26.03

Detection of Supergiant Variability with the HAO/Lowell/AFGL Solar Stellar Spectrophotometry Project (SSSP)


A bright star is routinely used to perform alignment and performance verification tasks for the HAO/Lowell/AFGL Solar-Stellar Spectrophotometer system. In early September, 1989, variations in the H$_\alpha$ line of HD 197345 (a Cyg), which exhibit a classic P Cygni profile, were detected using data collected during these adjustment observations. The red-shifted emission feature initially brightened by a factor of four (I$_{emin}$ to 1.09 I$_{emin}$) over three days and then decayed in intensity over the next two days to a level close to that of the initial observation. The minimum of the absorption feature remained at a more-or-less constant depth of about 0.32 to 0.38 I$_{emin}$ throughout the period of observation.

Empirical studies of the H$_\alpha$ profile of a Cyg (Kurucz and Morrison, 1982) indicate that the emission feature in the profile is sensitive to the choice of the extension parameter $\beta$ in the assumed stellar wind velocity profile $v(r)$. The basic structure of the wind is then inferred by the assumption of mass flux continuity, $dM/dr = 4\pi r^2 v(r)$. The short time scale observed for the variation of the bright emission feature in a Cyg calls into question the validity of the assumption of mass flux conservation in the case of this star, since the typical wind speed of 200 km sec$^{-1}$ and the estimate of the radius of the stellar envelope ($2 R_\odot$) imply a characteristic flow time of 100 days in the case of a Cyg.

To investigate further other kinds of temporal variation in the spectra of supergiants over the range of the H-R diagram, spectra of two other stars, p Cas and a Ori, have been monitored through the 1989 fall observing season.

26.04

Can the Winds From Wolf-Rayet Stars be Driven by Line Radiation Pressure Alone?

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We wish to bring into sharper focus the issues involved in explaining the fast, massive winds from Wolf-Rayet stars by line-driven wind theory. In the last few years the basic line-driven wind theory of Castor, Abbott, and Klein has been modified by several authors so that it is now in excellent agreement with the observations of most classes of early-type stars. The theory fails, however, to explain the winds from Wolf-Rayet stars, if the usual stellar parameters for these stars are adopted. In particular, there is a "momentum problem", in that the momentum flux carried away by the wind is roughly an order of magnitude larger than the momentum flux in the stellar radiation field. Many authors have suggested that this proves that the winds cannot be driven by line radiation pressure alone. We will show that this claim is false, and will examine what is required to explain the observed properties of Wolf-Rayet winds within the framework of the line-driven wind theory. In particular, we will investigate the dependence of the mass loss rate and terminal velocity on the mass, luminosity, and radius of the star, and on $k$ and $\alpha$, the two basic parameters of the line-driven wind theory.