

IMAGES OF THE ENVELOPE OF ALPHA ORIONIS

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ABSTRACT. Two images have been obtained, from observations made almost two years apart, of the H-alpha chromospheric envelope of Alpha Orionis at the diffraction limited resolution of the co-phased Multiple Mirror Telescope. Significant emission out to a distance of several stellar radii above the photosphere is observed.

1. INTRODUCTION

Several recent attempts have been made to design theoretical models for the extended atmosphere of the M type supergiant Alpha Orionis. However, the heights and thicknesses of the chromosphere within a few stellar radii of the star, in the region where the outward flow of matter is accelerated, has been relatively unknown. The H-alpha absorption line provides a valuable diagnostic since it is expected to be formed in this region. Using a narrow (1.2Å) H-alpha filter, and the fully-phased six-mirror Multiple Mirror Telescope (MMT)¹, images were obtained of the H-alpha chromosphere of Alpha Orionis at the greatest resolution available for imaging at optical wavelengths.

2. OBSERVATIONS AND DATA REDUCTION

Differential Speckle Interferometry (DSI) observations were made using the fully-phased MMT (Hege et al. 1985) on 1983 December 16/17, and again on 1985 November 2/4. The observational and data reduction procedures are discussed in detail by Hebden et al. (1986) and Hebden, Hege, and Beckers (1986). In order to extract images of the supergiant in the H-alpha line, the DSI imaging technique requires a reconstruction of the star's image in an adjacent continuum bandpass. A well defined photospheric radius, R_* , was found of 17 milli-arcseconds (mas) to 23 mas, dependent on the limb-darkening assumed.

¹ The Multiple Mirror Telescope Observatory is a joint facility of the Smithsonian Institution and the University of Arizona.

3. IMAGES OF THE H-ALPHA ENVELOPE

The images of the H-alpha envelope of Alpha Orionis for the 1983 December and 1985 November observations are shown in figure 1. The contours are plotted at intervals of approximately five percent.

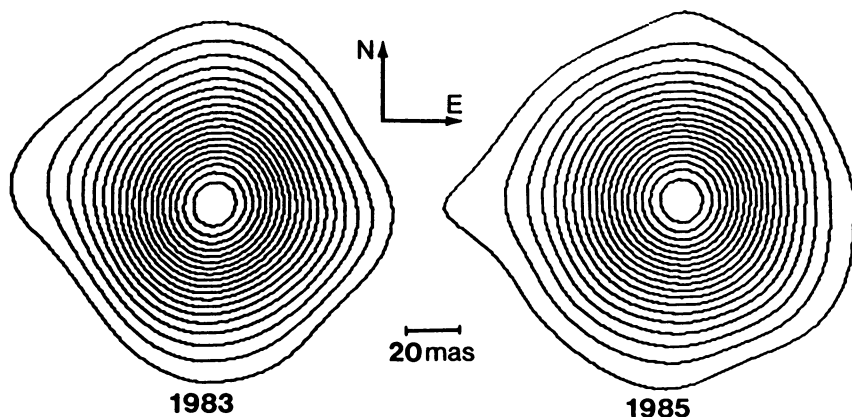


Figure 1. Images of the H-alpha envelope of Alpha Orionis

An intensity greater than one percent of maximum is detectable out to a radius of about 95 mas, or 4.5 stellar radii. Both images exhibit a small degree of asymmetry, corresponding to a position angle of about 280° . The absence of a distinct photospheric limb suggests that the optical depth in H-alpha is probably very large. The radial profiles of the images exhibit a remarkable agreement with a Gaussian-like distribution, with intensity falling to I_0/e at $2R_*$ and $I_0/10$ at $3R_*$. The size of the observed H-alpha envelope of Alpha Orionis appears to conform to estimates of the chromospheric radius obtained from radio observations (Altenhoff, Oster, and Wendker 1979; Newell and Hjellming 1982), and to the theoretical model of Hartmann and Avrett (1984). A quantitative comparison of our results and this theoretical model is described by Hebden, Eckart, and Hege (1987).

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4. REFERENCES

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