OBSERVATIONS OF TWO BINARY SYSTEMS WITH O4f TYPE COMPONENTS

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ABSTRACT. We present linear polarization observations of two binary systems with early Of type components, namely Sk-67°105 in the Large Magellanic Cloud, and LSS 3074 in our Galaxy. Both binaries show phase-locked polarization variations, from which we determined orbital inclinations for the systems.

1. Introduction

The empirical stellar upper mass limit from binary studies is about 60 $\mathcal{M}_\odot$, while the mass-luminosity relation indicates that some stars appear to be more massive than 120 $\mathcal{M}_\odot$. The origin of this discrepancy remains at present unexplained. It could be both due to inadequate models or insufficient observations, as the empirical masses of the earliest O type stars are very poorly known. Aimed to enlarge the database of empirical masses of early O stars, we have initiated an observing program of O type binary systems. Here we present a study of two binaries, namely Sk -67°105 and LSS 3074, which both contain early O type components.

Sk -67°105 is one of the hottest stars known in the LMC. With V=12.4 and M_{bol}=-11.2, Mianes et al. (1977) place this star near the main sequence of a 120 $\mathcal{M}_\odot$. The O4f+O6 binary nature of Sk -67°105 was discovered by Niemela and Morrell (1986).

LSS 3074 is also an O4f+O binary (Morrell and Niemela, 1990). It is a 12.6 mag star in the Centaurus region of our Galaxy. Because of its undetermined distance, no luminosity estimate is available for LSS 3074.

2. Observations and Results

The spectroscopic orbits of Sk -67°105 and LSS 3074 have been previously analyzed by Niemela and Morrell (1986) and Morrell and Niemela (1990), respectively. New observations have permitted

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Y. Kondo et al. (eds.), Evolutionary Processes in Interacting Binary Stars, 505–508.

us to improve the period of LSS 3074 to 2.185 days. Therefore we have recalculated its orbital elements with this period. The spectroscopic orbital elements of both binaries are resumed in Table 1.

TABLE 1. Circular Orbital Parameters for the Binary Systems

	Sk -67°105 O4f + O6:V		LSS 3074 O4f + O6-7:	
period (days)	3.301		2.185	
K ($km.s^{-1}$)	224	355	222	218
V_0 ($km.s^{-1}$)	254	285	-46	4
a.sin i ($R_\odot$)	14.5	19.5	9.5	9.4
$\mathcal{M}.\sin^3 i$ ($\mathcal{M}_\odot$)	41	26	9.5	10

To determine the actual values of masses of the binary components, we need to know the values of the orbital inclination (i). In principle, the orbital inclination of hot binary stars can be determined from the orbital modulation of their linear polarization (Brown et al., 1978). Therefore we observed both Sk-67°105 and LSS 3074 with the polarimeter of the Vatican Observatory attached to the 2.15 m telescope at CASLEO, Argentina. Sk-67°105 was observed during 9 nights on January 1991. LSS 3074 was observed during 8 nights on March 1990, and on January and June 1991. Typical errors in P% were 0.024 % for Sk-67°105 and 0.017 % for LSS 3074.

