

Research Note

Distance to the spiral galaxy NGC 6503 situated in the Local Void

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Abstract. Based on photometry of the brightest stars in the galaxy NGC 6503 we derive its distance to be 5.2 Mpc. Being located within the Local Void, NGC 6503, as well as the other isolated spiral NGC 6946, has a significant (~ 100 km/s) peculiar velocity toward the observer.

Key words: galaxies: distances – galaxies: individual: NGC 6503 – galaxies: stellar content

1. Introduction

Following the program of measurement of distances to ~ 200 nearby galaxies with radial velocities $V_0 < 500$ km/s (Karachentsev, 1994), we present here an estimate of photometric distance to the galaxy NGC 6503. According to the Reference catalogue (de Vaucouleurs et al., 1991 = RC3) this spiral of Sc type has a total apparent magnitude $B_T = 10.94$, and a standard angular diameter $D_{25} = 7.0$ arcmin. In spite of the low value of the measured radial velocity, +25 km/s (Begeman, 1987), the galaxy still remains without a direct distance estimate.

Like NGC 1156 (Karachentsev et al., 1996), NGC 6503 is one of the most spatially isolated galaxies in the Local universe. It is N° 873 in the Catalog of Isolated Galaxies by Karachentseva (1973). Peebles (1990) notes that two bright spirals, NGC 6503 and NGC 6946, are situated inside the so called “Local Void” that occupies a volume of ~ 10 Mpc in diameter (Tully, 1988). According to Peebles, such very isolated galaxies may have an unusual structure and peculiar velocity. However, the observations of NGC 6503 in HI and H_α lines (van Moorsel & Wells, 1985, Weavers et al., 1986, Begeman, 1987, Karachentsev & Petit, 1990) reveal no significant anomalies of its kinematics and structure as compared to other spiral galaxies. It is interesting to point out that a special survey undertaken on POSS-II films by Karachentseva & Karachentsev (1997) led to the discovery of three dwarf galaxies which turned out to be physical companions of the spiral NGC 6946 (Huchtmeier et al., 1997). However, the

same survey finds no companions around NGC 6503 except for one faint object (1754.4 +7008) with unknown radial velocity.

2. Observations

Photographs of NGC 6503 in the B and V bands were obtained on October 27, 1984 and July 3, 1986 at the prime focus of the 6 meter telescope with a seeing of FWHM=1.5 arcsec. A reproduction of the blue one is presented in Fig. 1. Later (on July 9, 1994 and March 5, 1995) at the same telescope with a CCD camera we observed two parts of the galaxy indicated in Fig. 1 with rectangles. The south-eastern side of the galaxy was imaged in the B, V, R bands of the Johnson-Cousins system with a matrix of 1160×1040 pixels. Frames for the opposite side of NGC 6503 were obtained with a matrix of smaller size, in the V, R bands only. In each case the seeing was ~ 1.5 arcsec. To provide a photometric calibration we observed the equatorial standard stars from Landolt (1992). A frame of the SE-side of the galaxy in R band is shown in Fig. 2.

The images were processed with the MIDAS package. The results of aperture photometry for 55 the bluest and the reddest stars in the SE-area are presented in Table 1. Its columns contain: (1) – the star number, (2), (3) – its rectangular coordinates, directed as indicated in Fig. 2, (4) – apparent V magnitude, (5), (6) – color indices.

3. The distance estimate

Fig. 3 reproduces a “color–magnitude” diagram derived from the data of Table 1. As the brightest blue supergiant candidates we selected the stars: 13, 15, and 10, excluding the star 52 as a likely foreground one. Their apparent magnitudes and colors are: $\langle B(3B) \rangle = 20.16$ mag, $\langle B - V \rangle = +0.16$, and $\langle V - R \rangle = +0.13$.

