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KINEMATICAL STUDY OF G 339.2 – 0.4, S 216, AND THE ARC OF THE PLANETARY NEBULA NGC 3242

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RESUMEN

Este trabajo tiene como objetivo reportar los datos obtenidos mediante fotografías de banda angosta e interferometría de FP de las nebulosas G 339.2 – 0.4 y S 216 así como del arco nebular que probablemente esté asociado a la nebulosa planetaria NGC 3242. Los datos así obtenidos refuerzan las sugerencias hechas previamente de que G 339.2 – 0.4 y S 216 sean consideradas como nebulosas planetarias de gran diámetro aún cuando no se hayan identificado sus estrellas excitadoras. En cuanto al arco centrado en NGC 3242, éste parece estar físicamente asociado a la nebulosa planetaria puesto que ambos objetos tienen velocidades de conjunto similares. Más aún, aunque sea un resultado muy incierto, la velocidad de expansión de este filamento resulta ser inferior a la de la propia nebulosa planetaria.

ABSTRACT

The purpose of this work is to show narrow band filter photographs and FP velocity data on the nebulae G 339.2 – 0.4 and S 216 and on the nebulous arc presumably associated with the planetary nebula NGC 3242. These data give support to previous suggestions that G 339.2 – 0.4 and S 216 are two large diameter PN although no obvious exciting stars were found. On the basis of their similar systematic velocities the arc centered in NGC 3242 seems to be physically connected with that PN. Our results, although highly uncertain, show the expansion velocity of the filament to be lower than that of the PN.

Key words: NEBULA-PLANETARY — INTERFEROMETRY — INTERSTELLAR-MATTER

I. INTRODUCTION

Large diameter planetary nebulae (PN) appear to be uncommon among the known planetaries. Indeed, Weinberger *et al.* (1983) estimate that there are only 1% of PN with angular dimensions larger than 10 arcmin; however, more recent studies show that this number can be increased considerably by observations at higher sensitivities (Jewitt, Danielson, and Kupferman 1986). In fact, these objects are difficult to detect or to study because of their low surface brightness, which in addition, introduces the selection effect of observing large objects only when the reddening is low.

These objects have been poorly studied because most of the observers have concentrated their attention on smaller objects of high surface brightness and consequently existing studies on these are scanty (Abell 1966). This situation begins to change and there are now more studies of these objects (Kaler 1981; Schönberner 1981; Weinberger *et al.* 1983; Jewitt *et al.* 1986).

Two types of large diameter PN can be distinguished: single shell PN of large diameter and of low surface brightness and "common" PN surrounded by a faint halo of larger dimensions. The single shell large diameter PN often show high [N II] (λλ 6548, 6584 A)/Hα ratios (Aller 1976), and they have, in general, very faint exciting stars ($\overline{M}$ ranges from 1.2 to 10.9 magnitudes, with a mean M = 8.7 mag; Weinberger *et al.* 1983). This may be the reason why some of them were classified as common H II regions, supernova remnants (SNRs), etc. (see for example Rosado and Kwitter 1982). It is thought that these nebulae are quite old and consequently, they represent the latest observable stages in the evolution of PN, a circumstance which makes them very interesting objects for study. On the other hand, the PN with halos have, in general, an exciting star which is much brighter than the large diameter single shell PN ($\overline{M}$ = 5.2 mag). The proper PN are brighter while the halos are much fainter. Very often, the inner PN shell of these PN with halos, have several components (mostly double shell, etc.). It is believed that these nebulae are younger than the larger diameter single shell PN. Recently, Jewitt *et al.* (1986) have detected halos in 2/3 of a sample of 44 PN studied. This would imply that halos are more common that it was thought. The presence of halos around PN is important because their study should provide insight into the mechanism of formation of a PN.

In this work three such objects are studied: namely the "halo" of the PN NGC 3242 and two other nebulae which are presumed to be large diameter single shell PN, S 216 and G 339.1 – 0.4.

II. THE OBSERVATIONS

The material obtained is as follows: monochromatic filter photographs in the Hα, [S II] (λλ6717, 6731 A) and [O III] (λλ5007 A) lines and two Fabry-Pérot (FP) interferograms in the light of Hα of the nebula G 339.2 −0.4; one Hα photograph and one Hα interferogram of regions (of 30 and 11 arcmin of diameter respectively) of the nebula S 216 and monochromatic filter photographs in the light of Hα and [N II] (λ6584 A) and three Hα and [N II] interferograms of the arc which seems to be a part of a large halo around the PN NGC 3242. Tables 1 and 2 give information about the plate characteristics of direct photographs and interferograms respectively.

All our data were obtained using the 2.1-m and 84-cm Cassegrain focus telescopes of the Observatorio Astronómico Nacional at San Pedro Mártir, Baja California Norte, in the same way as described in Rosado (1983). The direct photographs have been obtained by means of a focal reducer (Snyder F/2 objective) coupled with a single stage image tube. Four interference filters have been employed: Hα (λ_0 = 6563 A, $\Delta\lambda$ = 10 A), [S II] (λ_0 = 6719 A $\Delta\lambda$ = 16 A), [O III] (λ_0 = 5018 A, $\Delta\lambda$ = 9.7 A) and [N II] (λ_0 = 6584 A, $\Delta\lambda$ = 10 A). The fiber optics output of the image tube was recorded on 103 a-G films. The scale and angular field of these photographs were about 49 arcsec mm^{-1} and 11 arcmin respectively for observations performed with the 2.1-m telescope and 2 arcmin mm^{-1} and 30 arcmin for observations performed with the 84-cm telescope.

