24.08
Non-Maxwellian Electron Distributions in a Model of the Quiet Solar Atmosphere
P. MacNeice (ST Systems), J. Fontenla (MSSL), N. Jepjojevic (Univ. of Surrey)

Fontenla, Avrett and Loeser have recently constructed a model for the average quiet solar atmosphere spanning the deep photosphere through to the mid transition region (10^4 K). This model assumed energy balance between radiative losses and energy diffusing down from the corona for the layers above the chromosphere. Also this model considered atomic diffusion and its effect on hydrogen ionization. The model is extended up to coronal temperatures using optically thin radiative losses and a semi-circular loop geometry. The previous calculations assumed the electron distribution function to be close to Maxwellian. In order to test the effects of the non-maxwellian high energy tail of the distribution, we perform a more accurate Fokker-Planck calculation of this tail (cf. Jepjojevic and MacNeice, 1989, Phys. Rev. A, 40, 961). From these results we find that the downward heat flux is well described by the first order approach and also that the hydrogen ionization is not greatly affected. However the ionization rates of some elements other than hydrogen may be substantially affected by the tail. An accurate calculation for the electron ionization in models with steep temperature gradients must consider both, the atomic diffusion and the high energy tail of the electron distribution, for elements other than hydrogen.

Session 25: Cool Stars/Atmospheres
Display Session, Grand Ballroom

25.01
Deconvolved IRAS Profiles of Extended Evolved Stars
G. W. HAWKINS (UCLA)

IRAS profiles have been deconvolved for many evolved stars using the Richardson-Lucy algorithm (Richardson, 1972 J. Opt. Soc. Am., 62, 55), resulting in resolution 2-3 times better than detector sizes 1.5' and 3.0' at 60 and 100 μm. The one-dimensional program SCANPI is used to select parallel scans that are averaged together to increase the normal IRAS sampling to a rate sufficient for deconvolution. A few of the objects with extended emission include (with 100 μm deconvolved full width at half maximum, in arc minutes) VY Uma (1.5'), μ Cep (1.5'), S Sct (2'), U Hya (4'), Y Cnn (1.5'), U Ant (1.5'), α Ori (1.25'), Y Pav (1.25'), UU Aur (2'), IRC +10216 (1.5'), RZ Sgr (1.5'), and R Lyr (1.5').

A simple model is constructed where the circumstellar envelope is optically thin to photospheric radiation and the dust temperature is calculated as a function of distance from the star as in Appendix B of Sofia et al. (1985, Ap. J., 294, 242.). A power law density function is used in the envelope, n(r) ∝ r^{-α}, with dust grain emissivity ε(ν) ∝ ν^{α}. The density and emissivity are varied to fit the flux densities and spatial distribution of IRAS emission at 25, 60, and 100 μm, avoiding problems with large optical depth at 12 μm. The models suggest that extended IRAS emission at 60 and 100 μm results from stars which had greater mass loss rates in the past, rather than from stars with large current mass loss rates. IRAS point sources at 60 and 100 μm result from stars with constant or greater mass loss at present, compared to the mass loss rate ~ 1000 years ago.

A survey of 81 evolved stars at galactic latitudes > 15° in areas of low infrared cirrus emission reveals that ~ 40% of both carbon-rich and oxygen-rich stars are extended at 60 and 100 μm.

25.02
High Spatial Resolution Imaging of Circumstellar Envelopes in the Near Infrared

Julian C. Christou, Stephen T. Ridgway (Kitt Peak National Observatory, National Optical Astronomy Observatories)

We present diffraction limited images for a number of circumstellar shell sources observed at the KPNO 4m at near infrared wavelengths. The KPNO InSb IRIS imaging was used in speckle mode for the observations. Results will be presented for a number of cool, evolved stars with weak to strong circumstellar envelopes, in particular NML Cyg, IRC 10420, IRC 10216 and the Red Rectangle (HD 44179).

The reconstructed images show that the envelopes of these objects are very asymmetrical and also show color dependence. Preliminary models of the mass-loss mechanisms which generate these envelopes will also be presented.

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25.03
High Resolution FTS Observations of WZ Cas and TX Lac at 5 Microns Compared with Model Atmospheres

D. Goorvitch, J.H. Goebel (NASA/ARC), H.P. Larson (U of A), D.R. Alexander (WSU)

Observations of the two carbon stars WZ Cas and TX Lac in the spectral region from 3900 to 4000 cm^{-1} have been made from the KAO. These observations were made with the Univ. of Arizona double beam Michelson Interferometer with boxcar apodization at a resolution limit of 0.120 cm^{-1}. These observed spectra are dominated by molecular lines due to CN, CO and C2 and the 12C isotopic substitutions. We compared synthetic spectra generated using a number of carbon star atmospheric models. We have compared the following models: 1) Luttermonser, et.al. 3000 K with temperature inversion; 2) Lambert, et.al., 2800 K models including polyatomics; 3) Querci and Querci 3000 K model; 4) Erickson et al., 2850 and 3000 K models including polyatomics; and 6) Alexander, et al., 3000 K truncated to 2500 K temperature minimum. We conclude that this spectral region is dominated by the CO opacity and is a good diagnostic probe of the stellar CO abundance. Lines of CO, CN and C2 are formed in the 2500-3000 K region. WZ Cas is best fitted by Lambert's (T=Log g/0.1/Log E(0)) = (2800/0.1/0.2/8.92) model, while TX Lac is best fitted by the model of the Quercis (3000/0.3/28/7.10). The substellar oxygen abundance in the models of the Quercis comes from the assumed operation of the CNO process. Based upon the best available models to date, we conclude from our comparison that TX Lac shows CNO processed oxygen abundance, while WZ Cas shows solar oxygen abundance, with the carbon enrichment possibly coming from the triple alpha process.

25.04
Modeling the UV Photospheric Spectrum of K-M Giant Stars

K. Carpenter (LASP-NASA/GSFC) and G. Wahlgren (CSC/GSFC)

The mid-UV spectrum (2000-3300 A) of cool giant stars is a blend of complex photospheric absorption-line and chromospheric emission-line spectra. In the K-giants, it is difficult to distinguish chromospheric emission from local maxima in the heavily line-blanketed photospheric spectrum. Even where the existence of an emission line is clear, the level of the underlying photospheric spectrum is often very difficult to determine and any measurement of the integrated emission line flux is quite uncertain. In M-giants, there is