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ON THE NATURE OF EARLY-TYPE EMISSION LINE OBJECTS IN NGC611

C. Martayan^{1,2}, M. Floquet², A.-M. Hubert², J. Fabregat³, Y. Frémat¹, D. Baade⁴ and C. Neiner²

Abstract. The number and the nature of emission line objects in the young open cluster NGC6611 is still the object of debates. Due to the presence of a strong and variable nebulosity in the cluster, the number of emission line stars is highly depending on the technique and the resolution used for the observations. Thanks to observations with the ESO-WFI, in slitless spectroscopic mode, and with the VLT-GIRAFFE we have been able to disentangle the circumstellar and nebular emissions. We confirm the small number of true emission line objects and we precise their nature: mainly Herbig Be stars.

1 Introduction

NGC6611 is a young open cluster with $\log(\text{Age}) = 6.2$ or 6.8 , depending on the authors. According to Hillenbrand et al. (1993) and to de Winter et al. (1997) it contains a great number of emission line stars (ELS), whereas Herbig & Dahm (2001) only found a small number of these. It is however worth noticing that the two first studies were carried out using slit spectrographs, while Herbig & Dahm (2001) used a slitless instrument not sensitive to the surrounding emission originating from the Eagle nebula.

In order to further investigate the occurrence of emission line stars in NGC6611 and in order to determine the kind of objects it are, we used the Wide Field Imager (WFI) at ESO in slitless spectroscopic mode associated to a 200 nm passband $H\alpha$ filter. We further also made use of the multi-object spectrograph GIRAFFE at the VLT in MEDUSA mode. The spectra that were obtained in this way allowed us: 1) to determine the stellar parameters, 2) to disentangle the circumstellar and nebular emissions, and 3) to determine the true nature of the targets.

2 Number of Emission lines stars

2.1 WFI observations

With WFI, we obtained ~ 15000 spectra of the sources in NGC6611 and its surrounding field. Due to the fact that WFI in slitless mode is not sensitive to the ambient nebular emission, we listed the stars with and without circumstellar (CS) emission. However, this slitless mode cannot show the faint CS emission. A small number of ELS was identified and was preselected for the VLT GIRAFFE observations. This observation confirm those of Herbig & Dahm (2001).

2.2 VLT GIRAFFE observations

The 100 objects finally observed with GIRAFFE are shown in Fig. 2. Among them, only nine were identified as “true” CS ELS. The main part of the previously known ELS had their spectra contaminated by nebular emission, as shown in Figure 1 by the $H\alpha$ region obtained with WFI and GIRAFFE for two cases: a true CS ELS W483 and a false ELS W371 (previously identified as ELS).

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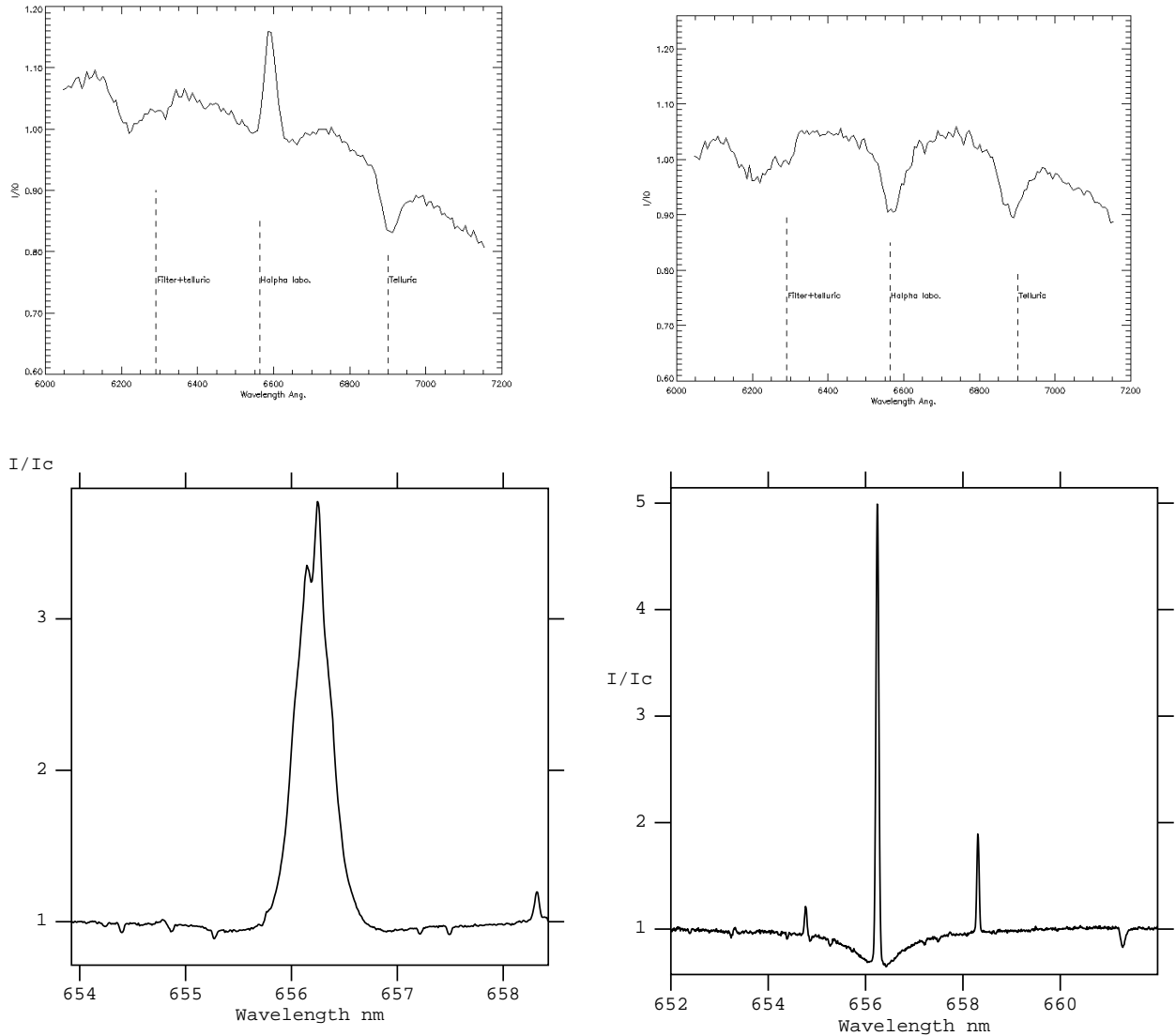


