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Membership, lithium and chromospheric activity of the young open clusters IC 2391, IC 2602 and IC 4665 from GES (Gaia-ESO Survey) observations



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Abstract

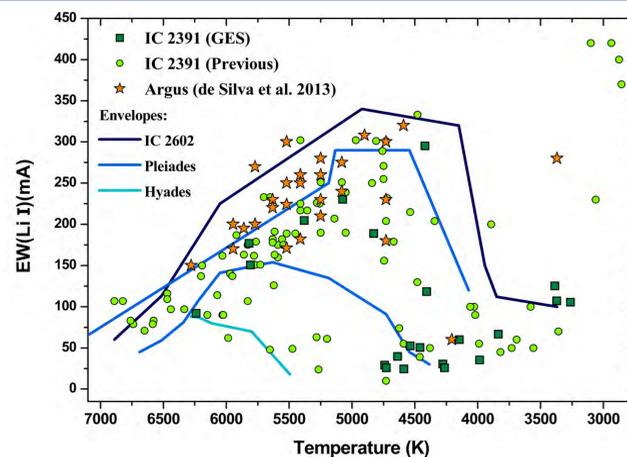
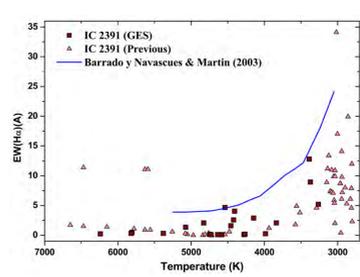
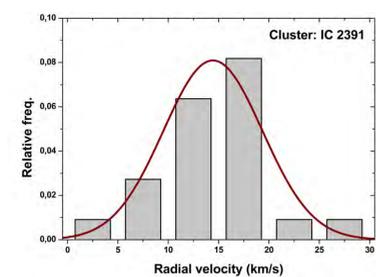
We conduct a comparative study of the main properties of the of the young open clusters **IC 2391**, **IC 2602** and **IC 4665**, focusing on their membership, lithium abundance and level of chromospheric activity and possible accretion. We use the fundamental parameters (effective temperature, surface gravity, and radial velocity) delivered by the Gaia-ESO survey (GES) consortium in the four internal data release (**iDR4**) to select the members of these clusters among the **UVES** and **GIRAFFE** spectroscopic observations. **Chromospheric activity** criterium, and iterative process between **radial velocity** distribution and **lithium-temperature** diagram are applied to determinate what objects are **members** or non members of the clusters. All this information allowed us to characterize the properties of the members of these clusters and identify some field contaminant **lithium-rich giants**.

IC 2391

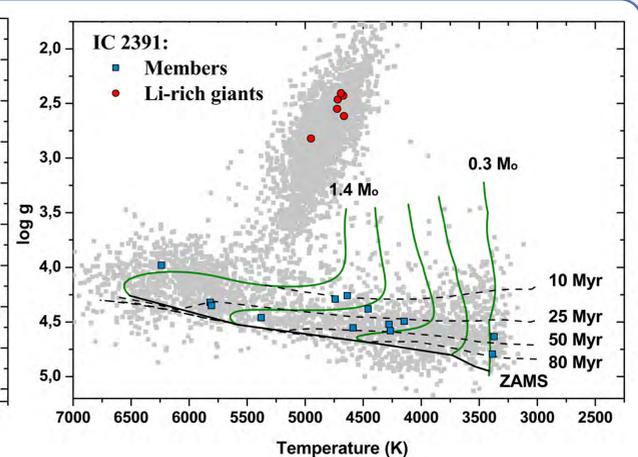


The table below shows the number of stars with Li detected in UVES and GIRAFFE spectra (iDR4) in the field of **IC 2391**, the number of stars selected as possible members, and the number of potential giants, some of them Li-rich ($EW(Li) > 50$). The membership selection was based on their radial velocities ($V_r = 14.4 \text{ km/s} \pm 2\sigma$), their position in the $EW(Li)$ vs T_{eff} and HR ($\log g$ vs T_{eff}) diagrams and the detection of chromospheric activity or accretion based in the H α line (see Figs). We have include also the Li and H α information of IC 2391 provided by other authors (Stauffer et al. 1997; Randich et al. 2001; Barrado y Navascués et al. 2004; Platais et al. 2007) and the related association Argus (De Silva et al. 2013).

