

Research Note

Central Star of NGC 3132: A Visual Binary

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Summary. A faint companion to HD 87892 has been discovered with the 3.6 m telescope (prime focus) of the European Southern Observatory at La Silla having the following parameters: separation $\varrho = 1''.65$, position angle $\vartheta = 226^\circ.3$. The companion, which can be considered as the actual planetary nucleus, is estimated to have $U = 14^m.8$, $L_*/L_\odot \approx 110$, $R_*/R_\odot \approx 0.035$. Its physical association with HD 87892 is probable.

Key words: planetary nebulae — central stars

Since the classification of HD 87892 as an A-type star (Evans, 1964), this bright central star of NGC 3132 ($272 + 12^\circ.1$) is no longer considered to be the exciting star of this prominent planetary nebula. There must be a hotter star responsible for the nebular radiation, which fact raises the question of the parameters of the actual planetary nucleus as well as the connection between HD 87892 and the planetary nucleus.

The physical parameters of the suspected nucleus were recently estimated by Méndez (1975) according to the H I and He II fluxes of the nebula; he found $T_* \sim 10^5$ K and the stellar radius comparable with that of white dwarfs. Contrary to Webster (1969) he has located HD 87892 at the same distance as NGC 3132 and considered the A-type star and the exciting star as members of a binary system.

An attempt has been made to find the exciting star of NGC 3132. Using the 3.6 m telescope (prime focus, $F/3$, scale = $18''.95 \text{ mm}^{-1}$) of the European Southern Observatory at La Silla a series of 10 short exposed plates in the U system (exposures of 5 s to 15 min on Kodak IIIa-J + UG 1) was taken in February 1977. Even a 2 min exposure (Fig. 1) shows the central star rather elongated; a faint companion to HD 87892 is clearly seen on the 5 s, 10 s and 20 s exposures (Fig. 2) and has the following parameters: separation $\varrho = 1''.65 \pm 0''.02$, position angle $\vartheta = 226^\circ.3 \pm 0^\circ.8$ (mean values from 7 exposures).

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Contrary to the somewhat eccentric position of HD 87892 (called A-component) the faint companion (X-component) lies on the axis of symmetry of the nebula. If we define this axis to be identical with the major axis of the elliptical main nebular ring (p.a. = $146^\circ.5$), then the measured distance of the A-component from this axis is $1''.7$ whereas that of the X-component is only $0''.2$.

As there are no appropriate photometric standards in the close vicinity of NGC 3132 the brightness of the new companion was estimated using the comparison sequence in the nearby open cluster NGC 3228 (Hogg, 1963). The plates of NGC 3132 and NGC 3228 were taken consecutively with the same exposure times and were developed simultaneously; the image diameter-magnitude dependence was assumed to have the same form in both fields. We could then derive the difference $\Delta U = U_X - U_A = 4^m.5$ between the X- and A-component.

NGC 3132 has been photographed in two other spectral regions: in the yellow region (Kodak IIIa-J + GG 495) and in the red one (Kodak 127-04 + RG 630). We succeeded in isolating the X-component on a plate taken in the yellow region (exposures 30 and 60 s, seeing $1''.0$) whereas it has not been detected in the red. The emulsion-filter combination which was used (IIIa-J + GG 495) represents a narrow-band colour system having $\lambda_{\text{eff}} \approx 5200 \text{ \AA}$ not too far from the V -system. For that reason the V magnitudes of the comparison sequence in NGC 3228 have been used giving the difference $\Delta v = v_X - v_A = 4^m.8$ in this instrumental, nearly visual system. As a consequence of $\Delta v > \Delta U$ the X-component has to be of an earlier spectral type than the A-component.

For a more accurate determination of Δv not only the V magnitudes but also the term $B - V$ would have to be taken into account. As the colour index $(B - V)_X$ is smaller than $(B - V)_A$ the actual Δv would be even larger than $4^m.8$. It is necessary to point out that the estimated yellow brightness of the X-component is of lower accuracy than in case of U_X . Nevertheless, the correctness of the qualitative statement on the spectral type of the X-component seems to be guaranteed.

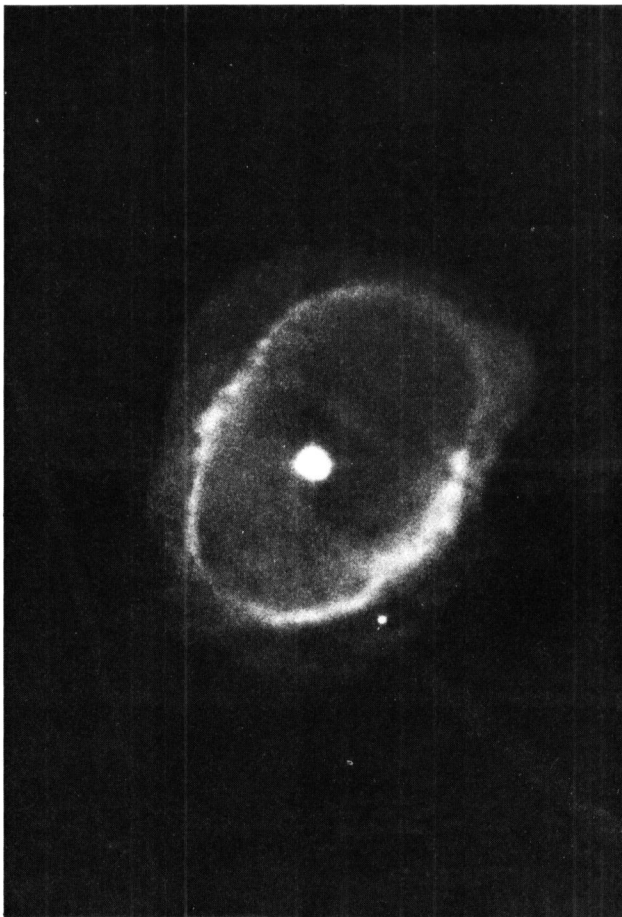


Fig. 1

Fig. 1. NGC 3132, 3.6 m telescope of the European Southern Observatory, La Silla, Kodak IIIa-J baked+UG 1, exp. 2 min, seeing $1''.2$, scale = $1''.0 \text{ mm}^{-1}$; north is on the top

