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STATISTICAL COMPARISON OF THE BASIC PARAMETERS OF HIGH SURFACE BRIGHTNESS AND NORMAL GALAXIES

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1. Introduction. The small group of High Surface Brightness Galaxies offers a large field of studying different properties of the galaxies at all. They were registered amongst the HSBG Seyfert Galaxies, X-ray sources, High Luminosity Objects and many Infra Red sources. This short review is devoted to the comparison of the basic properties of the Normal and High Surface Brightness Galaxies. The main reason for this is that there is not a proper definition of what "normal" galaxies are —till now most of the astronomers use the evaluations made by E. Holmberg or G. de Vaucouleurs many years ago usually based on small samples of galaxies.

Now we can construct a basic picture of normal galaxies using the homogeneous sample of galaxies to 14.5 magnitude from the Genter for Astrophysics, USA.

2. Definition of high surface brightness galaxies. Holmberg in 1952, making detailed surface photometry of ca. 100 bright galaxies defines B 13.6 (mag./sqr. min) as a better split of the objects with high surface brightness from the normal one. Using that criteria Arakelian, 1975 *[1]* determined the surface brightness of all galaxies north of 5 -3° having photographic magnitudes in CGCG [2J and diameters in MCG[3]. The basic relations were.

(1) B=m_Zw + 2.5Lg(Pi/4*D*d)-0,22 cosec(bII) [m/sqr. sec].

Statistically *B_Akn* are transformed to Holrnberg's one using the simple relations based on the least square fit for ca. 100 common objects:

(2) B_Akn = B+0.22D/d+0.73,

where *B* is the surface brightness in (mag/sqr. sec), *D* and *d* are the major and minor diameters in ('), *m_Zw* is the Zwicky's magnitude and *bII* is the galactic latitude with *B_Akn*< = 22.0 (mag/sqr. sec) for HSBG. Thus Arakelian devided 591 objects with HSB in the northern hemisphere.

As there were some proposals (see e. g. [4]) that the HSBG simple is the most compact part of the normal galaxies we shall try to show they are quite a homogeneous group. To prove that we reduce the Arakelian's system of surface brightnesses to the standard one using magnitudes and diameters in standard isophote 25 mag. per sqr. sec. The reduction procedure is the same as in K a r a c h e n t s e v e t a 1. [4] and includes the following steps:

1. Conversion of the MCG-diameters to *D_25* using Paturel's relations according [6]

(3) D_25=D_25 (al, del, T, bII),

where T is the morphological type of the galaxy.

2. Conversion of Zwicky magnitudes to corrected Holmberg's one

(4) = m_Holm(m_Zw, D, al, del, T, bII, R).

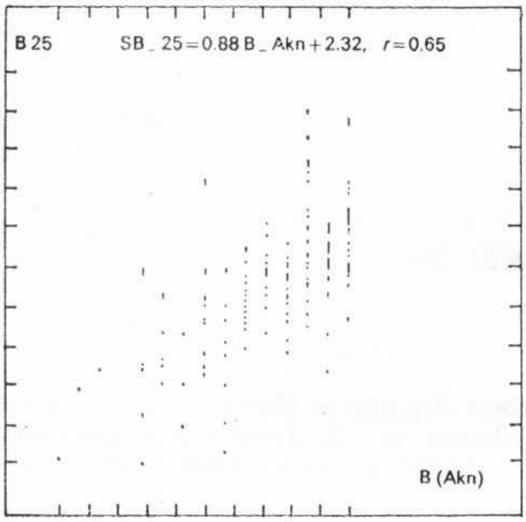

Fig. 1

where R is the ratio of major and minor diameters.

The final relation is in the form

(5)

SB_25=m_corr+2.5Lg(Pi/4*D_25)+ 8.89 (m/sqr. sec).

The dependence of B_Akn —SB-25 is presented in Fig. 1. Here we have used only the objects with known redshifts to make all corrections —277 objects at all. The least square fit gave us

(6)SB_25=(0.882±0.077)B_Akn+ (2.322±1.675)

with Pearson correlation coefficient r=0.653.

