epsilon aurigae

1982·84 ECLIPSE

CAMPAIGN NEWSLETTER

No. 6

PHOTOMETRY:
Jeffrey L. Hopkins
Hopkins-Phoenix Obs.
7812 West Clayton Dr.
Phoenix AZ 85033

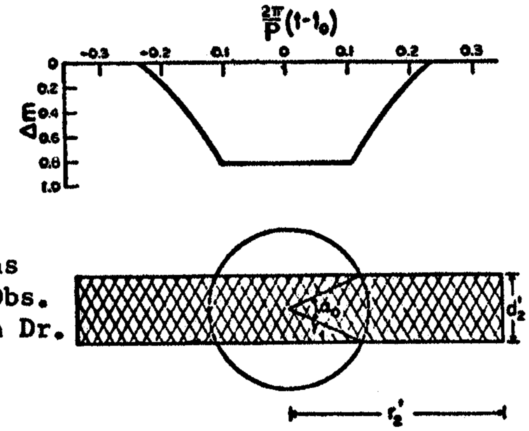


FIG. 1.—A schematic diagram of our model for ε Aurigae and its resulting light-curve during eclipse. It is assumed that we observe this system edge-on. Consequently, the rotating gaseous disk around the secondary component will appear to be a dark rectangle which obscures the primary component during eclipse. The light-curve at the top of the figure is derived by assuming a uniform stellar disk.

Huang 1965 Ap.J. 141

SPECTROSCOPY:
Robert E. Stencel
Code EZ-7
NASA - HQ
Washington DC 20546

FEBRUARY 1983

Dear Colleagues:

Welcome to totality! The eclipse of Episilon Aurigae appears to be close on schedule with first and second contacts occuring in July and December [1982], respectively. The number of reports on photometry and spectroscopy continues to increase, and we are pleased to publish in this issue a significant finding in polarimetry, in addition to other findings. We also provide information presented at recent meetings and in three International Astronomical Union Circulars during January [1983] - see page 2.

To improve the efficiency of our operation, we include in this issue a mailing list update response form. We will require return of this form from all interested readers to insure continued receipt of this newsletter.

This Newsletter is (partially) supported by a grant from NASA, administered through the American Astronomical Society.

IAU Circular No. 3759 1983 January 07

ε AURIGAE

G. Henson, J. Kemp and D. Kraus, Physics Department, University of Oregon at Eugene, write: "We have observed a sudden change in the polarization of ε Aur between 1982 Nov. 24 and Dec. 9 UT. Measurements in the V filter of normalized Stokes parameters over the interval Aug. 24-Nov. 24 averaged Q = +0.33 +/- 0.03, U = -2.3 +/-0.05. On Dec. 8 and 9 we observed values of Q = +0.017 +/- 0.013, U = -2.404 +/- 0.110 and Q = +0.021 +/- 0.012, U = -2.353 +/- 0.014, respectively, i.e., a 10-sigma drop in the Q parameter. Our photometric observations gave V = 3.75 +/- 0.01 on Dec. 9."

Brian G. Marsden

IAU Circular No. 3763 1983 January 20

ε AURIGAE

T. B. Ake, Computer Sciences Corporation: and T. Simon, University of Hawaii, report the following color-corrected magnitude measurements of ε Aur obtained with the IUE fine-error sensor: 1982 Apr. 4.8 UT, 3.11; Apr. 19.8, 3.14; July 24.5, 3.26; July 29.4, 3.27; Aug. 14.6, 3.25; Aug. 24.4, 3.29; Sept. 23.6, 3.56; Oct. 18.5, 3.67; Nov. 9.9, 3.79; Nov. 28.3, 3.88; Dec. 23.5, 3.91; 1983 Jan. 2.2, 3.92. These data indicate that totality occurred near 1982 Dec. 5. Preliminary analysis of the ultraviolet photometry (120-320 nm) at totality suggests that the eclipse is non-grey with depth of eclipse increasing with decreasing wavelength. Compared to the fine-error-sensor measurements, the eclipse is ~0.5 mag deeper at 300 nm and ~ 1.0 mag deeper at 150 nm. However, Cepheid-like pulsation in the continuum longward of 140 nm complicates the determination of the true eclipse lightcurve. Emission lines of O I 130.4 nm and Mg II 280.0 nm are present but do not participate in the variation.

D. Backman, E. E. Becklin, D. Cruikshank, T. Simon and A. Tokunaga, University of Hawaii; and R. Joyce, Kitt Peak National Observatory, report infrared photometry of ε Aur during the current eclipse ingress. At 1-5 microns the eclipse followed the predicted visual lightcurve to within 0.05 mag through 1982 Dec. 5, 95-percent of the way from first to second contact. On that date the eclipse was less deep by 0.16 mag at 10 microns (N band) and by 0.32 mag at 20 microns (Q band). The smaller eclipse depth in N and Q could be produced by emission from a 600-K blackbody of area 10 AU**2 (the object's distance from the sun being about 600 pc).

Brian G. Marsden

IAU Circular No. 3766 1983 January 24

ε AURIGAE

M. Parthasarathy and D. L. Lambert, McDonald Observatory, report: "Observations of ε Aur made since 1981 show a systematic increase in the strength of the K I 770-nm resonance line: W-lambda = 12 pm in early March 1982 (before the eclipse) but W-lambda = 54 pm now. The Na D lines behave similarly. The strengths of the high-excitation lines Mg II 448 nm, Si II 635 nm and N 869 nm have not varied significantly. Our IUE observations show that the eclipse depth is ~ 1 mag from 310 to 155 nm. However, the eclipse depth at 125 to 143 nm is ~ 0.3 mag. First contact occurred before July 29. The O 130-nm emission and the P Cyg-type emission of Mg II 280-nm lines do not seem to show significant variation associated with the eclipse. Fe II lines of ultraviolet multiplets 1, 62 and 63 show variation in the strength of their emission components."

Brian G. Marsden

PHOTOMETRY REPORT

We wish to thank all those who submitted data for this Newsletter. We will continue to publish light curves but also need the data in tabular form.

Dr. Stencel has submitted a chart (Figure I) of the IUE [satellite Star Tracker] data from December 1981 through January 1983.

Kevin Krisciunas reports three observations from the Santa Cruz mountains and San Jose, California using a 6" F/6 reflector. Kevin is now working with the UK Infrared Telescope Unit at Hilo, Hawaii.

