The stellar data are fit with wind/atmosphere models to find that the star is extraordinarily luminous, having $L = 10^{7.95} \, L_\odot$, making it one of the most luminous stars known; the range in luminosity is primarily due to uncertainties in extinction and intrinsic spectral energy distribution of the star. Coupled with the relatively cool temperature, $T_{\text{eff}} = 10^{4.19} \, K$, the star is clearly in violation of the Humphreys-Davidson limit.

The line of sight velocity of the star is confirmed to be $\approx 130 \, \text{km} \, \text{s}^{-1}$, assuring membership in the Quintuplet cluster. This, along with the inferred extinction, places the star at the Galactic Center.

The spectra of the Pistol confirm that the ionized gas has smoothly varying velocity gradients superposed on a bulk velocity of $130 \, \text{km} \, \text{s}^{-1}$. Radio and near-infrared hydrogen-to-helium line ratios suggest that the Pistol may have extrasolar helium abundance and that it must be excited, in part, by a star which is hotter than the Pistol Star. The morphology of the gas, the velocities in the gas, and the location of the star in the HR diagram suggest that the gas in G0.15--0.05 is matter which was ejected from the star.

125.02

UV observations of \( \omega \) Centauri with HST

N. D'Cruz, R. O'Connell, R. Rood, J. Whitney (UVa), B. Dormann (UVa & NASA/GSFC), W. Landsman, R. Hill (Hughes/STX), T. Stecher (NASA/GSFC), R. Bohlin (STScI)

The globular cluster \( \omega \) Centauri is unique amongst the globular galactic clusters for several reasons e.g., its abundance spread and its large population of stars. Ultraviolet Imaging Telescope (UIT) observations of \( \omega \) Cen have found over 1950 far-UV sources most of which are horizontal branch (HB) stars and their progeny. The UIT image together with ground based Stromgren \( u \) photometry was used to produce a color magnitude diagram (Whitney et al. AJ 1994, 108, 1350) which shows: (1) a gap around 16000 \( K \) in the HB, (2) HB stars cooler than the gap agree well with theoretical tracks, (3) some objects hotter than the gap lie below the zero-age HB (sub-HB stars), (4) many post-HB stars which correspond well with stellar theory, (5) a significant population of stars with colors indicating \( T_{\text{eff}}>50000 \, K \).

We are using HST/WFPC2 images of 3 selected fields on \( \omega \) Cen to investigate the features of the hot star population. Observations in the 160W and 555W filters were obtained. Preliminary analysis of the data confirms the population of very hot stars, including post-HB stars and the existence of HB gaps. Comparison of the data to theoretical HB tracks is being carried out.

125.03

On the Origins of Heavy Element Anomalies in HgMn Stars

C.R. Profitt (CSC/Catholic Univ. of America), D.S. Leckrone (NASA/GSFC)

The element mercury is overabundant, relative to solar system abundances, by as much as five orders of magnitude in most HgMn stars. Similar overabundances of platinum, gold, and thallium are found in a number of these stars. Several of these elements also show large isotope anomalies in the cooler HgMn stars, with mixtures weighted much more strongly towards the heavier stable isotopes than in standard mixtures. Nucleosynthesis explanations of these isotope anomalies appear implausible, and they are presumed to result from diffusive separation.

While radiatively driven diffusion undoubtedly plays a key role in the creation of these extreme abundance and isotope anomalies, the detailed mechanisms by which they form remain obscure. Our radiative force calculations have shown that radiation pressure in the stellar atmosphere cannot by itself support the mercury or thallium abundances observed in cool HgMn stars. Other mechanisms, such as mass loss, mixing, light induced drift, or magnetic fields must also play an important role.

We have made quantitative estimates of how several of these mechanisms might influence abundances and isotope separation. The magnetic fields required to affect atmospheric abundances appear to be substantially larger than allowed by existing observations. Light induced drift might be able to cause some isotope separation within a static distribution, but appears incapable of supporting the observed abundances. Mass loss rates would need to be $>10^{-7} \, M_\odot \, \text{yr}^{-1}$ to support the observed mercury enhancement. Such a large mass loss rate would have profound implications for the origins of all abundance anomalies in HgMn stars.

125.04

Recent Results from High-Resolution H\alpha Spectroscopic Monitoring of \( \alpha \) Cygni

N. D. Morrison and C. L. Mulliss (U. Toledo)

The star \( \alpha \) Cygni (HD 197345) is a bright A2 la-type supergiant. Its photometric and spectral variability are typical for early-type supergiants. As part of a campaign on spectral variability of BA-type supergiants, we have obtained high-resolution (\( R = 26,000 \)) spectra of \( \alpha \) Cyg in the region surrounding H\( \alpha \). In early August 1997, the behavior of the H\( \alpha \) line suddenly changed. The line, which had shown a roughly constant P-Cygni profile from April through July, developed a cyclic pattern of variability near the center of the absorption component. This pattern has persisted through November 1997. Thanks to an unusually densely sampled set of observations (47 observations with a median separation between observations of only 1.93 days) and to the persistence of the phenomenon, its cyclical nature is evident.

The timescale involved (about 40 days) and the cyclical nature of the variability suggest a corotating surface or wind feature as the source of this variability. The phenomenon may be related to the high-velocity absorption events reported in A-type supergiants by Kauffer et al. (1996, A&A, 305, 887).

We will demonstrate the cyclical character of the recent variability using several forms of visual presentation. We will also present preliminary results from a time-series analysis of the H\( \alpha \) profile.

125.05

Two-Component Winds from Luminous Late-Type Stars

V. S. Airapetian (CSC/GSFC), L. Offman (Hughes STX/GSFC), R. Robinson (Catholic Univ. of America), K. Carpenter, J. Davila (GSFC/NASA)

We present the results of a magnetohydrodynamic (MHD) simulation of winds from luminous late-type stars using a 2.5D, non-linear MHD computer code. In this simulation we assume that the wind is generated within a hydrostatic atmosphere with an initial isothermal pressure scale height of 0.072 \( R_{\odot} \), and a radial magnetic field. We also assume a transverse density gradient which we refer to as a “chromospheric hole.” Toroidal Alfvén waves are generated at the stellar surface by a forcing function having a single frequency, which is comparable to the turn-over frequency of convective cells in giant stars. To ensure that we are accurately assessing the terminal velocity of the wind, we carried out the calculations to a height of 20 stellar radii and a time period of more than 180 Alfvén transit times, which ensures that a steady state has been reached. In the higher density (low Alfvén velocity) regions outside of the “chromospheric hole” the Alfvén waves are freely propagating. Ponderomotive forces associated with these waves drive radial, compressive motions and contribute to stellar wind acceleration. The compressive motions then excite slow magnetosonic waves which non-linearly steepen into solitary waves that propagate on top of a background flow similar to the case of solar coronal holes. This produces a fast (40-80 km/s) and relatively dense component of the wind. In the lower density “chromospheric hole” region the Alfvén waves are strongly reflected and produce an outflow with both radial and azimuthal velocities which are $\approx 10\%$ of the local Alfvén speed. This component of the wind is slow ($\approx 10-30 \, \text{km} \, \text{s}^{-1}$) and less dense than the wind initiated outside of the hole. Depending on the magnetic topology in the atmosphere of a luminous late-type star, we may therefore expect either one (fast) or two components to the wind. Our results are consistent with recent observations of two discrete components to the wind in the K5 III hybrid star \( \gamma \) Dra. These components were detected in the Mg II h and k resonance lines and had velocities of 67 and 30 km/s, with the higher velocity component having a mass loss rate which is 10 times that of the slower speed wind.