A STUDY OF ULTRAVIOLET-EXCESS GALAXIES BASED ON THE KISO SURVEY

Bunshiro Takase, Takeshi Noguchi, and Hideo Maehara
Tokyo Astronomical Observatory

Abstract   A number of ultraviolet-excess galaxies have been detected
during the course of our surveys using the Kiso Schmidt telescope. In
this report, a classification scheme is proposed for 142 selected objects
on the basis of their morphological features, and the relation between
the morphological type and the degree of ultraviolet-excess is presented.
In general irregular galaxies with conspicuous H II regions and pair gal-
axies tend to show higher degree of ultraviolet-excess, while the degree
in spiral galaxies appears to range widely.

1. INTRODUCTION

A survey for ultraviolet-excess (hereafter abbreviated as UVX)
objects has been carried out as one of the programs of the Kiso 105 cm
Schmidt telescope of the Tokyo Astronomical Observatory (Takase et al.
1977). They are detected by means of the multicolor image method. Either
U, G, and R triple images or U and R double images are exposed on a single
plate. The observational technique is explained by Noguchi et al.(1980).

Takase (1980) found some 1,100 UVX galaxies which have been called
Kiso UVX galaxies (abbreviated as KUG) in 20 sky areas covering about
650 square degrees. The number of KUGs is roughly ten times that of the
Markarian galaxies over these areas. This implies that our direct image
photographs have much better detectability and considerably fainter limit-
ing magnitude than the Markarian's objective prism spectrograms.

The survey for KUGs has since been extended to much wider sky
areas. Further follow-up observations have also been made for randomly
selected samples of these objects with the 188 cm reflector of the Okaya-
ma Astrophysical Observatory. Up to now direct photographs of 44 KUGs
have been taken at the Newtonian focus where the plate scale is about
three times larger than that of the Schmidt photographs. Furthermore
spectrograms of 35 objects have been taken with the Cassegrain Image
Intensifier spectrograph attached to the reflector.

439

During the course of these surveys we have become interested in the wide variety of morphological features of KUGs and attempted to classify them into several types. This report is a concise version of the full paper (Takase et al. 1983), where a list of 142 objects with their morphological type together with their degree of UVX and several other informations is included.

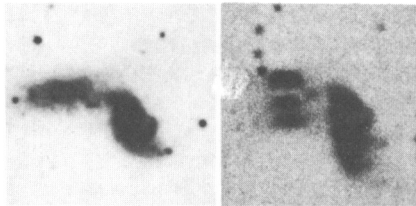## 2. MORPHOLOGICAL CLASSIFICATION

From direct photographs taken at Okayama together with the Palomar Sky Survey prints, and the Kiso multicolor plates as well, we tried to classify our sample of KUGs. Our classification scheme is as follows:
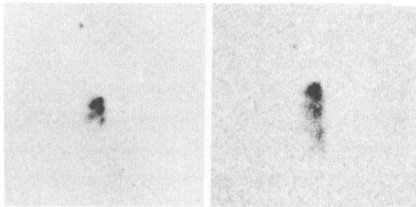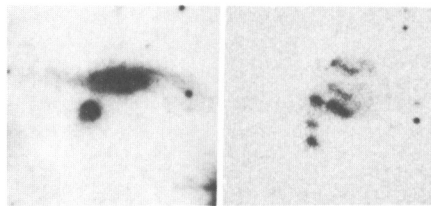
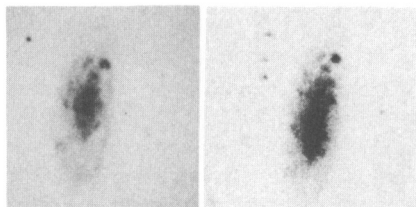

Type Ic: KUG 1626+413
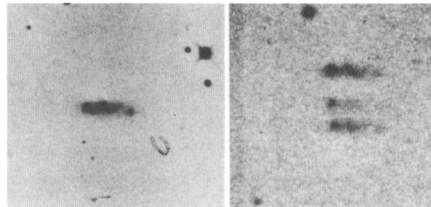
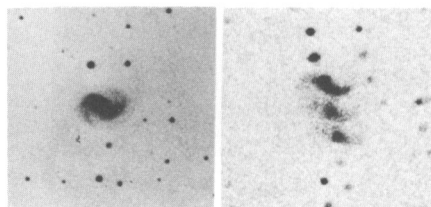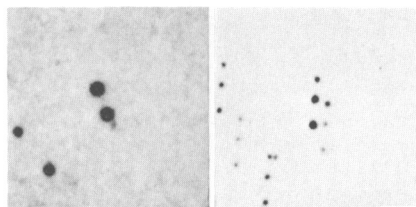Type Ig: KUG 0225-103

Type Pi: KUG 1047+332

Type Id: KUG 2259+157

Type Sk: KUG 2257+157

Type Sp: KUG 0239+345

Type C : KUG 0935+407

Figure 1. Representative objects of each classification type. In each pair the left one is a direct photograph while the right one is that reproduced from the Kiso three color plate, where U, G, and R images are lined up from top to bottom.