KRISCIUNAS EPSILON AURIGAE DATA (λ AUR USED AS COMPARISON)

DATE	JULIAN DATE	V MAGNITUDE
23/24 FEB 1982	2,445,024.6528	3.040 ± 0.005
3/4 Mar 1982	2,445,032.7049	3.005 ± 0.009
2/3 Jan 1983	2,445,337.6764	3.726 ± 0.007

Bob Fried of the Braeside Observatory [Flagstaff, AZ] submits data on Epsilon Aurigae for 8 October 1982 through 6 November 1982 (Table I).

Dr. Richard Miles of the Mouldsworth Observatory, Cheshire, England, submits his 1982 [April 82 through Jan 83] data on Epsilon Aurigae (Figures II, III, and IV). Dr. Miles reports that his transformation coefficients for the IP28A photomultiplier tube are 0.06, 1.54, and 1.02 for the V, (B-V) and (U-B) bandpasses, respectively. He is now using an EMI 9661B tube, which has a (B-V) coefficient of 1.03.

Stig I. Ingvarsson of the T.A.O. Observatory in Sweden has submitted V & B data on Epsilon Aurigae for July 1982 to January 1983. (Tables II and III and Figure V). Stig reports he has U data also, but that they are not fully reduced yet. All observations were made with a 41 arc sec diaphragm. This data now provides an outstanding reference set and permits a more exacting comparison to be constructed of all received observations to-date.

Zeta AUR and 32 CYG

Once again we ask for photoelectric observations of the long-period binary stars Zeta Aurigae and 32 Cygni, which are cousins of Epsilon Aurigae, and which will pass through secondary minima phases this spring [1983]. Suggested comparison stars are Lambda Aur for both Zeta and Epsilon Aurigae (the star 2 Aur makes a good check star; see Kondo and Harris (1964) Astron. Journal Vol. 69, p. 409); and 30 Cyg as a comparison star for both 31 Cyg and 32 Cyg.

These systems are described in a lucid article in the March 1983 issue of ASTRONOMY magazine. The interest in the secondary minima of Zeta Aur and 32 Cyg lies in attempts to measure the nature and extent of the accretion shock that envelopes the hot star in these systems. A series of sensitive ultraviolet spectroscopic observations are underway between now and mid year [1983] and optical photometry will help to verify precise phases and light variations. Photometric changes will not be as dramatic as during primary eclipse, however, although there may be surprises. For additional information and submittals of Zeta Aurigae and 32 Cygni data write to J.L. Hopkins.

Figure I. Eps Aur IUE Star Tracker Data, Dec. 1981 - Jan. 1983. (JD 2,444,750 - JD 2,445,750) (Compiled by R. Stencel).

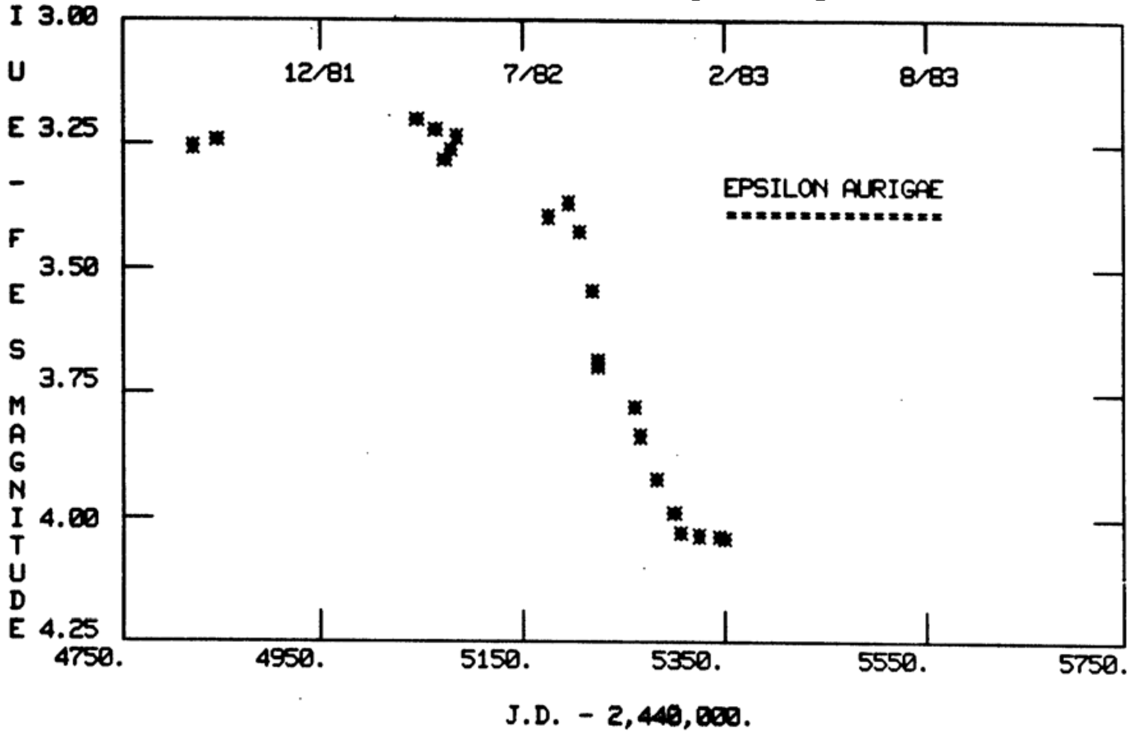


Table I. Eps Aur Photometry from Braeside Observatory, Flagstaff, AZ. 08 Oct. - 06 Nov. 1982 (JD 2,445,250 - JD 2,445,279). (R. Fried).