The FP interferometry was carried out with the same equipment used for the photographs but with the addition of a FP étalon. The optical mounting of the étalon corresponds to the "focal reducer" type described in Monnet (1970). The FP étalon used in these observations –different to that used in Rosado (1983)– has a resolving power of 10600 and a linear dispersion of about 20 A mm^{-1}. The measurements and data reductions were performed in the standard way (Courtés 1960). Further description of the measurements and reductions can be found in Rosado *et al.* (1982).

Unfortunately, some of the rings are contaminated by the geocoronal Hα line and the atmospheric OH lines at λ6568.7, 6553.7 and 6577.0 A. Since these lines appear clearly separated from the nebular rings, they could be identified and eliminated.

TABLE 1

CHARACTERISTICS OF THE NARROW BAND INTERFERENCE FILTER PHOTOGRAPHS

Plate number	Region	Filter	Exposure Time (min)	Telescope (mts)
SN 181	G 339.2 − 0.4	Hα	40	2.1
SN 189	G 339.2 − 0.4	[S II]	40	2.1
SN 191	G 339.2 − 0.4	[O III]	40	2.1
SN 143	S 216	Hα	60	.84
SN 300	Halo of NGC 3242	Hα	45	2.1
SN 301	Halo of NGC 3242	[N II]	45	2.1

III. THE INDIVIDUAL NEBULAE

a) *G 339.2 − 0.4*

The nebulosity discovered on the "Mathews Extension" to the Palomar Observatory Sky Survey (*POSS*) plates is described as an arc 6 minutes in diameter (Clark, Caswell, and Green 1975) and it is associated with the radio source G 339.2 − 0.4 of flat spectrum (α = −0.2. The deep red photographs of Zealey, Elliot, and Malin (1979) revealed a complete shell of emission of 6 arcmin in diameter which was thought to be the optical counterpart of a SNR of plerionic type, although van

TABLE 2

CHARACTERISTICS OF THE FP INTERFEROGRAMS[a]

Plate number	Region	Approximate 1950 Coordinates of the Centers		Filter	Exposure Time (min)
SN 310	G 339.2 − 0.4	$16^h41^m50^s$	− 46°04′	Hα	75
SN 318	G 339.2 − 0.4	$16^h41^m50^s$	− 46°04′	Hα	60
SN 250	S 216	$4^h40^m50^s$	+ 46°50′	Hα	60
SN 312	Halo of NGC 3242	$10^h21^m50^s$	− 18°28′	Hα	75
SN 313	Halo of NGC 3242	$10^h21^m50^s$	− 18°28′	[N II]	60
SN 316	Halo of NGC 3242	$10^h21^m50^s$	− 18°28′	[N II]	75

a. Interference Order at Hα = 1060. Telescope: 2.1-m.

den Bergh (1978), on the basis of its diffuse morphology, has discarded the SNR hypothesis and has suggested that this nebula could be a PN.

Murdin, Clark, and Haynes (1979) have investigated the radio and optical properties of this source; they confirm the spectral index $\alpha \cong -0.2$ and they obtain also red and blue spectra of the brightest portion of the nebula. These latter data suggest that the nebula could be a low excitation PN. However, Murdin *et al.* (1979) could not rule out the plerionic-SNR hypothesis due to the lack of kinematical observations. Unfortunately as they did not calibrate the red and blue spectra they could not obtain the reddening from the Balmer decrement.

Our monochromatic photographs in Hα, [S II] and [O III] (Figure 4, Plate) confirm the low values of the [S II]/Hα and [O III]/Hβ line-ratios obtained by Murdin *et al.* (1979) on the brightest portion and extend these conclusions to the whole nebula.

Two FP interferograms in Hα were also obtained. The heliocentric radial velocities are displayed in Figure 1. From these data it can be seen that the nebula does not show any violent motion (such as splittings of the FP profiles) which could support the plerionic-SNR hypothesis. Consequently, the kinematical data seem to confirm the suggestion that G 339.1 −0.4 is a low excitation PN and, in agreement with Bohuski and Smith (1974), that some large diameter PN have unusually low intrinsic velocities of expansion (from 40 to < 10 km s^{-1}). In addition, with the present data, the systemic velocity of the nebula is V_c (LSR) ≅ −28±6 km s^{-1}.

In the radial velocity field shown in Figure 1 one can appreciate a tendency of the points of the SW zone to have higher velocities than those of the rest of the nebula. However, the zone of low velocities is not so well defined in order to establish a reliable pattern. It should be interesting to have more data points in order to confirm or reject this suggestion.