1.1   Irregular with clumpy H II regions (denoted as Ic)
1.2   Irregular with a conspicuously giant H II region (Ig)
2.1   Pair of interacting components (Pi)
2.2   Pair of detached components (Pd)
3.1   Spiral with knotty arms (Sk)
3.2   Spiral with peculiar bar or nucleus (Sp)
4   Compact (C)

In Figure 1 representative samples of each type are given with pairs of direct and multicolor photographs. The Ic type is composed of several conspicuous conglomerations of H II regions. The Ig type has a single supergiant H II region complex usually at one edge of the elongated body of the galaxy. The Pi type is composed of mutually interacting and tidally deformed components of galaxies, while the Pd type is a pair consisting of a slug shaped elongated galaxy and a small globular galaxy, the latter of which usually has a higher degree of UVX than the former. The Sk type is morphologically not so peculiar as other types, except that there are several medium size H II region knots along spiral arms. The Sp galaxies have either a peculiar nucleus or an abnormal bar structure. For example they have a brilliant starlike nucleus, a hot spot complex, or a split or otherwise deformed bar. Seyfert galaxies may be included in this Sp type. Finally the C type are galaxies which are compact.

3. THE DEGREE OF ULTRAVIOLET-EXCESS AND RELATED STATISTICS

The degree of UVX or the color of each galaxy can be estimated from the brightness of the U image relative to the G and/or R images on our multicolor plates. Symbols H, M, and L are used for high, medium, and low degree of UVX, respectively. These correspond to the color index CI defined by Noguchi et al.(1980) approximately as

$CI \sim -0.5$ for H,
$CI \sim 0$ for M, and
$CI \sim +0.5$ for L.

Table 1 shows frequency statistics of 142 KUGs in respects of both the morphological type and the UVX degree. For Pi and Pd galaxies which have two or more components, only the one with the highest degree of UVX is included in the statistics.

It seems that the Sk and Sp types with a low UVX connect smoothly with normal S galaxies which have no UVX. Components of the Pi and Pd types with a lower UVX which are not counted in the Table have either a low or no UVX. So these may also continue to their respective normal gal-

Table 1

FREQUENCY STATISTICS IN RESPECTS OF THE
MORPHOLOGICAL TYPE AND UV-EXCESS DEGREE

TYPE \ UVX DEGREE		H	M	L	TOTAL
Ic		16	9	0	25
Ig		9	0	0	9
Pi		13	7	0	20
Pd		10	3	0	13
Sk		2	12	6	20
Sp		12	20	4	36
C		5	5	0	10
?		3	5	1	9
TOTAL		70	61	11	142

axies with no UVX. For the Ic , Ig and C types, however, the fact that there are no samples with a low UVX, may indicate that all of these types of galaxies are UVX objects.

4. REMARKS

        Some selection effects are unavoidable in sampling and classifying the objects. For example distant galaxies are sometimes overlooked or unclassifiable due to their small sizes, and those with unfavorable orientation are apt to be misclassified due to the projection effect, Thus the statistics given above are not so complete that they represent the real distribution of the morphological type and the degree of UVX.

        The portions of the objects with UVX have been in general interpreted as more or less giant H II regions where an active star formation is taking place (e.g., Benvenuti et al. 1982). The objects in our present sample range from weakly or moderately active Sk types to hyperactive Ic and Ig types. Some fundamental differences seem to exist among these various type objects.

        In order to study these characteristics in more detail, spectroscopic investigations are indispensable. A preliminary study has been made on the basis of our spectrograms obtained with the Okayama telescope, and it has been found that there are appreciable differences between the excitation states of nuclear and outer H II regions as suggested by several authors, e.g., by Kazaryan et al. (1981). In addition, a number of our objects have been observed with the Nobeyama 45 m radio telescope. The results of this radio observation will be published elsewhere (Maehara et al. 1983).

REFERENCES

Benvenuti,P., Casini,C., and Heidmann,J.1982, Monthly Notices Royal
        Astron. Soc., 198, pp. 825 - 831.
Kazaryan,M.A., Petrosyan,A.R., and Tamazyan,V.S. 1981, Soviet Astron.
        Lett., 7, pp. 359 - 360.
Maehara,H., Inoue,M.,Takase,B., and Noguchi,T. 1983, in preparation.
Noguchi,T., Maehara,H., and Kondo,M. 1980, Annals Tokyo Astron. Obs.,
        ser. 2, 18, pp. 55 - 70.
Takase,B. 1980, Publ. Astron. Soc. Japan, 32, pp. 605 - 612.
Takase,B.,Ishida,K.,Shimizu,M.,Maehara,H.,Hamajima,K.,Noguchi,T., and
        Ohashi,M. 1977, Annals Tokyo Astron. Obs., ser. 2, 16, pp. 74-109.
Takase,B., Noguchi,T., and Maehara,H. 1983, Annals Tokyo Astron. Obs.,
        ser. 2, 19, No. 2 , in press.