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THE PECULIAR EXTRAGALACTIC SYSTEM NGC 6438

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ABSTRACT

The peculiar interacting system NGC 6438 has been investigated at the Cerro Tololo Inter-American Observatory. It is shown that the irregular component and the S0 component have about the same redshift velocity of +2400 km s^{-1}, so that the large velocity differences originally reported by Sersic are not confirmed.

I. INTRODUCTION

Photometric and spectroscopic observations of the pair of interacting galaxies, NGC 6438, were published by Sersic (1966, 1968*a*). He drew attention to the remarkable appearance of the irregular component of the pair; the object is also shown in the Atlas of Southern Galaxies (Sersic 1968*b*). (Note that the orientation marked in the Atlas should be turned through 90°.) The main regions delineated by Sersic are the S0 component, the north and south "arms" of the irregular object, and a region "a," reddish in color, lying SE of the S0 component. The latter, being centrally placed in the irregular, appears to be its nucleus.

The most unusual feature of NGC 6438 reported by Sersic was that he measured many different redshifts in different parts of it, ranging from +2550 to +6650 km s^{-1}. The mean redshift tabulated in Sersic's Atlas is +4300 km s^{-1}. His conclusion was that the S0 galaxy had a redshift of +6300 km s^{-1}, the north arm of the irregular component had a mean redshift of +2680 km s^{-1}, and region "a"—the nucleus of the irregular—had a redshift of +4300 km s^{-1}. Though no details have been published, it has been reported that observations made in Australia do not confirm these results (Sandage 1971). In view of the importance of the phenomenon of large redshift differences in small groups of extragalactic objects, we have carried out an independent investigation with the 60-inch telescope at the Inter-American Observatory on Cerro Tololo. The object lies close to the South Pole, and for this reason guiding at the Newtonian focus of the Cordoba 60-inch telescope was reported by Sersic to be rather awkward. No such difficulty occurred, however, at the Cassegrain focus of the Cerro Tololo 60-inch.

II. OBSERVATIONS

Four spectrograms were obtained with the Cassegrain spectrograph attached to the 60-inch telescope. The Schmidt camera and Westinghouse image-tube combination, put into operation by Drs. Malcolm Smith and Patrick Osmer, was used, with Eastman Kodak II aD plates. Two gratings were used, one (number 35) blazed at 6750 Å in the first order, and the other (number 26) blazed at 4000 Å in the first order. These gratings give, respectively, dispersions of about 196 Å mm^{-1} at 6000 Å and 193 Å mm^{-1} at 4000 Å with the camera used.

In addition, two direct photographs were taken at the Cassegrain f/7.5 focus, on Eastman Kodak 103 aO emulsion with exposures of 60 and 20 minutes. The longer-exposure photograph is reproduced in Figure 1 (Plate 3). As was pointed out by Sersic,