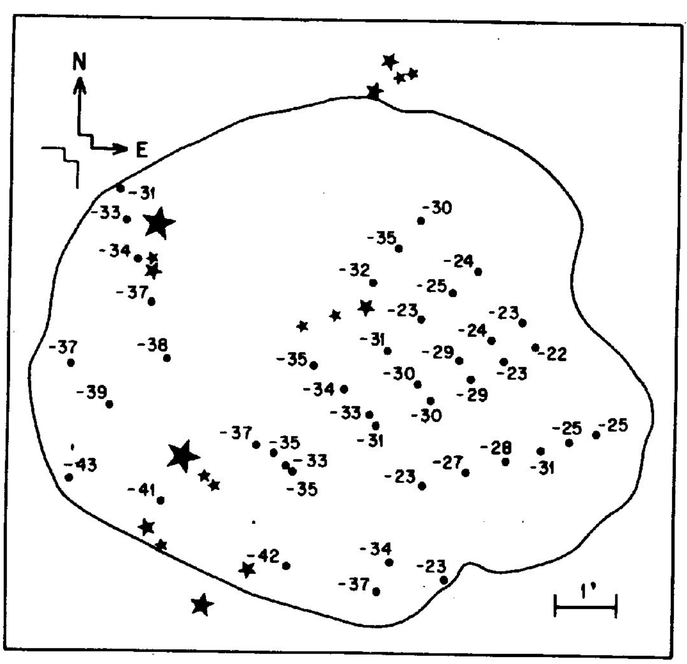

Fig. 1. The heliocentric radial velocity field of G 339.2 − 0.4.

The [S II] λλ6717/6731 line-ratio deduced from the optical spectra (Murdin *et al.* 1979) implies an electron density, n_e, varying from 400 to 2100 cm^{-3} with a mean value of about 1000 cm^{-3}, if an electron temperature of 10^4 °K is assumed and Pradhan (1978) cross sections are used. Furthermore, by using the derived value of n_e and the value of the radio flux at 5 GHz quoted by Murdin *et al.* (1979), $S_{5\ GHz}$ = 4.5 Jy, one can obtain the product of the distance (in pc), d, and the fraction of the volume which radiates, ε, as follows (Milne and Aller 1975):

$$d\epsilon = 1.7 \times 10^{13} \frac{S}{\theta^3\ n_e^{\ 2}} \qquad (1)$$

where S is the 5 GHz flux in Jy, θ, the angular radius in arcsec and n_e the electron density in cm^{-3}. In obtaining the relation (1) it was assumed that the fraction of He to H, y = 0.11, that all the He is singly ionized and that T_e = 10^4 °K. By substituting the values corresponding to this nebula: S = 4.5, θ = 180 and n_e = 1000, one obtains dε ≅ 13 pc.

For values of ε typical of PN (∿ 0.6) one obtains a short distance to this nebula. If this were the case, the exciting star should be easily identifiable which is not the case (see below). On the other hand, another estimate of the distance −or of ε− can be inferred if one assumes that the mass of the nebula (supposed to be a PN) is about 0.2 M$_\odot$ (Shklovski method). Thus, under the assumptions of abundances made above:

$$M = (1.3)\ 4/3\ \pi R^3\ n_e\ \overline{m}_H\ \epsilon \text{ cgs units} \qquad (2a)$$

$$= (1.3)\ 4/3\ \pi\ \theta_r^3\ d_{cm}^3\ n_e\ \overline{m}_H\ \epsilon \text{ cgs units} \qquad (2b)$$

where $R = \theta_r\ d_{cm}$ is the linear radius of the nebula (in cm), θ_r the radius in radians and d_{cm} in cm, $\overline{m}_H$ the mass of a proton in grams. Since dε ≅ 13 pc, in order to have a mass of about 0.2 M$_\odot$ ε must be of about 1/30 thus implying a distance of about 400 pc and a linear diameter of about 0.7 pc. At this distance, the nebula deviates from circular motion in an amount V_c (LSR) − V_{ISM} (400 pc) ≅ −22±6 km s^{-1} and/or has a mass smaller than the assumed 0.2 M$_\odot$

While the appearance, spectrum and kinematics of this nebula seem to favor the PN interpretation, there remains the problem of identifying the exciting star. Murdin *et al.* (1979) argue that only two stars at the periphery of the nebula have brightness corresponding to the 10th magnitude (among these, a B8 star). The stars found in a circle of about 30 arcsec in radius, centered on the nebula, are considerably fainter (the brightest have $m_V > 15$ mag). A search for blue stars was carried out at the center of this nebula by comparing the Hα and [S II] photographs with one in [O III] shown in Figure 4, Plate, a star has been seen in the [O III] photograph that appears extremely faint in the red photographs (unless the faintness could be due to the nearness of the cross-wire in the red photographs). This star is quite faint ($m_V \gtrsim 16$ mag), however, the amount of reddening is not known; placed at a distance of 400 pc, its absolute magnitude would be $M_V \gtrsim 8$ mag. This M_V is in agreement with those of the exciting stars of large diameter PN which have absolute magnitudes varying by about 10 mag (and perhaps more) from the average absolute magnitude of about +8.7 mag (Weinberger *et al.* 1983). Thus, the faintness of the proposed candidate does not seem to be a reason for rejecting it; and it should be interesting to persue its study.

b) *S216*

This nebula, considered to be an H II region by Marsalkova (1974) appeared to have strong [S II] emission relative to the Hα + [N II] emission as the survey of Parker, Gull and Kirshner (1979) has revealed. The [O III] photograph of that survey and an additional [O I] (λ 6300 A) photograph obtained with the same equipment revealed that these emissions are strong, the one in [O III] being concentrated near the center. The object appears as a diffuse circular nebula of 100 arcmin of diameter. Despite its relatively strong [S II] emission, its diffuse appearance and the lack of non-thermal radio emission argue against the assumption of a SNR, although no exciting star had been identified so far as being responsible for the nebular emission.

