

The light curve at $10\ \mu\text{m}$ of Algol near secondary minimum

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Summary. The light curve of Algol near secondary minimum is presented. It shows a smooth decrease in amplitude of ~ 0.3 mag which is symmetric about the minimum and starts at an Algol phase of ~ 0.42 .

Introduction

It has been suggested by Z. Kopal (private communication) that observations of the secondary minimum of Algol (β Persei) at $10\ \mu\text{m}$ represent a method of learning the extent of gravity darkening in stars of advanced spectral type. The light curve of Algol has previously been measured in the infrared by Chen & Reuning (1966); Jameson, Longmore & Crawford (1973); Smyth, Dow & Napier (1975); Longmore & Jameson (1975) and Magro *et al.* (1977). The depth of the secondary minimum increases into the red, becoming as deep as 25 per cent at $5\ \mu\text{m}$ (Magro *et al.* 1977). In this article we present new observations at $10\ \mu\text{m}$ which concentrate on the behaviour of Algol around the time of its secondary minimum.

Observations

All the data are shown in Fig. 1. The observations were made at the $f/74$ Cassegrain focus of the 5-m telescope at Mt Palomar in 1977 February and the $f/60$ focus of the 1.5-m telescope on Mt Wilson in 1977 October. The detector in each case was a germanium bolometer filtered to measure flux from 8 to $13\ \mu\text{m}$. The phase ϕ of Algol was calculated from the relationship for the primary visible minima $\text{JD}(\phi=0)=2440953.4657+2.8673075E$ given by Ashbrook (1976), corrected to the geocentric epoch; E is the number of cycles since the initial minimum.

The magnitudes of Algol on all nights were established relative to ρ Persei, an M4 star within 3° of Algol. The star ρ Per showed no evidence of having varied with respect to β Pegasi and β Andromedae between 1977 February and October but a variation as large as 5 per cent cannot be ruled out.

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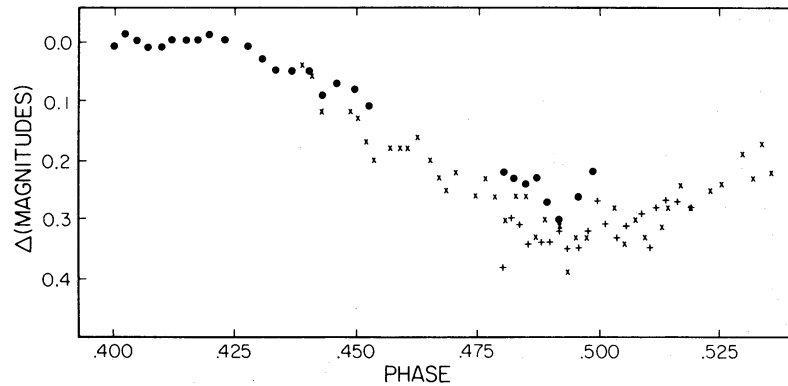


Figure 1. The light curve at $10\ \mu\text{m}$ for Algol around secondary minimum is shown. The magnitude difference Δ is with respect to the nearby star ρ Per. Solid circles were obtained on UT 1977 February 8 on the Palomar 5-m telescope; the \times and $+$ were obtained on UT 1977 October 1 and 4 respectively on the Mt Wilson 1.5-m telescope. Phase is based on the visual minimum as determined by Ashbrook (1976).

For the purposes of studying the secondary minimum, a magnitude difference Δ defined to be 0.0 at $0.40 < \phi < 0.42$ is presented in Fig. 1. A Δ of 0.0 corresponds to a $10\text{-}\mu\text{m}$ magnitude of Algol $[10\ \mu\text{m}] = 1.7 \pm 0.1$; the $10\text{-}\mu\text{m}$ mag of β And is $[10\ \mu\text{m}] = -2.07$. In addition to the data presented here, a measurement of Algol on 1977 October 2 at $\phi = 0.87$ gave $\Delta = 0.13 \pm 0.02$.

The measurements at Palomar were made on UT 1977 February 8. Approximately 4 min of observations of Algol were alternated with observations of ρ Per. The measurements of ρ Per followed a smooth curve expected from the atmospheric extinction with less than 1 per cent scatter. Clouds prevented observations from $0.45 < \phi < 0.48$. Data with ~ 3 per cent scatter in the flux of ρ Per were subsequently obtained for $0.48 < \phi < 0.50$. The statistical uncertainty in each point of the Algol data is less than 2 per cent.

The Mt Wilson data were obtained on UT 1977 October 1 and 4. Three observations of Algol, each of about 10-min duration, were alternated with a single observation of ρ Per. The measured fluxes of ρ Per followed a curve expected on the basis of the atmospheric extinction to within a scatter of 1 per cent. The statistical uncertainty in each point was ≤ 2 per cent on 1977 October 1 and ≤ 3 per cent on 1977 October 4.

Discussion

An interpretation of the present data will be given in a subsequent article by Z. Kopal. There is no evidence for a significant excess at $10\ \mu\text{m}$: outside of the eclipse $[10\ \mu\text{m}] = 1.7$, while $[4.8\ \mu\text{m}] = 2.0$ (Magro *et al.* 1977). The data show a smooth decline by 0.3 mag which starts at about $\phi \sim 0.42$. The limited data at phases greater than $\phi = 0.50$ are consistent with a symmetrical curve about $\phi = 0.50$.

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