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PLATE 3

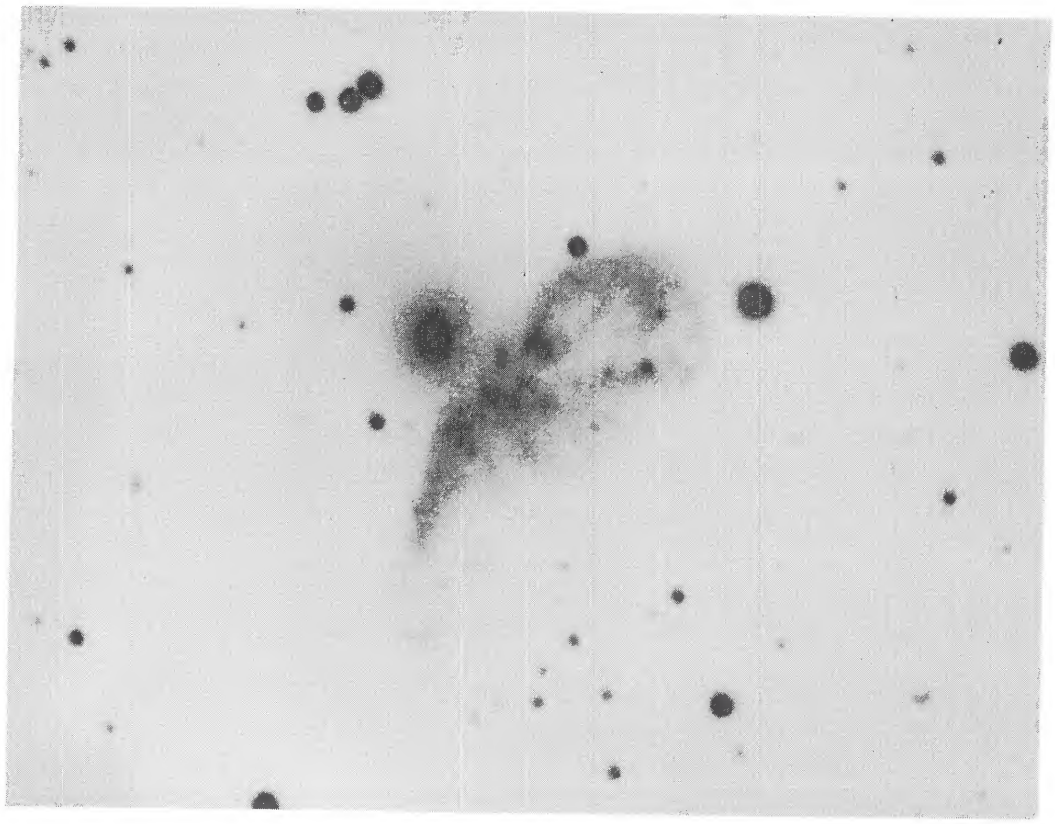

FIG. 1.—NGC 6438, photographed at Cassegrain focus of 60-inch telescope at Cerro Tololo. Eastman Kodak 103 aO emulsion, no filter, 60-min exposure. Scale: 1 mm = 2″.6. North at top, east at right. Note arcs of H II regions in irregular component.

the irregular component of NGC 6438 is very peculiar; details of its structure show more clearly in this Cerro Tololo plate than in previously published pictures.

Spectra of the irregular member of the pair of galaxies were obtained with the slit set in P.A. 47°, through the longest extension of the irregular, and south of the elliptical. This orientation was not covered spectroscopically by Sersic, but his orientation in P.A. 90°, through the elliptical, intersects it across the northern arm. Our best plate shows an inclined Hα emission line extending over about 1′; weaker [N II] λ6583 can be seen in the region where Hα is strongest. The ratio of the line intensities is about 3:1, Hα being the stronger; this is the normal spiral-arm intensity ratio (Burbidge and Burbidge 1962; Burbidge, Gould, and Pottasch 1963). The velocities measured from Hα are plotted in Figure 2. The velocity gradient is quite large.

Two spectra were taken with the slit through the S0 component; the best one was taken with the blue-blazed grating and the slit in P.A. 135°, cutting through the bright area of the irregular lying southeast of the S0 galaxy (Sersic's region "a"). The spectra in P.A. 47° missed this region. The spectra in P.A. 135° showed absorption lines of Ca II, the G-band, and the Na I D-lines (blended), all in the S0 galaxy, while Sersic's region "a" showed [N II] λ6583 at about the same redshift, and no Hα. This latter feature has been found to be characteristic of the nuclear regions of many spiral galaxies and practically all E and S0 systems in which nuclear emission features are seen (Burbidge and Burbidge 1965). It seems reasonable to suppose that region "a" is the nucleus of the irregular system; the colors measured by Sersic also support this interpretation.

The redshifts which we have measured in different parts of the system are listed in Table 1.

III. DISCUSSION

Sersic found evidence for large velocity differences, with peaks at +6300, +4300, and +2680 km s^{-1} located in the S0 component, the region "a" of the irregular, and the