Fesen, Blair, and Gull (1981) obtained spectra of the brighter eastern portion of the nebula. They were able to obtain the reddening from their observed Hα/Hβ ratios and thus placed an upper limit on the color excess of about 0.5 mag. The observed [S II] (λλ6717/6731) line-ratios suggest $n_e \lesssim 100\ \mathrm{cm}^{-3}$. From their spectra, it can be ruled out that this nebula is an H II region. In fact, strong lines of [O II] (λ 3727 A), [O III], (λλ4959, 5007 A), [O I] (λ6300 A), [N II] (λλ6548, 6584 A) and [S II] (λλ6717, 6731 A) are present, reminiscent of radiative shock emission or of low ionization PN spectra.

Reynolds (1985) has observed this nebula using a FP interferometer with a field of 49 arcmin and a spectral resolution of 12 km s^{-1}, in the lines of Hα, [N II] and [S II]. He finds an Hα flux of about 8.4×10^{-10} erg cm^{-2} s^{-1}, and confirms that the visual extinction, A_V, cannot be larger than about 1 mag; he obtains LSR systemic velocities in Hα and [S II] of +7.5±1.0 and +9.5±1.8 km s^{-1} respectively and finds no appreciable expansional motion ($V_{exp} \lesssim 4$ km s^{-1}). From several considerations he estimates the distance to the nebula as d $\lesssim 80$ pc. Weinberger *et al.* (1983), estimate also a small distance to this nebula (d ≅ 30 pc) on the basis of the emission measure estimated from *POSS* plates. Another estimate of the distance can be obtained by means of the distance scale of Cudworth (1974):

$$d = 108\ \theta^{-3/5}\ F(H\beta)^{-1/5}\ \mathrm{pc}\ , \qquad (3)$$

where θ is the radius in arcsec and F(Hβ) the unreddened Hβ flux in erg cm^{-2} s^{-1}. If S216 is a PN and that if it is optically thin (as seems to be the case, see Reynold's discussion) putting θ = 3000 and F(Hβ) = 6.4×10^{-10} ($A_V \cong 1$ mag), one obtains d ≅ 60 pc, which confirms the nearness of this nebula.

In the present work an Hα photograph and an Hα FP interferogram of regions of this nebula have been obtained; Figure 5, Plate shows the Hα photograph and Figure 2 the radial velocity field. No appreciable internal motions are detected from these data. The LSR systemic velocity obtained is V_c (LSR) = 13± 4 km s^{-1}. Both results are in agreement with those of Reynolds (1985). At a distance of about 80 pc, the nebula has a peculiar velocity relative to the surrounding interstellar matter (ISM) –the deviation of the nebular velocity from galactic circular motion– of about 10 km s^{-1} and its linear diameter is supposed to be about 2.4 pc, somewhat typical of large PN (Weinberger *et al.* 1983).

c) *The "Halo" of NGC 3242*

The PN NGC 3242, classified by Kaler (1974) as a double ring PN, shows in addition, a faint nebulous arc located about 10 arcmin southwest of the PN that was first noted by Minkowski (1965, private communication to T.K. Menon). This arc seems to be associated with the PN itself as its center coincides with the PN and

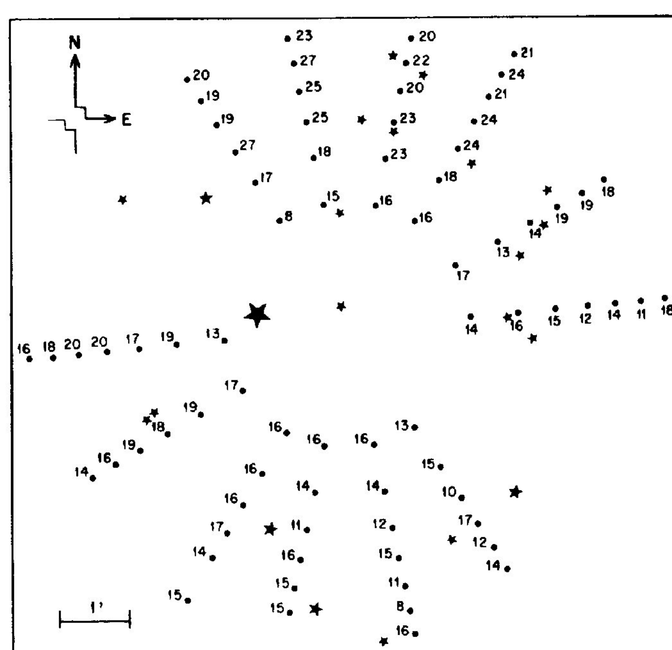

Fig. 2. The heliocentric radial velocity field of a region of S 216.

also because the radio maps at 1400 MHz reveal a clear connection between the optical nebulous arc and the radio contours (Kaftan-Kassim 1966). Later on, Bond (1981) by inspection of the *POSS* prints, had found that a faint nebulosity (of which the brightest portion is the arc) entirely surrounds the PN. Bond has suggested that this nebulosity could be an elliptical halo of the PN with dimensions of about 18 × 24 sq. arcmin and, consequently, NGC 3242 could be classified as a giant PN with halo (following Kaler's (1974) designation). Weinberger *et al.* (1983) were not able to identify the reported halo around the PN; however, the presence of the filament points towards this idea while, on the other hand, the dimensions quoted by Bond (1981) must be taken as highly uncertain. With respect to the PN, it shows a double ring morphology, being the dimensions of the inner and outer rings of about 15.2 and 38 arcsec respectively. The PNN shows a continuum spectrum; however, in the *UV* one might identify some P Cygni profiles, an evidence that the PNN has stellar winds (Cerruti-Sola and Perinotto 1985). These authors assign $T_{eff} \cong 89125$ °K and $L_* = 10^3\ L_\odot$ as the effective temperature and the luminosity of the PNN, respectively.