Name	Age	N [*] UVES	N [*] GIRAFFE	N [*] selected as members	N [*] potential giants	N [*] potential Li-rich giants $EW(Li) > 50$
IC 2391	20-50 Myr	23	366	22	146	6



$EW(Li)$, T_{eff} diagram for the possible members of **IC 2391** selected with the GES (iDR4) data and the previous know members from other authors. For comparison we also plot the upper envelope of $EW(Li)$ for IC 2602, upper and lower envelope for the Pleiades and upper envelope of the Hyades.



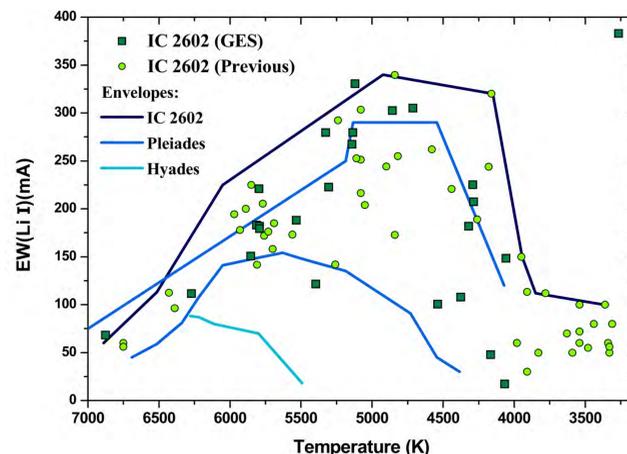
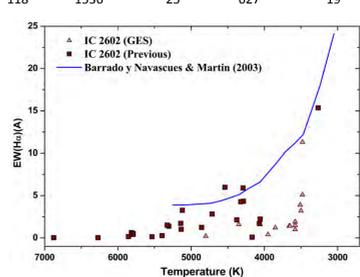
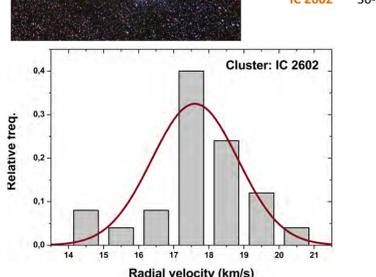
$\log g$, T_{eff} diagram. We mark **IC 2391** members (blue filled squares) and possible Li-rich giants in the field (red filled circles). As reference we have also plotted all the GES stars with $\log g$ and T_{eff} determined (grey squares) and the evolutionary tracks and isochrones from Baraffe et al. (2015).

IC 2602

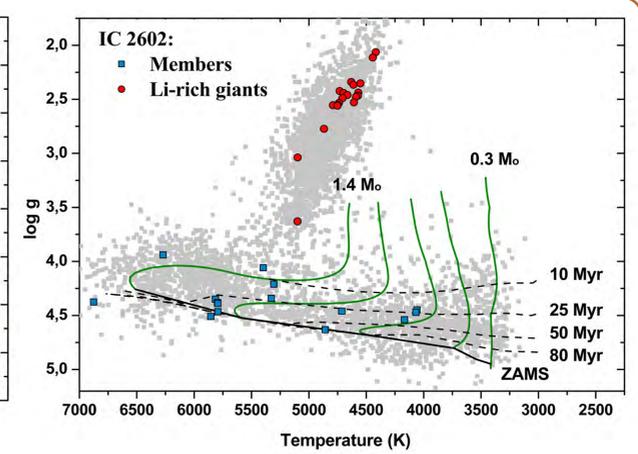


For **IC 2602** membership selection among the stars with Li detected in UVES and GIRAFFE spectra (iDR4) was based on their radial velocities ($V_r = 17.6 \text{ km/s} \pm 2\sigma$), their position in the $EW(Li)$ vs T_{eff} and HR ($\log g$ vs T_{eff}) diagrams and the detection of chromospheric activity or accretion based in the H α line (see Figs). We have include also the Li and H α information of IC 2602 provided by other authors (Stauffer et al. 1997; Randich et al. 1997, 2001).

Name	Age	N [*] UVES	N [*] GIRAFFE	N [*] selected as members	N [*] potential giants	N [*] potential Li-rich giants $EW(Li) > 50$
IC 2602	30-67 Myr	118	1536	25	627	19



$EW(Li)$, T_{eff} diagram for the possible members of **IC 2602**.



