Spectroscopic Studies of Nearby Cool Stars: The DUNES Sample

J. Maldonado*, R. M. Martínez-Arnáiz.†, C. Eiroa* and D. Montes†

*Universidad Autónoma de Madrid, Dpto. Física Teórica C-XI, Facultad de Ciencias, Cantoblanco, Madrid, Spain, jesus.maldonado@uam.es
†Universidad Complutense de Madrid, Dpto. Astrofísica, Facultad de Físicas, Madrid, Spain

Abstract.
At the Universities of Madrid we are carrying out a systematic analysis of the spectroscopic properties of the nearby (d < 25 pc), late-type stellar population with the aim of contributing to the knowledge of the stellar formation history in the solar neighbourhood. Part of our sample will be observed by DUNES, a Herschel OTKP aiming at detecting and studying cold, faint dust disks around nearby stars. In this contribution we present some preliminary results of the kinematics of the DUNES sample.

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INTRODUCTION

We are carrying out a high resolution echelle spectroscopic project with the aim of contributing to achieve a fair picture of the local star formation history, by characterizing the FGK local population ($d < 25pc$) in terms of the kinematics and chromospheric activity/age/rotation/stellar parameters relationships in groups of stars with different ages.
These stars are also potential targets of future projects aiming at detecting Earth-like planets or exo-zodies. As a matter of fact, part of our sample will be observed in the framework of the Herschel Key Project DUNES -DUst around NEarby Stars- (P.I: C. Eiroa). DUNES aims at detecting cold dusty disks, at flux levels as low as the Solar Edgeworth- Kuiper Belt. A good knowledge of the stellar properties is required to achieve DUNES goals. Thus, our spectroscopy study is highly relevant for this Herschel Key Project.

SPECTROSCOPIC OBSERVATIONS AND DATA

High resolution echelle spectra of 247 stars have already been obtained by our team between 2005 and 2008 by using the FOCES spectrograph at the 2.2 m telescope of the Calar Alto Observatory and the SARG spectrograph at the 3.56 m Telescopio Nazionale Galileo (TNG) in La Palma Observatory. The FOCES spectral range covers from Ca II H &K (3993, 3968 Å) to Ca II IRT (8498, 8542, 8662 Å) with a resolution between 0.08 and 0.35 Å, and the SARG spectra cover from 4960 to 10110 Å with a resolution between 0.07 to 0.18 Å. The spectra have been reduced by using the standard

procedures included in the IRAF packages *imred*, *ccdred* and *echelle*, i.e overscan, scattered light correction and flat-fielding. Spectral orders have been extracted by using the routine *apall* and Thorium-Argon spectra have been used for wavelength calibration. Additional spectra for 107 stars have been obtained in public archives and libraries like S^4N [1] and the spectroscopic survey of López-Santigo [2].
The spectra have been used to carry out a systematic study of these stars in terms of stellar fundamental parameters estimates, kinematics, rotational velocities, chromospheric activity levels and ages [3, 4, 5, 6]. Here, we report on preliminary results concerning the kinematics of the DUNES stars.

SPATIAL VELOCITIES AND AGE ESTIMATES

Heliocentric radial velocities have been determined by using the cross-correlation technique. Spectra of the targets stars were cross-correlated order by order, using the routine *fxcor* in IRAF, against spectra of radial velocity standards of similar spectral types. Uncertainties in the derived velocities are around 1-2 km/s. We have used these radial velocities together with proper motions and parallaxes taken from Hipparcos and Tycho-2 catalogues to calculate the galactic space-velocity components (U,V,W) in a right-handed coordinated system - positive in the directions of the Galactic Center, Galactic Rotation and the North Galactic Pole, respectively. The (U,V) and (W,V) planes, usually known as Boettlinger Diagrams, are used to analyse the membership of stars to different stellar kinematic groups (Fig. 1). For a total of 354 stars, 26 have been identified as possible members of the Local Association, 23 of the Hyades Supercluster, 9 of the Ursa Major Moving Group, 15 as possible members of the IC2391 Supercluster and 5 for the Castor Moving Group. Another 49 stars are in the boundaries that determine the young disc population but their ascription to some moving groups is not clear.

