Most of the 1665 MHz maser components are distributed in a shell with a radius of 1.2′, marginally smaller than the value of 1.5′ for the main shell at 1612 MHz. However, there are indications of clumps or portions of shells at much smaller and larger radii. At some velocities, the angular structure of the 1612 MHz emission has changed significantly with time. It is possible to parameterize the majority of maser components by an oblate spheroid (axial ratio $\sim 1.5$) for which the side of the equatorial plane is tilted $\sim 35^\circ$ above the line of sight and the outflow velocity increases from $\sim 28$ km s$^{-1}$ in the plane to $\sim 63$ km s$^{-1}$ along the polar axis. The increases in maser intensity from widely separated portions of the shell over a timescale of several years support a radiative pumping model, while the apparent gas densities and temperatures suggest that the masers trace the regions of highest H$^-$ density. At the radius of the maser shells ($\approx$ 4000 AU), the magnetic field is estimated to be $15$ mG $\approx B \approx 1/6$ mG.

35.14
A Study of Photometric Variability and Water Masers Emission from Miras and Irregular Variables

E.J. Grossman (Wesleyan U.) and P.J. Benson (Wellesley C.)

We have been using 24-inch telescopes equipped with CCD cameras at both Wesleyan University and Wellesley College to monitor the Mira stars VX UMa and LO Aur and the irregular variables SV Peg and AC Cyg in V.R. and I bands. The light curves produced from these observations are compared with water maser spectra being taken approximately once a month with the 37-meter radio telescope of Haystack Observatory.

Benson and Little-Marenin (Bull. AAS, 22, 1208) have shown that water emission from Miras often reveals a variability with a period similar to that of the visual light curve with a slight phase shift. The two Miras selected for this study have not been observed optically and exhibit some peculiar maser behavior. VX UMa has three features which appear to vary independently, and the variations do not appear to have the same 215.2 day periodicity listed in the General Catalogue of Variable Stars (GCVS). LO Aur amplitudes as a Mira, but there is no period listed in the GCVS for this star. It has several maser features over a broad velocity range (about 18 km s$^{-1}$) similar to the maser emission breadth for supergiants. The two irregulas are also known to display some unexplained phenomena. AC Cyg has exhibited multiple spectral features in the past, but its maser emission has remained undetectable since March 1988. SV Peg has at least five features, one or more of which have been detected in most observing sessions.

We present the most recent results of this study. It is believed that a correlation of water maser emission with the light curve in different photometric bands will lead to a better understanding of the mechanisms and processes at work in these stars.

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35.15

P. J. Benson (Wellesley C.), I. R. Little-Marenin (CASA, U. Colorado & Wellesley C.), and R. R. Cadmus (Grinnell C.)

In 1987 water maser emission at 22 GHz was discovered to be associated with the carbon stars V778 Cyg and EU And, confirming the presence of oxygen-rich material near the two carbon stars. Since then we have monitored their water maser emission at approximately monthly intervals with the 37-meter telescope of Haystack Observatory. Starting during the summer of 1989 we have obtained photometric data for these stars in order to establish the correlation between water maser emission and optical variability.

The light curve for V778 Cyg shows broad maxima and sharp minima at an amplitude of 0.1 mag. The period between successive minima is 302 d. The three components of the water maser spectrum of V778 Cyg at -20, -17, and -15 km s$^{-1}$ show large random as well as systematic flux variations and a comparison between the optical and water maser data shows that minimum optical flux is followed by a minimum in the maser flux with a phase lag of about 0.23 phase (70 days).

The light curve of EU And also shows some periodicity. The water maser spectrum of EU And usually shows one narrow component between -32 and -28 km s$^{-1}$ which has been fairly weak since shortly after discovery in 1986 December. It showed an increase in intensity during 1991 summer.

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36.01
NITE Synthetic Spectra of the Mira-type Variable S Car

D.G. Luttermoser, G.H. Bowen (Iowa State U.)

The latest findings of the on-going research concerning NITE radiative transfer in hydrodynamic models representative of Mira-type variable stars are presented. The equations of radiative transfer and statistical equilibrium are solved with PANDORA in a snapshot approximation at various phases for a hydrodynamic model of a pulsating AGB star. NITE cooling and heating rates and electron densities then are used in subsequent runs with the Bowen hydrodynamics code. Hydrodynamic models, modified with the NITE cooling rates, then are used to generate synthetic spectra with the PANDORA code for comparisons with observations.

We report here on NITE radiative transfer calculations for an atmospheric model representative of the Mira-type variable S Car (K7-M4 IIIe) using a 5-level hydrogen atomic model. Variations in the synthetic hydrogen-line spectra over a pulsation cycle are similar to variations in the actual stellar spectra. A fundamental discovery is made from these calculations: The hydrodynamic models produce Balmer lines where the flux of H$\alpha$ is less than H$\beta$ and the flux of H$\beta$ is less than H$\gamma$. This has been observed in the spectra of Mira-type variables, and in the past, has been attributed to observation by overlying absorption. We show here that radiative transfer in the lines alone can give rise to this phenomenon in shocked atmospheres.

36.02
A New Look at the Standard $T_{eff} = 10000$ K, log $g = 4$, non-LTE Model Atmosphere

T. Lanz (NASA/GSFC), I. Hubeny (USRA), B. Altner (ARC)

We present a series of non-LTE model atmospheres for $T_{eff} = 10000$ K and log $g = 4$, using varying degrees of physical sophistication. We consider a simple and seemingly trivial problem, namely the pure hydrogen atmosphere, which nevertheless must be understood before one embarks on calculations of more involved model atmospheres. We demonstrate that the traditional approach, based on a fixed number of (low) non-LTE and (higher) LTE levels (usually 5 and 11, respectively), which considers only a few of the lowest-lying hydrogen lines and assumes depth-independent Doppler profiles, yields considerable errors in the predicted spectrum. Instead, we have calculated an essentially "exact" pure hydrogen model, taking into account detailed (Stark+ Doppler) profiles for all lines, while using the