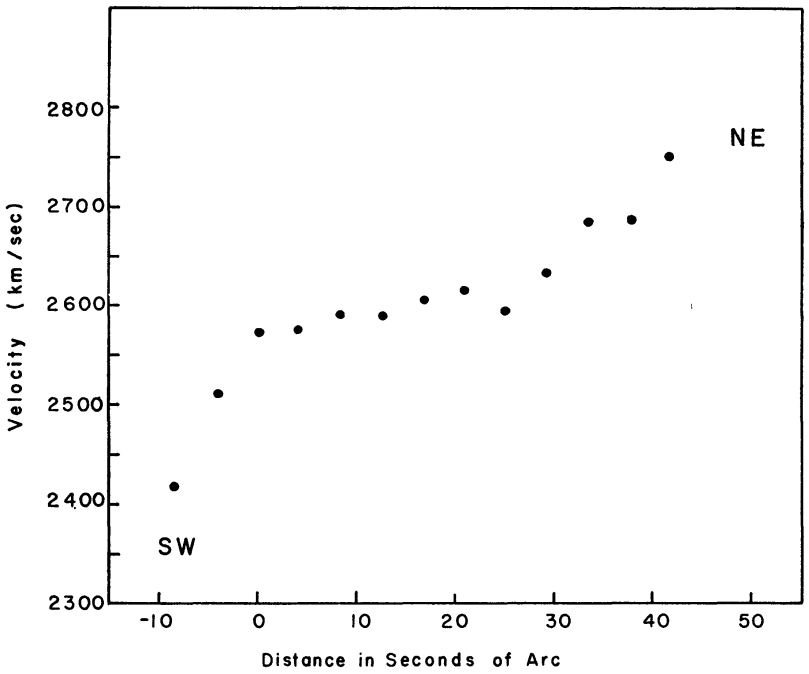

FIG. 2.—Velocities measured in Hα in P.A. 47° through longest extension of irregular component. Zero point of abscissa is SW edge of region of strongest continuum seen on spectrum. Velocities are uncorrected for rotation of our Galaxy.

TABLE 1

VELOCITIES IN NGC 6438

Component	Lines Measured	Velocity [km s^{-1}]
S0 galaxy . . .	H, K, G, D blend	+2522
Nucleus (region "a") of Irregular . .	[N II] λ6583	+2596
Arms of Irregular	Hα	+2600

north "arm" of the irregular, respectively. However, we find no evidence for either of the two larger velocity components. Also, we could find no evidence for gas in the S0 component. In particular we could not see the broad emission features which Sersic identified as Hα, [Ne III] λ3868, and [O II] λ3727 at a redshift of +6300 km s^{-1}. The line [O II] λ3727 at ∼+2600 km s^{-1} redshift could, however, be present; the image-tube camera falls off steeply in sensitivity in the ultraviolet. Our spectra in P.A. 47° passed through part of the region covered by Sersic's spectra in position A from which he measured Hα at +6260 and +2550 km s^{-1} and [O I] λλ6300, 6364 at +2740 km s^{-1}. We saw only Hα and weaker [N II] λ6583 with the continuous velocity gradient shown in Figure 2.

We have thus been unable to confirm the large redshift differences announced by Sersic. It may be noted that in the similar object VV 117 (Burbidge and Burbidge 1959), in which an elliptical or S0 has a highly asymmetrical close companion, no large redshift differences are present. Apparently such differences are more likely to be present when the companion is a compact galaxy or QSO, as is the case for NGC 7603 (Arp 1971*a*) and NGC 4319 and Markarian 205 (Weedman 1970; Arp 1971*b*). No part of the irregular object in NGC 6438 is compact.

Finally, we conclude that the correct redshift for the system is +2573 km s^{-1}, or +2402 km s^{-1} corrected for a rotation of 250 km s^{-1} of our Galaxy, rather than the figure of +4225 km s^{-1} given by Sersic (1966). With H_o = 75 km s^{-1} Mpc^{-1}, this gives a distance of 32 Mpc, and using Sersic's combined m_{pg} = 13.0 and his adopted galactic absorption, we obtain M_{pg} = −19.7.

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REFERENCES

Arp, H. C. 1971*a*, *Ap. Letters*, **7**, 221.
———. 1971*b*, preprint.
Burbidge, E. M., and Burbidge, G. R. 1959, *Ap. J.*, **130**, 12.
———. 1962, *ibid.*, **135**, 694.
———. 1965, *ibid.*, **142**, 634.
Burbidge, G. R., Gould, R. J., and Pottasch, S. 1963, *Ap. J.*, **138**, 945.
Sandage, A. R. 1971, *Nuclei of Galaxies* (Study Week, Pontifical Academy of Sciences, Vatican City), p. 381.
Sersic, J. L. 1966, *Zs. f. Ap.*, **64**, 202.
———. 1968*a*, *Non-Stable Phenomena in Galaxies*, I.A.U. Symposium No. 29 (Acad. Sci. Armenian SSR, Yerevan), p. 403.
———. 1968*b*, *Galaxias Australes* (*Obs. Astr. Cordoba*), p. 54.
Weedman, D. W. 1970, *Ap. J.* (*Letters*), **161**, L113.