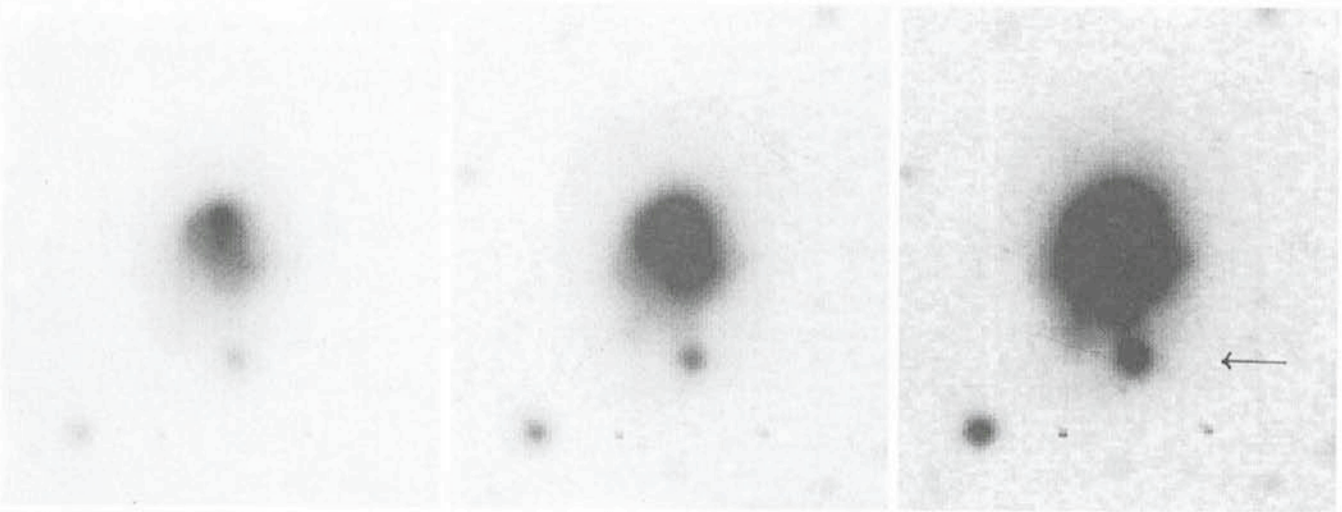

Fig. 6: *CCD image of ESO 400-G43 obtained with the ESO 3.6 m telescope, showing the galaxy as seen in the visual wavelength region. Three different representations of the same exposure are shown in order to let the structural details appear more clearly. The compact object indicated by the arrow is part of the galaxy and shows strong emission lines.*

5. Epilogue

From the preceding discussion we understand that much is still to be learnt about blue compact galaxies. Are they young or are they galaxies that have experienced several bursts of star formation? The answer at this stage has to be yes and no, a diplomatic but still logical answer since we cannot rule out any of these two possibilities. One way of getting ahead is by combining credible spectral synthesis models with carefully planned observations within a broad wavelength region. Results from such work will also be valuable when studying how the IMF and the chemical abundances are related and how they vary across the face of a galaxy. We are now extending our models by implementing spectra of metal-poor stars to the models already presented. More observations in different colours with a CCD camera attached to a large telescope would give us valuable information about the sub-structure within the objects. Is it complex like in the case of ESO 338-IG04? Do all BCGs have a relaxed structure in the infrared? We note that CCD observations of ESO 400-G43 (Fig. 6) show a smooth (although not symmetrical) structure surrounding the compact core also in the visual. And what is the nature of the peculiar emission-line object situated immediately south of the main body (arrow)? We are facing an exciting future in the exotic work of BCGs!

A Complete Optical Survey of Candidate Quasars Down to B = 22.0 with the ESO 3.6 m Telescope

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The study of the number-magnitude relationship of quasars, together with the statistical analysis of redshift and luminosity distributions of complete samples of quasars at different limiting magnitudes, provides the best tool to investigate the problem of the cosmological evolution of such objects. A summary of the present knowledge on the optical number counts of quasars can be found in recent reviews (see, for example, Woltjer and Setti 1982; Véron 1983). Moreover, after the Einstein X-Ray Observatory provided definitive evidence that quasars are strong X-ray emitters (Tananbaum et al. 1979; Zamorani et al. 1981), the observed optical number counts of quasars have often been used to estimate the overall contribution of this population to the soft X-ray background (Setti and Woltjer 1982; Zamorani 1982). One of the most important sources of uncertainty in this estimate is represented by the still relatively poor knowledge of the detailed behaviour of the number counts relationship for faint ($B > 19.5$) quasars. In fact, it has been shown that, given the observed flattening at faint magnitudes of the number-magnitude relationship, most of the quasars' contribution to the X-ray background is expected from objects in the magnitude range 20–22 (Bonoli et al. 1980).

