techniques and frequency ranges. Following stages, for example for extragalactic objects, should (hopefully) end up with counts, redshifts and magnitudes for a large number of objects, enabling us to gain knowledge of their spatial distribution and of the physical relations between the constituents. Therefore, the formation of selected areas for extragalactic research, that are located in the Galactic Polar areas, are clearly justified. An important aspect is the choice of the size of the regions (or sub-regions), and it is advantageous to have, at least, two equivalent (in principle) ones for considerations on the isotropy of the distributions.

We shall refer here to one of such regions containing the South Galactic Pole (SGP), in connection to the surveys of QSOs that have been conducted there and specifically to the search of faint ultra-violet excess (UVX) objects with the 70/100 cm Maksutov telescope located at the Cerro El Roble Astronomical Station of the Universidad de Chile. The sizes selected for the surveys have been different, but all of them are approximately centered at  $\alpha=00\text{h } 53\text{m}$  (1950)  $\delta=-28^\circ 03'$ , which

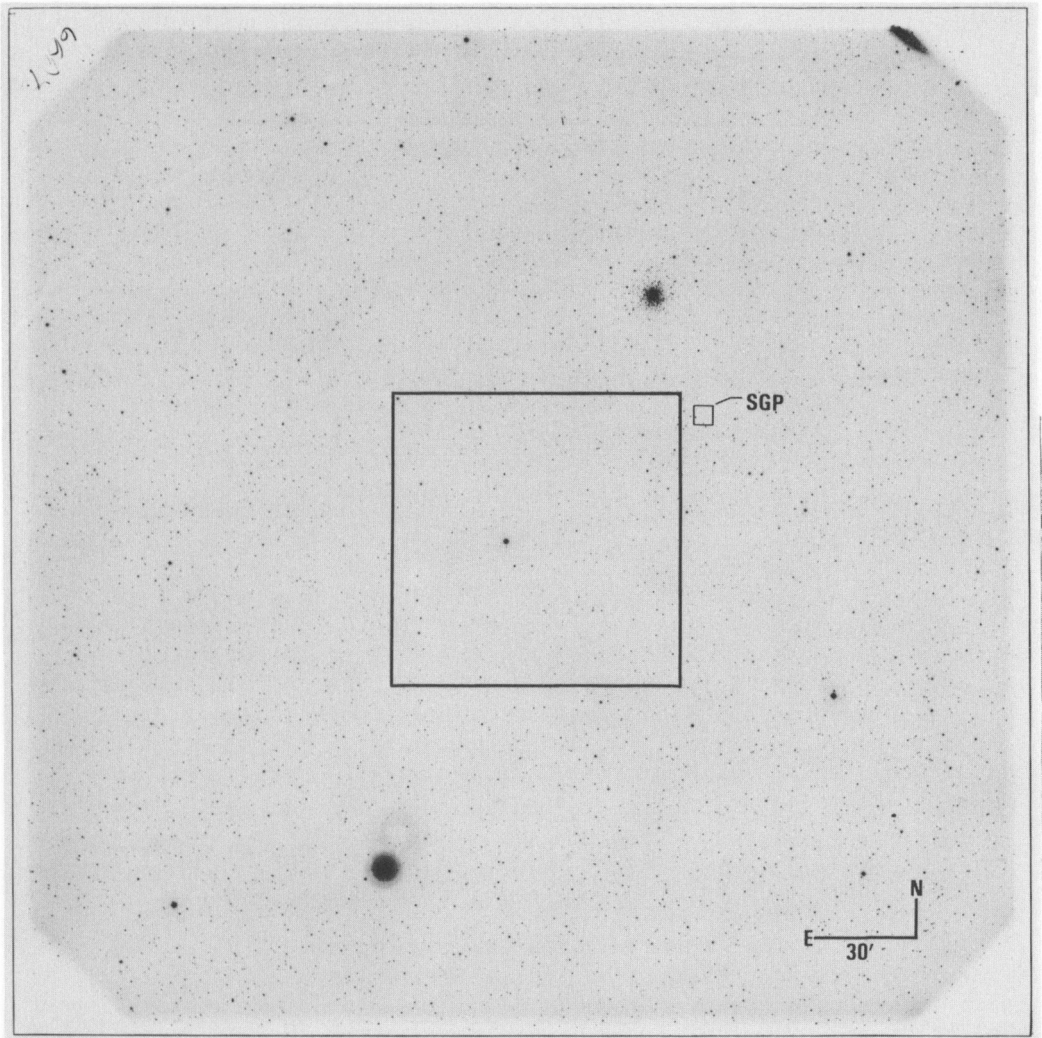


Figure 2. Reproduction of a plate (IIaO+GG 385, 25 min) taken with the 70/100 cm telescope located at the Cerro El Roble Astronomical Station of the Universidad de Chile ( $f/3$ , scale 99 arcsec/mm). Northeast is at the top left-hand corner. Three independent optical-searches of QSOs have been conducted in this  $25 \text{ deg}^2$  area centered at  $\alpha=00^{\text{h}} 53^{\text{m}} (1950)$   $\delta=-28^{\circ} 03'$ , containing the SGP. The region inside the central square drawn in this illustration has been selected by us for a deeper survey of QSOs. A potentially powerful path for extragalactic research is to concentrate observational efforts in selected areas, particularly in Galactic Polar areas such as this one.

