Inside the Stars, IAU Colloquium 137
ASP Conference Series, Vol. 40, 1993
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[Fe/H] AND LITHIUM ABUNDANCE FOR DETACHED ECLIPSING BINARIES

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1. Background

We are now seeing a new generation of stellar models based on the recent opacity tables by Rogers and Iglesias (1992). Various changes in other important physical ingredients like nuclear reaction rates, convection parameters, mass loss rates, helium/metal ratios, relative abundances of heavy elements etc. are also included. Besides the Sun the most obvious objects for confrontation of the new grids with observations are binary components, pulsating stars, and well-studied open and globular clusters. Among these candidates the detached, double-lined eclipsing binaries play a unique role as our only source of absolute dimensions which 1) can be considered valid for single stars and 2) are accurate enough for serious tests of the input physics of modern stellar models.

At least during central hydrogen burning an accuracy of 1-2% is needed, and today masses and radii of that precision are available for about 90 eclipsing binary components (Andersen, 1991). The great majority of these stars are within or near the rather well, but still not fully covered main sequence band. More data are under way (Andersen et al., 1992).

At one fundamental point there is, however, a clear lack of data for these binaries. Quite obviously detailed confrontation must be based on stars of known [Fe/H] matching Z of the models, but accurate results from detailed spectroscopic analyses have been published for only 4 systems: V818 Tau in the Hyades, AI Phe, UX Men and TZ For. As for masses and radii the demand on [Fe/H] is rather strick, an accuracy of 0.10-0.15 dex is needed.

2. The [Fe/H] project and its present status

On this background a spectroscopic program on [Fe/H] determination for additional binaries is presently being carried out. High resolution (R = 60000), high S/N (100-200) spectra have been observed for the about 25 double-lined eclipsing binaries shown in Fig. 1. The ESO Coudé Echelle Spectrograph (CES) was used, and spectra from several 50Å wide regions have been obtained.

For F and G type systems preliminary LTE analyses of weak (≈ 50mÅ) FeI lines show that an accuracy of 0.10-0.15 dex can be reached. Only six candidates have been studied so far; the individual [Fe/H] values range between -0.20 and 0.10.

https://doi.org/10.1017/S0252921100017711 Published online by Cambridge University Press

LTE analyses of TiII, CrII, FeI and FeII lines indicate some difficulties for the B and A type systems. In general abundances better than about 0.2 dex can not be expected unless more precise determinations of microturbulence velocities become possible. NLTE effects are noticed in the FeI results but have not yet been examined.

A detailed confrontation with models will be done when abundances for all systems are available.

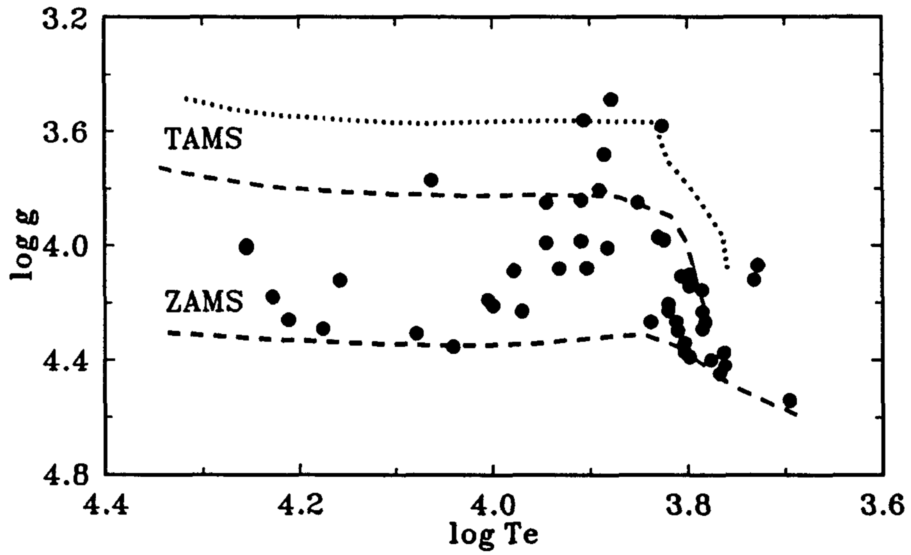

Fig. 1. log T_e - log g diagram for binary components observed in the [Fe/H] project. Main sequence band defined by standard (*dashes*) and overshooting (*dots*) models (Claret & Giménez, 1992).