3. Basic characteristics of normal galaxies. To say definitely HSBG is a homogeneous group by its internal parameters or not we construct a control sample of normal galaxies chosen amongst CfA sample — Huchra et al. [6]. We have selected all 1939 objects of 2408 which did not belong to any group of galaxies such as SyG, MrkG, AknG, DDO galaxies and so on. We have excluded also the galaxies from the Local Group. The reduction procedure was the same as for the HSBG cited above. The average value for such basic parameters as radial velocities, linear diameters, luminosities, surface brightness and so on are presented in Table 1. We have included three subsamples of galaxies: HSBG having redshifts and detected from IRAS mission —these data we shall use in the future; all HSBG having redshifts —277 objects and 1939 CfA galaxies. We present the means and their variances for the three groups. For the last two we have included the median values too.

To check the statistical significance of the differences we have used Student's „t-test”. The values of *"t"* are shown at the Table together with the theoretical values for *P* = 0.9, 0.95, 0.975 and 0.99 [7]. We could see the significant difference in the surface brightness between the normal and high surface brightness galaxies —the topic we have had to prove.

4. Comparison between normal and HSB galaxies. Fisher's "f-test" shows us that the differences cited above are significant enough because of the great samples. In Fig. *2a* we present a histogram of the surface brightness and in Fig. 2b —of radial velocities for the normal and HSB (marked by backslash) galaxies. HSBG in average are further then the normal galaxies. This probably is a selection effect. The same is true for the IR HSBG. The same result for Seyfert IR galaxies was marked by M i l e y and d e G r i j ρ [3].

The distribution of the absolute magnitude is shown in Fig. *3a.* According to Veron-Cetty M. & P. Veron [9] criteria at least 7 HSBG are QSOs. All they have M Hol -23.0. At the same time no one of the normal galaxies exceeded that limit,

The similar histogram for the distribution of the linear diameters of the two samples is presented in Fig. *3b.* In spite of their compactness amongst HSBG there are really supergiant objects with diameters D>80 kpc worthy to be studied in the future.

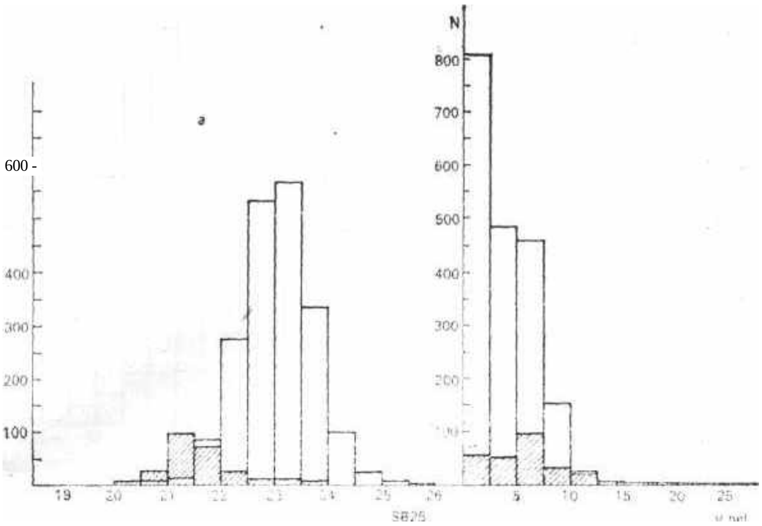

Fig. 2

As a whole 30 objects are with diameters >30 kpc —a value larger than the average and median for CfA normal galaxies.

Eventually in Fig. *3c* we present the histogram of the blue luminosities of the two samples. Remember that *LbI~nuF(4400)*

(7) Lg FbI=-7.43-m/2.5 (watt/sqr.m)

(8) Lg Lbl = 53.28+ 2LgV_hel + Lg Fbl (watt)

5. Conclusions. Statistically is shown that the High Surface Brightness Galaxies are a homogeneous group with different average parameters from the ones of the normal galaxies. The main differences are:

The normal galaxies have lower luminosities and larger diameters than HSBG ones.

The HSBG are further in average.

