

Exo-zodies and exo-EKBs around Nearby Cool Stars: The DUNES sample



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Our team is carrying out a systematic analysis of the spectroscopic properties of the nearby late-type stars population with the aim of widen the knowledge of the stellar formation history in the solar neighbourhood. The Cool FGK stars in the solar neighbourhood are the natural places to search for circumstellar dusty structures analogous to the Solar zodiacal light and the Edgeworth-Kuiper belt. An important number of our observed stars are included in DUNES, an approved Herschel OTK with the aim of detecting cool faint dusty disks. In this contribution we present some properties of the DUNES stars.

Sample description

Our team leads a high resolution echelle spectroscopic programme with the aim of achieve a fair picture of the local star formation history by characterizing the FGK local population ($d < 25$ pc) in terms of the kinematics and cromospheric activity/age/rotation/stellar parameters relationships in groups of stars with different ages.

These stars are potential targets of future projects aiming at detecting Earth-like planets or exo-zodies. In this way, most of our stars will be observed in the framework of DUNES (DUST around NEarby Stars) an approved Herschel Open Time Key Project with the aim of detecting cool faint dusty disks, at flux levels as low as the Solar EKB. DUNES will observe 133 FGK stars in the solar neighbourhood; Herschel data of 106 additional stars with shared with DEBRIS, a second approved Herschel OTK.

DUNES stars are a subset of a larger sample formed by the main squence stellar population within 25 pc. Thus our immediate aims are intimately related with the high level objective of characterizing the FGK local population (see contribution by Martínez-Arnáiz et al., this meeting)

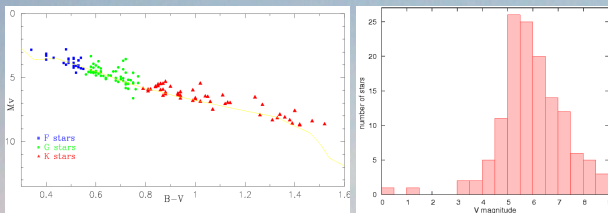


Fig. 1. Left: HR diagram for the DUNES stars. Right: V magnitude histogram distribution for the DUNES stars.

A good knowledge of the stellar photosphere and fundamental properties is required for the detection of exo-zodies and EKB, wich might be as faint as $L_{dust}/L_{star} \sim 10^{-6} - 10^{-7}$.

Stellar parameters, like T_{eff} , gravity or metallicity are already available for most stars, but not to the required extent; particularly for K type stars. Spectroscopic values taken from the literature have been chosen as first option.

Photometric data have been revised and parameters have been obtained by using different empirical relationships. Strömgren photometry, if available, have been considered as second option.

Hipparcos spectral types have also been checked with our own estimates based on observed B-V colours and other catalogues.

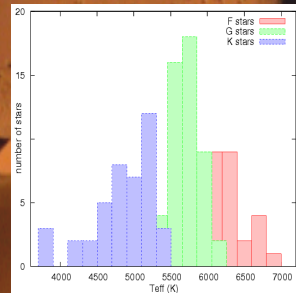


Fig.2. Effective Temperature distribution of the DUNES stars.

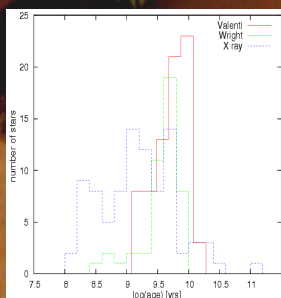


Fig. 3. Ages distribution of the DUNES stars. Different colours indicate different age estimations. The sample includes a range of stellar ages from 0.1 to roughly 10 Gyrs.

Stellar ages are needed to study the evolution of cold disks. Figure 3 shows the age-distribution of the DUNES stars obtained with three different methods: ischrone (Valenti & Fisher 2005), CaII H & K (Wright 2004) and X-ray (DUNES team estimates)

Unfortunately, age is one of the hardest stellar parameters to determine accurately and different methods do not usually agree. Differences can be as high as a factor 10.

Spectroscopic Observations

Spectroscopic observations (high resolution echelle spectra) of 236 stars were obtained by our team between 2005 and 2007 by using the FOCES spectrograph at the 2.2 m telescope of the Calar Alto Observatory and the SARG spectrograph at the Telescopio Nazionale Galileo (3.56m) in La Palma Observatory. Additional spectra for other 82 stars have been obtained in public archives and libraries like S4N (Allende Prieto et al., 2004) and the spectroic survey of López-Santiago (López-Santiago, 2005).

From all these stars, 98 of them are included in the DUNES (+ Debris team) sample.

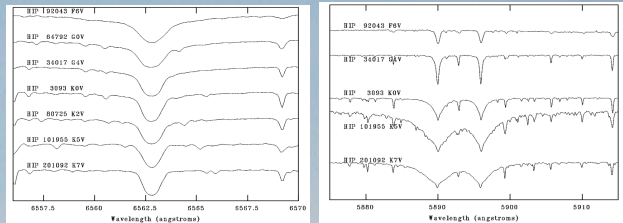


Fig. 4. Example of observed spectra for some DUNES stars. Left panel: Halpha line region; Right panel: NaI D1 D2 lines region.

A detailed analysis of these stars has been made following this squire:

Kinematics (membership to Stellar Kinematic Groups): Heliocentric radial velocities have been determined by using the cross-correlation technique. We have used these radial velocities together with precise measurements of proper motions and parallaxes taken from Hipparcos and Tycho-2 catalogues to calculate the galactic space-velocity components (U,V,W) the (U,V) and (W,V) planes (Boettinger Diagrams) are used to analyse the membership of stars to different SKGs (Montes et al, 2001). See Fig 5.

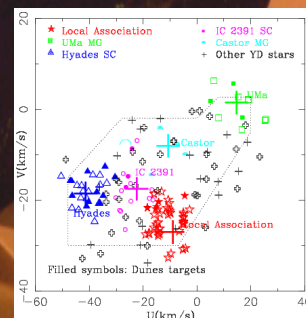
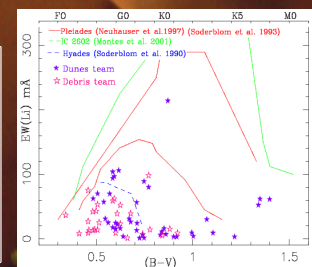


Fig. 5. (U,V) plane of the observed stars. Different colours and symbols indicate membership to different young moving groups. Dunes targets (Dunes + Debris) are plotted with filled symbols. From the total of 316 analyzed stars, 76 stars have been identified as possible members of young SKGs whereas other 50 stars are inside or near the boundaries that determine the young disc population as defined by Eggen (1984, 1989)

EW of LiI vs (B-V) for the observed DUNES stars (filled symbols) and for the Debris team stars. The green line is the IC2602 envelope (Montes et al., 2001); red lines are the upper and lower Pleiades envelopes (Neuhauser et al., 1997 and Soderblom et al., 1993) and blue line indicates de Hyades supercluster envelope (Soderblom et al., 1990). According to its lithium abundance the star HIP43726 should be ~ 78 Myrs old, while 10 stars are between 78 and 600 Myrs old.



- **Age estimates** by comparing the Li I 6707.8 Amstrongs line EW with those of stars in well known young open clusters of different ages. See Fig 6.

- **Rotational velocities** by using the Cross Correlation Thetchnique.

- **Cromospheric activity levels:** by using the spectral subtraction technique in the main optical activity tracers: $H\alpha$, $H\beta$, $H\gamma$, $H\delta$, $H\epsilon$, CaII H & K, Ca II IRT, NaI D₁, D₂

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