NUCLEUS OF NGC 2903

(Letter to the Editor)

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Abstract. The nucleus of NGC 2903 is identified on near infrared photographs. The energy distribution of this nucleus in the visual region of the spectrum is estimated from available observations. The continuum compares well with the nuclei of Seyfert galaxies, but is weaker by one to two orders of magnitude.

1. Introduction

Sandage (1961) has enumerated eight knots in the central region of the spiral galaxy NGC 2903. Véron and Sauvayre (1965) suggest that the knot located 'at the intersection of the bar and the H-α spiral arm' is the nucleus of the galaxy. Most of the published photographs are overexposed in their central regions. A useful photograph is presented by Oka *et al.* (1974) (see also Turnrose, 1976; Osmer *et al.*, 1974). The brightest knot on the blue plates designated 'c' by the above authors is generally taken to be the nucleus of the galaxy (see, for example, Simkin, 1975). Simkin finds, however, that the dynamical centre lies 4 arc sec north-east of this knot from a rotation curve in the position angle of 29°. On the other hand, Oka *et al.* (1974) note the existence of a 'bright region' between the knots 'c' and 'd' (their designation) on prints of red plates obtained by Lynds. This position lies 4 arc sec north-east of the knot 'c' at a position angle of ~18°. The infrared photographs of Oka *et al.* (1974), however, did not show the details due to the lower resolution and poor visibility.

2. Identification

As part of an observational programme on the central regions of Sersic–Pastoriza galaxies (Prabhu, 1979), we have obtained high-resolution photographs of the central region of NGC 2903. The photographs, obtained using a Varo 8605 image tube and Kodak II-aD plates, have an image scale of 16 arc sec mm^{-1}. The unfiltered photographs cover a range 4000–8700 Å. The blue region was isolated using a 2 mm filter on a Schott BG 12, and the infrared region by a Wratten 89B. Also, a photograph was obtained with an Hα interference filter of 46 Å width at half intensity of the transmission band. The brightest knot in the infrared is ~2 arc sec (Figure 1) and lies at the position between 'c' and 'd' at a distance of 4 arc sec from 'c'. It is not seen in the blue. All the knots, except the infrared knot, appear in the Hα picture. Diffuse Hα

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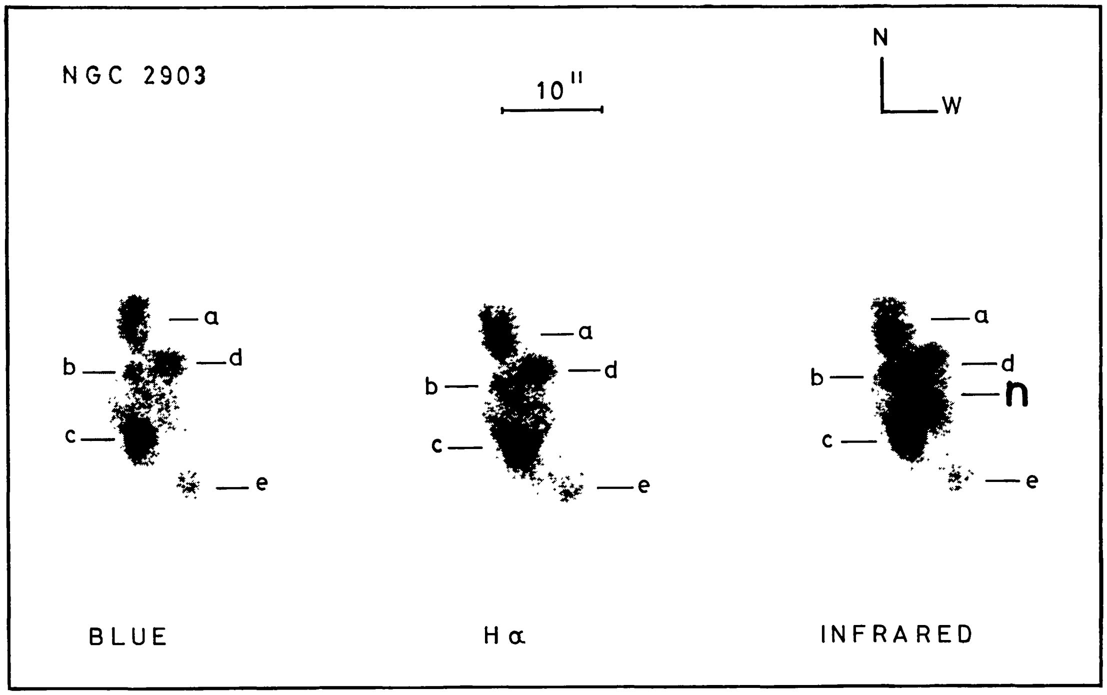

