Completing the census of low-mass stars and brown dwarfs in ε Cha and Chamaeleon I

Karolina Kubiak[1], K. Muzic[1], I. Sousa[1], V. Almendros Abad[1], R. Köhler & A. Scholz[2]

[1] CENTRA - Center for Astrophysics and Gravitation, University of Lisbon, Portugal
[2] School of Physics and Astronomy, University of St Andrews, UK

arXiv:2102.05589

Introduction

The Chamaeleon complex is a set of dark clouds located at the distance of ~200 pc, and a place of intense star formation activity. Other young populations such as ε Chamaeleonitis and the southern part of LCC are found nearby on the sky, but at shorter distances (~100 pc). While the centers of these young populations have been thoroughly studied, the census is still highly incomplete in the periphery of the main star formation sites. Thanks to the availability of the wide-field photometric and astrometric surveys, we can now efficiently look for young stars and brown dwarfs over the large extended regions of the sky, and thus help improve our understanding of the star and brown dwarf formation processes in low-density environments.

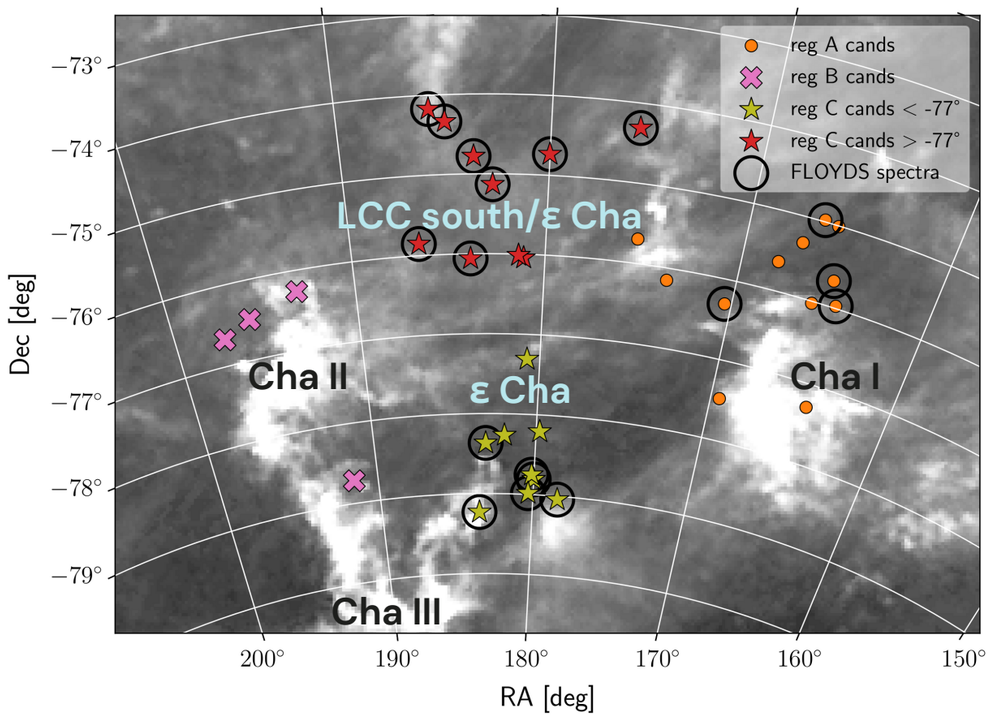
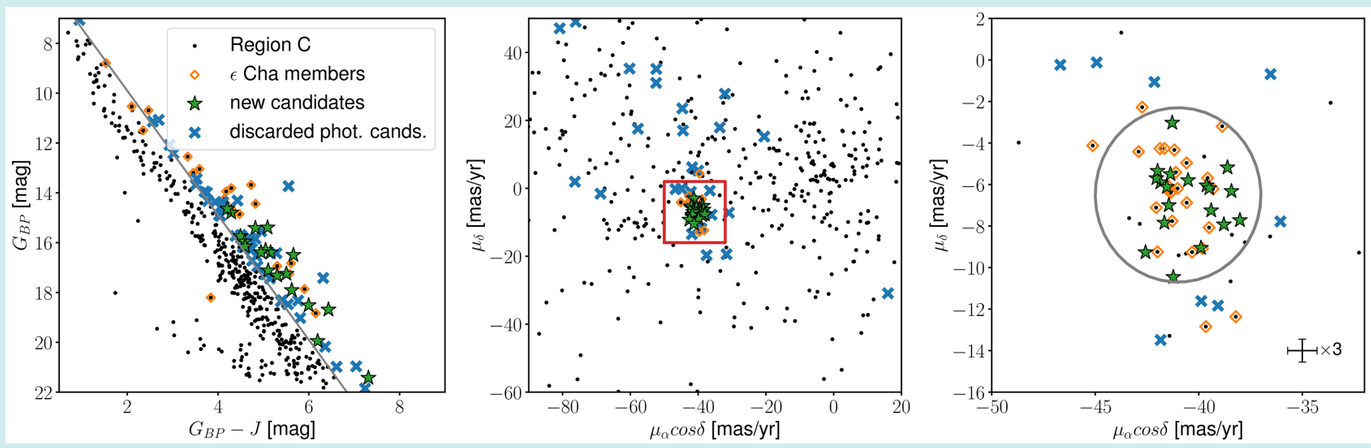


Figure 1. The region covered in our study, along with the candidates associated with Cha I and Cha II star forming regions (~200 pc), and ε Cha moving group and/or the southern part of the Lower-Centaurus Crux association (LCC; ~100 pc).