It is known that the luminosity of the brightest blue stars in a galaxy correlates with its integral luminosity (Sandage & Tamman, 1974, de Vaucouleurs, 1978). To estimate the distance modulus we use the relation

$$(m - M)_0 = 1.51 \cdot \langle B(3B) \rangle - A_B - 0.51 \cdot B_T + 4.14,$$

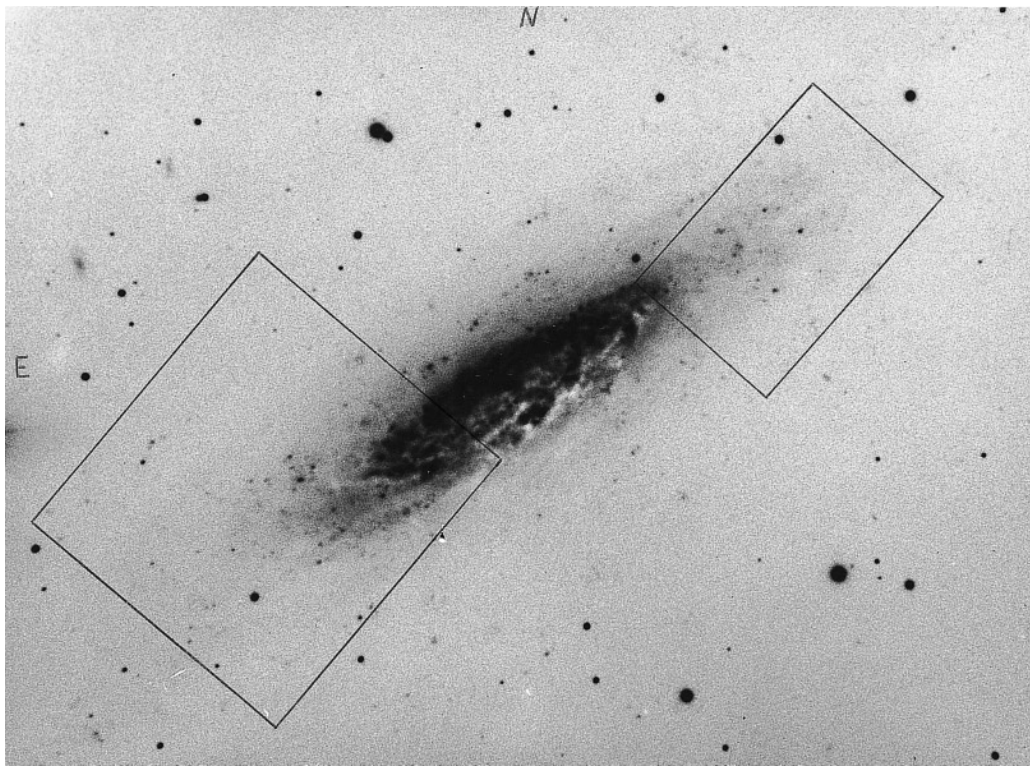


Fig. 1. A reproduction of NGC 6503 from the 6-meter telescope plate in B band. Two rectangles show the CCD frame location.

