THE EPSILON AURIGAE ECLIPSE

BY

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I. INTRODUCTION

Are you turned on by intriguing objects? Do you wish that you could study interesting objects such as SS433? How about observing the largest known star, or a solar system or star being born, or perhaps a black hole? Try observing the Epsilon Aurigae eclipse.

Why all the interest in Epsilon Aurigae? The star was first noticed as being variable in 1821 and has been observed each eclipse since, a total of six. Despite the number of times the eclipse has been observed more questions than answers have arisen. Epsilon Aurigae has a visual magnitude of 3 which reduces to about 3.8 during the eclipse. Its spectral classification is F0-F2 and its period is approximately 27.1 years. The approximate distance is 2000 light years. Epsilon Aurigae is located 3° southwest of Capella and makes up one of the stars in the group known as "the kids". Its RA(1950) is 4h 58m and it declination (1950) is +43° 45'.

II. EPSILON AURIGAE LIGHT CURVE

During ingress the visual magnitude fades .8 magnitudes in about 200 days. It remains at approximately 3.0 M_v for about 400 days. During egress a near mirror image of the ingress returns the star to 3.0 M_v in about 200 days. Although the light curve appears smooth, morphology of the light curve reveals many irregularities. These irregularities seem to vary from eclipse to eclipse. During the 1958 eclipse a large hump of .2 M_v appeared at mid-eclipse. To make matters worse the F0 supergiant is subject to aperoidic variability of .2 magnitude. No secondary eclipse has been observed, however, the predicted light change of .06 M_v would be swamped by the stars aperiodic variability.

III. TRADITIONAL MODEL

With the traditional interpretation of the eclipse a giant star of mass greater than 13Mo and a diameter greater than 2500 times that of the sun is needed as the eclipsing body. This means a star of about the same mass as the F0 star but invisible. The implication is then a star of size greater than any other known star with a density of about one billionth that of the sun or what could be considered an absolute vacuum. These ideas along with other details tend to disfavor the traditional model.

IV. THE SHELL MODEL

With the shell model the eclipsing object is a small companion star of type O or B surrounded by a layered cloud of gases, dust, or small particles. The companion star is suggested to be 2 magnitudes fainter than the F0 star and thus unobservable. However, problems still arise with this model.

V. THE TRANSIT MODEL

With this model a small condensed object,e.g., a black hole, is surrounded by a flattened disk of rotating gases. The disk is seen edge wise and never completely covers the F0 star. The eclipsing disk could be the accretion disk of a black nole, a planetary system in the making or the beginning of a protostar.

VI. EPSILON AURIGAE QUESTIONS

1. What is the nature of the material which produces extinction during the eclipse?

2. What is the nature of the secondary object associated with the eclipse?

3. What is the cause of the small irregularities in brightness and the color variations which occur at all orbitial phases but increase in magnitude during the eclipse?

VII. 1982 - 1984 OBSERVATIONS

During the 1982 - 1984 eclipse a concentrated effort will be made to obtain the following types of data:

1. Infrared photometry, infrared spectroscopy, and infrared polarization.

2. UBVRI and other filter photometry.

3. Visual photometry.

4. High dispersion spectrophotometry (H -α, Na D).

5. UV studies using the International Ultraviolet Explorer Satellite.

6. Precision low dispersion spectrophotometry.

VII. I.A.P.P.P.

Dr. Robert Stencel will be coordinating the spectroscopy data and I will be helping with the photometric data. The IAPPP has been asked to support the UBVRI photometry of Epsilon Aurigae. Lambda Aurigae is to be used as a comparison star and is located 5° from Epsilon. Transformation coefficients must be known and extinction determined each observing session. An Epsilon Aurigae Campaign Newsletter has been started to quickly disseminate information to interested observers. For further information please contact me.

IX. CONCLUSION

This next eclipse should produce much more data than any of the previous eclipses. Many questions should be answered and the possibility of new discoveries will enhance the search for the answers.

REFERENCES:

1. EPSILON AURIGAE CAMPAIGN NEWSLETTER #1 18 January 1982

2. "The Mystery of Epsilon Aurigae" by Francis J. Reddy, SKY & TELESCOPE May 1982 Page 460.

3. "The Light and Colour Variation of Epsilon Aurigae", K. Gyldenkerne (1970), VISTAS IN ASTRONOMY Vol. 12 Page 199.