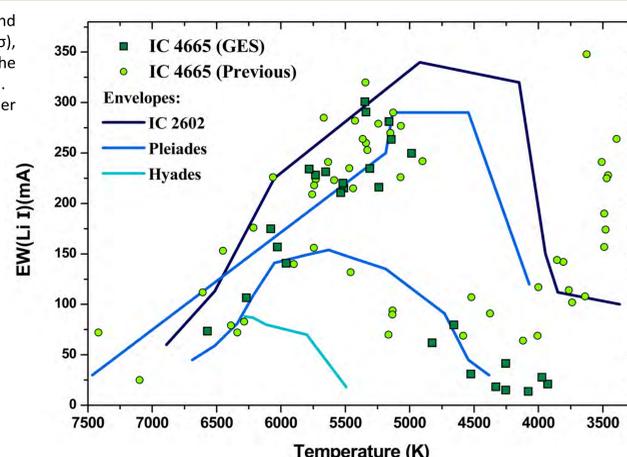
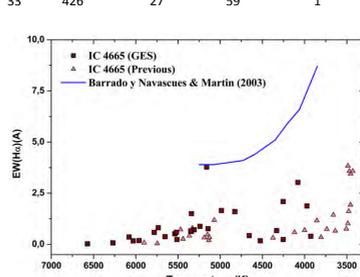
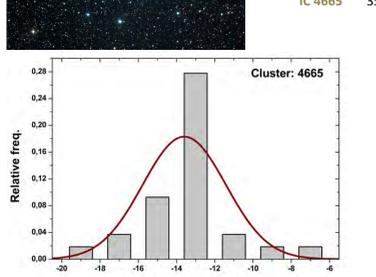
$\log g$, T_{eff} diagram for the possible members of **IC 2602**.

IC 4665

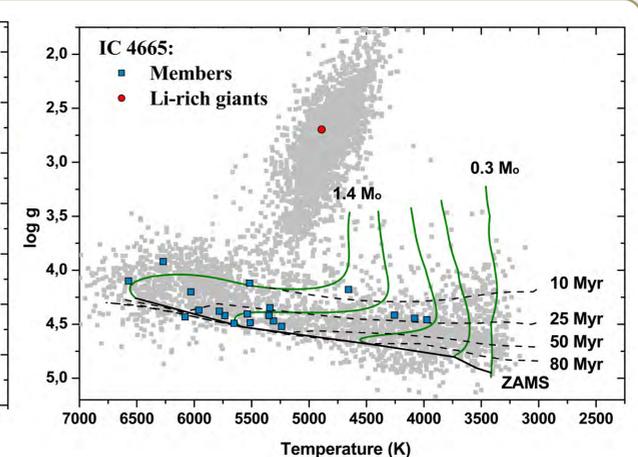


For **IC 4665** membership selection among the stars with Li detected in UVES and GIRAFFE spectra (iDR4) was based on their radial velocities ($V_r = -13.6 \text{ km/s} \pm 2\sigma$), their position in the $EW(Li)$ vs T_{eff} and HR ($\log g$ vs T_{eff}) diagrams and the detection of chromospheric activity or accretion based in the H α line (see Figs). We have include also the Li and H α information of IC 4665 provided by other authors (Martin & Montes 1997; Jeffries et al., 2009).

Name	Age	N [*] UVES	N [*] GIRAFFE	N [*] selected as members	N [*] potential giants	N [*] potential Li-rich giants $EW(Li) > 50$
IC 4665	35-43 Myr	33	426	27	59	1



$EW(Li)$, T_{eff} diagram for the possible members of **IC 4665**.



$\log g$, T_{eff} diagram for the possible members of **IC 4665**.

Lithium EW measurements and stellar parameters:

- **UVES**: We have used the spectra provided by GES (iDR4). Initial EWs (equivalent widths) of the Li (6707.76 Å) line and adjacent Fe (6707.43 Å) line were measured with the automatic tool *TAME* (Tool for Automatic Measurement of Equivalent Widths, Kang & Lee 2012). This tool allowed us to discard all spectra with $EW(Li) < 5 \text{ mÅ}$. We then did an individual analysis of each of the remaining spectra by measuring the $EW(Li)$ and $EW(Fe)$ manually with the *IRAF* task *splot*, using the *TAME* values for comparison purposes. With enough resolution $EW(Li)$ and $EW(Fe)$ can be measured individually, but in the case of lower resolution spectra only $EW(Li + Fe I)$ can be measured. EWs were corrected as $EW(Li) = EW(Li + Fe I) - EW(Fe I)$ in those cases where the Li and Fe lines could not be resolved. $EW(Fe I)$ was estimated using the *ewfind* driver within MOOG code (Sneden 1973) as explained in Tabernero (2014) and Lanzafame et al. 2015).

- **GIRAFFE**: We have also used the EWs (already corrected in the case of the WG12 clusters) from the spectra provided by GES (iDR4).

For all the following analysis, we have used the recommended parameters provided by GES (iDR4). See also the poster in this meeting by Gutiérrez Albarrán, Montes et al..

References:

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