REVEALING THE POPULATION OF YOUNG ASSC 20

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The study of ASCC20 is part of a big project where the main goal is to produce a reliable census and to derive different remarks for a sample of 11 open clusters.

1. Objectives

- To derive a census of low mass stars using multi-wavelength photometry and spectroscopy, from our own observing runs and from different public databases, going deeper than the Gaia final results.
- To derive IMFs down to the sub-stellar domain.
- To locate the Lithium Depletion Boundary to derive an alternative age based on this method and to compare with previous values.

2. Selection of candidates

- ASCC-20 is an open cluster with an estimated age of 22 Myr (based on the upper main sequence fitting) and located at 450 pc with A_V = 0.129 mag (Kharchenko et al. 2005a). Francis & Anderson (2012), using Hipparcos data, have derived a distance of ~320 pc.
- We have created a multi-wavelength photometric database of sources around the cluster by using archival data. The complete set of photometry contains the bands: $B_T V_T$ (Tycho-2), *grIz*, *JHKs* (2MASS), and *W1W2W3W4* (WISE).
- In order to select a bona fide census, a selection based on several Colour Magnitude Diagrams (CMDs), Colour-Colour Diagrams (CCDs) and theoretical stellar evolutionary models from Allard et al. (2012) has been made (Fig. 1).

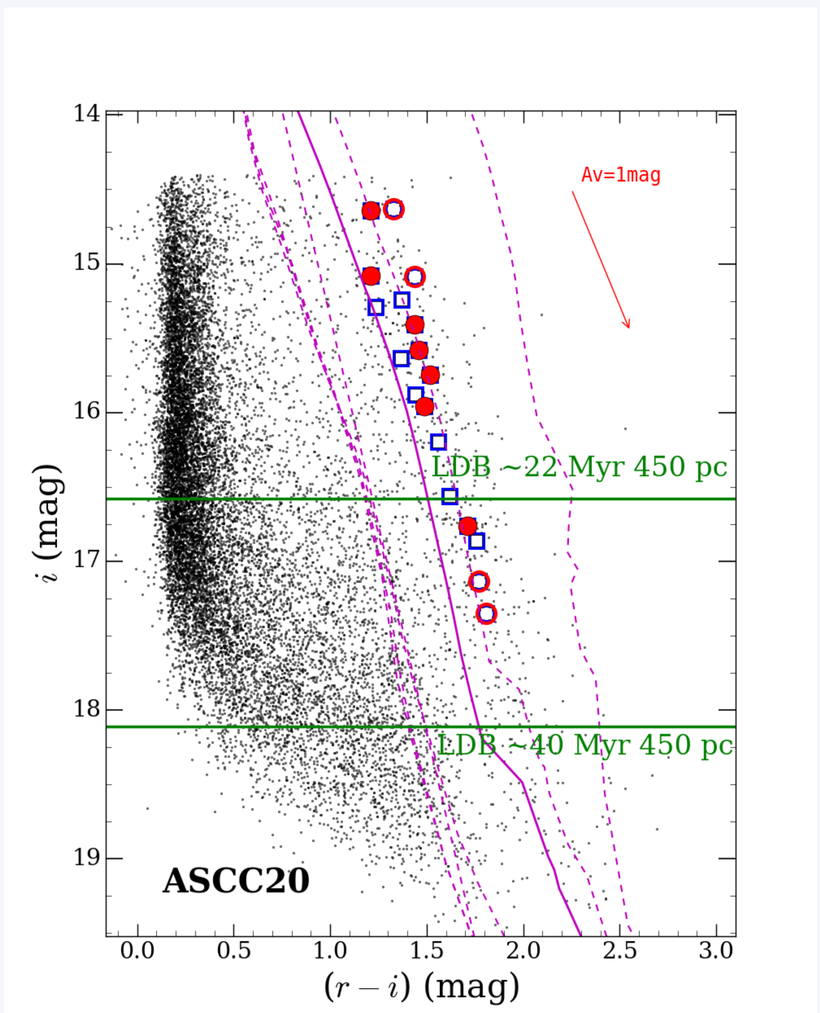

Fig. 1 CMD (*r-i*) vs. *i* . We have plotted those members confirmed with spectroscopy: members with H*α* line in emission (blue empty squares); members with enought resolving power to measure the Li 6708Å are showed in red circles: H*α* in emission with lithium detected (filled) and H*α* in emission without lithium. Dashed-lines correspond to 1, 10, 100, 150, 1000, and 10 000 Myr isochrones from Allard et al. (2012), assuming a distance of 450 pc and A_V=0.129 mag. The magenta line is a 20 Myr isochrone. We have estimate the LDB for two different ages.

3. Spectroscopic follow-up of candidates

- Several spectroscopic campaigns have been carried out using CAHA-TWIN and GTC-OSIRIS in order to confirm their membership.
- Spectral types have been derived by visual inspection and also using a least squares minimization, by comparing the spectra with several libraries of templates (Fig. 2).

4. Spectroscopic analysis of the members

- Equivalent widths of some spectral features, H*α* and alkali elements (Li, Na and K) are measured (Fig. 2).