It is well known, however, that kinematics is a necessary but not sufficient criterion to establish membership to young moving groups because some old stars may have similar space motions as young stars. Thus, complementary age estimates are needed in order to classify a star as a *real* member of a moving group. The lithium abundance in late type spectral stars is a well-known age indicator. Thus, the Li I 6707.8 Å line *EW* have been measured and a comparison between the obtained *EWs* and the lithium abundance of well known stars in clusters of different ages has been made (Fig. 2). With our spectral resolution the Li I 6707.8 Å line is blended with the Fe I 6707.41 Å line. In order to correct the possible contamination by Fe I we have used the empirical relation between the colour index $(B-V)$ and the Fe I *EW* given by [7] (for more details see [6]).
Our next step will be to use the kinematic results in conjunction with the lithium abundance and other age estimates (X-ray, colours-magnitude diagrams) in order to identify true members of moving groups, and to analyze their origin and structure.

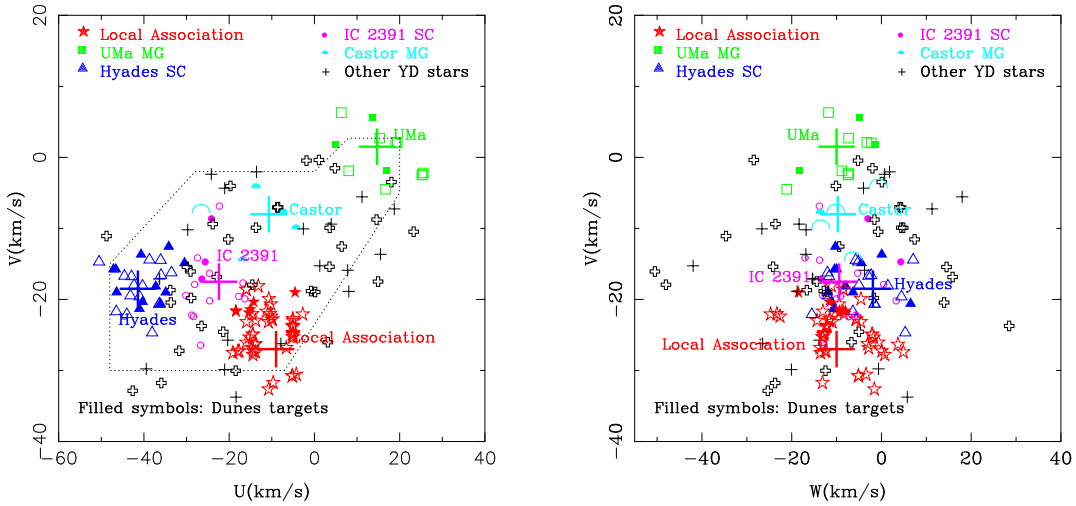

FIGURE 1. (U,V) and (W,V) planes of the observed stars. Different colours and symbols indicate membership to different young moving groups. DUNES targets are plotted with filled symbols. From the total of 354 analyzed stars, 78 have been identified as possible members of SKGs whereas other 49 stars are inside or near the boundaries that determine the young disc population as defined by [8, 9].

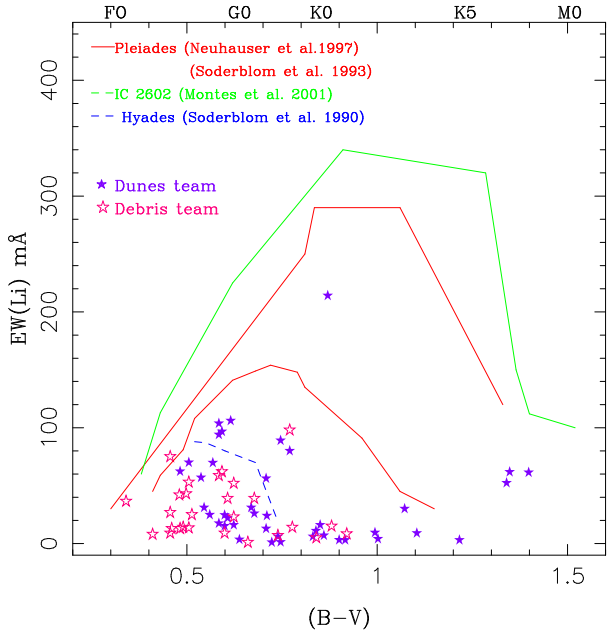

FIGURE 2. *EW* of the Li I vs $(B-V)$ for the observed DUNES stars (filled symbols). The green line is the IC2602 envelope [10]; red lines are the upper and lower Pleiades envelopes [11, 12] whereas the blue line indicates the Hyades envelope [12].

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