

Photospheric parameters and C abundances in solar-like stars with and without planets

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Abstract. We have been analyzing a large sample of solar-like stars with and without planets in order to homogeneously measure their photospheric parameters and Carbon abundances. Our sample contains around 200 stars in the solar neighborhood observed with the ELODIE spectrograph, for which the observational data are publicly available. We performed spectral synthesis of prominent bands of C₂ and C I lines, aiming to accurately obtain the C abundances. We intend to contribute homogeneous results to studies that compare elemental abundances in stars with and without known planets. New arguments will be brought forward to the discussion of possible chemical anomalies that have been suggested in the literature, leading us to a better understanding of the planetary formation process. In this work we focus on the C abundances in both stellar groups of our sample.

Keywords. stars: fundamental parameters, stars: abundances, planetary systems

1. Introduction

The Sun is widely thought to be formed from material representative of local physical conditions in the Galaxy at the time of its formation and to represent a standard chemical composition. This *homogeneity hypothesis* has been often put in question because of many improvements in the observations techniques and data analysis. With the discovery of new planetary systems, the already known *heterogeneity* sources (stellar nucleosynthesis, stellar formation process) have gained a new perspective and brought new questions. It is now a fact that stars with giant planets are, on average, richer in metals than those for which no planet was detected (Gonzalez 2006 and references therein). Some authors suggested that this kind of anomaly may not only involve the content of heavy elements but also some light elements like Li, C, N, and O (Ecuivillon *et al.* 2006 and references therein). Other authors found no difference in the abundance of light elements when comparing stars with and without planets (see Ecuivillon *et al.* 2004 and references therein). The studies above are not conclusive yet. We need new tests, using more accurate and homogeneous data, with a larger number of stars. Abundances of these elements in solar-like stars will bring new information that will surely help to distinguish the different stellar and planetary formation processes. This is the purpose of our work, in which we analyzed a sample of 200 stars to homogeneously measure the photospheric parameters and C abundances.

2. Data and Method

Our sample consists of 200 single solar-like stars in the solar neighborhood, observed in high signal-to-noise ratio (≥ 200) and high resolution (42 000) with the ELODIE spectrograph (Baranne *et al.* 1996) of the Haute Provence Observatory (France), and for

which data are publicly available (Moultaka *et al.* 2004). We obtained T_{eff} , $[\text{Fe}/\text{H}]$, $\log(g)$, and ξ (through the excitation equilibrium of neutron iron and the ionization equilibrium between Fe I and Fe II). We also performed spectral synthesis of some regions containing bands of the C₂ Swan System (e.g. at $\lambda 5165$), using the MOOG LTE code (Snedden 2000, <http://verdi.as.utexas.edu/moog.html>).

3. Results and discussion

The present work is still ongoing and we show here our first results: photospheric parameters and C abundances based on the intensity of the C₂ (0,0) band head at $\lambda 5165$. A comparison of the photospheric parameters here obtained to those published by other works having stars in common shows a good agreement between the samples. Figure 1 (left) shows the solar spectrum and synthetic spectra for different C abundances. The right panel shows the diagram $[\text{C}/\text{Fe}]$ versus $[\text{Fe}/\text{H}]$, comparing stars with and without planets. It seems that stars with planets are slightly richer in C than field stars, but a larger number of planetary systems is required to confirm this possibility.

4. Conclusions

The preliminary results on C abundances are presented here for a large number of nearby solar-like stars, based on homogeneous photospheric parameters obtained from spectra with high signal-to-noise ratio and high resolution. Our analysis used public spectra from the ELODIE database, which represent about 90% of all data. The remaining 10% include many stars with detected planets and having many observations that shall be analyzed in the same way as soon as they become available to the scientific community, since they will contribute to more reliable conclusions.

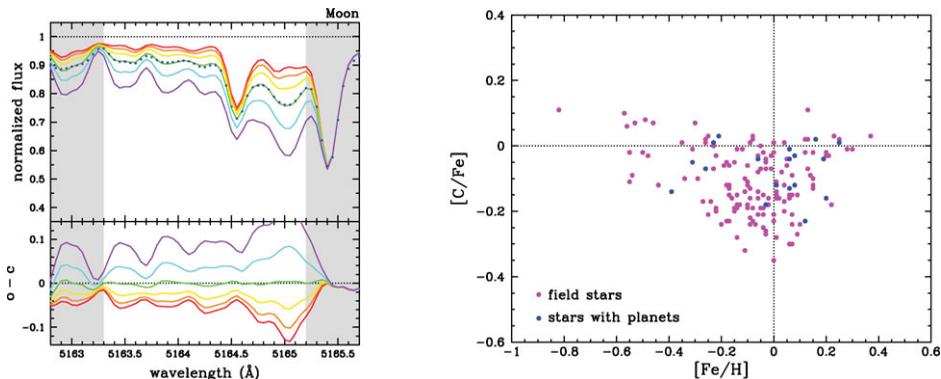


Figure 1. *Left:* spectral synthesis applied to the solar spectrum for several C abundances (in steps of 0.1 dex). The best fit gives $[\text{C}/\text{Fe}] = 0.01$ dex. *Right:* $[\text{C}/\text{Fe}]$ versus $[\text{Fe}/\text{H}]$ diagram comparing stars with and without planets.

References

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