# PHOTOELECTRIC PHOTOMETRY OF THE ECLIPSE OF EPSILON AURIGAE

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ABSTRACT. The U,B,V photometric observations of ε Aur during the ingress and totality phases obtained at the Skalnaté Pleso Observatory in 1982 - 1983 are published. The mid-eclipse brightening is confirmed. The observations suggest that the structure of the eclipsing dusty disk is not homogeneous.

ФОТОЭЛЕКТРИЧЕСКАЯ ФОТОМЕТРИЯ ЗАТМЕНИЯ ε ВОЗНИЧЕГО. В работе опубликованы фотометрические наблюдения в системе U,B,V звезды ε Возничего полученных на обсерватории Скалнате Плесо в течение годов I982 - I983. Потверждено поясне-ние звезды в половине затмения. Наши наблюдения намечают присутствие неодно-го пылевого затмевающего диска.

FOTOELEKTRICKÁ FOTOMETRIA ZÁKRYTU EPSILON AURIGAE. V práci sú publikované fotometrické pozorovania ε Aur počas poklesu jasnosti a totality, získané na Skalnatom Plese v rokoch 1982 - 1983 vo farebnom systéme U,B,V. Je potvrdené zjasnenie hviezdy počas totality. Pozorovania naznačujú, že štruktúra zakrýva-júceho prachového disku nie je homogénna.

## 1. INTRODUCTION

Epsilon Aurigae is an eclipsing binary system with an orbital period of 27.1 years. During the primary minimum, the F0 Iae supergiant is eclipsed by a disk-shaped cool companion. Based on their (5 - 20) μm infrared photometry,

Backman et al. (1984) found that the eclipsing body, a cool dusty disk, has a temperature of 500 K. The decrease of brightness in the V region during the totality, lasting 330 days, is about 0.8 mag. The photometry of the 1982 - 1984 eclipse of ε Aur was published by Boyd et al. (1984), Oki et al. (1984), Flin et al. (1985), Hopkins (1985), Schmidtke et al. (1985), Parthasarathy and Frueh (1976).

In this paper we present our U,B,V observations of ε Aur made during the ingress and totality phases of the 1982 - 1984 eclipse.

## 2. OBSERVATIONS AND DISCUSSION

Our U,B,V observations of ε Aur were obtained on 16 nights between March 14, 1982 and November 25, 1983 with a single-channel photoelectric photometer installed in the Cassegrain focus of the 0.6 m photometric telescope at the Skalnaté Pleso Observatory. The stars HR 1644 and 59 Per were used as comparison stars, λ Aur as the check star. The U,B,V magnitudes of the check and the comparison stars are listed in Table 1. For λ Aur we used the mean values of the measurements in the Photometric Catalogue (Blanco et al., 1968), while for HR 1644 and 59 Per we derived the U,B,V magnitudes from our photometry.

Table 1

| Star | R.A.(1950.0) | Decl.(1950.0) | U | B | V |
|---|---|---|---|---|---|
| λ Aur | $5^h15^m37^s.2$ | $40^\circ03'25''$ | 5.456 | 5.332 | 4.710 |
| HR 1644 | $5^h03^m15^s.1$ | $43^\circ06'31''$ | 6.966 | 6.697 | 6.230 |
| 59 Per | $4^h39^m21^s.1$ | $43^\circ16'19''$ | 5.328 | 5.442 | 5.383 |

The photometric observations have been corrected for atmospheric extinction and reduced to the standard U,B,V system. The observations are listed in Table 2, in which each entry represents the mean value of 5 - 10 individual observations. The U,B,V light curves of ε Aur are in Fig. 1. Each point represents the average of observations made during one night.

The most interesting aspect of totality is the mid-eclipse brightening starting around JD 2445410 and ending around JD 2445580 (Schmidtke et al., 1985). Two of our observations made on JD 2445441 and JD 2445442 confirm this phenomenon. The mid-eclipse brightening is seen in all three bandpasses used. The brightening can be caused by the gravitational lensing effect (Schmidtke, 1985), or by the refraction effect in the atmosphere of the eclipsing body (Kudzey, 1985). The geometry of an eclipsing ring with a large central opening seen obliquely (Wilson, 1971) can also explain the observed mid-eclipse effect.

The U,B,V observations of ε Aur during totality show remarkable variations of light. These variations are apparently caused by the inhomogeneous structure of the cool dusty eclipsing disk.