4. BURNHAM'S CELESTRIAL HANDBOOK by Robert Burnham,Jr., (1978), Vol. One, Page 267.

EPSILON AURIGAE DATA

* BS 1605
* M_V = +3.0 TO +3.8
* SPEC = F0
* PERIOD = 27.1 YEARS
* DISTANCE = 2000 LIGHT YEARS
* RA(1950) = 4h 58m
* DEC(1950) = +43° 45'

FIGURE 1

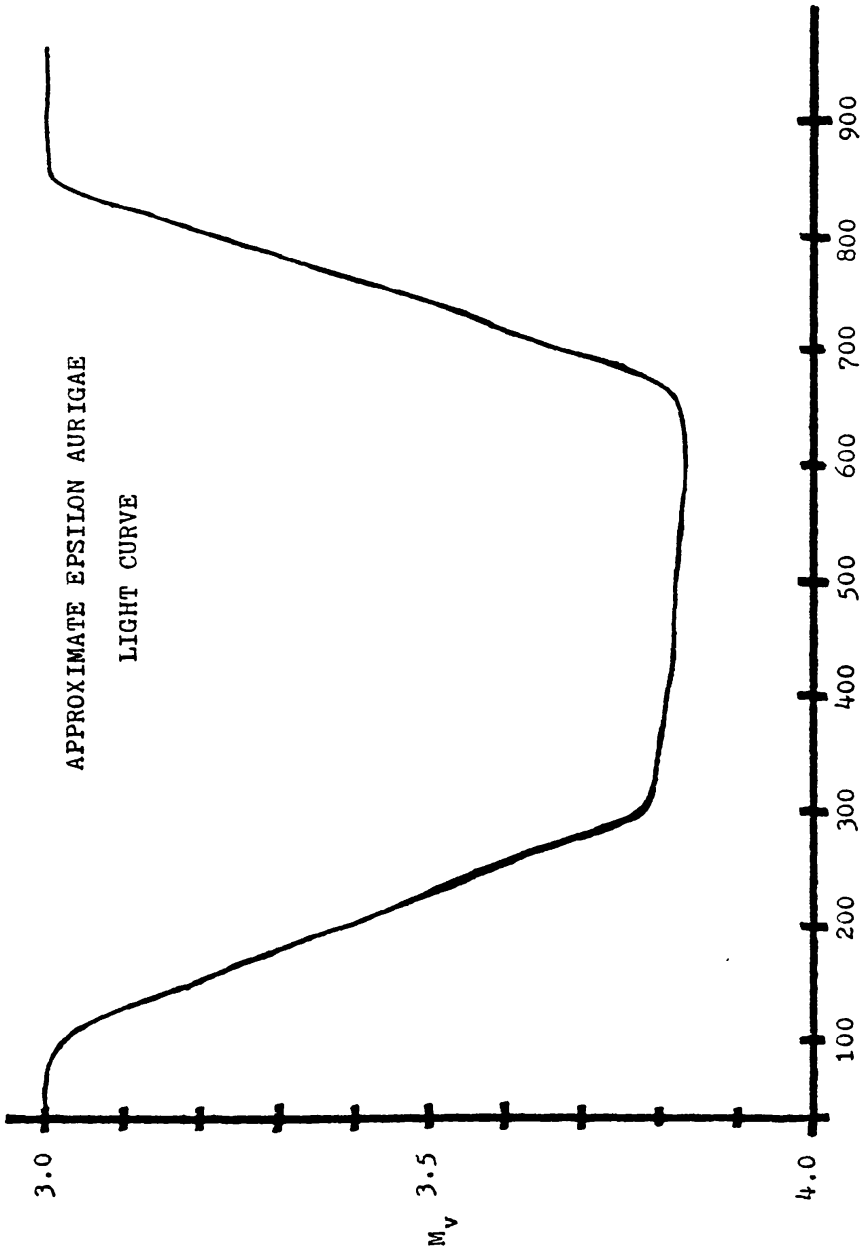
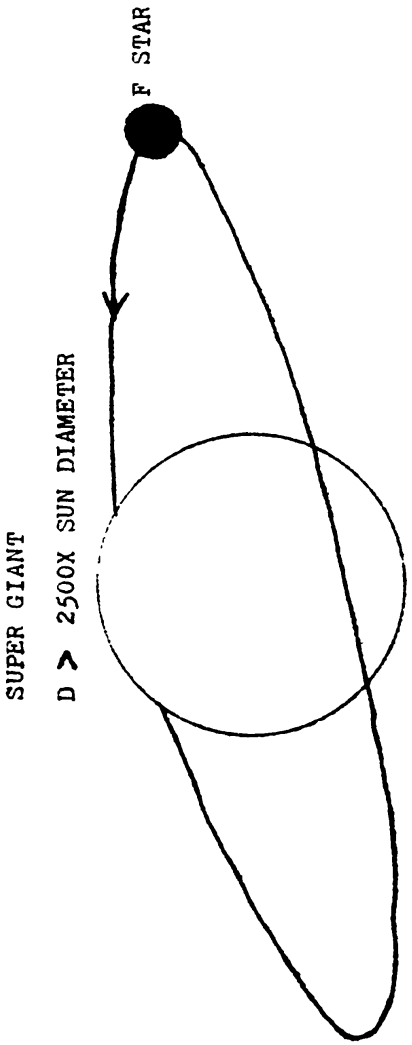
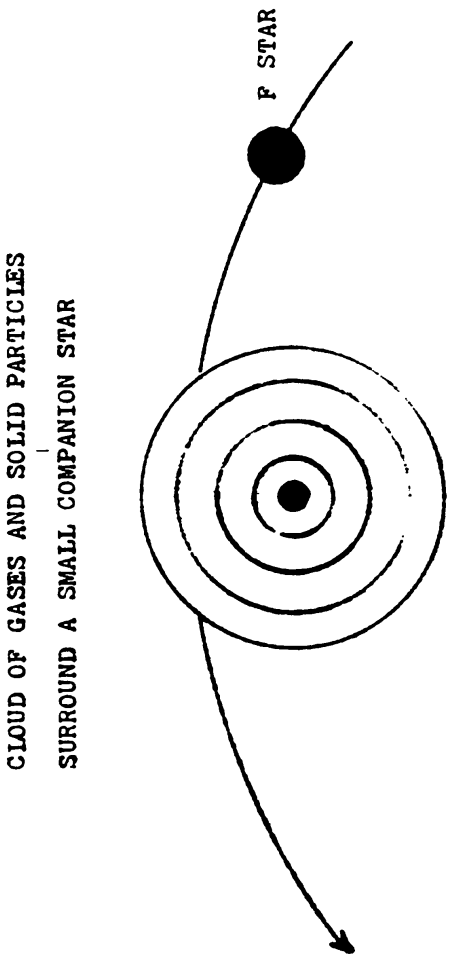


