Abstract

We are carrying out a systematic analysis of the spectroscopic properties of nearby (d<25 pc) FKG stars aiming to widen the knowledge of the stellar formation history in the solar neighborhood. The stars already observed are included in the Darwin catalogue (ESA mission to detect and characterize Earth-like exoplanets). The determination of the fundamental parameters of these stars is one of the needed preparatory works of the mission. In this contribution we present a preliminary analysis of the spectroscopic echelle spectra obtained in Calar Alto and La Palma observatories. Both the spectroscopic observations and the physical parameters obtained will be deposited in DAMA (Darwin archive Madrid), a Virtual Observatory tool that is being developed.

Scientific Context

The study of the stellar population in the solar neighborhood possesses an unquestionable interest for a wide range of investigations dealing with the overall properties of the Galaxy, but it also has an intrinsic astrophysical value: the precise characterization of the fundamental stellar parameters. Nearby cool stars like the Sun (FKG spectral types) are very useful to understand the structure and evolution of the Galaxy once their proximity has been exploited. These stars have intrinsically narrow absorption lines that allow to determine radial velocities with high precision. Combining them with Hipparcos accurate astrometry makes possible to define a volume limited sample and analyse their kinematics (membership to some moving groups). In addition, these stars constitute the natural places to look for the presence of extra-solar planets and planetary systems. The knowledge of the physical properties (age, photospheric and chromospheric activity) of the stars and of their immediate environment (companions, debris and exo-terrestrial disk) are essential for the success of future space missions, like Darwin, aiming to detect Earth-like planets, to characterize planetary atmospheres and to carry out comparative planetology (i.e. relating planet properties to the astrophysical characteristics of their host stars).

Here we present the results obtained so far of our ongoing long-term high-resolution spectroscopic study of the FKG stars in the solar neighborhood. These stars are included in the Darwin catalogue (see contribution to some moving groups). In addition, these stars constitute the natural places to look for the presence of extra-solar planets and planetary systems. The knowledge of the physical properties (age, photospheric and chromospheric activity) of the stars and of their immediate environment (companions, debris and exo-terrestrial disk) are essential for the success of future space missions, like Darwin, aiming to detect Earth-like planets, to characterize planetary atmospheres and to carry out comparative planetology (i.e. relating planet properties to the astrophysical characteristics of their host stars).

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Chromospheric Activity

Representative spectra in the Hα and Ca II H & K regions of some of the stars of the sample are plotted in Fig. 2 and 3. Echelle spectra allow us to study the behaviour of the different optical chromospheric activity indicators from the Ca II H & K to the IR lines, formed at different atmospheric heights. The chromospheric contribution of these features has been determined using the spectral subtraction technique described in detail by Montes et al. (1995, 1997, 1999). The synthetic spectrum was constructed using the program STARLIGHT, developed at Padova (Sbordone 1995).

The inactive stars used as reference in the spectral subtraction were observed during the same observing runs as the active stars.

Spectral Correlation, Teff

Spectral types and luminosity classes are two important parameters in the study of stars. Although most of our targets have already a spectral type assigned, in many cases this type is not reliable and must be revised (this is a critical point for the Darwin mission). One of our aims is therefore to establish spectroscopic criteria to classify accurately our sample.

In order to achieve this goal, we follow the procedure by Montes et al. (this meeting) to establish relationships between the equivalent width (EW) of some lines (see Fig. 4) and the temperature (color index).

Age, EW(Li)

The resonance doublet of Li I 6707.8 Å is an important diagnostic of age in late-type stars since it is destroyed easily by thermonuclear reactions in the stellar interior. At this spectral resolution and with the rotational velocity (vrot > 8 km/s) of the observed stars, this line is blended with the Ca II H line by about 1 Å. In Fig. 5 we have centered the total measured equivalent width, (EW(Li) + EW(CaII)), by subtracting the EW of CaII calculated from the empirical relation given by Soderblom et al. (1998). The obtained values are plotted in the EW(Li) vs. spectral type diagram (Fig. 5).

In order to obtain an estimate of the age of our stars we compare their EW(Li) with those of stars in well known young open clusters of different ages (see Fig. 7).

Kinematics

Heliocentric radial velocities have been determined by using the cross-correlation technique. The spectra of the program stars were cross-correlated order by order, using the routine fxcor in IRAF, against spectra of radial velocity standard of similar spectral types.

References

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