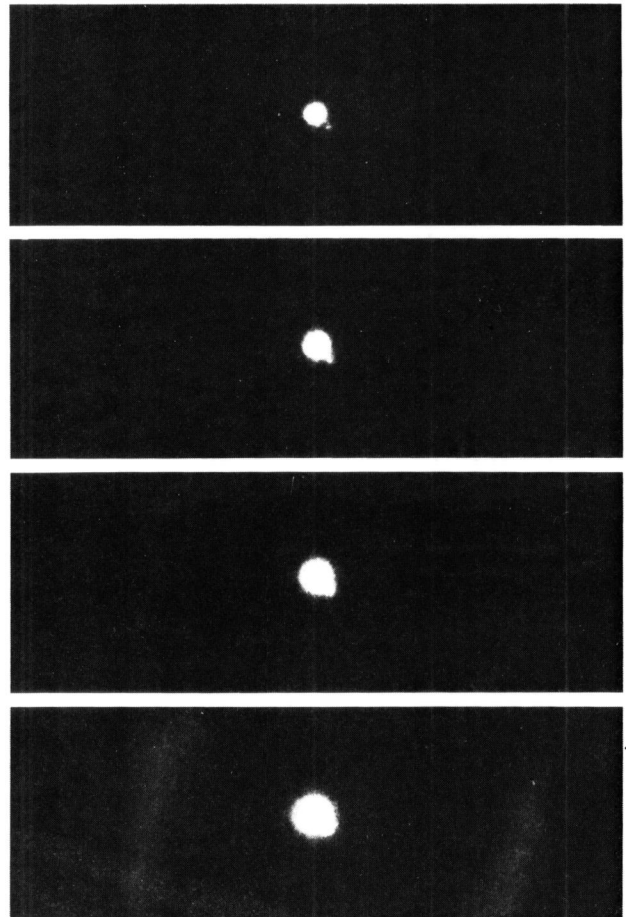


Fig. 2

Fig. 2. HD 87892: a visual binary within the planetary nebula NGC 3132; the same telescope, emulsion and filter combination, exp. 5, 10, 20, 40 s, seeing $1''.5$, scale = $0''.67 \text{ mm}^{-1}$

We may summarize that the faint component of HD 87892 is most likely to be the actual exciting star of NGC 3132 for the following reasons: it lies on the axis of symmetry of the nebula, and has a spectral type earlier than A.

We can estimate some physical parameters of this star. Our *UBV* photoelectric photometry of HD 87892 from 1974 leads to $V=10.07$, $B-V=+0.09$, $U-B=+0.10$ (ESO, La Silla, 50 cm reflector—preliminary results). The contribution of the nebula was eliminated by measurements through different diaphragms, so that the following *U* magnitudes for both components can be derived: $U_A=10.27$, $U_X=14.8$. If the X-component radiates as a black body of about 10^5 K (Méndez, 1975), its intrinsic colour index $U-V$ would be about -1.6 mag , and the visual brightness of the X-component $V_X \approx 16.4$ (assuming in the first approximation no reddening in the direction of the nebula). We use this calculated value because it should be more accurate than the yellow magnitude estimated above from the observed Δv . If we assume the distance of the nebula to be

$d \approx 0.9 \text{ kpc}$ [the mean value of four determinations; Cahn and Kaler (1971)] the absolute visual magnitudes would then be about $M_{V,A} = +0^m.3$ in accordance with its spectral type, and $M_{V,X} = +6^m.6$, respectively. Using the bolometric correction of -7^m we obtain the luminosity $L_*/L_\odot \approx 110$ and the radius $R_*/R_\odot \approx 0.035$ for the X-component—parameters which correspond to a sub-luminous blue star and which are typical for the central star of an evolved planetary nebula.

The question of the physical connection between HD 87892 and its visual companion (and the nebula NGC 3132) remains open. Nevertheless, there are some considerations which might support the hypothesis of a physical pair within the nebula NGC 3132:

(a) The chance coincidence of the bright A-type star with NGC 3132 is rather improbable;

(b) if both components of HD 87892 were physically related its projected separation (assuming $d \approx 0.9 \text{ kpc}$) would be 1485 A.U. , a value of the same order as for the known visual pairs among the central stars of other planetary nebulae (Cudworth, 1973);

(c) the line connecting the two components of the central star almost coincides with the minor axis of the nebular ring (nebular "equator"); on the other hand, the centre of gravity of both components would not lie so close to the axis of symmetry of the nebula as the X-component does;

(d) there exists another binary nucleus with similar parameters: NGC 1514, A0III + sdO (Kohoutek, 1967; Greenstein, 1972). Also the nucleus of NGC 2346 could belong to the same class of binary central stars (Kohoutek and Senkbeil, 1973).

The estimated physical parameters of the faint companion of HD 87892 are only preliminary. Also the hypothesis that HD 87892 is a physical pair (A2V-III + blue subdwarf) requires further observations which we intend to make in the near future.

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