BRAESIDE OBSERVATORY

P.O. Box 906 • Flagstaff, Arizona 86002

TABLE I

PROGRAM STAR: EPSAUR

COMP STAR(CK STAR): LAMAUR

UT DATE	JD[GEO]	UT	ST	DIAP	INTG	delta(v)	delta(b-v)	delta(u-b)
10-08-82	5250.8642	0844	0222	5	5	-1.226	-0.058	+0.295
10-08-82	5250.8681	0850	0228	5	5	-1.214	-0.074	+0.290
10-08-82	5250.8720	0856	0234	5	5	-1.201	-0.078	+0.285
10-12-82	5254.8427	0813	0207	5	5	-1.186	-0.079	+0.286
10-12-82	5254.8457	0818	0212	5	5	-1.185	-0.081	+0.291
10-12-82	5254.8505	0825	0219	5	5	-1.204	-0.070	+0.295
10-14-82	5256.8437	0815	0216	5	10	-1.183	-0.075	+0.269
10-14-82	5256.8496	0823	0224	5	10	-1.191	-0.059	+0.253
10-14-82	5256.8554	0832	0233	5	10	-1.190	-0.071	+0.277
10-15-82	5257.8408	0811	0216	4	10	-1.189	-0.077	+0.288
10-17-82	5259.9697	1116	0529	5	10	-1.187	-0.076	+0.286
10-17-82	5259.9775	1127	0540	5	10	-1.173	-0.086	+0.270
10-17-82	5259.9843	1137	0550	5	10	-1.181	-0.080	+0.271
10-19-82	5261.9443	1040	0501	5	10	-1.193	-0.091	+0.267
10-19-82	5261.9511	1050	0511	5	10	-1.157	-0.102	+0.266
10-19-82	5261.9580	1059	0520	5	10	-1.184	-0.079	+0.274
10-28-82	5270.7617	0617	0114	5	10	-1.148	-0.067	+0.254
10-28-82	5270.7675	0626	0123	5	10	-1.151	-0.067	+0.252
10-28-82	5270.7763	0638	0135	5	10	-1.147	-0.075	+0.256
11-02-82	5275.8300	0755	0311	5	10	-1.121	-0.066	+0.271
11-02-82	5275.8359	0804	0320	5	10	-1.115	-0.065	+0.262
11-02-82	5275.8417	0812	0328	5	10	-1.119	-0.063	+0.269
11-06-82	5279.7724	0632	0204	5	10	-1.085	-0.066	+0.257

DIAP #5 - 31", #4 - 40'

SUBMITTED 9 FEBRUARY 1983

Figures II - IV. 1982 Eps Aur Data from Mouldsworth Observatory, England. Apr. 1982 - Jan. 1983 (JD 2,445,050 - JD 2,445,350). (R. Miles).

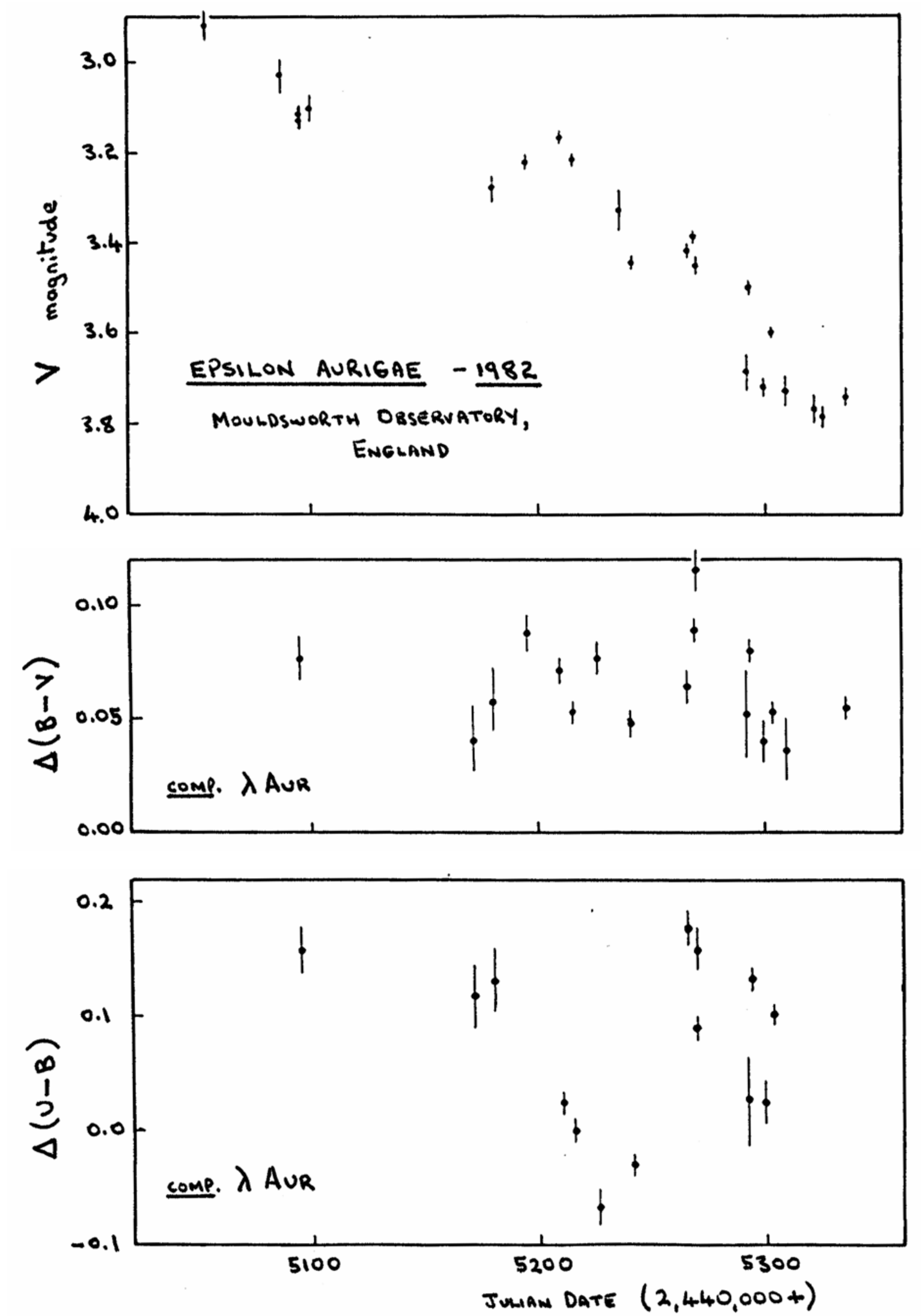


Table II. 1982 Eps Aur Photometry Report from TAO Observatory
Jul. 21 - Dec. 29, 1982 (JD 2,445,172 - JD 2,445,332) (S. Ingvarsson).