Values of the distance to NGC 3242 range from 0.787 kpc (Maciel and Pottasch 1980) to 1.697 kpc (Cudworth 1974). Spectroscopic work on this nebula has been performed by Barker (1978) who finds that the [O III] emission is quite large relative to Hβ while the [N II] and [S II] emissions are much fainter than Hα. The tables of Sabbadin and Minello (1978) show similar line-ratios. The electron density obtained from these spectroscopic studies are of about 2×10^3 cm^{-3}. The estimated mass of this PN is about 0.18 $M_\odot$ if a distance of 1.697 kpc is assumed (Sabbadin and Minello 1978). On the other hand, the Hβ flux reported by Milne and Aller (1975) of 1.7×10^{-10} erg cm^{-2} s^{-1} permits to determine the rms electron density. By taking an $E(B-V) = 0.15$ mag (Milne and Aller (1975), an angular diameter of 38 arcsec and by assuming a case B photoionized nebula with $T_e = 10^4$ °K (Osterbrock 1974) one obtains that $\epsilon\ n_e$ ranges from 1.7×10^3 to 2.5×10^3 cm^{-3} according with the difference in the assumed distance (from 1.697 to 0.787 kpc respectively). Thus, ϵ, the fraction of the volume which radiates is $\lesssim 1$.

Kinematical studies of the central PN have been performed by Wilson (1950), Weedman (1968) and Welty (1983). These authors report different values of the heliocentric systemic velocity of this PN, $V_\odot$(PN). The mean of these values is adopted and consequently, $V_\odot$(PN) = 6.3±2 km s^{-1}. On the other hand, the value of the expansional velocity of the PN, V_{PN}, reported by Wilson (1950) and Welty (1983) is of about 22 km s^{-1}; additionally, Weedman (1968) finds a positive gradient of V_{PN} with the distance to the center of about 7 km s^{-1} – (arcsec)$^{-1}$. In fact, he registers expansional velocities amounting to 40 km s^{-1} at larger distances from the center (8 arcsec). Here, a value of $V_{PN} \gtrsim 22$ km s^{-1} is adopted.

In this work some of the properties of the suspected halo of NGC 3242 have been studied in an attempt to clarify its nature. Firstly, a search for this halo in the red and blue *POSS* prints has been carried out but only the arc could be seen; one can barely perceive a very faint elliptical nebulosity but it was impossible to be sure it was really there. The arc is barely detectable in the *POSS* red print. This implies that, the Hα surface brightness, S(Hα), should be 5.5×10^{-6} erg cm^{-2} s^{-1} strad^{-1} (Peimbert, Rayo, and Torres-Peimbert 1975) if the contribution of the [N II] lines is negligible but since this contribution is not negligible in the present case (see below) one can correct this contribution by assuming an [N II] (λλ6548, 6584 A)/Hα ratio of about 0.5 and by assuming the same reddening correction as in the PN. The two effects cancel themselves out and one obtains almost the same limiting surface brightness. Since the emission measure, EM (pc cm^{-6}) is related to the unreddened Hα flux in the following form:

$$S(H\alpha) = 8.75 \times 10^{-8}\ EM \qquad (4)$$

(case B photoionized nebula with $T_e = 10^4$ °K), thus EM $\gtrsim 60$ pc cm^{-6} which implies an rms electron density n_e (rms) $\gtrsim 76$ or 110 cm^{-3} if an angular diameter of 21 arcmin and a distance of 1.697 or 0.787 kpc are assumed respectively. This estimate is made by assuming implicitly that the existent halo has the dimensions reported by Bond (1981). The electron density of the halo seems to be, at least, a factor of 20 lower than the electron density of the central PN.

Hα and [N II] monochromatic photographs of a field of about 11 arcmin in diameter covering the brightest arc were obtained (see Figure 6, Plate). From these, it can be seen that –contrary to the low [N II]/Hα ratio of the PN itself– the arc has higher [N II]/Hα line-ratios. The Hα photograph reveals two distinct components in this nebulosity: a set of fine filaments, also seen in the [N II] photograph, and a diffuse emission region.

