THE MULTIPLE SYSTEM SK−67°18 IN THE LMC

V. S. NIEMELA
IAFE, Buenos Aires, Argentina

W. SEGGEWISS
Observatorium Hoher List, Daun, B.R. Deutschland

and

A. F. J. MOFFAT
Université de Montréal, Canada

Abstract. The bright star Sk−67°18 (Brey 5) in the Large Magellanic Cloud (LMC) contains an eclipsing binary system. Our radial velocity study reveals that the orbital period is almost exactly two days. The spectra also show that the star's primary component is not of spectral type WN, but that the star is rather an Of+O type binary where the primary is probably of type O3f*. Furthermore, Sk−67°18 appears to be a high-mass multiple system.

Key words: LMC – O3f*-type stars – stars, individual: Sk−67°18

1. Introduction and observations

This investigation is one of a series in which spectroscopic binary stars in the Magellanic Clouds are studied (*e.g.*, Niemela & Morrell 1986; Moffat & Seggewiss 1986; Moffat, Niemela & Marraco 1990). Sk−67°18 (Sanduleak 1970) is a bright, blue star located within the association NGC 1747 of the LMC. Walborn (1977) classified the spectrum of Sk −67°18 as O6-7+WN5-6. Between 1980 and 1990 a total of 58 photographic and digital spectrograms were obtained at *CTIO* and *ESO*, Chile. Photometric data were secured in 1982 (Walraven *VBLUW*) and 1988 (Johnson *V*) at *ESO*.

2. Analysis and discussion

The light variations of Sk−67°18 (Fig. 1) prove the star to be an eclipsing system and indicate a period of almost exactly two days. Two similar light minima seem to be present (depth about 0.2 mag). But, there are up to now no observations of times of minima.

From an inspection of the RV data (see Fig. 2) we note the following: (1) The RVs of the N IV 4058Å and He II 4686Å emission and N V 4604Å absorption lines show a variation of large amplitude $K \approx 380$ km s^{-1}, similar for all three lines. The best period results from the analysis of all velocity and photometric data: $P = 1.99945$ d with the epoch $T_0 =$ JD 2446505.009. (2) The He II 4686Å emission varies with much scatter. Our spectrograms also confirm Walborn's (1977) statement of spectral variability, which we

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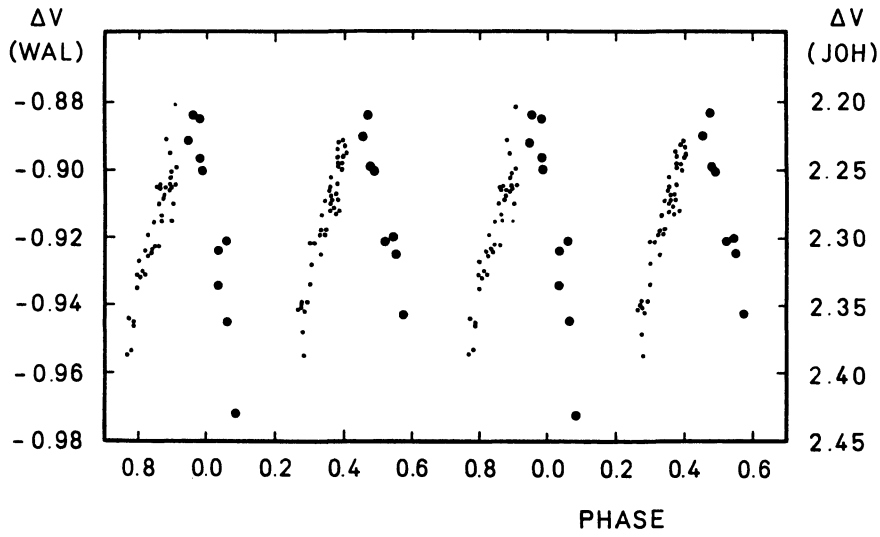

Fig. 1. The light-curve of Sk−67°18 from Walraven (small dots) and Johnson (large dots) photoelectric magnitudes.

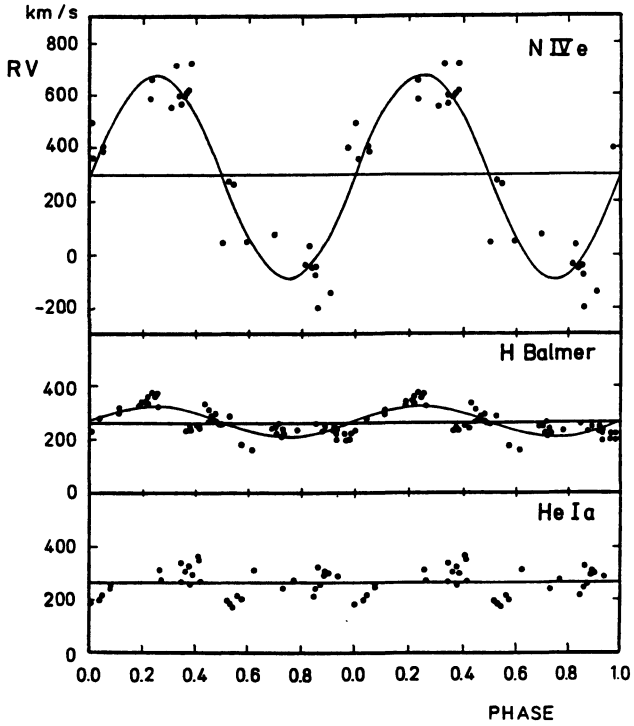

Fig. 2. Observed radial velocities of Sk−67°18 for the N IV 4058Å emission and the H Balmer and He I absorption.

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mainly observe as striking profile variations.
(3) The RVs of the H Balmer absorption lines (Fig. 2) vary with nearly the same period and epoch as the emission lines, but with considerably smaller amplitude.
(4) The neutral He absorption lines show almost no variation in the just mentioned period (formal velocity amplitude $K = 21 \pm 15$ km s^{-1}).

Since we observe (i) that the mean RVs of the H Balmer absorption lines follow the same orbital motion as the emission lines, and (ii) that the absorption lines are not blue-shifted, the emission-line star cannot be of WN type, but rather of spectral type Of. The presence of N V absorption and N IV emission indicates a spectral type O3f* for the brightest component of Sk−67°18. This spectral class is supported by the N IV/N III emission ratio.

Neutral helium should not be visible in an O3f* star. But the non-variability of the He I absorptions as seen in Fig. 2 is easily explained if they arise, *e.g.*, in a close visual companion, too close to be resolved at the distance of the LMC. The considerable strength of the He I absorption lines in the spectrum of Sk−67°18 together with its absolute magnitude $M_V = -6.9$ (Walborn 1977), means that the companion to the close binary also has to be very luminous, probably a supergiant of spectral type O8–B0.

The variable shapes of the He II absorption lines are too noisy to be measured with confidence. But on some of our spectra, the He II absorption lines seem to have components that suggest an orbital motion in antiphase to that of the O3f* star. Therefore, the close binary companion to the O3f* star is probably also an O-type star.

The considerably lower amplitude of the radial velocity orbit of the hydrogen Balmer lines and their variable width indicate that these lines are blends, probably consisting of three components. The strongest contribution to these lines comes from the O3f* star.

The high mass function of $f(M) = 9.5$ M$_\odot$ suggests that the total mass of Sk−67°18 is well above 80 M$_\odot$.

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