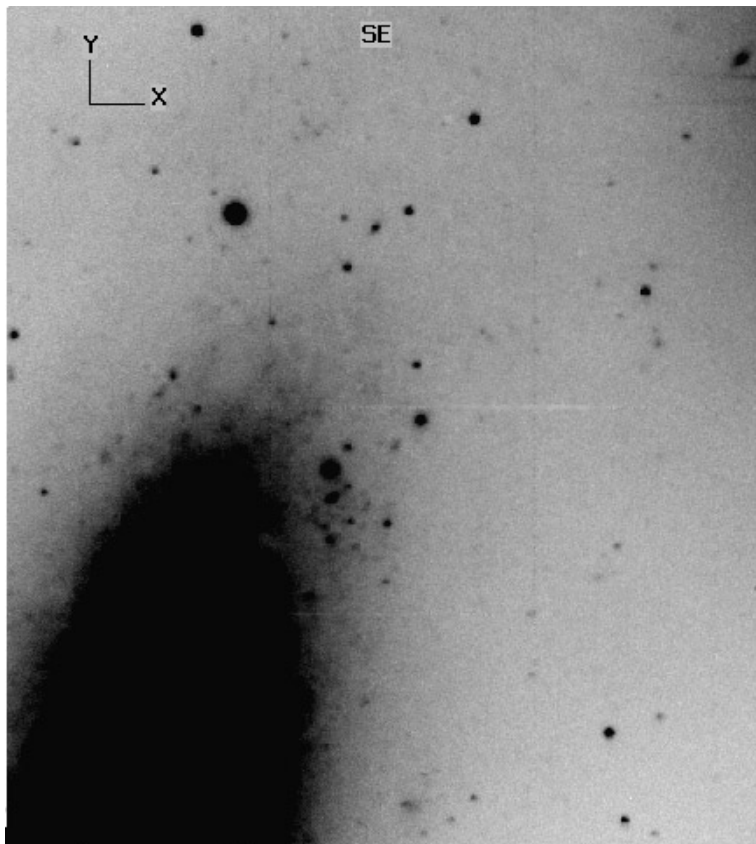


Fig. 2. The south-eastern side of NGC 6503 imaged with the CCD in R band. South-east is at the top. Directions of the X, Y coordinates are indicated.

Table 1. Photometry of the stars in NGC 6503

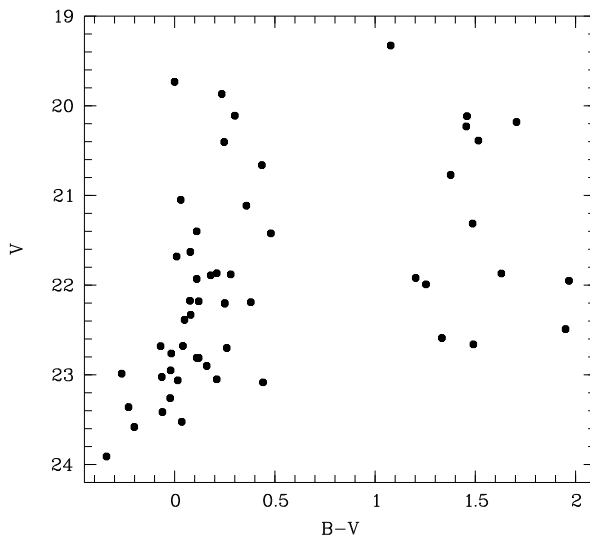
N	X	Y	V	B-V	V-R	N	X	Y	V	B-V	V-R
1	3.8	101.8	23.36	-0.23	-0.11	29	59.0	18.7	22.68	-0.07	0.02
2	7.1	65.8	21.87	1.63	1.05	30	59.7	57.1	21.05	0.03	-0.21
3	10.1	35.0	21.88	0.28	-0.22	31	59.8	70.1	20.18	1.71	0.78
4	10.4	23.7	21.89	0.18	-0.05	32	62.3	116.6	22.66	1.49	1.29
5	10.6	38.5	21.40	0.11	-0.21	33	63.0	74.2	21.92	1.20	0.80
6	12.1	33.3	22.21	0.25	0.22	34	66.3	84.8	22.99	-0.26	-0.10
7	13.8	38.7	22.33	0.08	0.10	35	66.4	27.1	22.39	0.05	0.08
8	14.1	60.1	22.90	0.16	0.07	36	69.1	74.8	22.70	0.26	-0.20
9	14.4	107.2	23.26	-0.02	-0.04	37	69.2	14.8	23.41	-0.06	-0.21
10	19.4	20.0	20.40	0.25	0.16	38	70.3	60.1	20.66	0.44	0.10
11	21.8	57.7	21.42	0.48	0.19	39	74.1	133.8	23.91	-0.34	-0.04
12	22.0	61.0	22.19	0.38	0.26	40	74.1	20.9	23.05	0.21	-0.02
13	22.2	25.9	19.73	-0.00	0.11	41	74.2	117.8	20.77	1.38	0.86
14	27.5	125.3	21.99	1.25	0.90	42	75.6	89.4	21.95	1.97	1.53
15	28.4	47.3	19.87	0.24	0.12	43	76.4	79.2	20.39	1.52	0.69
16	35.3	81.3	21.63	0.08	-0.07	44	80.8	134.2	22.81	0.11	-0.24
17	35.4	151.0	19.33	1.08	0.64	45	86.1	134.9	20.12	1.46	0.88
18	40.7	65.7	21.11	0.36	0.23	46	87.7	95.6	22.68	0.04	0.02
19	42.5	55.5	22.20	0.25	0.03	47	92.1	119.1	23.06	0.02	-0.31
20	44.6	23.3	21.93	0.11	-0.04	48	94.1	17.6	23.58	-0.20	-0.31
21	46.6	15.3	23.02	-0.06	0.13	49	111.0	21.5	20.23	1.45	1.03
22	50.5	6.8	22.81	0.12	0.19	50	113.8	5.2	21.31	1.49	1.10
23	50.6	84.7	23.08	0.44	0.20	51	113.8	75.6	23.52	0.04	-0.11
24	51.3	150.4	21.87	0.21	0.01	52	117.7	102.9	20.11	0.30	-0.06
25	53.5	131.3	22.76	-0.02	-0.29	53	119.0	107.7	22.59	1.33	0.88
26	55.0	145.2	22.18	0.12	-0.06	54	119.6	95.9	22.95	-0.02	-0.25
27	55.6	46.7	22.49	1.95	1.22	55	120.2	93.4	21.68	0.01	-0.09
28	57.3	80.6	22.17	0.08	-0.14						