Three FP interferograms of this region were obtained in Hα and [N II]. The radial velocity field obtained from these interferograms is shown in Figure 3. From these data one can obtain the systemic velocities of both the filamentary and the diffuse regions of the arc. The heliocentric values of these velocities are of +15.5±7.9 , +7.7±9.5 km s^{-1} respectively, as compared with the heliocentric velocity of the central PN of 6.3±2 km s^{-1}. Thus, the diffuse component of the arc has the same systemic velocity (within the uncertainties) as that of the central PN, suggesting a physical association between the arc and the PN. On the other hand, the systemic velocity of the filaments is slightly higher. If this difference is significant it may be due to an expansional motion in which case only one half of the expanding shell is seen. The velocity of expansion of the arc would be: $V_a = V_\odot$ (filaments) – $V_\odot$(PN). Given the uncertain-

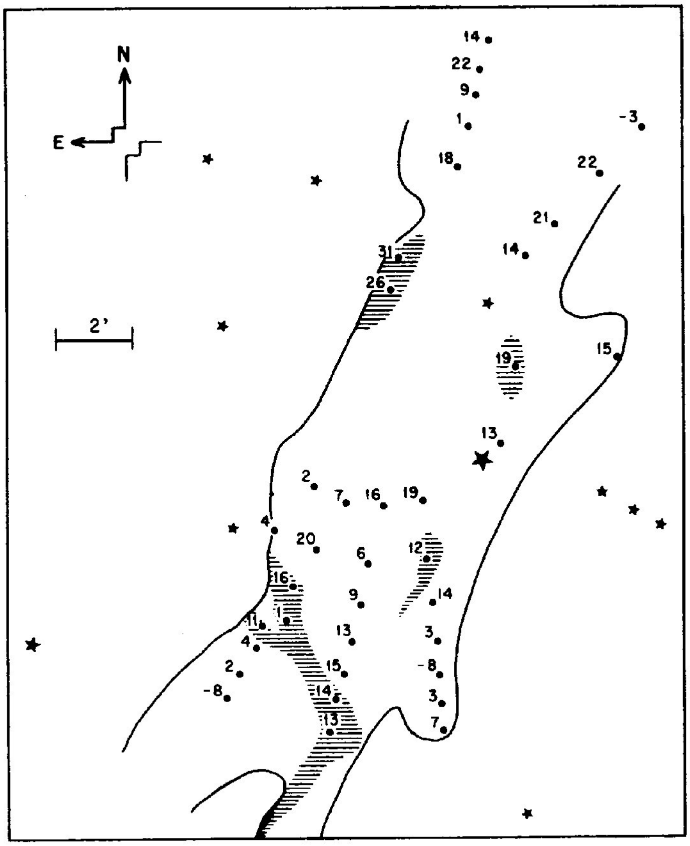

Fig. 3. The heliocentric radial velocity field of the nebulous arc associated with NGC 3242. The hatched area shows the filamentary regions.

ties in the estimation of the systemic velocities shown above it is quite difficult to obtain a more reliable value of V_a; one finds $V_a \cong 9.2 \pm 7.9$ km s^{-1}. If the arc effectively forms part of a larger "halo" surrounding the PN as Bond (1981) has claimed, this estimate of the arc expansional motion may throw light on the mechanism of the halo formation (Jewitt *et al.* 1986). In fact, a comparison between V_a and V_{PN} ($\gtrsim$ 22 km s^{-1}) favors the model of multiple ejection of PN shells or the model of colliding winds of Kwok, Purton, and Fitzgerald (1978). One can note that the predictions of these models remain valid even if the differences in systemic velocities are not significant since there are no other signs of expansional motion of the arc.

On the other hand, by comparing the systemic velocity of the PN with the circular rotational velocity of the neighbouring gas at distances of 0.787 of 1.697 kpc, one obtains that the PN has peculiar velocities of about 17 or 30 km s^{-1} respectively. Further work on this nebulosity is required, in particular a complete mapping of the region in order to detect the whole elliptical nebulosity claimed by Bond (1981).

IV. DISCUSSION

The monochromatic photographs and the kinematical data obtained on G 339.2−0.4 and S 216 favor the classification of these nebulae as PN of large diameter. These nebulae have several common features; both have a diffuse appearance, they do not show violent motions, their spectra indicate low excitation, their densities are lower than those of typical PN, they have a motion which deviates from the circular rotational motion of the surrounding gas and they seem to have faint exciting stars. The inconclusive identification of their exciting stars is the main argument against their identification as PN. It is necessary to study the possible stellar candidates in order to confirm or reject this identification.

On the other hand, it is important to note that the large peculiar velocities of these PN (in particular, that of G 339.2−0.4) could produce changes in the morphology of the nebulae if these peculiar velocities are effectively that large. According with Smith (1976), a decentering of the star relative to the nebula is predicted. This should be confronted with the data and thus serve as an independent method of evaluating the distance to the nebulae. By applying Smith's (1976) model to G 339.2−0.4, by using the parameters deduced in §III*a* and by assuming a neighbouring gas with electron density of 1 cm^{-3}, the predicted decentering of the PNN comes to about 1.2 arcmin. The proposed candidate for the exciting star is effectively decentered by an amount similar to the predicted one.

With respect to the suggested halo of NGC 3242, this work does not corroborate nor reject, the existence of a complete nebulosity around the PN; however, the existence of an arc centered on the PN is an evidence in favor of the existence of the halo. This work gives evidence in favor of a physical connection of the visible arc with the PN. Furthermore, by assuming that this arc forms part of the suggested halo and by taking into account the large uncertainties, it seems that the halo expansion velocity (if any) is lower than that of the PN but this result must be confirmed with more observations. Here again, there appears the possibility of large peculiar velocities of the PN (and its halo) with respect to the surrounding ISM. Although the peculiar velocity may not affect too much the central PN, it could be important in shaping the halo of larger dimensions. However, since the whole shape of the halo is not known with certainty, one must await further observations as suggested in §III*c*.