corresponds to  $b \approx -89^{\circ}$ . Clowes and Savage (1983) have found 162 QSOs candidates from eye-inspection of  $25 \text{ deg}^2$  of a UK-Schmidt objective-prism plate. Shanks et al. (1983) have formed a sample of 660 UVX

Table I. Counts for the 373 UVX objects in the 44 deg<sup>2</sup> in the SGP

B	N	N(<B)	logN(<B)
9.0- 9.9	1	1	0.00
13.0-13.9	4	5	0.70
14.0-14.9	17	22	1.34
15.0-15.9	27	49	1.69
16.0-16.9	58	107	2.03
17.0-17.9	80	187	2.27
18.0-18.9	110	297	2.47
19.0-19.9	66	363	2.56
20.0-20.9	9	372	2.57
21.0-21.9	1	373	2.57

objects ( $U-B < -0.35$ ) in a 11.5 deg<sup>2</sup> area using machine measurements of UK-Schmidt plates. Campusano and collaborators have conducted a search of optical counterparts in a 72 deg<sup>2</sup> area (Campusano and Torres, 1981), have recently formed a UVX sample of 373 objects in a 44 deg<sup>2</sup> region, and are presently carrying a grism search of QSO candidates in a 1.4 deg<sup>2</sup> zone (Campusano and Moreno). In this report we outline the characteristics of the Cerro El Roble sample of UVXs; a full account of this investigation has been given elsewhere (Campusano and Torres, 1983). A spectroscopic survey of QSO candidates in the SGP is being carried out by Campusano and Zamorano at the Las Campanas Observatory with the 2.5 meter telescope.

## II. THE OBSERVATIONS AND THE SELECTION METHOD

The 44-deg<sup>2</sup> surveyed area was covered with five Maksutov fields. They were chosen to be partially overlapping (see Fig. 1), in order to estimate the completeness of our sample. The intersection of the fields, or overlapping region, is the central 25-deg<sup>2</sup> area; a photograph of this zone is shown in Fig. 2.

For the selection of UVXs, separate U and B plates were obtained and then inspected with an unmodified Zeiss Blink comparator. The exposure times were set to give a limiting magnitude of  $B \sim 20$  mag and a balance of the images for  $U-B \sim -0.6$ . The selection was performed through several independent inspections which involved the two authors and the research assistant L.E. González. Three degrees of ultraviolet excess were assigned: strong (S), medium (M) and weak (W). Blue magnitudes were estimated for the selected objects, using the Cuffey variable iris astrophotometer of CTIO, La Serena.

## III. PROPERTIES OF THE CERRO EL ROBLE SAMPLE

From an analysis of our survey we have arrived to the following

properties and conclusions:

1. We have established a catalogue of 363 faint UVX objects with  $U-B \lesssim -0.6$  and brighter than  $B \sim 20$  mag. in a region of  $44 \text{ deg}^2$  centered in the South Galactic Pole. Counts are given in Table I.
2. The catalogue was found to be extremely incomplete at  $B > 19$  mag.
3. The completeness of the catalogue at  $B \lesssim 19$  could be estimated thanks to the choice of the field plates with overlapping regions. Our sample of UVXs is approximately 30% complete in non overlapping regions and 50% complete in overlapping regions (with two plates). Therefore, the searched area can be divided in a central overlapping region of  $25 \text{ deg}^2$ ,  $\sim 50\%$  complete, and the remaining one with a degree of completeness of  $\sim 30\%$ .
4. Our central overlapping region has a surface density of  $7.2 \text{ UVX/deg}^2$  at  $B \sim 19$  mag. This surface density is about twice that found by Savage and Bolton (Savage 1978; Bolton and Savage 1978; Savage and Bolton 1979) in their original selection of UVXs near the South Galactic Pole. This result would suggest a considerable degree of incompleteness of their UVX search, if errors in the magnitude scales are absent and the distribution of UVXs in the sky is isotropic.
5. The surface density of the sample of Braccesi, Formigini and Gandolfi (1970) is approximately 1/3 of the corrected value, for incompleteness, of our central region. Therefore, a certain degree of incompleteness is possibly present in the Braccesi sample.
6. We rediscovered only one of the two known QSOs with  $B \lesssim 19$  that we should have detected as UVXs.
7. One of us (LEC) has identified already 27 new QSOs from our UVX catalogue in a fast preliminary inspection of spectroscopic data collected at the Las Campanas Observatory (Chile).
8. From statistical analysis of the surface distribution of the UVX objects in the central overlapping area, we found a slight suggestion of non-uniformity when we used cells of  $0.3 \text{ deg}^2$ . Further evidence would be desirable to reject or confirm the suspected inhomogeneity.

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