Fig. 1. The contrast prints of the central region of NGC 2903 in the blue light, in the Hα line and in the infrared. The nucleus is marked by the letter 'n' in the infrared picture. The other designations are those of Oka *et al.* (1974).

emission is, however, present between all the knots and also at the position of the infrared knot. The congruence of the infrared knot with the dynamical centre as well as the geometrical centre of the pairs (c, d), (b, f) and (a, e) identifies this knot with the true nucleus of NGC 2903 (cf. Figure 2).

3. Energy Distribution

The extreme red colour of the nucleus of NGC 2903 agrees well with the observations of other Sersic–Pastoriza galaxies (Prabhu, 1979). The contributions of the nucleus of NGC 2903 to the photometry of Tifft are obvious in his observation (Tifft, 1969) that 'within 10 arc sec the ultraviolet continues to rise while the longer wavelengths turn redder again'. With the aperture centred on knot 'c', and including the nucleus, the observations show an ultraviolet enhancement due to the former and a red enhancement due to the latter. This contribution led Tifft (1963) to add M2 giants to his model of the nuclear region of NGC 2903.

Two sets of photoelectric observations of the central region of the galaxy enable us to evaluate the spectrum of the nucleus. Alloin (1973) has scanned the spectrum with an aperture of 10 arc sec diameter centred on knot 'c'. The aperture thus barely includes the nucleus. Turnrose (1976) has scanned the spectrum with an aperture of 7 arc sec centred again on knot 'c'. This aperture nearly excludes the nucleus. Subtracting the observations of Turnrose from those of Alloin, we obtain a spectrum of

