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Physical parameters for the EXPORT sample. Rotational velocities and effective temperatures

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Abstract. The methods used to calculate projected rotational velocities and effective temperatures for the targets observed during the 1998-1999 La Palma International Time campaign are described here. This is part of a project whose main goal is to perform a detailed chemical analysis of these objects and to study their potential implications in the planetary formation phenomenon.

1. Introduction

A precise determination of rotational velocities is of fundamental importance to understand the process of planetary formation. Despite this, most of the values published in the literature are based on poor quality data or are affected by systematic errors. These problems are not present in this work where the same configuration and a careful selection of lines, where rotation is the only source of broadening, have been used. Effective temperatures, on the other hand, constitute the most important stellar parameter for locating stars in the H-R diagram and/or for abundance determinations. Despite the numerous set of tools of different nature used as "thermometers", an accurate temperature determination is, in most occasions, difficult to achieve. This is the case for most of the stars of our sample where the information coming from the stellar photosphere can be hidden or contaminated by the presence of disks.

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2. Rotational velocities

Projected rotational velocities have been measured using the method described in Gray (1992). In short, it is based on the relation between $v \sin i$ and the frequencies where the Fourier transform of the rotational profile reaches a relative minimum (Figure 1). If the spectral resolution is reasonably high, the instrumental profile may add, at high frequencies, relative minima to the Fourier transform, therefore, not contaminating the transform of the rotational profile (Figure 1, right panel). Unlike other methods (e.g. Sletteback 1975), the one presented here does not need any *a priori* calibration providing direct and independent measurements of $v \sin i$.

2.1. Estimated uncertainties

There are three main sources of errors associated to the above described method. i) The continuum placement, which distorts the shape of the Fourier transform modifying the position of the relative minima, ii) the sampling frequency: Defining this frequency as $\sigma_N = 0.5/\Delta\lambda$ and according to the spectral resolution of our observations, the lowest $v \sin i$ value that can be achieved is ≈ 4 km/s, hence, for stars with $v \sin i$ lower than this value it is not possible to determine the rotational velocity but only an upper limit, iii)blending: The typically high rotational velocities of most of the stars in our sample make it very difficult to apply the method to isolated lines. Blended features were used instead. A careful inspection using synthetic spectra was performed to avoid contamination in the Fourier transform due to the intrinsic profile of the blended features.

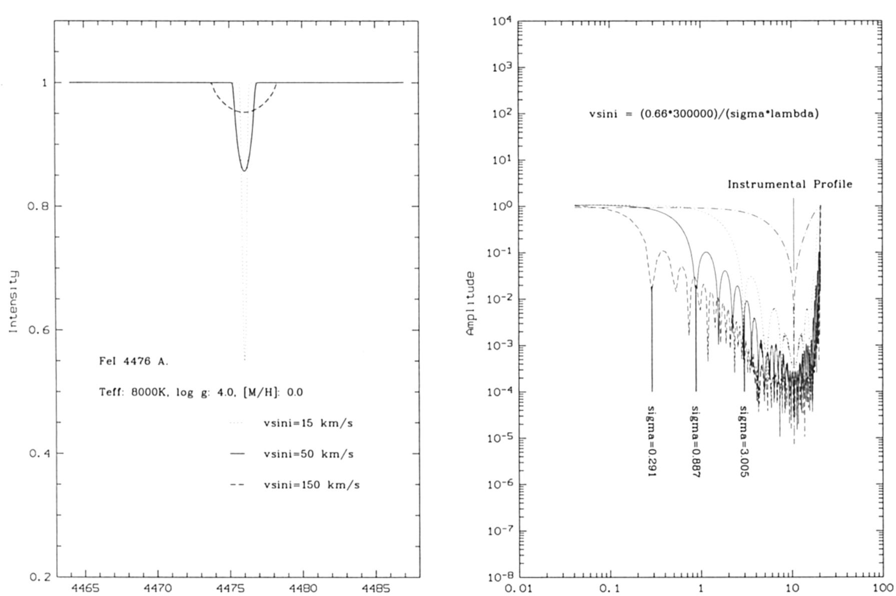

Figure 1. Determination of projected rotational velocities via Fourier Transform

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3. Effective temperatures

Four methods have been investigated:

- **uvbyβ photometry**

  In our range of temperatures, β is an optimum temperature indicator whereas c_0 can be used as gravity parameter. Effective temperatures were estimated using the Moon & Dworetsky calibration (1985). There are two main uncertainties associated to this method: on one hand, extinction that, in star-forming regions, can substantially differ from the usually adopted law for the ISM, giving rise to systematic errors in the value of the reddening-free index c_0 and, on the other hand, emission in Hβ affecting the β index.

- **Balmer lines**

  Balmer lines are known to be optimum temperature indicators for Teff $\leq$ 8500 K due to their negligible gravity and metallicity dependence. The observed spectral range includes Hβ, Hγ, Hδ. Effective temperatures were calculated comparing the observed Balmer line profiles with a grid of broadened synthetic profiles generated using ATLAS9 (Kurucz, 1993)

- **Photospheric line ratios**

  This method is described in Gray & Johanson (1991). In short, it relies on the comparison of ratios of equivalent widths of photospheric lines of the same element and different excitation potentials with synthetic models. Although this method is not sensitive to the problems affecting the two previously quoted methods, it is very time-consuming as it requires a careful photospheric line selection and a optimization of the atomic parameters (log gf, excitation potentials). Also, it is only applicable to slow rotators.

- **Spectral type – Temperature relations**

  Effective temperatures can be also estimated using their relation with the spectral type (e.g. Cohen & Kuhi 1979). The main drawback of this method is the uncertainties associated to the spectral classification which result in large errors in temperatures (e.g. 800 K from F0V to F6V).

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