Selection of the new candidates



Selection of the new candidates is based on their expected red colors, and clustering in both proper motion and parallax space, using the data from Gaia DR2 and 2MASS. We identify in total 35 new candidates (see Fig. 1).

Figure 2. En example of the member selection procedure for the region encompassing ε Cha and the souther part of the LCC.

Follow-up spectroscopy

To confirm the membership of our candidates, we followed-up 18 objects with the FLOYDS spectrograph mounted at a 2-m robotic telescope at Siding Springs Observatory, Australia. The optical spectra allow us to determine the spectral types and extinction, and reveal the objects' youth through Hα emission, and the shape of the gravity sensitive lines of Na I.

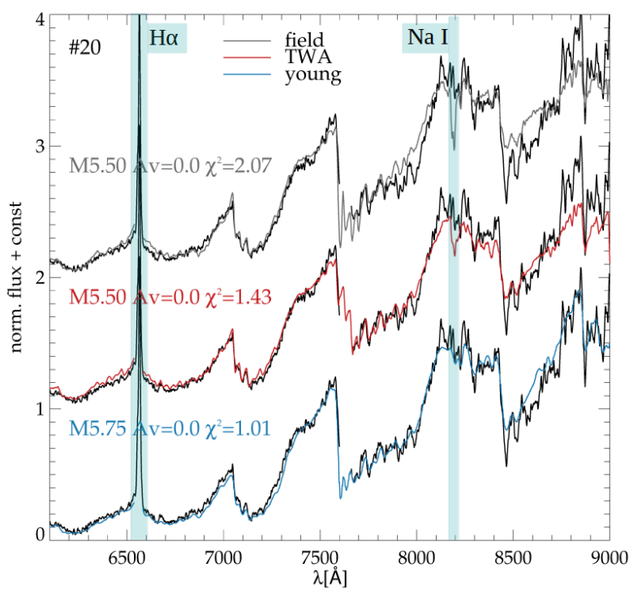
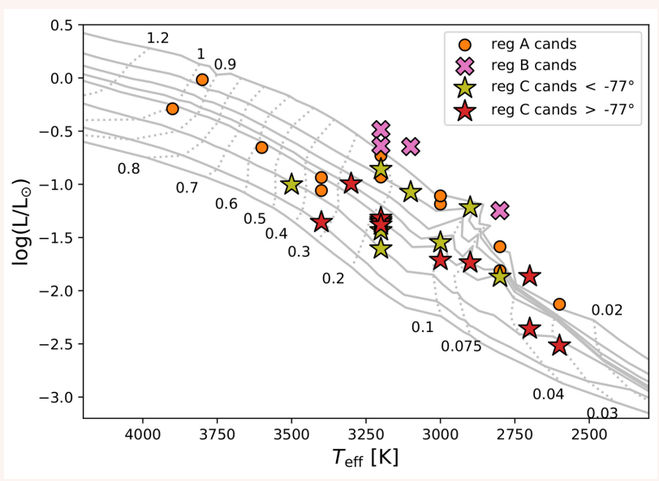
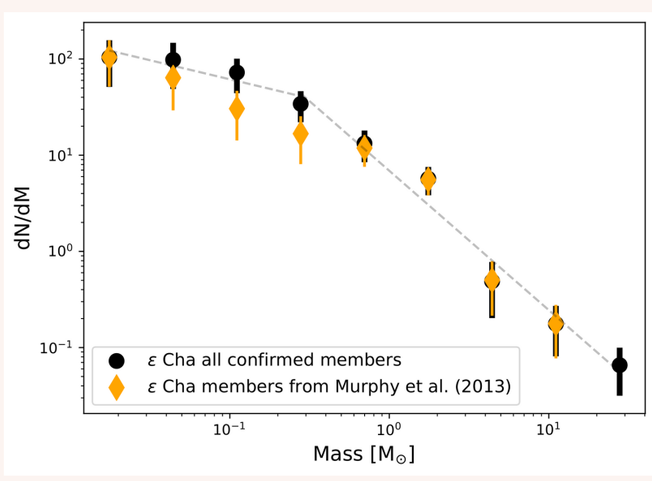


Figure 3. The spectral template fit was performed using the spectra of the field dwarfs, as well as those belonging to young star forming regions (1-3 Myr), and TW Hydra (TWA) moving group (8-10 Myr). Here we show one of the candidate spectra, along with the best fitting template from each class. The gravity-sensitive Na I doublet is marked, as well a the Hα emission.

Ages and mass distribution

Most of the spectroscopic candidates are confirmed as young members of Cha I, ε Cha, and/or LCC. Moreover, the positions in the HR diagram (Fig. 4) speak in favor of most of the other candidates also being young (~1-10 Myr). We derive the first Initial Mass Function (IMF) in ε Cha extending into the substellar regime, with the slope of the IMF consistent with that of other young clusters.





IMF in the form:

$$dN/dM \propto M^{-\alpha}$$

M<0.5 $M_\odot$ α = 0.42±0.11
M>0.5 $M_\odot$ α = 1.44 ± 0.12

Figure 4. Left: HR diagram for all the candidates, along with the BT-Settl isochrones (solid lines) and the lines of constant mass (dotted lines). The isochrones correspond to the ages (1, 2, 3, 4, 5, 10, 20, 30) Myr, from top to bottom. The masses are in $M_\odot$. **Right:** The IMF of the ε Cha updated census, complete down to ~ 0.03 $M_\odot$.

This work is supported by the FCT – Fundação para a Ciência e a Tecnologia, I.P., project ID PTDC/FIS-AST/28731/2017