Chemical Tagging the Hyades Supercluster as a consistency test of Stellar Kinematic Groups

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Abstract
Stellar Kinematic Groups are kinematically coherent groups of stars which may share a common origin. These groups spread through the Galaxy over time due to tidal effects caused by galactic rotation and disk heating, however the chemical information survives. The aim of chemical tagging is to show that abundances of every element in the analysis must be homogeneous between members. We have studied the case of the Hyades Supercluster in order to compile a reliable list of members (FGK stars) based on chemical tagging information and spectroscopic age determinations of this supercluster. This information has been derived from high-resolution echelle spectroscopy. For a small subsample of the Hyades Supercluster, stellar atmospheric parameters (Teff, log g, and [Fe/H]) have been determined using a own-developed automatic code which takes into account the sensitivity of iron EWs measured in the Cepheid host stars. We have derived the abundances consistent with the chemical abundance trends reported in previous studies. The chemical tagging method has been applied with a carefully differential abundance analysis of each candidate member of the Hyades Supercluster, using a well-known member of the Hyades cluster as reference.

Sample selection
The sample was selected using kinematical criteria in E, F galactic velocities taking a dispersion of ±10 km/s around the core velocity of the group (Montes et al. 2001). We had taken also additional candidates and spectroscopic information about some of these stars from López-Santiago et al. (2010), Martínez-Arnaúz et al. (2010), and Maldonado et al. (2010). Some exoplanet-host star candidates are also taken from Montes et al. (2010).

Observations
The spectroscopic observations (see Fig. 2) were obtained at the 1.2 m Mercator Telescope in La Palma in January and May 2010 with HERMES, a high resolution echelle spectrograph. The spectral resolution is R=80,000, and the wavelength range covers from 3800 Å to 7550 Å. Our S/N ranges from 70 to 300 (120 on average) in the F band. A total of 61 stars were observed. In this contribution only single main sequence stars (from F7 to K4) have been analyzed, being 42 in total.

Abundance determination
Absolute abundances were calculated using the equivalent width (EW) method in a line-by-line basic. Line lists were taken from González Hernández et al. (2010) and the code (Sneden 1973) using our determined atmospheric parameters and a solar spectrum taken in a line-by-line basis. Line lists were taken from González Hernández et al. (2010) and the standard solar spectrum taken in a line-by-line basis. Representative abundances are given in Table 1.

Table 1: Example table of determined parameters and abundances as well as the typical parameter errors. VB 153 is in the Hyades cluster reference star used in the differential analysis, BZ Cet is in a Hyades cluster confirmed member, and HD 53532 is a Hyades Supercluster candidate star that satisfies chemical homogeneity.

<table>
<thead>
<tr>
<th>Name</th>
<th>Teff (K)</th>
<th>log g</th>
<th>[Fe/H]</th>
<th>[Mg/Fe]</th>
<th>[Si/Fe]</th>
<th>[Ca/H]</th>
</tr>
</thead>
<tbody>
<tr>
<td>VB 153</td>
<td>5650 ± 60</td>
<td>1.1</td>
<td>-0.10</td>
<td>0.06</td>
<td>0.05</td>
<td>-0.01</td>
</tr>
<tr>
<td>BZ Cet</td>
<td>5036 ± 45</td>
<td>1.1</td>
<td>-0.09</td>
<td>0.06</td>
<td>0.09</td>
<td>0.03</td>
</tr>
<tr>
<td>HD 53532</td>
<td>5707 ± 45</td>
<td>1.1</td>
<td>-0.04</td>
<td>0.06</td>
<td>0.08</td>
<td>0.03</td>
</tr>
</tbody>
</table>

Differential abundances
Differential abundances ([AX/H]) have been determined by comparison with the reference star VB 153, a known Hyades cluster member, in a line-by-line basic (see Paulson et al. 2003 and De Silva et al. 2006a). We have computed the differential abundances for the following elements: Fe, Mg, Al, Sr, Ca, Sc, Ti, V, Cr, Mn, Co, and Ni, the most representative of them are shown in Figs. 6 to 10. A first candidate selection within the sample has been determined by applying a 5σ rejection for the Fe standard deviation in the Hyades cluster (0.05 dex, Paulson et al. 2003, see Fig. 6). In this subsample another 2.5σ diagnostic has been applied in order to prove homogeneity in each element (see Figs. 7 to 10).

Conclusions
We have computed the stellar parameters and their uncertainties for 42 single main sequence Hyades Supercluster candidate stars, after that we have obtained the chemical abundances of 12 elements, and the differential abundances. From the chemical tagging analysis we have found that 27 stars from the original sample are homogeneous in abundances for all the elements we have considered (≈ 44% of the sample), 3 stars fail to be homogeneous in one element. A more detailed analysis to check the consistency between the differential parameters and the chemical homogeneity is in progress.

References
Montes et al. 2002, ASP Conf. Ser., 305, 231