Two main methods have been successfully applied to the optical selection of quasars:

(1) The ultraviolet excess (UVX) method (see, for example, Braccesi et al. 1980), based on the observational evidence that almost all the known quasars with $z < 2.2$ show $U\text{-}B < -0.40$. Since high galactic latitude stars with this colour are rare objects, especially at faint magnitudes, this method provides quite complete and reasonably uncontaminated samples of candidate quasars with $z < 2.2$.

(2) The search for emission-line objects and/or objects with blue continuum on deep "grism" plates. This method is highly efficient in finding high redshift quasars, and, in fact, almost all the radio quiet quasars with redshift larger than 3 have been found by this technique. However, its level of completeness

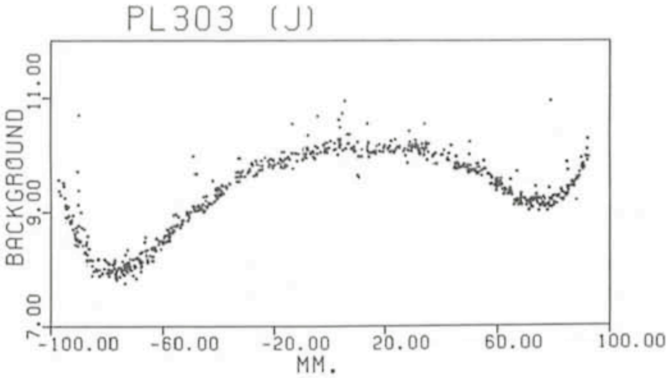

Fig. 1: *Typical behaviour of the linearized background in a slice across a triplet plate.*

(both in terms of limiting magnitude and emission line equivalent width) is very difficult to assess (Clowes 1981).

The characteristics of the two methods are such that they are most effective when applied at the same time on the same field in order to increase the combined level of completeness, as recently also discussed in this journal by Cristiani (1984).

We give here a still preliminary account of the optical search for faint quasars we are performing with the ESO 3.6 m telescope. So far we have applied a colour selection method, which represents an extension of the UVX method (see Koo and Kron 1982 and below), to a high galactic latitude field centred at RA = 03h 10m and $\delta = -55°$ (b = $-50°$); in the current months we will perform grism and first spectroscopic observations on the same field.

Various sets of deep exposures have been obtained in the passbands U(IIIa-J + UG1), J(IIIa–J + GG385) and F(IIIa–F + GG495). The triplet corrector at the prime focus of the ESO 3.6 m telescope gives a corrected, unvignetted field of about 60 arcminutes in diameter. This represents a very important performance in a programme aiming to extract, by colour measurements, a population of faint objects having low surface density. On each plate the whole useful field was scanned with the ESO PDS micro-densitometer. We adopted an aperture of 50 x 50 microns (0.9 x 0.9 arcsec), which represented a compromise between resolution and number of pixels to be stored and analyzed. An automatic procedure was then applied to extract position and fluxes for all the objects brighter than a given percentage of the local background. Due to the large variations of the background across the triplet useful field (Fig. 1), the sensitivity of the method changes with the position. For the present purposes the selection cut-off was set in such a way to ensure that all the objects brighter than J = 23.0 were extracted and measured. Calibration spots were used to linearize fluxes. This procedure can run as a MIDAS subprogramme as well as an independent programme. Analysis of a whole plate scan (12 million pixels) takes approximately 45 minutes of CPU on a VAX 11/780 computer. J and F magnitude scales were calibrated by using a few CCD exposures obtained at the Danish 1.5 m telescope on La Silla by R. Buonanno and F. Fusi-Pecci on the globular cluster NGC1261, which lies on the border of the field. U, J, F triplet plates with photometric wedge have also been obtained, but, as yet, they have not been fully used for calibration purposes. At the present stage of data reduction a systematic offset as large as 0.20 magnitudes in each band cannot be excluded.