Fig. 1. WFI (upper panels) and GIRAFFE (lower panels) $H\alpha$ spectra obtained for the CS emission line star W483 (left panels) and for W371 (right panels) which spectra are contaminated by emission originating from the Eagle nebula.

3 Nature of NGC661 stars

To determine the nature of the stars in the sample observed with GIRAFFE, we first determined the fundamental parameters and second we studied the spectral energy distributions (SED).

3.1 HR parameters

We determined the astrophysical parameters (T_{eff} , $\log g$ and $V \sin i$) by fitting the GIRAFFE data with synthetic spectra and by adopting a procedure described in Frémat et al. (2006). Fundamental parameters (mass, radius, age, luminosity) were then estimated by interpolation in theoretical evolutionary tracks computed for a Solar metallicity (Schaller et al. 1992). A part of stars in the sample (mainly the massive stars) are young and are close to the ZAMS. However, the analysis of our results demonstrates that a group (intermediate mass stars) of our NGC6611 targets have an age too old for the age of this star-formation region. Consequently, these stars must be, in fact, considered as pre-main sequence stars (PMS), which go to reach the ZAMS. We therefore re-estimated their age using the PMS evolutionary tracks computed by Palla & Stahler (1993) and Iben(1965).

3.2 Infrared study

Intrinsic instellar reddening ($E(B-V)$) was measured for each star by means of the instellar lines detected at 443.0 and 661.3 nm, and was used to correct the UBVI, JHK (taken from the 2MASS survey), $3.6\mu\text{m}$, $4.5\mu\text{m}$, $5.7\mu\text{m}$ and $8\mu\text{m}$ (SPITZER) magnitudes. Each SED is normalized to the SED of a non ELS classical B star. For certain of non ELS in the sample, the SED show an infrared excess, as well as for 5 of the ELS. The origin of this more or less strong infrared excess is a possible disk or cocoon around the central star. The presence of the infrared excess is compatible with Herbig Ae/Be stars or with PMS. This infrared study confirms the presence of PMS and allows to determine/confirm that the main part of the ELS observed are Herbig Ae/Be stars.

3.3 Nature of the true ELS

Combining the information from the spectra, from the fundamental parameters, and from the infrared study, we determined that:

- the stars WFI[N6611]017, W080, W235, W483, W500, W503 are Herbig Ae/Be stars.
- The star W031 is a possible Herbig Ae/Be star but a doubt remains.
- And the star W301 is a classical Be star.

4 Conclusions

By combining WFI and GIRAFFE data and by determining the astrophysical and fundamental parameters of the stars, we identified 8 Herbig Ae/Be stars and one possible classical Be star. In addition, we also detected in our sample several PMS stars without emission. Further, from the analysis of the results obtained for the most massive MS B type stars, we estimated that the Age of the NGC6611 cluster is $\log(\text{Age})=6.8$, which is in fair agreement with the previous determinations.