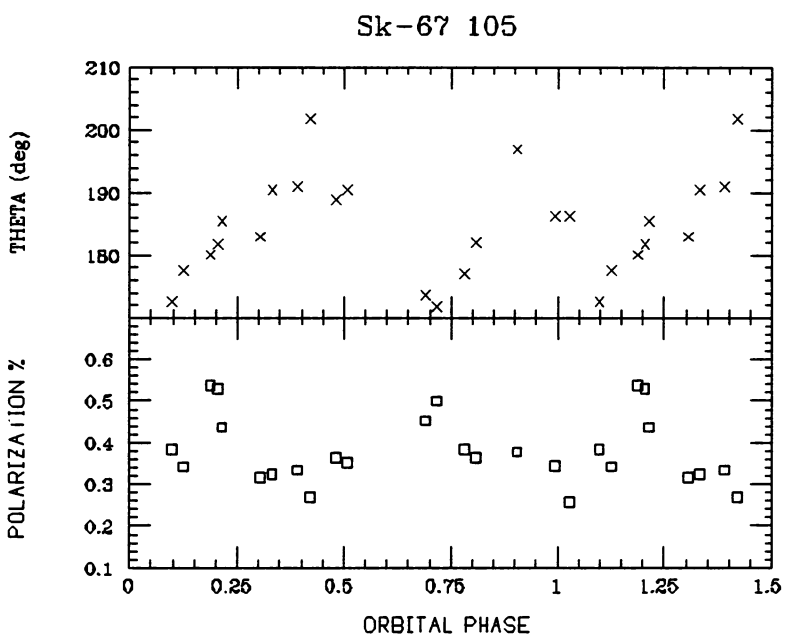

Figure 1. Linear polarimetry of Sk-67°105. The upper panel shows the position angle, and the lower panel the % polarization versus orbital phase.

https://doi.org/10.1017/S0074180900122831 Published online by Cambridge University Press

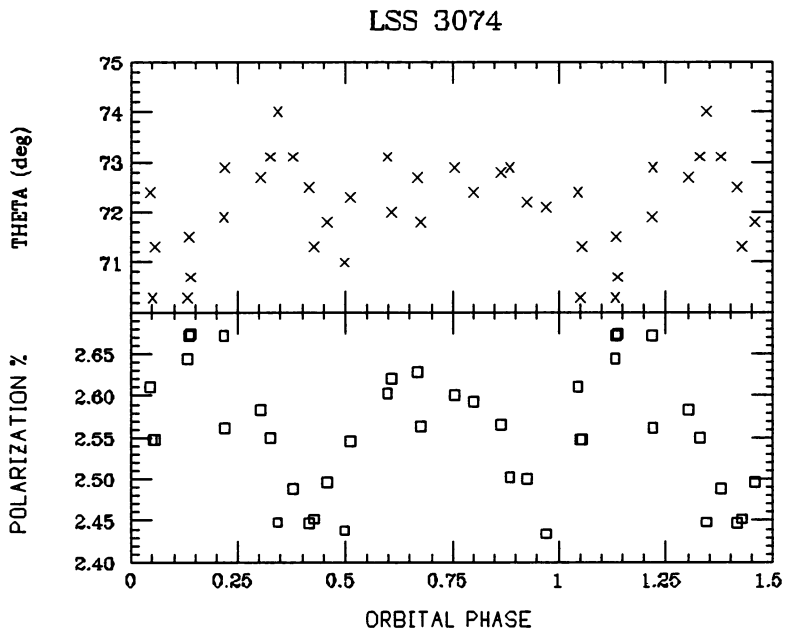

Figure 2. Idem Fig. 1 for LSS 3074

Figures 1 and 2 present the observed variation of the linear polarization (P%) and of the position angle (θ) of the polarization vector as a function of the orbital phase. As clearly seen in these figures, both binary systems show phase- locked variations.

The interpretation of the observed phase-locked variations of the linear polarization in the framework of the binary model (Brown et al., 1978), indicates an inclination i=86° for Sk -67°105, and i=75° for LSS 3074.

If the orbital inclinations found were correct, then the masses of the binary components would be:

$\mathcal{M}_{O4f}$=(41-43) $\mathcal{M}_\odot$	$\mathcal{M}_{O6V}$=(26-27) $\mathcal{M}_\odot$	for Sk -67°105
$\mathcal{M}_{O4f}$=(10-11) $\mathcal{M}_\odot$	$\mathcal{M}_{O6V}$=(11-12) $\mathcal{M}_\odot$	for LSS 3074

However, in massive close binaries with short periods, the tidal deformation may introduce additional polarization biasing the inclinations toward i=90° (e.g. Dolan and Tapia, 1989). The reality of the high inclinations that we find, derived from the binary model of polarization variations, should be tested by photometric observations of both binary systems.

https://doi.org/10.1017/S0074180900122831 Published online by Cambridge University Press

ACKNOWLEDGEMENTS. We thank the Vatican Observatory for the loan of VATPOL polarimeter to the CASLEO Observatory in San Juan, Argentina.

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