Table 1

Average parameters for the high surface brightness and normal galaxies

Objects	VJiel	m_cor	m_Zw	D_kpc	M_Holm	SB_25	Lg_Lb	Lg-Fbl	Lg-D	B_Akn
Akn-IR <X>	5.72	13.62	14.18	13.55	—20.28	21.39	36.44	—13.21	4.07	21.68
(I49) sigma	3.23	1.09	1.09	6.61	1.29	0.46	0.50	0.44	0.26	0.32
Akn + z < X >	6.37	13.85	14.45	17.23	—20.20	21.64	36.40	—13.32	4.11	21.64
(277) sigma	4.41	1.04	1.01	15.63	1.58	0.72	0.61	0.40	0.35	0.35
med	5.70	14.02	14.70	13.28	—20.37	21.52	36.47	-13.42	4.12	21.70
Cfa <X>	3.82	12.86	13.60	27.65	—19.99	23.06	36.22	—12.98	4.35	
(1939) sigma	2.65	0.96	0.94	16.48	1.61	0.67	0.63	0.38	0.32	—
med	3.24	13.13	13.90	24.78	-20.31	23.06	36.35	—13.10	4.3o	
t_2214	0.87	1.020	0.895	0.636	0.130	2.099	0.286	0.888	0.740	---

TabI: alpha 0.900 0.950 0.975 0.990 t
2214 1.28 1.65 1.96 2.33

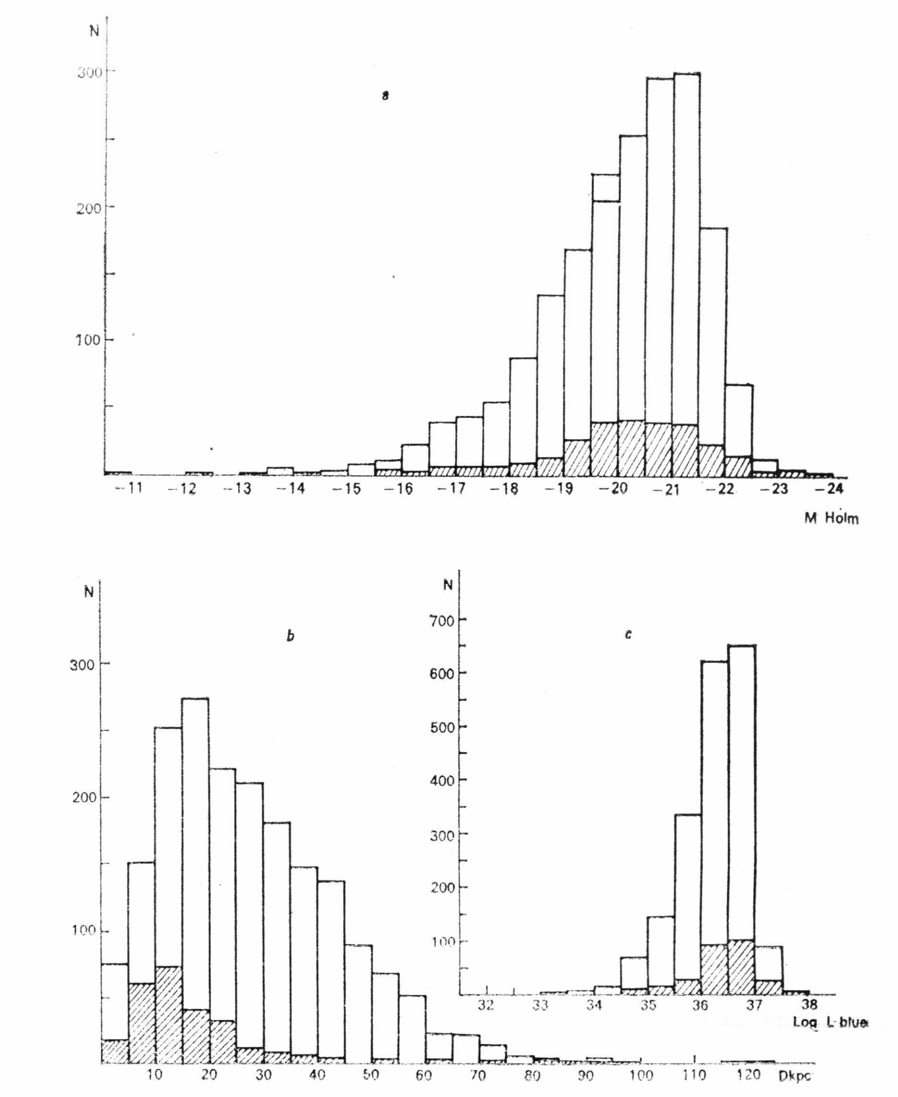

Fig. 3

IR luminosities are more common for the more compact objects.
Amongst CfA normal galaxies there are new 93 objects with high surface brightness, i. e. SB_25< =22.0.

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