EPSILON AURIGAE DATA REPORT

Comp. star BD +42°1170

NAME: STIG I. INGVARSSON
OBSERVATORY: T. A. O.
YEAR: 1982

REPORT DATE: JAN. 31 1983
SOLID STATE/PMT: PMT

DATE		U T	JD(Geo)	ΔV	σ	ΔB	σ
JUL	21/22	23:10	5172,465	- 3,201	0,010	- 3,075	0,004
	26/27	00:01	5177,501	3,101	0,002	3,057	0,010
	30/31	23,54	5181,496	3,158	0,008	2,996	0,008
	31/01	23,41	5182,487	3,144	0,006	3,044	0,018
AUG	02/03	23,36	5184,487	3,139	0,016	3,076	0,010
	04/05	23,53	5186,495	3,163	0,004	3,032	0,006
	28/29	22,59	5210,458	3,116	0,010	2,956	0,008
SEP	04/05	23,25	5217,476	3,070	0,006	2,887	0,010
	11/12	23,24	5224,475	2,936	0,020	2,761	0,014
	16/17	21,52	5229,411	2,851	0,010	2,701	0,016
	23/24	21,38	5236,401	2,760	0,016	2,695	0,024
OCT	17/18	23,06	5260,463	2,683	0,002	2,543	0,006
	24/25	23,00	5267,458	2,669	0,002	-----	-----
NOV	05/06	23,27	5279,477	2,589	0,002	2,449	0,004
	06/07	20,03	5280,335	2,590	0,008	2,461	0,004
	07/08	19,40	5281,319	2,584	0,012	2,447	0,006
	29/30	20,38	5303,360	2,486	0,002	2,332	0,002
DEC	07/08	19,20	5311,306	2,467	0,008	2,305	0,008
	12/13	20,12	5316,342	2,460	0,002	2,308	0,004
	16/17	19,00	5320,292	2,474	0,014	2,320	0,002
	23/24	20,53	5327,370	2,472	0,010	2,315	0,004
	28/29	19,30	5332,313	2,475	0,004	2,326	0,002

Table III. 1983 Eps Aur Photometry Report from TAO Observatory
Jan. 02 - Jan. 31, 1983 (JD 2,445,337 - JD2,445,366) (S. Ingvarsson).

EPSILON AURIGAE DATA REPORT

Comp. star BD +42° 1170

NAME: STIG I. INGVARSSON

OBSERVATORY: T. A. O.

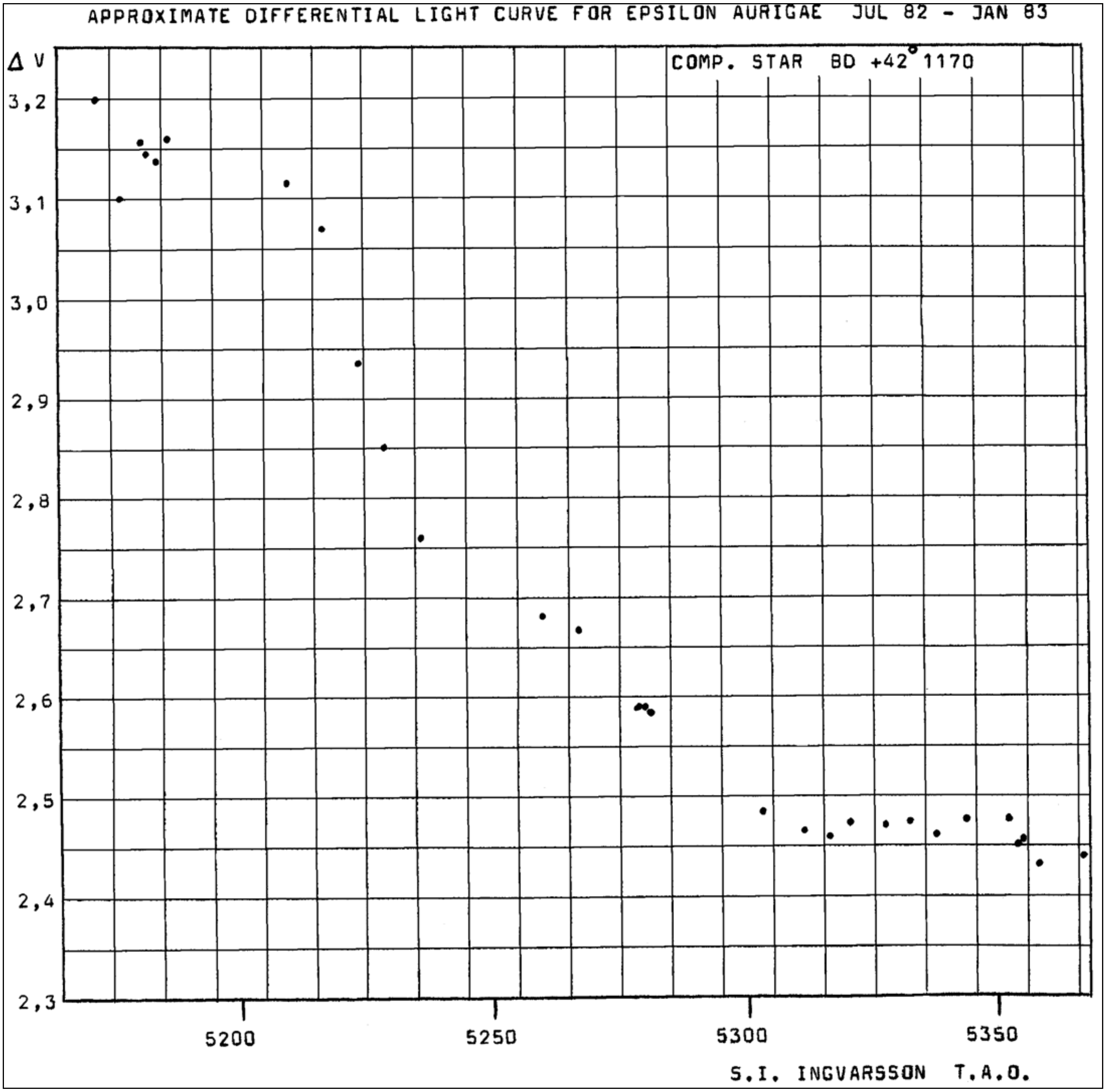
YEAR: 1983

REPORT DATE: JAN. 31 1983

SOLID STATE/ PMT: PMT

DATE		U T	JD(GEO)	Δ V	σ	Δ B	σ
JAN	02/03	18,13	5337,259	−2,462	0,008	−2,330	0,004
	08/09	17,03	5343,210	2,479	0,004	2,338	0,004
	08/09	20,02	5343,335	2,471	0,004	2,334	0,008
	16/17	17,26	5351,226	2,479	0,002	-----	-----
	18/19	22,40	5353,444	2,451	0,002	2,315	0,004
	19/20	18,30	5354,271	2,459	0,006	2,317	0,002
	22/23	22,36	5357,442	2,433	0,002	2,300	0,002
	31/01	17,52	5366,244	2,443	0,003	2,330	0,012

Figure V. Eps Aur Photometry Report from TAO Observatory
Jul. 1982 - Jan. 1983 (JD 2,445,172 - JD2,445,366) (S. Ingvarrson)



JD 2,440,000 +

POLARIMETRY REPORT

THE POLARIZATION OF EPSILON AURIGAE:
A PARTIALLY TRANSPARENT SECONDARY BODY?
AN UPDATED REPORT 4 FEB 1983

J.C. Kemp, G.D. Henson, and D.E. Kraus; Physics Dept., University of Oregon, Eugene, OR 97403. 503-687-2952; 503-686-4760; 503-382-8331.

