THE PHYSICAL NATURE OF THE BLUE OBJECTS IN THE FIELD OF BD+15°2469 (VIRGO CLUSTER)

L.Abati Erculiani[1] and H.Lorenz [2]
[1]Istituto di Astronomia,Università di Padova,
Vicolo dell'Osservatorio, I-35100 Padova,Italy.
[2]Zentralinstitut fur Astrophysik der Akademie der Wissenshaften der DDR,DDR-15 Potsdam,R.-Luxemburg-Str.17a

INTRODUCTION

This is the second Asiago blue objects field studied to determine the physical nature of ultraviolet excess objects (UVX) at high galactic latitudes using low dispersion objective prism plates. As the first of this series (Abati 1982)this work has a double aim :

1. to determine the proportions in the component populations of UVX objects selected by the two-colour method on Schmidt telescope plates;
2. to determine the surface density of quasars down to a limiting magnitude m_{pg} = 18 mag.

The two colour method is an efficient way to find quasars by optical means (Sandage 1965, Braccesi et al.1970).
The majority of quasars with $z < 2.2$, as nonthermal continuum sources, shows an ultraviolet excess greater than that of the hot main sequence halo stars, F and G subdwarfs and frequently of white dwarf or blue compact galaxies. Nevertheless, there is a contamination among the UVX quasar candidates selected by colour criteria (Becker 1970, Braccesi 1980, Savage et al.1978). Therefore the separation of the U-B colour index is only partial. Objective prism spectra allow spectral classifications up to a half spectral class (Nandy et al.1977) and additionally show dominant emission or absorption features in the spectra. Thus, without extensive spectral investigations, quasar candidates can be extracted from lists of UVX objects.
Here we investigate the Asiago A_3 UVX objects list (Barbieri and Benvenuti 1974) which cover the magnitude range between 15 and 18 mag in the Virgo cluster region. As the field lies in the Virgo cluster, our nearest neighbour and best studied cluster of galaxies, the surface density of quasars and their location towards the cluster galaxies can be compared with the results obtained in fields outside of clusters of galaxies.
The spectral classification of the UVX objects has been obtained using objective prism plates of the 48" U.K. Schmidt telescope and the 52" Tautenburg Schmidt telescope. The properties of the objective prism spectra of these two telescopes are nearly the same; reciprocal disper-

M. Capaccioli (ed.), Astronomy with Schmidt-Type Telescopes, 475–480.

sion of 2500 A/mm at H_γ and 3500 A/mm at H_β .
The U.K.plates kindly allowed by the Edinburgh Royal Observatory are exposed on Eastman-Kodak IIIa-J hypersensitized emulsion and cover the wavelength range λ 3300-5200 A.
The A_3 objects of the central part of the field (3^o x 3^o) have been studied also on the Tautenburg objective prism plates. The plates have been exposed both on Kodak 103a-E (wavelength range λ 3300-6700 A) and ORWO ZU 21 (Wavelength range λ 3300-5000 A). The limiting magnitude of the Tautenburg plates is 18.5 mag in the B-band.
All the A_3 UVX objects have been checked on a direct IIIa-J U.K.Schmidt telescope plate, also kindly provided by the Edinburgh Observatory, in order to select the compact galaxies with a starlike appearance on the Asiago Schmidt plates.

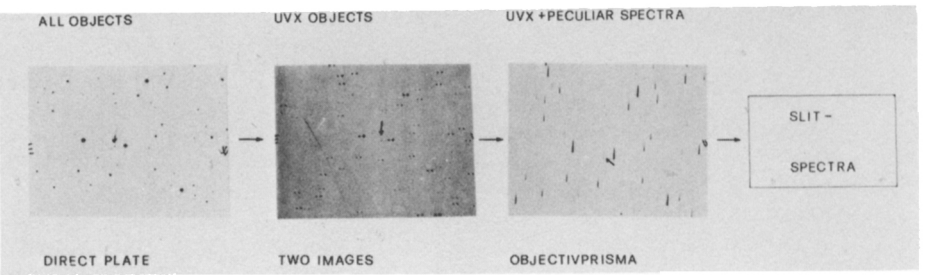

Figure 1 Search line.

