Session 50: White Dwarfs and Circumstellar Shells
Display Session
Pavilion

50.01
Accretion and Diffusion in the Atmosphere of the V471 Tauri’s White Dwarf

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The discovery of variability in the soft X-ray light curve of V471 Tauri (Jensen et al. 1986, ApJ, 309, L27) indicated the white dwarf is either accreting material from the K star or is undergoing nonradial pulsations. In order to discriminate between the two processes, an optical light curve of V471 Tauri was obtained by Clemens et al. (1992, ApJ, 391, 773), from which they have concluded that the accretion hypothesis is the most viable one. We have explored in detail the accretion model by carrying out time-dependent simulations of diffusion in the envelope of V471 Tauri including the effect of accretion from the companion K star. The study of Mallan et al. (1991, ApJ, 374, 707) demonstrates that the accretion rate on the white dwarf must be reduced by at least four orders of magnitude compared to the rate of $10^{-13}$ M$_{\odot}$/yr expected from an application of the Hoyle-Bondi theory. We have explicitly verified that for this accretion rate, the amount of metals accreted is incompatible with the optical light curve. Because of this inconsistency we have investigated accretion following a flare on the K star. Our calculations assume that the accretion rate following a flare reaches a value of $5 \times 10^{-15}$ M$_{\odot}$/yr during an interval of time about equal to one week. The heavy elements accreted diffuse out the UV photosphere after about two months but remain at an abundance of 10$^{-5}$ for helium and 10$^{-5}$ for carbon in the soft X-ray/EUV photosphere. Our calculations suggest that, most of the time, the white dwarf in V471 Tauri accretes at a sufficiently low rate that the photospheric abundances of elements heavier than hydrogen are unaffected. However, a short accretion phase following a flare will provide the source of opacity required to darken the magnetic pole of the white dwarf and is consistent with the optical observations.

This work has been supported by NASA contracts NAS5-30180 and NAS5-29298.

50.02
CO Observations of IRAS Selected Evolved Stars

Michael Woodhams (Princeton U.)

The first results of a CO survey of over 250 IRAS sources conducted at the Caltech Submillimeter Observatory are described. Most of the survey was conducted in the 345 GHz J=5-4 line to minimize interference from molecular clouds. The survey was designed to observe the brightest sources in various regions of the 12/25/60um colour-colour diagram to provide a complete sample of stars at all of the late stages of evolution.

This survey has attempted to fill the gaps left by previous observations so that selection effects can more easily be accounted for. In each of 10 regions of the 12/25/60um colour-colour diagram the survey is complete to a given 60um flux, after excluding sources south of $\delta = -45^\circ$ and sources that are previously observed in CO or are known not to be evolved stars. About 150 stars were detected, and mass loss rates are derived for some of these, with an emphasis on red supergiants.

The late stages of stellar evolution are dominated by mass loss. This process is poorly understood, and bears on such questions as the rate of mass return to the ISM, the effect on late stellar evolution, the white dwarf mass as a function of initial stellar mass, and the formation rate of planetary nebula, white dwarfs and supernovae.

Due to dust formation in their winds, cool evolved stars are IR bright. This makes the IRAS point source catalog a powerful tool for finding and studying such stars. Molecular lines allow us to directly observe the dense stellar winds and to estimate the mass loss rates.

50.03
Non-LTE Analysis of the hot subdwarf, BD 75 325

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High-resolution IUE spectra of O stars show numerous, strong lines of iron and nickel. Recent astronomers at Kiel, Germany have demonstrated that not only do metal lines affect significantly the appearance of the UV spectrum of hot stars, but they affect the structure of the atmosphere itself. Their results reinforce the view that realistic model atmospheres of hot stars must take into account Non-LTE line blanketing.

The hot subdwarf, BD +75°325, is an excellent case for testing NLTE model atmospheres, because it does not have a wind, and its spectrum has very sharp lines (FWHM=20 km s$^{-1}$ or less). We have recently obtained a high-resolution, high-S/N spectrum of BD +75°325 with the Goddard High Resolution Spectrograph on Hubble. These observations indicate that "classical" non-LTE models, i.e., plane-parallel atmospheres in hydrostatic equilibrium without line-blanketing by metal lines, are inadequate in that they cannot match the depths of the numerous absorption lines. Therefore, we have constructed a series of NLTE line-blanketed model atmospheres with Fe and Ni lines and are studying how it improves the agreement with observations.

50.04
Line Blanketed Model Atmospheres for Metal-rich White Dwarfs

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In many cases of a close binary system composed of a white dwarf, a companion main-sequence or giant star, and an accretion disk around the white dwarf, the UV spectrum of the system contains contributions from both the white dwarf and the disk. In order to derive information about the system from its UV spectrum, the white dwarf atmosphere has to be accurately modeled. The chemical composition of the white dwarf is very likely to be quite unusual, however, because it may have near solar composition due to accretion. Due to its high surface gravity, the white dwarf’s lines are generally very broad, and thus metal line blanketing may play a very important role.

We have therefore begun a project of calculating a grid of non-LTE, fully line-blanketed model atmospheres for white dwarfs, for a large range of metal abundances, from zero (pure DA) to solar composition. The method is described in a companion paper (Hubeny and Lanz) at this meeting. We consider a representative model atmosphere with $T_{\text{eff}} = 15000$ K and log $g = 8$. In this preliminary study, only hydrogen and iron (Fe II and Fe III) opacity was considered. The models take into account 45815 Fe II and 23059 Fe III lines (all lines between the levels with measured energies). As expected, the NLTE effects are rather small for this temperature, but the effect of metal line blanketing is very important. In particular, we demonstrate how the metal line blanketing influences the UV spectrum and the hydrogen Lyman and Balmer lines profiles.

The work on the project was supported in part by the NASA grant No.65 under program NRA 91-OSRA-12.

50.05
EUV Observations of Hot DA White Dwarfs

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We present analyses of EUV photometric observations of hot DA white dwarfs from the sky survey now being completed by the Extreme Ultraviolet Explorer (EUV) satellite. The EUVE data are from one to four bandpasses, centered at 100, 200, 450, and 600 Å. We also include data from the ROSAT Wide Field Camera (WFC) and EXOSAT where applicable. We determine limits on the temperatures and gravities by fitting Koester’s model fluxes to the Balmer line profiles from our high S/N optical spectra. The solid angle is set using published V magnitudes. The EUVE data are then used to determine limits to the photospheric composition and the interstellar columns for the targets.