FIGURE 2



TRADITIONAL MODEL

FIGURE 3



SHELL MODEL

FIGURE 4

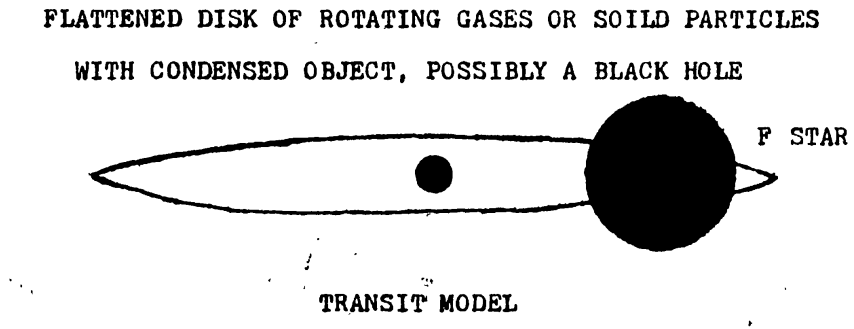


FIGURE 5

EPSION AURIGAE QUESTIONS

* WHAT IS THE NATURE OF THE MATERIAL WHICH PRODUCES EXTINCTION DURING THE ECLIPSE?

* WHAT IS THE NATURE OF THE SECONDARY OBJECT ASSOCIATED WITH THE ECLIPSE?

* WHAT IS THE CAUSE OF THE SMALL IRREGULARITIES IN BRIGHTNESS AND THE COLOR VARIATIONS WHICH OCCUR AT ALL ORBITAL PHASES BUT INCREASE IN MAGNITUDE DURING THE ECLIPSE?

FIGURE 6.

1982-1984
OBSERVATIONS

- INFRARED PHOTOMETRY, SPECTROSCOPHY AND POLARIZATION
- UBVRI AND OTHER FILTER PHOTOMETRY (IAPPP)
- VISUAL PHOTOMETRY
- HIGH DISPERSION SPECTROPHOTOMETRY (H- , Na D)
- UV STUDIES (INTERNATIONAL ULTRAVIOLET EXPLORER SATELLITE)
- PRECISION LOW DISPERSION SPECTROPHOTOMETRY

FIGURE 7

I.A.P.P.P.

* UBVRI PHOTOMETRY DATA
* LAMBDA AURIGAE COMPARISON STAR (5^{o} FROM EPSILON)
* MUST DETERMINE EXTINCTION EACH OBSERVING SESSION
* MUST KNOW TRANSFORMATION COEFFICIENTS
* CAMPAIGN NEWSLETTER

FIGURE 8