RESULTS

277 A_3 UVX objects have been classified as shown in Table 1.

Table 1 - Spectral classification of the A_3 blue objects -

	U-B ≤ -0.2		U-B ≤ -0.4		U-B ≤ -0.7		
	N	%	N	%	N	%	
Hot stars	116	43	33	45	6	31	
F and G stars	105	39	19	26	0	0	
W.D.	7	3	4	5	3	16	
Galaxies + G?	20	7	6	8	1	5	
Quasars + Q?	22	8	11	15	9	47	
Total number	270		73		21		
Double/peculiar	7		5		2		

$\rho_{Q_{max(Q+Q?)}}$ =0.98 Q/deg^2; $\rho_{Q_{min(Q)}}$ =0.49 Q/deg^2; $\rho_{W.D.}$ =0.31 W.D./deg^2

https://doi.org/10.1017/S0252921100107092 Published online by Cambridge University Press

Most of them are stars (43% hot stars, 39% F and G stars, 3% W.D.) 8% are quasars and 7% compact galaxies, unresolved at the scale of the Asiago Schmidt telescope. 7 blue objects have been identified as double stars.
The surface density of W.D. is 0.31 WD/sq.deg.
The surface density of A_3 UVX quasars spreads from 0.49 Q/sq.deg. to 0.98 Q/sq.deg. in good accordance with the one determined from previous works.
Figure 2 shows the distribution of blue objects in the A_3 field as a function of magnitude for different colour index. From this figure (a) one can see that the number of all kinds of objects decreases as the U-B becomes more negative. It is to be pointed out that while the proportion of stars decreases, the proportion of quasars increases (c). Star contamination is lower both at fainter magnitudes and at more negative U-B. In the magnitudes range here considered the number of quasars, at a given U-B, is higher at fainter magnitude. This fact reflects the steep quasar luminosity function. From the same figure (b) it is evident that the proportion of quasars, at a given magnitude, increases at more negative U-B.

BLUE COMPACT GALAXIES

Fifteen A_3 blue objects are identified as galaxies and forty as suspected galaxies in the B.B. list. This means that these objects, which look like stars on the two images plates, have nonstellar appearance on the Asiago direct plates. Two out of the fifteen galaxies lie outside the objective prism field. Eleven out of the thirteen ones inspected show typical galaxies' spectra and two have star like spectra.
All the A_3 blue compact galaxies have been observed recently by Karachentsev and Karachentseva (1982) at the 6m telescope of the URSS during a large investigation of about 100 galaxies in the Virgo cluster. From the radial velocity measured by H and K lines, one can see that 10 out of them are dward emission galaxies, members of the Virgo cluster, and 3 are background galaxies.
The two A_3 blue objects proposed as galaxies in B.B. and here classified as stars do not appear in K.K. galaxies list, and this proves the reliability of the classification obtained from objective prism.
Out of the forty suspected galaxies 8 lie outside the objective prism field, 27 are classified as stars and 5 as galaxies. One of them has been studied by K.K. and estimated as a background galaxies, not connected with the Virgo cluster.

https://doi.org/10.1017/S0252921100107092 Published online by Cambridge University Press