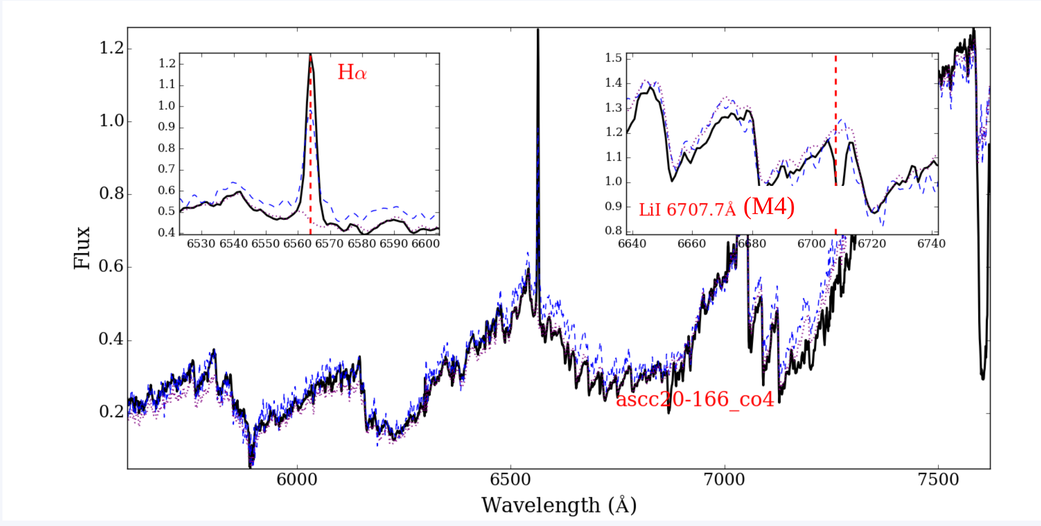

Fig. 2 Spectrum of ascc20-166 (black solid line). It is normalized to a continuum at 7400Å. The insets show the regions around the H*α* and the Li 6708Å features. Template spectra from Bochanski et al. 2007 are showed in blue dotted line (active) and purple dashed line (no active). We can see in this source a clear lithium detection.

- Metallicities and luminosities of the M spectral type sample are studied measuring spectral indices related with the CaH and TiO molecular bands, Fig.3, (see Reid et al. 1995 and Lépine et al. 2007c).
- Some sources show other emission lines, i.e. He I 5875Å triplet and [OI] 6300Å. These fulfill the empirical T Tauri criteria from Barrado y Navascués & Martin (2003), Fig. 4.

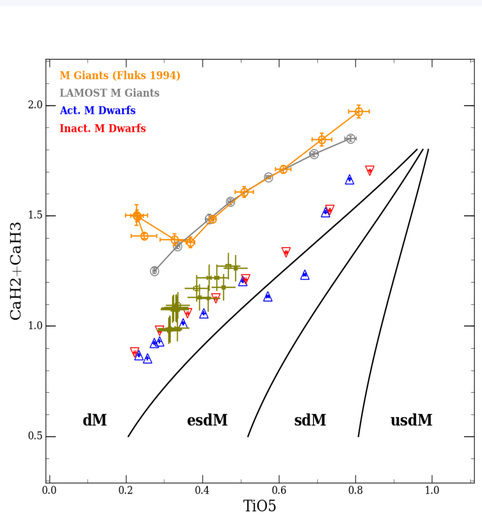

Fig. 3 (CaH 2 + CaH 3) vs. TiO 5 index-index diagram of our GTC-OSIRIS sample. Green crosses are our candidates. In order to compare we plot M giant templates from Fluks et al. 1994 (orange empty circles) and from Zhong et al. 2015b (gray crosses), and M dwarf templates from Bochanski et al. 2007: active (blue triangles) and no active (red triangles). Boundaries of the four metallicity subclasses are shown as black lines (Lépine et al. 2007c and 2013c).

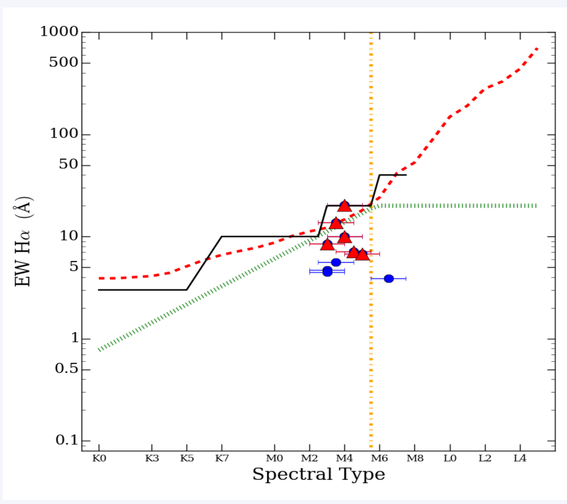

Fig. 4 H*α* equivalent width vs. spectral type. Only targets with H*α* in emission are showed. From Barrado y Navascués & Martin (2003), we plot the chromospheric criterion (green dotted line) and the saturation (purple dashed line). The solid black line shows the accretion criterion defined by White & Basri (2003). The red triangles are sources with the He I 5875Å feature in emission.

5. Conclusions

- This is the most complete study of ASCC20 up to date. We have confirmed the membership of several candidates down to the M7 spectral type.
- The spectral analysis reveals the youth of the cluster.
- Gaia will provide exact distance and proper motion for the cluster. However our census is deeper and complement those data.