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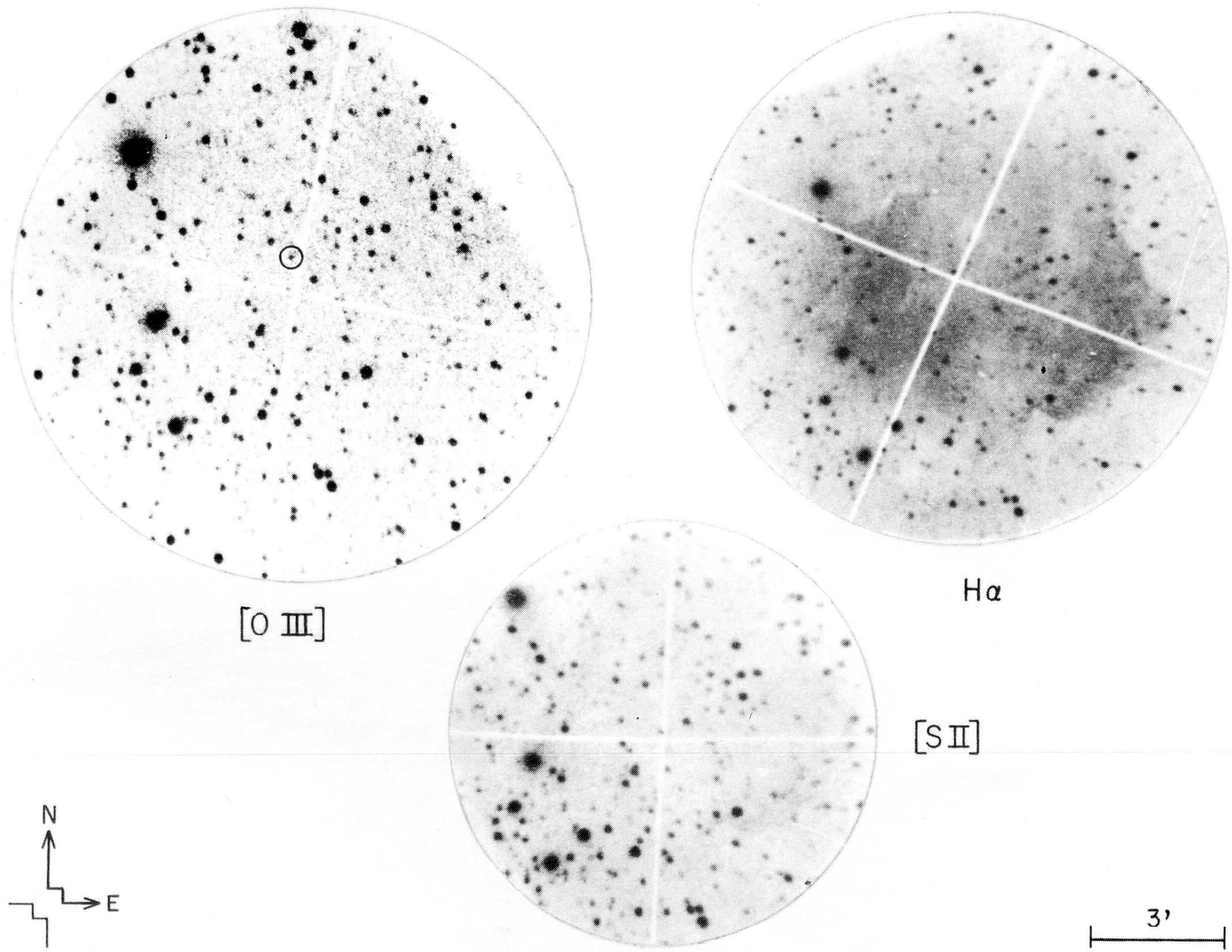

Fig. 4. [O III], Hα and [S II] photographs of the nebula G 339.2−0.4. The [O III] photograph shows (encircled) an interior blue star which could be the exciting star (see the text).