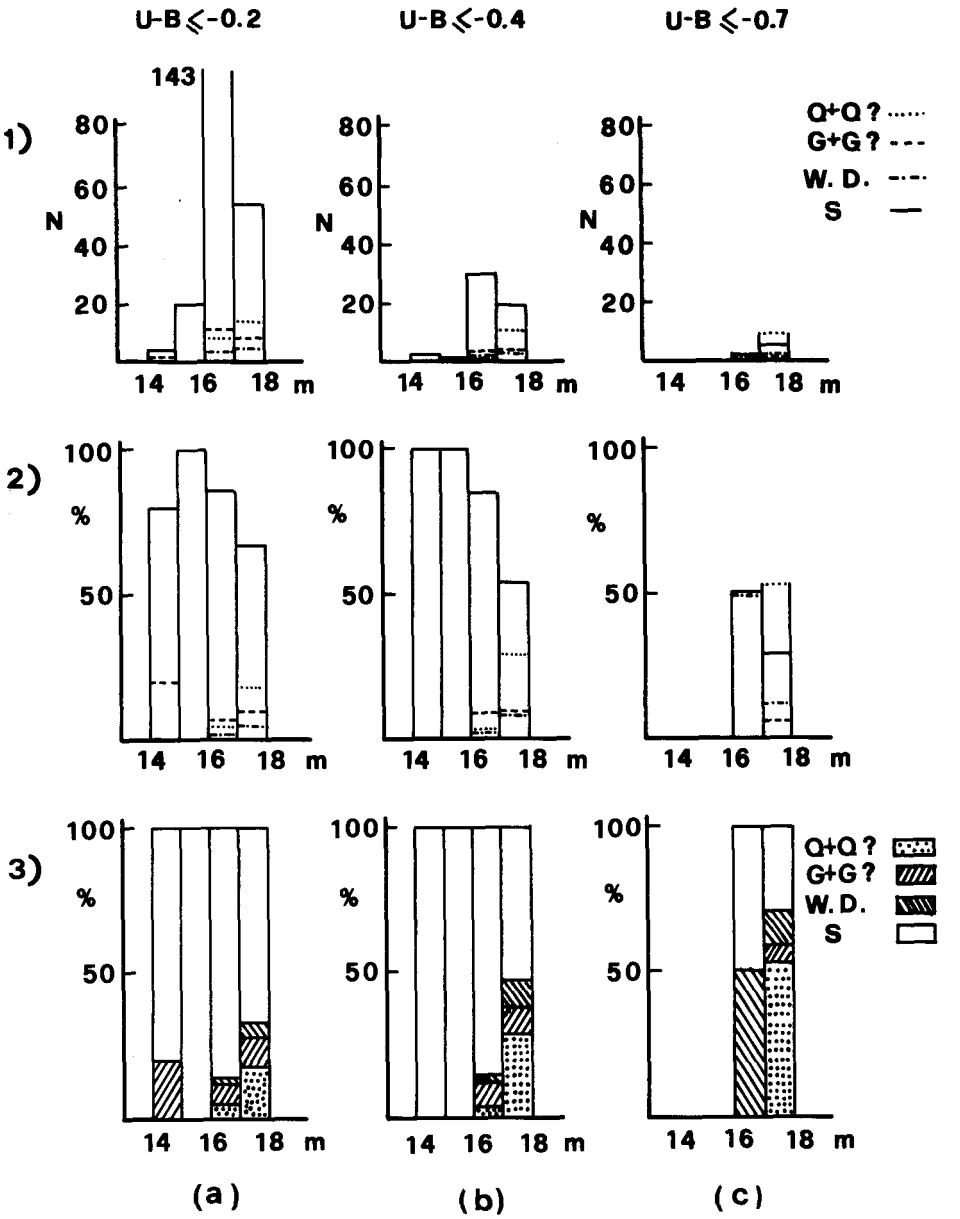

Figure 2.-1) The distribution of A_3 blue objects as a function of magnitude in the subsamples with different U-B.
2) The normalized distribution of A_3 blue objects as a function of magnitude in the subsamples with different U-B.
3) The proportions of A_3 blue objects as a function of magnitude in the subsamples with different U-B.

https://doi.org/10.1017/S0252921100107092 Published online by Cambridge University Press