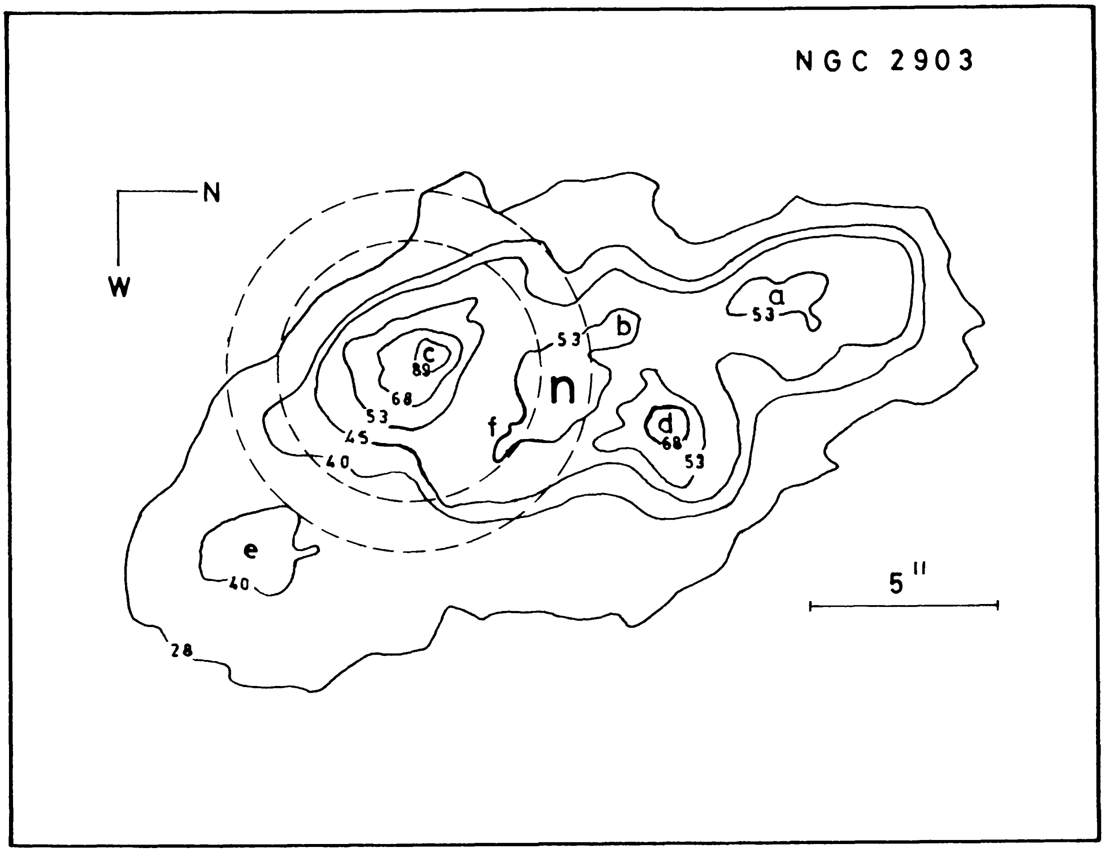

Fig. 2. The equal intensity contours of the central region of NGC 2903. The intensities marked are relative to the peak of knot 'c'. The designations are those of Oka *et al.* (1974) except for the nucleus (n). The smaller dashed circle is the aperture used by Turnrose (1976) while the bigger one that of Alloin (1973) in their respective spectrophotometric observations.

the annular region of 8.5 arc sec diameter and 1.5 arc sec width (Figure 2). The most prominent constituent of this annulus in the red region is the nucleus. The remaining part of the annulus may contribute in the blue and the ultraviolet. The Balmer continuum is clearly present in the spectrum shown in Figure 3. It is probably emitted by the entire annular region, as is seen in the Hα photograph. We also add an infrared point ($\sim$8000 Å) based on our observation (Prabhu, 1979) that the nucleus is 0.9 mag brigher in the infrared than knot 'c' compared to the blue ($\sim$4250 Å).

The spectrum in Figure 3 has a spectral index of 2.23 $\pm$ 0.04 (s.e.) between $\lambda\lambda$ 6500–3700. It may steepen if we account for the contribution of the non-nuclear region of the annulus to the blue region. On the other hand, the 10 and 21 μ fluxes measured by Rieke and Low (1972), which most likely originate in the nucleus, are too low for this spectral index. The spectral index between 10 μ and 6500 Å is 0.75. The entire spectrum strongly resembles, however, the synthetic continua of Neugebauer *et al.* (1976) for the nuclei of Seyfert galaxies and, in particular, their observations of Markarian 34. The contribution of dust at $\sim$200 K to the red continuum of the nucleus of NGC 2903 could be significant. Observations with a 3 arc sec aperture centred on the nucleus