References

- de Winter, D., Koulis, C., The, P. S., et al. 1997, AAS, 121, 223
Frémat, Y., Neiner, C., Hubert, A.-M., et al. 2006, AA, 451, 1053
Herbig, G. H. & Dahm, S. E. 2001, PASP, 113, 195
Hillenbrand, L. A., Massey, P., Strom, S. E., & Merrill, K. M. 1993, AJ, 106, 1906
Iben, I. J. 1965, APJ, 141, 993
Palla, F. & Stahler, S. W. 1993, APJ, 418, 414
Schaller, G., Schaerer, D., Meynet, G., & Maeder, A. 1992, AAS, 96, 269

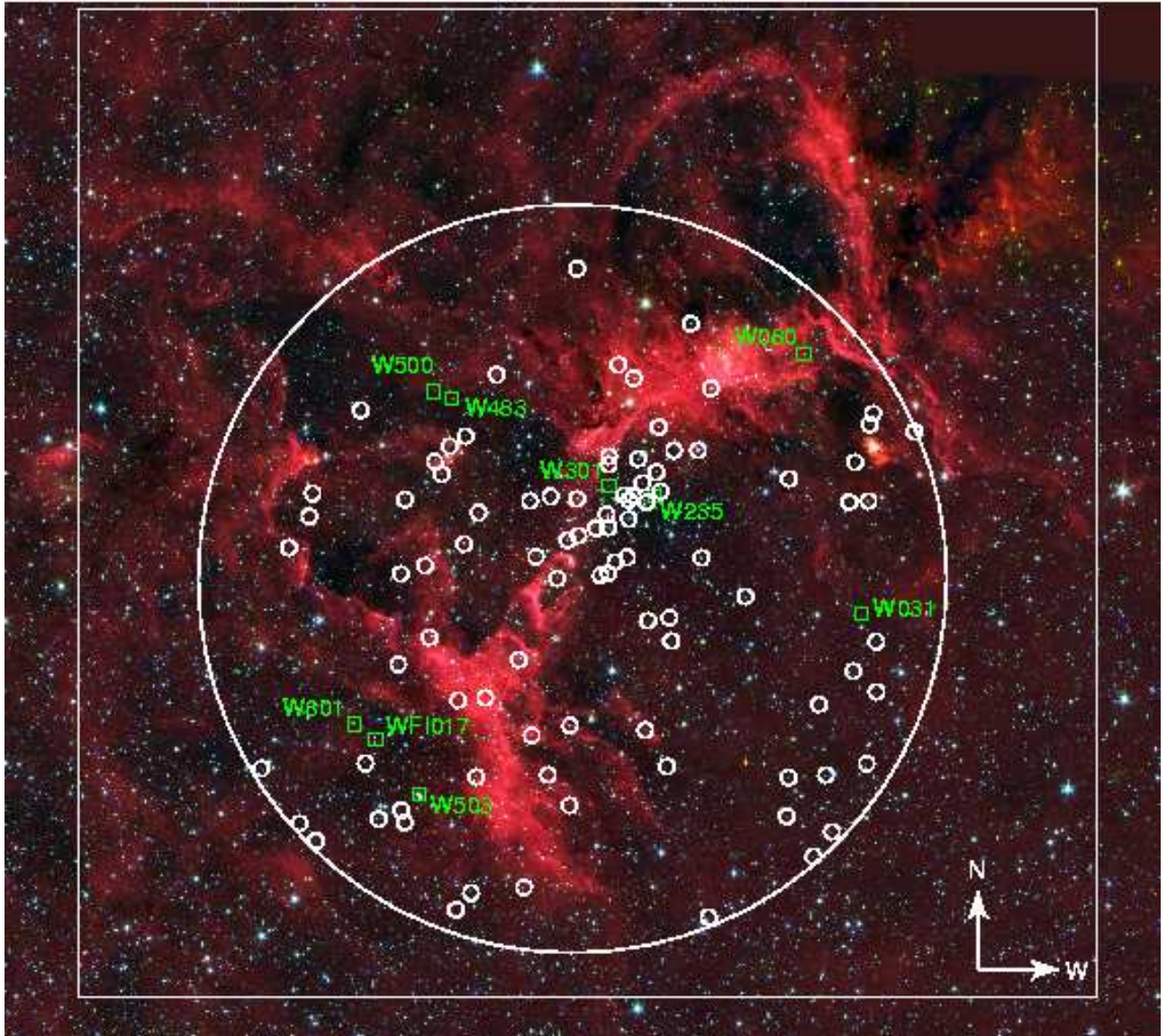


Fig. 2. Location of the stars observed with the VLT-GIRAFFE in the field of NGC6611. The image is a RGB mosaic with 3 channels of SPITZER (B: $3.6\mu\text{m}$, G: $4.5\mu\text{m}$, and R: $8\mu\text{m}$). The small white circles are for the non-ELS stars, the green boxes are for the ELS stars. The large white circle shows the field of GIRAFFE and the large white box shows the field of the WFI-spectro. WFI017 stands for WFI[N6611]017.