3. Lithium

As part of the project Li-abundances are being determined for the components of 13 main sequence binaries. Most of the objects are F-type stars with masses between 1.1 and 1.6 $M_\odot$; two G stars (0.85 and 1.05 $M_\odot$) and one Am star (2.0 $M_\odot$) are included. Temperatures range between 5000 and 8000 K and rotational velocities from 7 to 40 km/s. Compared to existing Li studies based on cluster members or single field stars this sample has the clear advantage that masses and surface gravities are very accurately known.

Results from a *visual inspection* of the LiI resonance line at 6707.8 Å are shown in Fig. 2. The stars have been sorted in two groups; those with a clearly visible and often strong Li line (*open circles*), and those with either no Li line detected or eventually just a very weak feature (*filled circles*). The limit between the two groups is estimated to be located around log N(Li) $\approx$ 2.0.

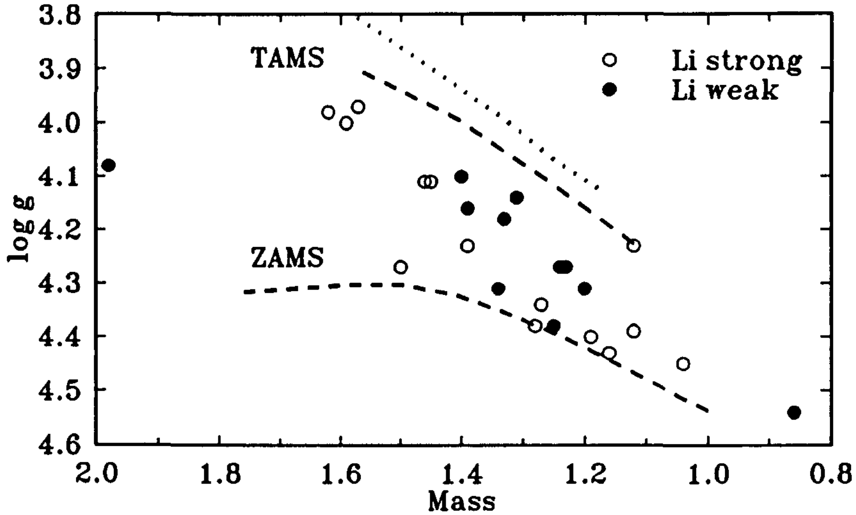

Fig. 2. Preliminary Li results for components of 13 main sequence binaries.

Sorting the stars according to mass some interesting trends are noticed already from the visual inspection of the spectra:

1. Independent of age a strong Li line is observed in all stars with masses between about 1.40 and 1.65 $M_{\odot}$. Due to evolution three of the stars are now located right in the center of the Li-gap at 6700 K observed for the Hyades and other not too young open clusters (Boesgaard, 1991). Ages for these binary components with no Li depletion are well above that of the Hyades.

2. For all stars from about 1.20 to 1.40 $M_{\odot}$ and older than about 2.5 10^9 yr the Li line is not detected or very weak. Among the younger candidates with ages below about 1.5 10^9 yr a tendency of slow rotating stars (vsin*i* $\approx$ 10 km/s) in wide orbits to be Li-strong, and faster rotating stars (vsin*i* $\approx$ 40 km/s) in narrower orbits to be depleted is noticed.

3. In all stars from about 1.00 to 1.20 $M_{\odot}$ a strong Li line is observed.

A definitive discussion of the data within the framework of current theories for depletion, dilution or destruction of Li has to await a proper determination of the Li abundances and [Fe/H] values. This will be done in the near future.

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