All the objects brighter than J = 22.5 were then separated into stars and galaxies according to the value of the moment of the image (Kron 1980), measured after linearization and background subtraction. Fig. 2 shows the weighted mean of the moments obtained from six plates (two for each bandpass)

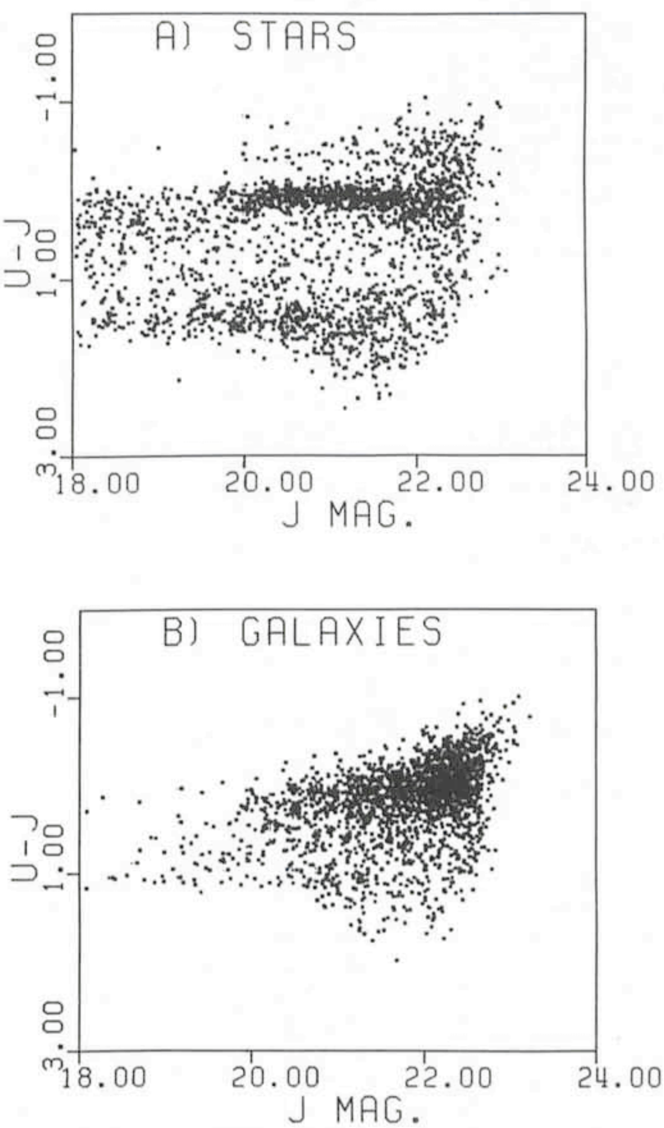

Fig. 3: *U–J versus J for "stars" (a) and "galaxies" (b), as obtained by averaging two plates for each passband.*

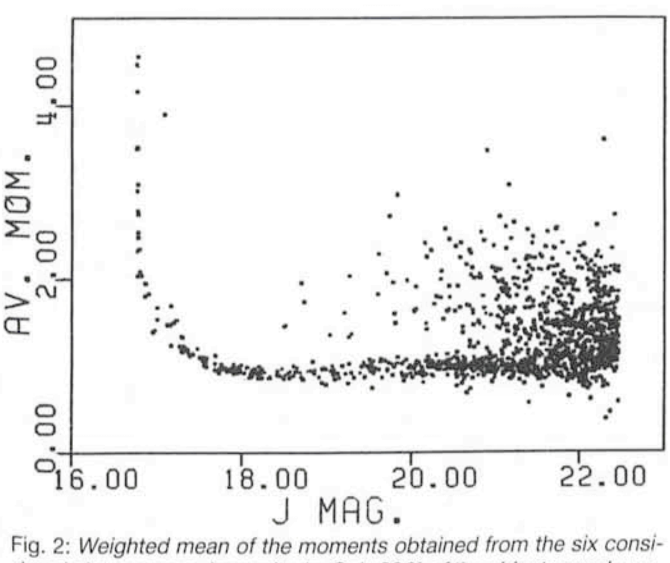

Fig. 2: *Weighted mean of the moments obtained from the six considered plates versus J magnitude. Only 20 % of the objects are shown, in order to avoid overcrowding of points.*

versus the J magnitude. Stellar objects populate a well-defined domain in the lower part of the diagram, while galaxies are spread on a large area, corresponding to higher values of the moment. The bright star domain bends towards higher moments because of the plate saturation, which gives a flat top to the images. The adopted method leaves only a few objects brighter than J = 22 with an uncertain classification. However, the number of objects with dubious classification increases very rapidly at fainter magnitudes.