SYNOPSIS

The optical polarization changes through the recent ingress into the eclipse, coupled with astrometric and photometric data, suggest that the primary star is, geometrically, totally eclipsed; but that, also, the secondary body ("cloud"?) is partly transparent, about 50%.

A. OBSERVATIONS

We have been measuring the linear (also circular) polarization of the object since 23 August 1982, using the 61-cm and 81-cm telescopes at Pine Mountain Observatory. The main interest will be in the linear polarization. The circular [polarization] showed very small values. In unfiltered (S-20) light we found:

$q = +(0.041 \pm 0.007)\%$ on 6/7 Nov 82
$q = +(0.028 \pm 0.006)\%$ on 24/25 Jan 83

These small values suggest an interstellar origin (twisted grain alignments). It is not likely that this parameter will be diagnostic of the nature of Epsilon Aurigae.

The linear polarization values, with errors, are given in Table I, for the U, B, V bands. The points are plotted in Figures I(a) and I(b). The errors in the points are typically 0.01% for V and B, and 0.02% for U. Thus, virtually all of the structure seen in Figures I(a) and I(b) is real. There is a large interstellar component of 2 - 2.5%. thus, it is best to analyze the data in terms of the Stokes parameters:

$Q = p \cos(2\theta)$ and $U = p \sin(2\theta)$
rather than in terms of p, θ.

B. THE LINEAR POLARIZATION: RAPID AND SLOWER VARIATION

During ingress, the relatively rapid structure on time scales of ~10 days (Figures I(a) and I(b)) suggest maybe "clumpiness" in the obscuring secondary body, as it drifts over the primary star.

There is one especially fast transition, seen in the U parameter in [the] V band during 28/29 Dec – 29/30 Dec [1982]. We see a change by 0.3% in 24 hours.

In Figure I(c) a light curve through this period, adapted from data supplied by Jeff Hopkins (Hopkins Phoenix Observatory), is shown. While there is slow change of the order of $0^m.1$ in ~15 days, no sharp light change accompanied the very rapid and large polarization change of 28/29 Dec [1982].

To analyze the variation on the longer time scale of the ingress, 100 - 200 days, we have drawn smooth, dashed curves through the points in Figures I(a) and I(b). The dashed curves thus average out certain "fine structure", i.e., certain relatively rapid features.

From the dashed curves of Figures I(a) and I(b), we have plotted the smoothed variation on the Stokes-parameter (QU) plane, [see] Figure 2.

In such a plot, one can effectively remove the interstellar polarization by a simple translation of the Q,U axes. (If the super-giant primary star is rotationally distorted and has an intrinsic polarization, that component can likewise be removed.)

It is reasonable to take the location of the out-of-eclipse polarization at a Q,U point near the beginning of ingress. While we began our observations after first contact, at the first data point (23 August) [1982] the object's brightness had dropped only about $0^m.1$. The typical V-band polarization around that time:

$Q = +0.7\%$ and $U = -2.4\%$

appears to be representative of the out-of-eclipse value.

In Figure 2 we see a swing of the polarization along a flat "Figure-8" path from lower right to upper left, then back roughly to the presumed origin, over the course of ingress. The "return" path is very rapid, from JD2,445,325 to 2,445,350, which includes the very sharp transition of Dec. 28-30 [1982].

Through the Figure-8 path we draw a mean axis (see Figure 2), which is found to make an angle of $2\theta = 120°$ with the +Q axis. This axis or direction is physically important for models.

C. A MODEL: ECLIPSING LIMB POLARIZATION OF THE PRIMARY

Two mechanisms for the variable polarization associated specifically with the eclipse are:

- (a) Aligned grains in the secondary, assumed to be [a] partly transparent dust cloud.
- (b) Limb polarization from the primary star, which appears when the disc is partially obscured.

If (a) were the main process, the polarization disturbance would persist all through the eclipse; it would not show sharp "contact" effects. We thus rule this out as at least the main mechanism. (A careful search for this process as relates for example to "clumpiness" in the cloud structure is, however, important.)

In fact the overall pattern we see is consistent with (b). At the bottom of Figure 2 is sketched the geometry of ingress, assuming for schematic purposes that the secondary is spherical. According to the astrometric orbit (van de Kamp 1978, *Sky & Telescope* 56, 397), the primary at ingress is moving east and is above the line of nodes.*

Near second contact, assuming the primary to be completely or almost completely eclipsed, the primary displays a small limb sector. This sector has a limb polarization parallel to the secondary limb at that point. Precisely, in our case that point is at the latitude about +60° on the secondary disk, to explain the polarization.

Since the polarization inside the eclipse, after second contact, seems to revert to the before-eclipse value, it must be that the eclipse is total. Since the secondary is very cool and since the visible-light drop is 0m.8, the secondary body must be about 50% transparent.

---

* The line of nodes is almost E-W, with p.a. 93°.

Such a scenario explains the very sharp transition of 28-30 December [1982]. That is the time of "second polarimetric contact", just before which the limb polarization was a maximum. That no sharp light transition accompanies that is explained by the assumption of 50% transparency of the secondary cloud.

A puzzle is the sharp boundary in the partly-transparent secondary, which seems to be required here.

It is important to go on observing the polarization throughout the eclipse phenomenon. We look, for example, for other "boundary effects" inside the obscuring body.

Separately, we should take cognizance of possible variable polarization in the primary star due to its Cepheid-like pulsation. This is probably a very low-amplitude effect; however, it could add "fine structure" to the polarization curves just as in the light curve. The pulsation in question would have to be non-radial, as in the RV Tauri stars, etc.

PHYSICS OF THE PRIMARY-STAR LIMB POLARIZATION

Note that while we did not have UBV coverage throughout our program, the three-color polarimetry, especially in late Dec. [1982] – Jan. [1983], indicates no significant color dependence in the varying polarization. (There is some sign of a different behavior in the U band.) Thus, free-electron scattering is the logical source of the intrinsic polarization. In the F0I primary star, we must then have a fairly high free-electron density in the photosphere.