whose parameters have been calibrated by Karachentsev & Tihkonov (1994) from the galaxies with Cepheid distance estimates and members of the nearby groups. It should be noted that our photometry of stars in the NW-area, as well as the blinking of B,V plates did not reveal brighter blue stars throughout the galaxy body. Therefore, adopting the above mentioned values of $\langle B(3B) \rangle$ and B_T , we derive $(m - M)_0 = 29.01 - A_B$. Based on galactic HI column density Burstein & Heiles (1984) obtained a galactic extinction $A_B = 0.14$ mag. However, the total colour of NGC 6503 presented in RC3 as well as the mean colour of the brightest blue stars suggest a larger extinction $A_B = 4.3 \times E(B - V) = 0.73$ mag. With the mean of two estimates, 0.44 mag, we get the modulus 28.57 mag or $D = 5.2$ Mpc.

The situation with the brightest red stars of the galaxy looks rather uncertain. For three stars (31,2,42) with colors $(B - V) > +1.6$ their mean apparent magnitude amounts to $\langle V(3R) \rangle = 21.33$, that gives us a modulus of 28.70 mag at $M_V(3R) = -7.7$ (de Vaucouleurs, 1978). However, the standard error of the mean apparent magnitude for them is too large (± 0.56 mag), to attach any significance to this estimate.

4. Conclusions

Detailed investigations of NGC 6503 in the HI line by Bege-man (1987) show that the galaxy has the usual flat rotation curve, which extends 3.7 times beyond the standard op-

**Fig. 3.** The V vs $(B - V)$ diagram for the measured stars.

tical radius. According to its total mass-to-luminosity ratio, $M_T/L_B = 2.3M_\odot/L_\odot$, and also the fraction of hydrogen mass, $M_{HI}/M_T = 0.14$, the galaxy seems an ordinary late type spiral. This is why one may expect that the application of the Tully-Fisher (1977) method to it should give a reliable distance estimate. Actually, the Tully-Fisher distance modulus for NGC

6503 (Bottinelli et al. 1985) is 28.58 mag, in good agreement with the photometric modulus.

However, NGC 6503 is distinguished by its peculiar velocity. With respect to the Local Group centroid its radial velocity corresponds to $V_0 = +281$ km/s. Adopting a local value of the Hubble parameter $H = (75 \pm 10)$ km/s/Mpc, and the distance 5.2 Mpc we derive for NGC 6503 a peculiar velocity $V_{\text{pec}} = (-109 \pm 60)$ km/s. According to Sharina et al. (1997) another spiral, NGC 6946, situated in the Local Void, has a distance of (6.2 ± 0.5) Mpc and a corrected radial velocity $V_0 = +354$ km/s, which yields a peculiar velocity of (-110 ± 60) km/s. Thus, the two bright spirals, remarked by Peebles (1990) have a significant non-Hubble component of velocity, directed from the Local Void centre towards us. These new data back up the arguments of Karachentsev & Makarov (1996) in favour of an anisotropy of the local Hubble flow.

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