Mem. S.A.It. Vol. 78, 656

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Metallicity of low-mass members of the Orion Nebula Cluster

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Abstract. We present the results of a pilot study aimed at measuring the metallicity of seven low mass members of the Orion Nebula Cluster (ONC). We find a very close to solar metallicity for six of the sample stars, while one star might have an over-solar metallicity, with [Fe/H] = 0.3 ±0.07.

Key words. Stars: pre-main sequence - Stars: abundances - open cluster and associations: Orion Nebula Cluster

1. Introduction

Surveys of old planet-host stars -the end product of planet formation- have shown that gas giants planets preferentially form around metal-rich stars. With few exceptions, all observational studies suggest that high the metallicity is of primordial origin (e.g., Santos 2004 and references therein). On the other hand, accretion disks of T Tauri stars are commonly assumed to be the site of planet formation; a consistent scenario would therefore suggest that metal-rich star forming regions (SFRs) exist or that a population of metal-rich T Tauri stars are present within SFRs.

In this context, we started a project aimed at measuring [Fe/H] in low-mass T Tauri stars in a variety of SFRs. We present here the result of a first pilot study focusing on the ONC.

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2. Observations & data reduction

Our sample consists of seven late-K members of the ONC. The spectra were acquired with FLAMES@VLT/UT2. Five stars were observed with the fiber-link to UVES and CD4 cross-disperser, providing a wavelength coverage between 6700 Å and 10000 Å and a resolution R $\sim$ 40,000. Spectra of the other two stars were acquired with Giraffe and HR15 setup (R $\sim$ 19,000, 640-680 nm). Our sample stars are listed in Col. 1 of Table 1. Data reduction was performed using UVES/FLAMES and GIRAFFE pipelines.

3. Analysis

3.1. Estimate of veiling

We estimated the spectral veiling by comparing the equivalent widths (EWs) of different spectral features of the ONC stars with those of a sample of 11 members of the older clus-

Table 1. Sample stars, stellar parameters and metallicity. IDs (Col. #1) come from Getman et al. ('c') and Hillenbrand ('h'). We list $T_{\rm eff}$ values, the surface gravity, the microturbolence, the projected rotational velocity, and the metallicity. σ_1 and σ_2 represent the error of the best fit determination and the uncertainty due to stellar parameters, respectively. In the last line we give the results for a members of IC 2391, previously studied by Randich et al. (2001) and for which we derive a similar metallicity.

star	T_{eff} (K)	logg	ξ (kms^{-1})	vsini (kms^{-1})	[Fe/H] $\pm\,\sigma_1\,\pm\,\sigma_2$
c1151	4197	3.32	1.2	13	0 ± 0.05 ± 0.05
c1134	4395	3.97	0.8	20	0 ± 0.05 ± 0.05
c753	4197	3.77	0.8	15	0 ± 0.05 ± 0.05
c241	4197	3.92	0.8	10	0.3 ± 0.05 ± 0.05
c1516	4775	4.09	1.1	35	0 ± 0.05 ± 0.05
h1020	4200	3.77	0.8	13	−0.1 ± 0.05 ± 0.05
h664	4200	4.13	0.8	13	−0.1 ± 0.05 ± 0.05
vxr76a	4200	4.0	1.1	8	−0.05 ± 0.05 ± 0.05

ters IC2602 and IC2391, whose spectra are not affected by spectral veiling. Given r = $\mathrm{EW_{IC}}/EW_{\rm ONC}-1$, we find r $\sim$ 0 for all the sample stars.

3.2. Method

The analysis was performed by means of spectral synthesis in the interval (6695 Å – 6715 Å) using MOOG code by Chris Sneden (1973 – 2002 version) and Kurucz model atmospheres. We optimized a list of spectral lines by inverse solar analysis on the solar spectrum acquired with UVES. Stellar parameters were derived as follows: effective temperatures ($\mathrm{T_{eff}}$) were taken from Getman et al. (2005), surface gravities (log g) were derived using the expression $\log g = 4.44 + \log(\mathrm{M}/\mathrm{M}_{\odot}) - \log(\mathrm{L}/\mathrm{L}_{\odot}) + 4\log \mathrm{T_{eff}} - 15.0447$. Finally, for stars observed with UVES microturbulence (ξ) was derived by removing the trend between EW and Fe abundances derived using 63 Fe I lines.
For the two stars observed with Giraffe, we assumed ξ values equal to those of stars with similar temperature observed with UVES. Final [Fe/H] values were determined as those providing the best fit of the observed spectrum. This procedure allowed us to derive also the projected rotational velocities.

4. Results

The results of our analysis are listed in Table 1. The table indicates that six stars have a metallicity consistent with the solar value, in good agreement with previous determinations from B-type stars (Cunha & Lambert 1992). On the other hand, and most interestingly, one star has a metallicity a factor of two above solar. Not only the quoted metallicity provides the best fit of the observed spectrum, but the direct comparison of the spectrum of c241 with that of c753, also indicates a higher metallicity for c241. The low veiling of c241, together with the small near-infrared excess (Hillenbrand 1997) and narrow Ca II profile (Flaccomio et al. in prep.), suggest that this star has already dissipated its circumstellar disk. We speculate that dissipation of circumstellar disk might have lead to the formation of a gas giant planet orbiting this star.

References

Cunha & Lambert 1992, ApJ, 399, 586C
Getman et al. 2005, ApJS, 160, 319
Hillenbrand 1997, AJ, 113, 1733H
Randich et al. 2001, A&A, 372, 862R
Santos et al. 2004, A&A, 415, 1153
Sneden 1973, ApJ, 184, 839