By coincidence, we have just discovered the eclipsing limb polarization in another system, Algol. (Kemp, Barbour, Henson, and Krauss, paper in preparation.) [* see ref. below]

In that case the effect is extremely small, 0.01% or 30 times smaller than that proposed in Epsilon Aurigae. But Algol's primary star is a non-evolved B8V type, having evidently a much lower free-electron density.

[* Ed. Note: ref. added 2005]
Kemp, Henson, Barbour, Kraus, and Collins, ApJ 273 pp. L85-L88 1983 Oct. 15

Table I. Epsilon Aurigae Polarimetry from Pine Mountain Observatory.
24 Aug 1982 - 02 Feb 1983 (JD 2,445,205 - JD 2,445,367).

<u>Epsilon Aurigae</u> polarimetry Pine Mt. Obs. J.C. Kemp, G.H. Henson, D.J. Kraus

V,B,U bands Format: JD244..., Q, U, Q error, U error (all in percent)

Here Q,U are the precise <u>equatorial</u> parameters $Q = p \cos(2\theta)$, $U = p \sin(2\theta)$.

Data here as of 3 Feb 83. Data collection is continuing.

V band

5205.979	0.688	-2.403	0.015	0.015
5221.948	0.789	-2.379	0.005	0.002
5233.986	0.714	-2.263	0.008	0.012
5243.899	0.672	-2.246	0.007	0.015
5253.012	0.727	-2.288	0.006	0.015
5273.906	0.799	-2.337	0.010	0.014
5280.797	0.695	-2.095	0.008	0.010
5289.029	0.676	-2.142	0.008	0.010
5298.027	0.607	-2.132	0.014	0.021
5311.976	0.395	-2.150	0.013	0.111
5312.949	0.390	-2.103	0.012	0.014
5313.951	0.409	-2.144	0.010	0.019
5314.984	0.425	-2.177	0.010	0.010
5328.936	0.506	-2.027	0.017	0.022
5332.718	0.530	-1.993	0.013	0.016
5333.702	0.624	-2.312	0.003	0.017
5334.708	0.635	-2.334	0.009	0.023
5342.678	0.710	-2.391	0.019	0.100
5345.667	0.712	-2.436	0.007	0.015
5346.714	0.736	-2.468	0.006	0.006
5349.832	0.722	-2.470	0.008	0.010
5354.849	0.716	-2.457	0.021	0.150
5355.714	0.718	-2.453	0.010	0.012
5362.662	0.693	-2.475	0.008	0.010
5364.874	0.640	-2.407	0.019	0.027
5366.695	0.632	-2.325	(0.010	0.010) *
5367.810	0.618	-2.318	(0.010	0.010) *

B band

5332.766	0.526	-2.248	0.007	0.015
5333.749	0.562	-2.259	0.006	0.012
5342.715	0.665	-2.322	0.010	0.120
5345.721	0.700	-2.401	0.007	0.011
5349.873	0.738	-2.469	0.012	0.013
5354.942	0.719	-2.437	0.015	0.034
5355.792	0.719	-2.446	0.009	0.011
5362.768	0.681	-2.512	0.006	0.009
5366.803	0.639	-2.387	(0.010	0.010) *
5367.881	0.579	-2.319	(0.010	0.010) *

U band

5230.972	0.679	-1.981	0.020	0.022
5244.930	0.658	-1.859	0.020	0.020
5332.879	0.542	-2.031	0.045	0.039
5333.849	0.516	-1.938	0.019	0.016
5342.752	0.640	-2.169	0.068	0.250
5345.849	0.668	-2.186	0.020	0.027
5349.909	0.658	-2.127	0.022	0.034
5354.910	0.603	-2.165	0.020	0.039
5355.756	0.696	-2.254	0.017	0.023
5362.702	0.635	-2.254	0.020	0.021
5366.760	0.565	-2.284	(0.020	0.020) *
5367.846	0.568	-2.354	(0.020	0.020) *

(* Data on last two dates called over by phone; errors had not been computed, but nights were very clear and 0.01% is typical.)