Fig. 3 shows the U–J versus J diagram for stars (a) and galaxies (b), as obtained by averaging two plates for each passband. As typical of high galactic latitude fields, stars are clearly splitted in two main families, hot subdwarfs and M dwarfs. The colour of galaxies undergoes a systematic change with magnitude and a large number of ultraviolet excess galaxies appears at magnitudes fainter than J = 22. This last fact, together with the increasing difficulty in separating faint compact galaxies from true "stellar" objects, sets the most important limit to the reliability of the UVX method in selecting quasars at extremely faint magnitudes. For these reasons we limit our present search to objects brighter than J = 22 and, within this magnitude limit, we define as quasar candidates all the star-like objects lying outside the domain of galactic stars on the U–J vs J–F diagram.

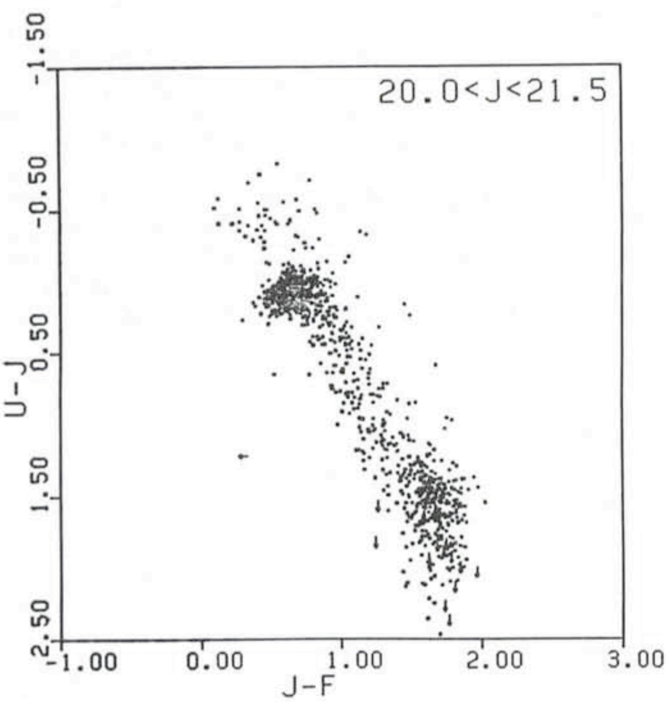

Fig. 4: *U–J versus J–F for all the "stellar" objects in the magnitude range 20.0 < J < 21.5.*

The uncertainties in the zero points of the U, J and F magnitudes do not affect the selection of the QSO candidates, which is based only on the relative position of the objects with respect to galactic stars. Fig. 4 shows the colour-colour diagram that we obtain for the "stellar" objects in the magnitude range J = 20.0–21.5. The data represent the average of two plates for each coulor. The two clumps of hot subdwarf stars and M dwarf stars are clearly visible. Most of the objects lying outside the "normal stars locus" are ultraviolet excess objects. A few objects with "J–F" excess but no ultraviolet excess are also present. They could be high redshift quasars (as well as photometric errors . . .). In any case, these objects with anomalous colours do not appear to contribute in a significant way to the total counts in this magnitude range.

From the present data, in an area of 0.69 square degrees, we obtain a surface density of 84 "non star" stellar images per square degree brighter than J = 21.5 and 185 brighter than J = 22.0, in very good agreement with the results obtained by Koo and Kron (1982) in the Selected Area 68. The comparison of our counts at J = 20 with the results obtained by Braccesi et al. (1980) in the 13h+36 field is less satisfactory. They found a density of about 27 UVX candidate quasars per square degree at B = 20.0, corresponding to J = 19.9. A spectroscopic follow-up of these objects yielded a density of about 20 confirmed quasars per square degree brighter than B = 19.8. According to this result, about 20 objects brighter than J = 20 would then be expected in our field, whilst we found 8. Due to the poor statistics, this discrepancy is at present only suggestive of a real effect. It is possible that statistical fluctuations, together with zero point errors in the J magnitude, can give full account of the different densities. However, considering also recent Koo's results (1983) (16 quasars per square degree with 19.5 < J < 20.5), it seems possible to conclude that there is a tendency, in recent deep optical counts, to find, around J = 20, a lower surface density of UVX objects than that found by Braccesi et al. This, if confirmed by future work with better statistics, would produce a softer bending in the counts than previously assumed for studying evolutionary models and estimating the QSOs contribution to the X-ray background.

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