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IR Boron Lines in Stellar Spectra

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Abstract. We have computed synthetic spectra of the infrared B I transitions at 1.166 and 1.624 μm in order to examine the possibility of abundance determination by using these lines. We found that the IR boron lines are better observed in cool giants and supergiants. S/N > 150 and R $\approx$ 60000 are required in order to determine the boron abundances.

1. Introduction

The abundances of the primordial light elements Li, Be and B are important for the better understanding of big bang nucleosynthesis, chemical evolution of the Galaxy, and stellar evolution.

Boron stellar abundances are difficult to measure because the lines commonly used lie in the UV region (e.g. Duncan et al. 1998). On the other hand, the IR boron lines are very weak in the solar spectrum, and even using very high S/N data (S/N $\approx$ 1500) it is only marginally detected (Cunha & Smith 1999).

In this work we have investigated the behavior of the IR boron lines, in order to know if these lines can be observed in stars other than the sun.

2. Synthetic Spectra

For boron, we used transition probabilities from the recent critical data compilation of W.L. Wiese and J.F. Fuhr (1999, private com.). Atomic and molecular lines present in this region were taken from Meléndez & Barbuy (1999).

The synthetic spectrum is calculated assuming LTE. We employed the Kurucz model atmospheres, considering 4000 < T_{eff} < 7000 K, gravities 0.0 < log g < 4.5, and [M/H] = 0. The spectra have a FWHM resolution of $\approx$ 60000.

Our calculations showed that the IR B I lines are stronger in supergiants of $T_{eff} \approx$ 4500 K, with decreasing intensities for higher and lower temperatures. The B I lines at 1.166 (1.16600, 1.16625) μm are stronger than the lines at 1.624 μm. The line at 1.1660 μm is the strongest IR B I line, but it is blended with a carbon atomic line.

We have simulated observed spectra by adding noise to the synthetic spectra. In Fig. 1 the intensity variation of B lines is shown for different abundances. In this case, S/N > 150 is required to obtain the boron abundance. Higher S/N are needed in order to analyze other stars. For example, S/N > 300 is required for a K giant with T_{eff} = 4500, log g = 1.5 and [M/H] = 0.

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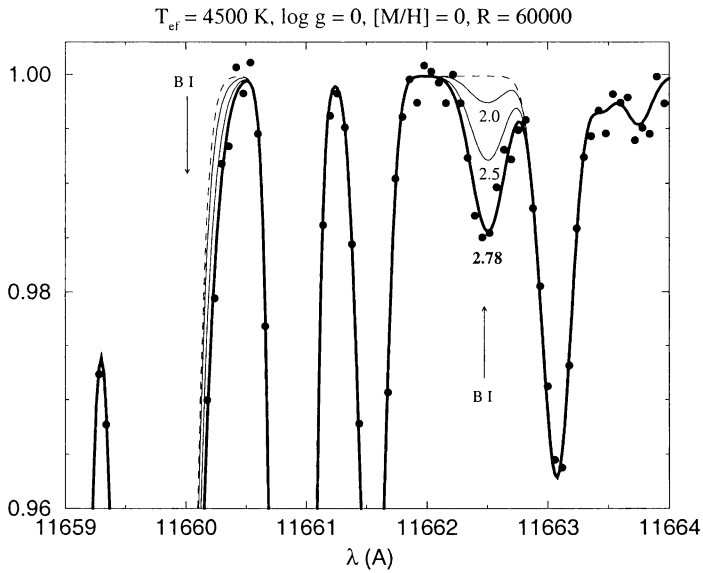

Figure 1. Synthetic spectra for no boron (- - -) and log N(B) = 2.0, 2.5 and 2.78. Points: log N(B) = 2.78 and S/N = 200.

3. Applications

Li, Be and B are fragile elements and are good tracers of the internal physics of stars. Gathering simultaneous data on these three elements can give us powerful tools for better understanding stellar evolution.

The B abundance determinations by Duncan et al. (1998) for 2 Hyades giants show a B depletion by a factor of 10, that agrees with the Be depletion found by Castilho et al. (1999) for 3 field Li-rich giants, indicating deep mixing.

4. Summary

We have investigated the possibility of detection of IR boron lines in stellar spectra. The strongest B I line in the IR is the 1.1660 μm-line, but it is blended. Alternatively, the 1.16625 μm-line could be used for abundance determinations. The most suitable conditions are for cool supergiants. $S/N > 150$ and $R \approx 60000$ are required for this work. *J. M. thanks Ph.D. fellowship 97/0109-8 (FAPESP).*

References

Castilho, B. V., Spite, F., Barbuy B., Spite, M., De Medeiros, J.R., & Gregorio-Hetem, J. 1999, A&A, 345, 249

Cunha, K., & Smith, V. 1999, ApJ, 512, 1006

Duncan, D. K., Peterson, R. C., Thorburn, J. A. & Pinsonneault, M. H. 1998, ApJ, 499, 871

Meléndez, J., & Barbuy, B. 1999, ApJS, 124, 527

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