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CENTRAL STAR OF PLANETARY NEBULA NGC 2346:
NEW ECLIPSING BINARY

NGC 2346 (215+3^o1; AR₁₉₅₀ = 7^h06^m49^s.7, D₁₉₅₀ = -0^o43'29") is a bipolar planetary nebula having an A-type central star. This spectral type is too late for planetaries and the most plausible explanation seems to be a binary model of the nucleus, already discussed by Kohoutek and Senkbeil (1973), and Méndez (1978). Méndez and Niemela (1978), and Méndez (1980) observed variable radial velocity of this star with a period of 16 days.

We have searched for variability of this object since 1974 at the European Southern Observatory, La Silla, Chile. In January and February 1982 we have found drastic changes of the nuclear brightness (reported already in IAU Circ. No. 3667). Our photoelectric UBV and BV measurements of NGC 2346 are summarized in Table I. They were carried out using (A) the 50 cm telescope and a pulse counting photometer (EMI 6256A photomultiplier, diaphragm 21 arcsec), internal accuracy about ±0.01 mag; (B) the 1 m telescope and a pulse counting photometer (EMI 9658R, dia. 22.9 arcsec), accuracy about ±0.02 mag. In (C) we present supplementary BV measurements kindly provided by R. Kiehling with the Bochum 61 cm telescope (dia. 18.2 arcsec).

Table I contains stellar magnitudes only; the contribution of the nebular radiation was eliminated by observing through different diaphragms (15, 21, 30 and 40 arcsec). Stars in the E-regions Nos. 2-7 (Cousins, 1973) served as photometric standards. In case of observations given in (B) and (C) the brightness of NGC 2346 was referred to the local comparison star "b".

The UBV magnitudes of five comparison stars listed in Table II were measured at ESO, La Silla (50 cm and 1 m telescopes) during 1978-82; their internal accuracy is ±0.01 mag or better.

The following conclusions can be made from the V and B light curve of NGC 2346:

1) The deep, very broad but sharp minimum at $\text{Min. I} = \text{JD } 2445010.85 \pm 0.15$ can be interpreted as a partial eclipse (probably close to totality) of the main A-type component of the close-binary system. The amplitudes are: $A_V = 2.2$ mag, $A_B = 2.6$ mag.

2) In January a part of the ascending branch of the previous minimum was observed, probably at $\text{Min. I} = \text{JD } 2444993.65 \pm 0.35$, so that the orbital period $P = 17.2 \pm 0.4$ day can be estimated.

Table I Photoelectric observations of the central star of NGC 2346 in January - February 1982

(A) Measurements with 50 cm telescope

JD 2440000+	V	B - V	U - B	n
4995.620	12.660	+0.425	+0.487	8
4997.631	11.650	0.322	0.341	9
4998.647	11.396	0.305	0.315	6
4999.686	11.338	0.285	0.290	9
5000.575	11.337	+0.277	+0.308	9

(B) Measurements with 1 m telescope

JD 2445000+	V	B - V	n
2.657	11.29	-	2
4.656	11.34	-	2
5.666	11.44	-	2
6.577	11.69	+0.28	1
7.573	11.97	0.36	1
8.572	12.40	+0.42	1

n - number of measurements

(C) Measurements with 61 cm telescope made by R. Kiehling

JD 2445000+	V	B - V	n
08.571	12.31	+0.55	1
09.561	12.92	0.67	1
10.573	13.43	0.58	2
11.568	13.04	0.62	2
12.538	12.57	0.48	2
13.538	12.20	0.50	2
14.539	11.88	0.42	1
15.535	11.54	+0.38	1

Table II UB magnitudes of the comparison stars

Star	V	B - V	U - B	n
a	10.24	+0.14	+0.17	4
b	11.02	0.36	0.13	6
c	12.01	0.11	0.12	2
d	12.80	0.25	+0.21	7
e	13.21	+0.09	-0.15	8

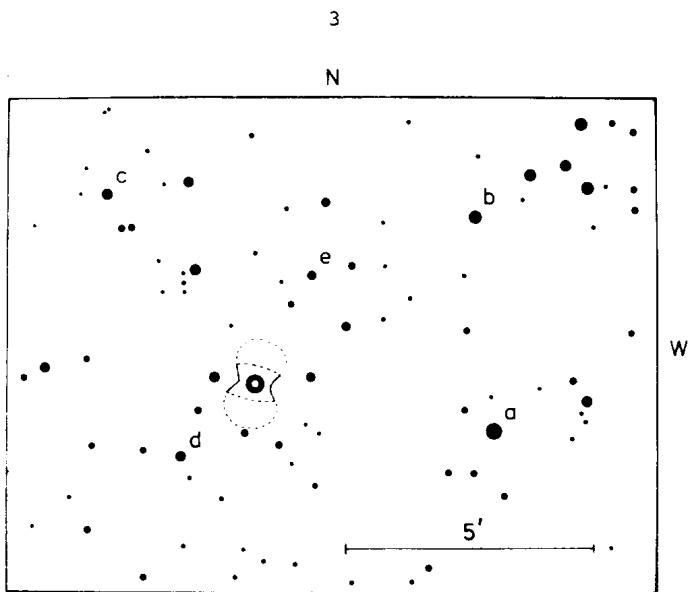


Fig.1 Finding chart for NGC 2346 and for comparison stars a, b, c, d, e.

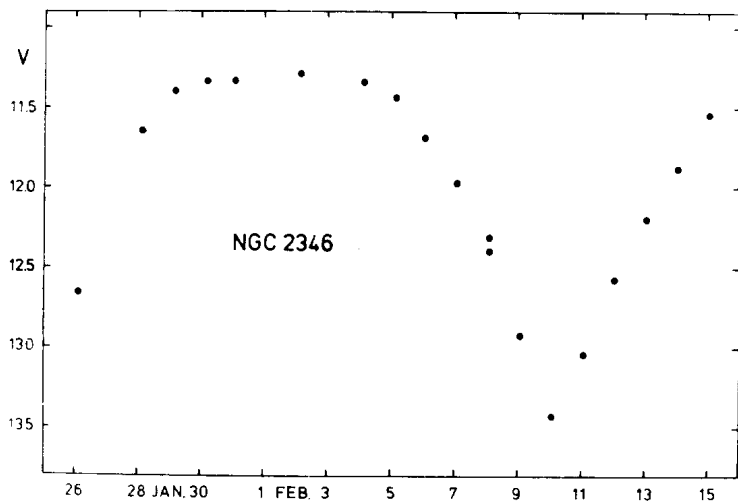


Fig.2 V light curve of the central star of NGC 2346 in 1982.

3) The extremely broad minimum and the shape of the light curve outside the eclipse could be explained by the non-spherical components and the possible gaseous stream between them.

4) The secondary component is of later spectral type, $V = 13.50$, $B - V = +0.70$ can be found assuming the total eclipse.

5) The secondary minimum has not been detected.

We tentatively classify the system as a semi-detached close binary. Adopting $K = 18 \text{ km.s}^{-1}$ for the half amplitude of the radial-velocity curve (Méndez, 1980), we obtain $a = 0.03 \text{ AU}$ for the semi-major axis of the relative orbit, and $f(M) = 0.01$ for the mass function.

There is no evidence for large light changes of NGC 2346 in the past, although small light variations were possible according to our observations. We expect that the conditions for the geometrical eclipse of the system have changed due to fast rotation of the line of apsides caused by (a) non-spherical components, (b) strongly elliptical orbit, and (c) presence of a third body (the actual planetary nucleus).

Further systematic observations are planned.

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