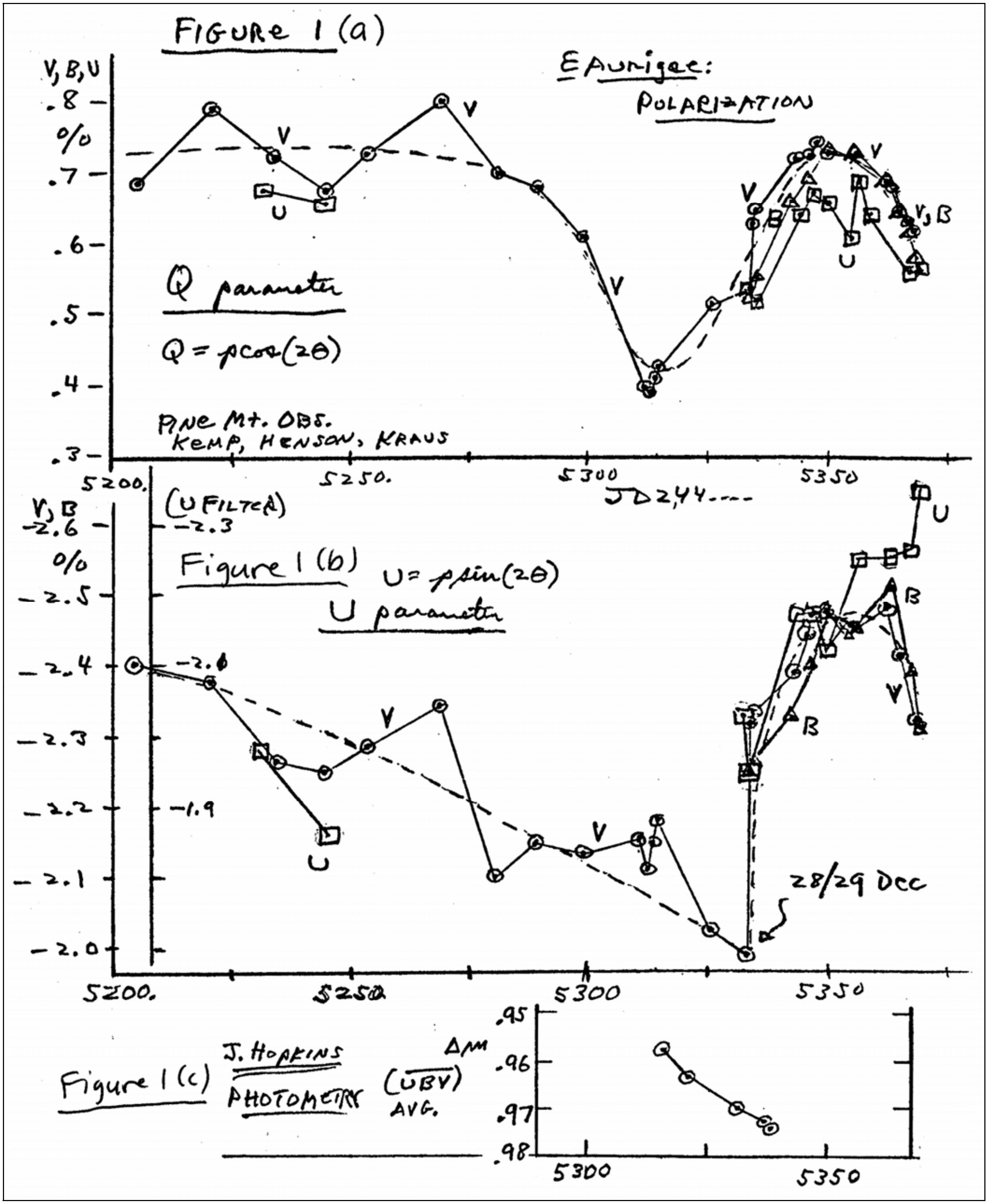


FIGURE 1 (a)
E Aurigae:
POLARIZATION
Q parameter
Q = pcos(2θ)
PINE Mt. OBS.
KEMP, HENSON, KRAUS
JD 244----
(U FILTER)
Figure 1 (b)
U = psin(2θ)
U parameter
28/29 Dec
Figure 1 (c)
J. HOPKINS
PHOTOMETRY
(UBV) AVG.
Δm

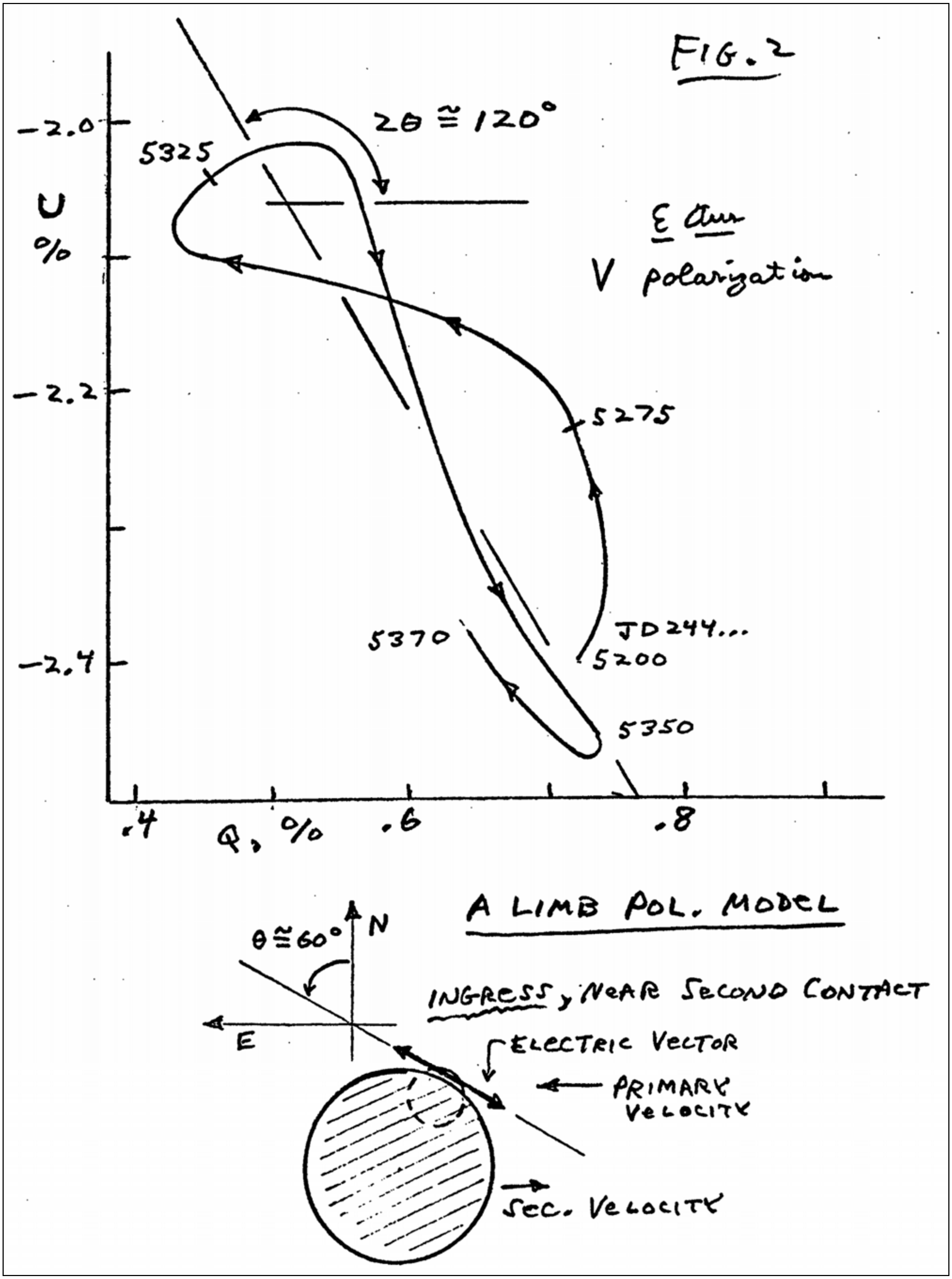


FIG. 2
2θ ≅ 120°
-2.0
-2.2
-2.4
U %
5325
ε Aur
V polarization
5275
JD 244...
5200
5370
5350
.4
Q, %
.6
.8
A LIMB POL. MODEL
θ ≅ 60°
N
E
INGRESS, NEAR SECOND CONTACT
ELECTRIC VECTOR
PRIMARY VELOCITY
SEC. VELOCITY

SPECTROSCOPY REPORT

New data is beginning to be received which may provide the breakthrough to understanding the invisible component of the Epsilon Aurigae system. The data, particularly from the infrared, is hinting at characteristics which were never before observed or recognized. In addition to the increase during ingress of the strength of the K I 7699Ä feature reported by Parthasarathy and Lambert [1] (Texas) IR photometry, IR spectroscopy, optical polarimetry and UV spectroscopy presently suggest that the invisible component may be a cool, dusty disk.