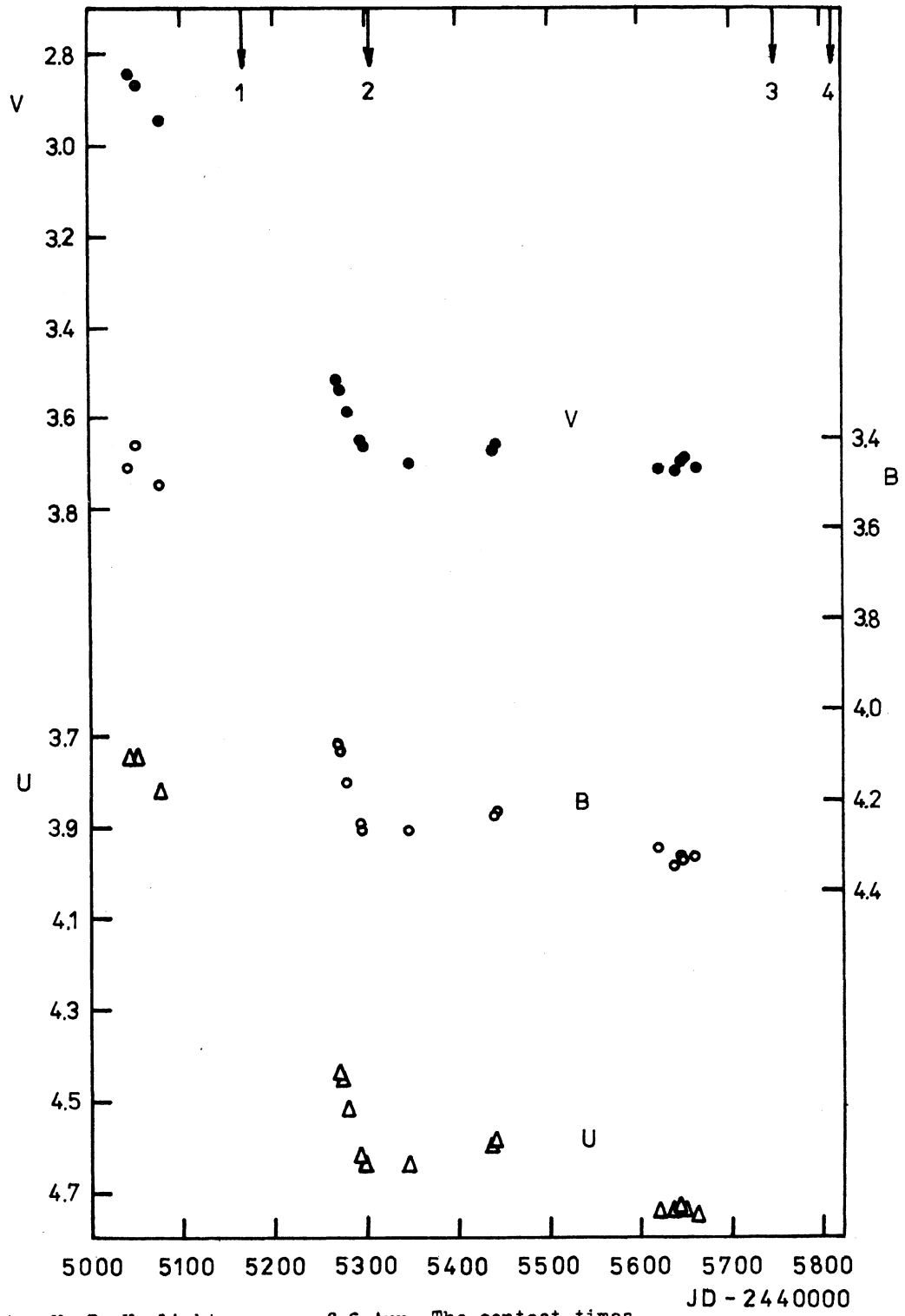


Fig. 1 U, B, V light curves of ε Aur. The contact times derived by Schmidtke et al. (1985) are marked by arrows.