BLUE OBJECTS AND CLUSTER OF GALAXIES

The location of the A_3 UVX quasar candidates has been checked as regards the bright Virgo cluster galaxies and the more distant cluster of the Zwicky catalogue (Zwicky 1961) in order to inspect the relation quasar-galaxy and quasar-cluster of galaxies.
Nine out of the twenty-two quasar candidates (Q+Q?) are near bright galaxies at distances $r < 1^o$ (300 Kpc at the Virgo cluster distance).
Four out of the twenty-two quasar candidates are located, in their projection, inside clusters of galaxies classified respectively as Distant (one), Medium Distant (one), and Very Distant (two).
However, since from the objective prism spectra the redshift of quasar candidates cannot be doubtlessly measured, further spectroscopical work at higher dispersion is worthwhile in order to inspect the possibility of physical associations.

PRELIMINARY HIGH DISPERSION SPECTROSCOPICAL RESULTS

Twelve quasar candidates of A_1 and A_3 fields have been investigated at higher dispersion using the UAGS spectrograph attached to the prime focus of the 6m BTA Telescope of the Academy of Sciences of USSR. 10 out of them are quasars with redshift ranging from 0.40 to 2.04.
Further spectroscopical work is in progress.

CONCLUSIONS

1) The 276 A_3 blue objects have been separated into their component populations: 85% of them are stars (43% hot stars, 39% F and G stars, 3% white dwarfs) 8% quasars and 7% compact galaxies . 2) The proportions of different kinds of objects change with the magnitude and colour index. In particular the proportion of quasars increases both to fainter magnitudes and more negative U-B. 3) The surface density of UVX quasars to a magnitude limit of B = 18 mag. spreads from 0.49 Q/sq.deg. to 0.98 Q/sq.deg. in good agreement with previous works. 4) Recent investigations on the A_3 blue objects marked as galaxies show that eleven of them are dwarf members of the Virgo cluster. 5) Four out of twenty-two quasar candidates are located in their projection inside distant Zwicky clusters of galaxies. 6) The results here obtained for the A_3 field, which lies in the Virgo cluster, agree,within the statistical uncertainty,with the ones of the A_1 field, outside clusters of galaxies.

ACKNOWLEDGEMENTS

We should like to thank the staff of the U.K.Schmidt Unit and the Tau-

tenburg Observatory of the Academy of Sciences of the G.D.R. for providing to us the objective prism and direct plates.
We are particularly grateful to Dr.M.Hawkins, Dr.I.D.Karachentsev and Dr.G.M.Richter for their helpful comments.

REFERENCES

Abati Erculiani,L.:1982,Astron.Astrophys.Suppl.Ser.48,333.
Barbieri,C.,Abati Erculiani,L. and Rosino,L.:1968,Publ.Oss.PD.N.143.
Barbieri,C. and Benvenuti,P.:1974,Astron.Astrophys.Suppl.Ser.13,269.
Becker,W.:1970,Astron.Astrophys.9,204.
Braccesi,A.,Formiggini,L. and Gandolfi,E.:1970,Astron.Astrophys.5,264.
Braccesi,A.,Zitelli,V.,Bonoli,F. and Formiggini,L.:1980,Astron.Astrophys 85,80.
Cheney,J.,E. and Rowan-Robinson,M.:1981,Monthly Notices Roy.Astron.Soc. 195,497.
Green,R. and Schmidt,M.:1982,preprint.
Karachentsev,I. D. and Karachentseva,V. E.:1982 Pism.Astron.Zh.8,198.
Nandy,K.,Reddish,V.C.,Tritton,K.P.,Cooke,J.A.and Emerson,D.:1977,Monthly Notices Roy.Astron.Soc.178,63p.
Sandage,A.:1965,Astrophys.J.141,1560.
Savage,A.,Bolton,J.G.,Tritton,K.P.,Peterson,B.A.: 1978,Monthly Notices Roy.Astron.Soc.183,473.
Zwicky,F.S.:1961,Cat.of galaxies and cluster of galaxies,Caltech.