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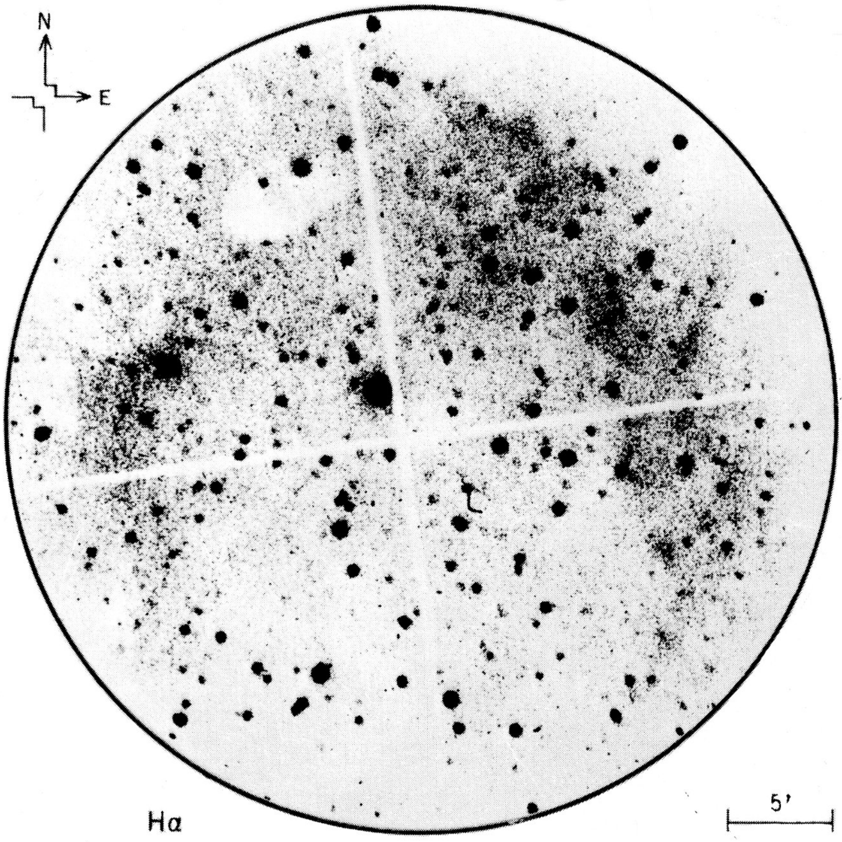

Fig. 5. Hα photograph of a region of the nebula S 216.

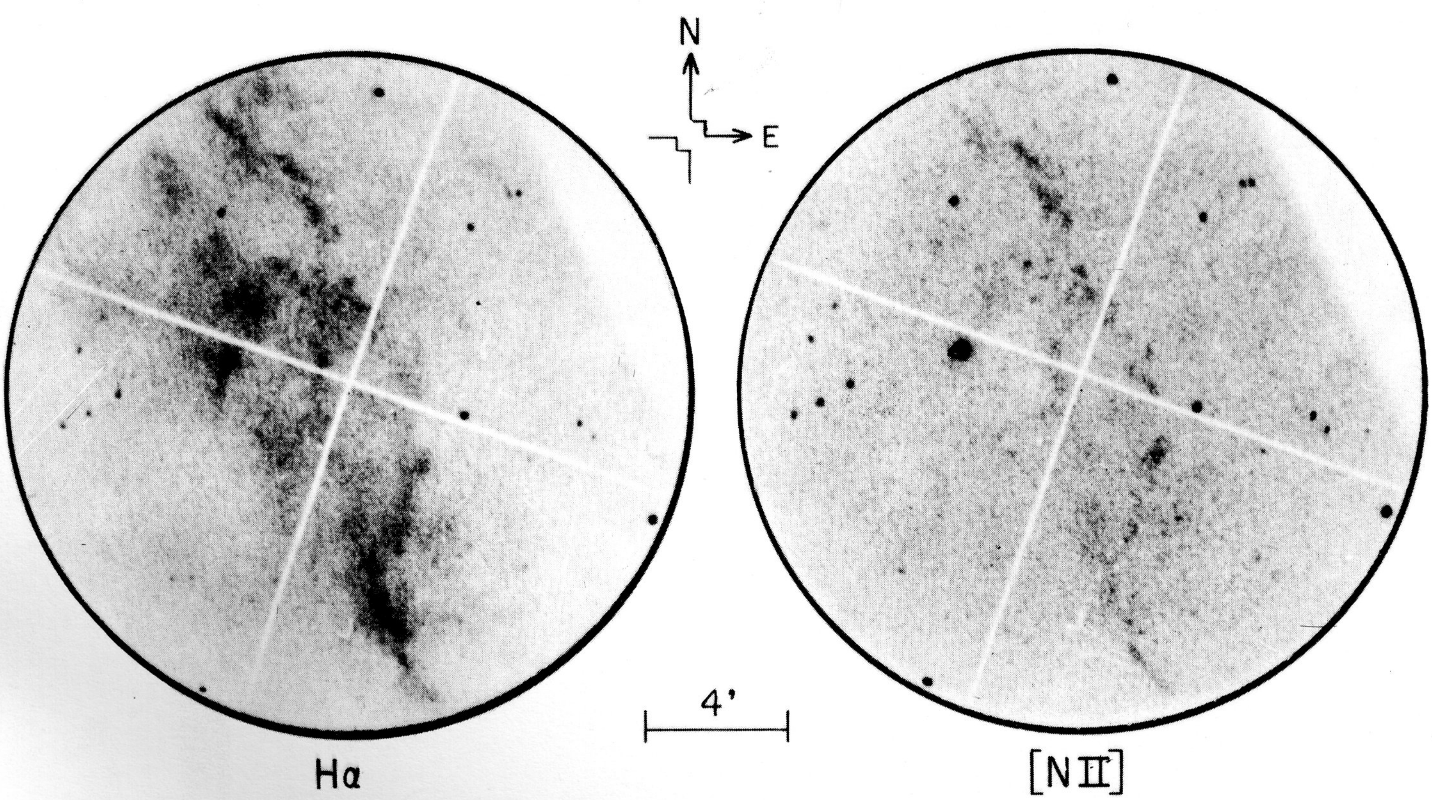

Fig. 6. Hα and [N II] photographs of the nebulous arc associated with NGC 3242.

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