Table 2

| J.D. hel 2440000+ | U | B | V |
|---|---|---|---|
| 5043.4163 | 3.743 | 3.461 | 2.857 |
| .4230 | 3.755 | 3.471 | 2.845 |
| .4285 | 3.750 | 3.461 | 2.848 |
| .4353 | 3.719 | 3.449 | 2.848 |
| 5051.3406 | 3.716 | 3.412 | 2.884 |
| .3501 | 3.728 | 3.416 | 2.885 |
| .3705 | 3.758 | 3.421 | 2.870 |
| .3783 | 3.760 | 3.407 | 2.859 |
| 5076.3048 | 3.808 | 3.498 | 2.943 |
| .3110 | 3.810 | 3.497 | 2.949 |
| .3168 | 3.834 | 3.517 | 2.960 |
| .3220 | 3.838 | 3.511 | 2.959 |
| .3272 | 3.820 | 3.481 | 2.944 |
| 5270.5203 | 4.454 | 4.102 | 3.535 |
| .5306 | 4.444 | 4.096 | 3.542 |
| .5406 | 4.449 | 4.087 | 3.522 |
| .5503 | 4.439 | 4.077 | 3.515 |
| .5648 | 4.433 | 4.081 | 3.525 |
| .5754 | 4.437 | 4.084 | 3.529 |
| .5855 | 4.433 | 4.082 | 3.531 |
| 5272.5580 | 4.453 | 4.089 | 3.545 |
| 5280.5400 | 4.529 | 4.159 | 3.604 |
| .5501 | 4.515 | 4.152 | 3.594 |
| .5549 | 4.510 | 4.157 | 3.603 |
| .5685 | 4.552 | 4.157 | 3.585 |
| 5295.5118 | 4.596 | 4.259 | 3.641 |
| .5213 | 4.648 | 4.266 | 3.682 |
| 5296.5637 | 4.653 | 4.259 | 3.676 |
| .5736 | 4.637 | 4.249 | 3.678 |
| .5842 | 4.644 | 4.247 | 3.667 |
| .5953 | 4.637 | 4.251 | 3.665 |
| .6064 | 4.642 | 4.247 | 3.670 |
| .6162 | 4.648 | 4.251 | 3.674 |
| .6265 | 4.627 | 4.246 | 3.668 |

| J.D. hel 2440000+ | U | B | V |
|---|---|---|---|
| 5347.5150 | 4.656 | 4.276 | 3.719 |
| .5207 | 4.654 | 4.273 | 3.701 |
| .5273 | 4.645 | 4.267 | 3.711 |
| .5337 | 4.627 | 4.254 | 3.707 |
| .5412 | 4.631 | 4.265 | 3.706 |
| 5441.3099 | 4.594 | 4.225 | 3.673 |
| .3129 | 4.593 | 4.233 | 3.677 |
| .3202 | 4.614 | 4.230 | 3.683 |
| .3213 | 4.609 | 4.231 | 3.684 |
| .3225 | 4.599 | 4.221 | 3.701 |
| 5442.3256 | 4.593 | 4.227 | 3.662 |
| .3268 | 4.591 | 4.226 | 3.671 |
| .3279 | 4.584 | 4.219 | 3.681 |
| .3304 | 4.596 | 4.233 | 3.676 |
| .3444 | 4.585 | 4.223 | 3.668 |
| .3456 | 4.599 | 4.232 | 3.666 |
| .3467 | 4.587 | 4.218 | 3.674 |
| 5622.6319 | 4.743 | 4.305 | 3.725 |
| .6462 | 4.751 | 4.304 | 3.725 |
| 5640.4647 | 4.736 | 4.326 | 3.710 |
| .4732 | 4.747 | 4.343 | 3.743 |
| .4809 | 4.749 | 4.348 | 3.733 |
| 5646.6531 | 4.752 | 4.326 | 3.709 |
| .6617 | 4.738 | 4.324 | 3.702 |
| .6700 | 4.734 | 4.319 | 3.705 |
| .6800 | 4.731 | 4.315 | 3.706 |
| 5647.6186 | 4.742 | 4.320 | 3.704 |
| .6309 | 4.741 | 4.322 | 3.703 |
| .6412 | 4.746 | 4.331 | 3.706 |
| .6508 | 4.740 | 4.322 | 3.704 |
| .6598 | 4.737 | 4.325 | 3.700 |
| .6738 | 4.750 | 4.335 | 3.713 |
| .6834 | 4.744 | 4.333 | 3.706 |
| 5663.5705 | 4.755 | 4.326 | 3.720 |

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