Session 36: Stellar Evolution
Display Session
Pavilion

36.01
An Observational Study of IRAS "25 Micron Peakers"
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The IRAS Faint Source Database (FSDB) contains 1010 sources which have their maximum flux in the 25 \mu m band and which also have good detections at each of the 12, 25, and 60 \mu m bands. Radiation peaking at this wavelength implies a temperature of about 100-200 K, and is presumably arising from a circumstellar dust shell. By initially restricting somewhat the colors of these objects in the IRAS color-color plane, we reduced this to a sample of 274 objects. Of this number, 93 have been identified as planetary nebulae, 30 as proto-planetary nebulae, and 12 as "other" sources. It is suspected that many of the remaining 150 unidentified sources are also proto-planetary nebulae.

To investigate this suggestion, we have begun a systematic study of the nature of the "25 \mu m peaks." As a first step, we have sought to locate optical counterparts for the unidentified sources by comparing their IRAS positions with those of stars in the STScI Guide Star Catalog. From this positional comparison, we determined good optical candidates for 50 of the sources. We are now in the process of (1) confirming the association by a ground-based observation of the optical candidate at 10 \mu m, (2) obtaining follow-up near-infrared and optical photometry of the confirmed sources to combine with the IRAS data to delineate the flux distributions from 0.4 to 60 \mu m, and (3) obtaining optical spectroscopy to investigate the properties of the photospheres of the sources. The preliminary results of this study will be presented, along with examples of some interesting objects which have been identified.

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36.02
Rotation and the Evolution of Low Mass Stars
M. H. Pinsonneault (Yale U.)

Evolutionary stellar models have been constructed for low mass stars, and their surface rotation rates and light element abundances are compared with observations in open cluster stars and the Sun. An angular momentum loss law that saturates at high surface rotation rates allows rapid surface rotation in young main sequence stars, and the mass dependence of the rotation is found to depend on the assumed magnetic field geometry and thus the assumed cluster ages. Different prescriptions for internal angular momentum transport are investigated, and their impact on observable quantities is discussed.

36.03
The Search for Acoustically-Driven Mass-Loss in Evolved Stars

Recent ab-initio calculations of stochastic stellar wind models by Cuntz (1992 in Cool Stars VII, ASP Conf. Ser. 26, p.383) have proven remarkably robust in predicting observed chromospheric flow patterns including possible variabilities with time in selected cool, evolved stars. The calculations solve the equations of hydrodynamics using the method of characteristics and assume: (i) saw-tooth shock wave profiles, and (ii) wave periods were changed stochastically while keeping the wave amplitudes constant (see Cuntz 1990 ApJ. 349, p.141). Among the results of fitting chromospheric flow velocities is the implication that the permitted range of acoustic wave periods for a given star is constrained.

We made use of the IUE satellite during August and September 1992 to repeatedly observe two stars, the yellow giant Aldebaran (K5 III) and the red supergiant, Betelgeuse (M2 Ia), in order to sample variations in their atmospheres on timescales of \(10^4\) to \(10^5\) seconds, which bracket the predicted mean acoustic wave periods for these objects. In particular, we obtained deep exposures in order to measure density-sensitive line ratios within the CI] intercombination features near 2325A (cf. Lennon et al. 1985 ApJ. 294, p.200) to test the hypothesis that density fluctuations could be measured as a consequence of these acoustic waves. The results of these observations will be presented and discussed in terms of the number and amplitude of acoustic waves contributing to the chromospheric heating and mass loss from these stars, as well as the wave origins in the evolving oscillatory structure of these stellar interiors. We are pleased to acknowledge IUE--NASA grant NAG5-2103 for partial support of this effort.

36.04
Evolved Stars in M67
M. J. Tripicco, R. A. Bell (U. Maryland), B. Dorman (U. Virginia)

As part of an ongoing project to generate synthetic integrated spectra covering a range of chemical compositions and ages, we have calculated a new set of solar abundance evolutionary tracks. These have been used to produce isochrones for ages between 4 and 16 Gyr. Rather than using a color-temperature conversion table, as is generally done, we instead calculate detailed synthetic spectra at intervals along the isochrones and so directly determine colors for a variety of photometric filter systems. As a test we have compared the 5 Gyr isochrone from this set to the color-magnitude diagram of the well-studied old open cluster M67. The fit is quite good from the unevolved main sequence through the turnover and continuing up the first ascent giant branch if an apparent distance modulus of \((m-M)_V = 9.50\) and reddening of \(E(B-V) = 0.032\) are used. The isochrones assume a Helium abundance \(Y = 0.27\) and convective parameter \(\alpha = 1.6\). The effect of variations in \(\alpha\) and in the surface pressure boundary condition (based on model atmospheres) are discussed. Evolution through the He-burning phases has also been included in a consistent manner. Differential comparison of the zero-age horizontal branch and subsequent evolutionary tracks for various masses with the position of the M67 clump giants reveals a surprisingly large amount of mass loss; masses of less than 0.70 \(M_\odot\) are strongly indicated. The implications of this loss of nearly half the stellar mass are examined.

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36.05
 Stellar Photospheric Convection, and the Effect on Spectral Line Asymmetry
Y.-C. Kim, P. Demarque (Yale Univ.), P. A. Fox (IAO)

In the past few years, information about stellar photospheric convection has become available via the study of stellar spectral line asymmetries. Since the net effect of hot rising convective elements and cool sinking elements in a convection zone is the depression of the blue wings of absorption lines, we can 'see' the direct effect of the photospheric convection by studying the line bisector, which is a locus of midpoints between the sides of the profile. The fact that the gross parameters of stellar convection are accessible to observation permits direct observational tests of stellar convection theories. In addition, it may be possible to constrain some of the rather arbitrary parameters that enter into stellar models (e.g. the mixing length). These parameters influence stellar evolution in the HR-diagram, and have an impact on a wide variety of other fields in astrophysics.

Firstly, numerical models for photospheric convection in a compressible, radiation-coupled, non-magnetic, gravitationally stratified medium have been calculated to find the general properties of stellar convection zones for different stars, using a realistic equation of state and opacities. By suitable analysis of models and comparison with ob-