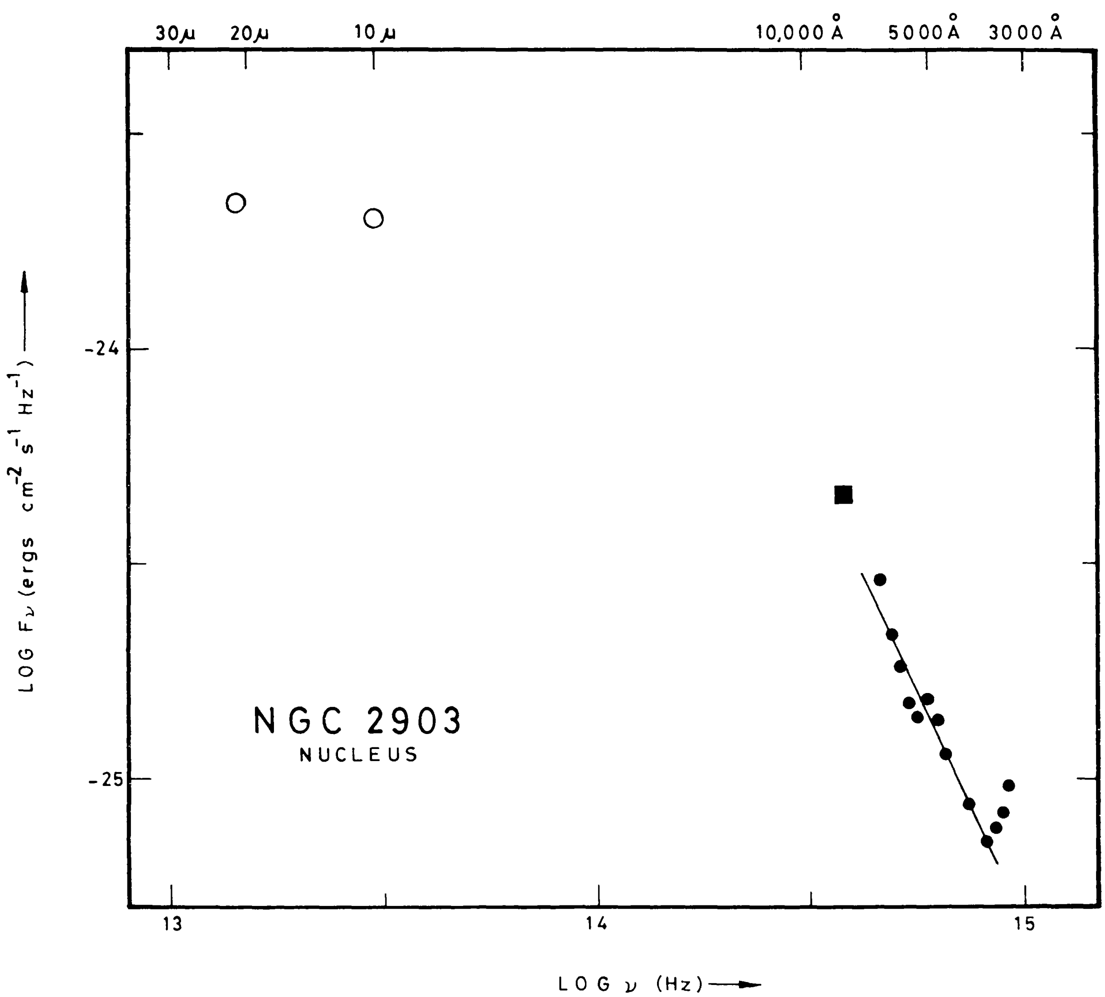

Fig. 3. The spectrum of the nucleus of NGC 2903. The straight line is a least-squares fit to the points (dots) obtained by subtracting the observations of Turnrose (1976) from those of Alloin (1973). The 10 and 21 μ observations of Rieke and Low (1972) (open circles), and the 8000 Å observations of the present investigation (filled square), are also shown.

and covering the range of 0.3–10 μ are desirable for a detailed comparison with the synthetic models.

4. Discussion

The structure of the knot 'c', the nucleus and the knot 'd' in the central region of NGC 2903 compares well with the 3.75 cm sources G0.7–0.0, Sagittarius A, G0.6–0.1 (Downes and Maxwell, 1966) at the centre of our galaxy. Assuming a distance of 7.7 Mpc for NGC 2903, the separation c–d is 300 pc. The separation between the corresponding sources in the Galaxy is 200 pc. Thus the sizes of the two nuclear regions are comparable. The 10 μ luminosity of the nucleus of NGC 2903 is, however, 300 times stronger than the corresponding value for the nucleus of our Galaxy. The infrared luminosities of the nuclei of Seyfert galaxies are, on the other hand, 10 to 1000 times higher than the corresponding value for the nucleus of NGC 2903. Thus the nucleus of NGC 2903 is of an intermediate nature between the nuclei of Seyfert galaxies and the nucleus of the Galaxy. The relatively nearby position of NGC 2903 affords us good spatial resolution (1 arc sec = 40 pc). Thus a detailed study of the central region (nucleus, individual knots and the diffuse region) of NGC 2903 would assist both in an understanding of the nature of Seyfert nuclei and also of the nature of the galactic nucleus.

Acknowledgements

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