Dr. Kemp (Oregon) has observed a significant and 'discontinuous' change in the optical polarization of Eps Aur between Nov. and Dec. 1982, near second contact (see attached letter and IAU Circular No. 3759).[2] An ad hoc explanation for this could involve light from the primary shining through aligned grains. The alternate explanation involving residual limb polarization in an annular eclipse could not produce the discontinuous variation seen. He also reports a smaller, longer-term polarization variation which appears to be related to the 100-120 day Cepheid pulsation.

Drs. Backmann and Bell (Hawaii) have derived a color temperature of 600K for the secondary of Eps Aur based on their 10- and 20-micron photometry.[3]

Drs. Ake (CSC) and Simon (Hawaii) reported at the recent AAS meeting [3] on their 1-5 micron FTS spectroscopy and found the development of a blue-shifted (65 km/sec) absorption component within an asymmetric Brackett line of hydrogen. Also, the continuum variation appears [to be] wavelength independent ('grey').

Drs. Chapman, Kondo, and Stencel (NASA) have reported on their UV spectroscopy in a paper submitted to the Astrophysical Journal.[4] [see abstract, next page.] The spectral changes argue for extra opacity shortward of 3000A, which could be dust in the vicinity of the secondary. this, combined with previously reported IR photometry by Wolff (1973) [sic, Woolf (1973), see [5]] suggests an equilibrium temperature for dust near the secondary of less than 1500K. In addition, the lack of variation in the Mg II core emission suggests an extended emitting region which is little affected by the eclipse.

Speculation: The ingress data suggest a cool object (1000K: IR ptm., UV opacity) with possibly a well organized core (polarization jump near second contact) which could have retrograde rotation (blue-shifted absorption) and be surrounded by an extended shock region (Mg II emission constancy) caused by the interaction of the F star wind (and pulsations) and the extremities of the secondary component of Eps Aur. This hypothetical design implies various continuing changes which should be observable: e.g., motion of the blue-shifted absorption toward redshift if the retrograde core rotation exists (although this violates angular momentum conservation), polarization changes near third contact, etc. Continued photometry to relate the spectral changes to the Cepheid pulsation is vitally important. We welcome additional reports and ideas.

[Ed. Notes: References in brackets [ ] added 2005]

[1] IAUC 3766, 1983 Jan. 24
[2] IAUC 3759, 1983 Jan. 07
[3] IAUC 3763, 1983 Jan. 20
[4] Chapman, Kondo, and Stencel, ApJ 269 pp. L17-L19 1983 Jun 01
[5] Woolf, N.J., ApJ 185 pp.229-237 1973 Oct 01. [Note, name also misspelled in Chapman, Kondo, and Stencel (1983). There are two other researchers named Wolff.]

“ACCEPTED FOR ASTROPHYSICAL JOURNAL”

THE PARTIAL PHASE OF THE ECLIPSE OF EPSILON AURIGAE

Robert D. Chapman* and Yoji Kondo
Laboratory for Astronomy and Solar Physics
Goddard Space Flight Center

and

Robert E. Stencel[1]
Astronomy and Relativity Office
NASA Headquarters

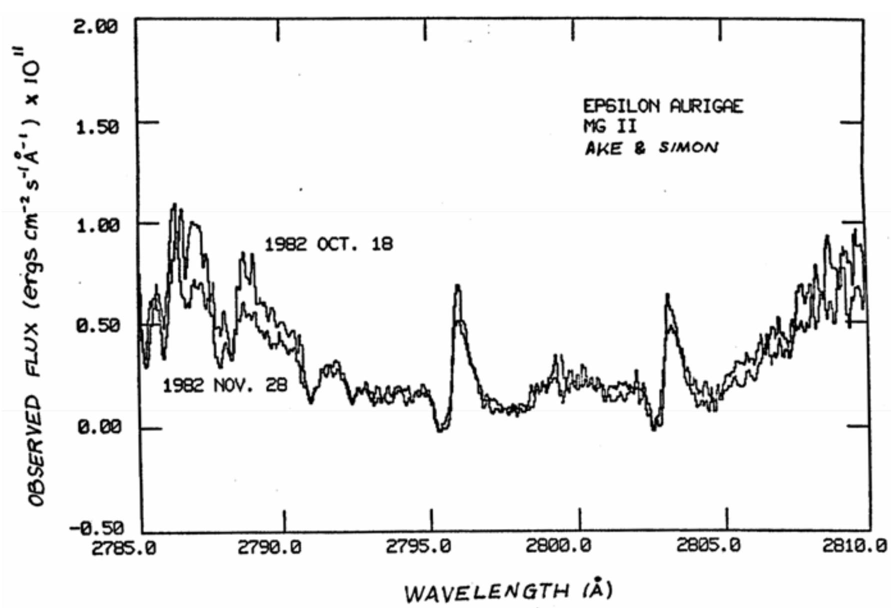
Received 1982 December 17; revised 1/22/83; accepted 1/27/83

Abstract

Ultraviolet spectra of the peculiar eclipsing binary ε Aurigae (F0 Ia + ?) were obtained with the International Ultraviolet Explorer (IUE) at pre-eclipse and ingress partial phases. The results show a wavelength dependence of the eclipse in contrast to the grayness (non-wavelength dependence) of the eclipse observed in visible light. From the current results, incorporating previous observations, we suggest that: (a) the obscuration of the visible light of the F supergiant is the result of electron scattering, perhaps in the disk proposed by Huang; (b) the increase in the eclipse depths toward shorter wavelengths observed in the ultra-violet is caused by dust; and (c) the temperature of the disk is in the range of 1000 to 2000K.

1 On leave from the Joint Institute for Laboratory Astrophysics

* Preprints available from Dr. Chapman, Code 680, NASA-GSFC, Greenbelt, MD 20771, USA



[Ed. Note added 2005: Published in ApJ 269 pp. L17-L19 1983 Jun 01]

Epsilon Aurigae Campaign Newsletter

MAILING LIST UPDATE / NL6 1983

An observing campaign is only as effective as its active participants. The costs of preparing and mailing this newsletter requires us to ask each recipient to indicate a willingness to remain on the mailing list by responding with the return of the form listed below.

** Mail the completed form to: Dr. Robert Stencel, Code EZ-7, NASA-HQ, Washington DC 20546 USA.

To receive future mailings, this form must be completed and returned:

NAME: ______________________________

ADDRESS: ______________________________

____

____

____

____

Telephone/Telex: ______________________________

Please indicate participation level:

O PHOTOMETRY	O SPECTROSCOPY	O Interested Bystander
- UBV(RI)	- Ultraviolet	
- 4 color uvby	- Optical	
- Other:	- Infrared	
____________	- Other: ______________	