8.5 Mining the Sky for "Isolated" Very Young Stars

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Abstract

Accreting young stars whose origin cannot be unmistakably linked to standard stellar birthplaces are extremely rare and also challenging candidates for the commonly accepted theory of stellar formation. We present preliminary results of optical observations conducted on "isolated" stars showing strong near- and far-infrared excesses that could be due to circumstellar discs. We acquired high-resolution optical spectra allowing us to investigate in detail their nature and physical parameters. We concluded that 5 of our targets are very young stars, with ages of around 10 Myr or even younger. They offer the opportunity to study the stage between transition and debris circumstellar discs and may help to shed new light on atypical formation processes of stars and planets in low-mass clouds.

Introduction

Accreting T Tauri stars (TTSs) whose origin cannot be unmistakably linked to standard stellar nurseries (i.e. in loose associations) are extremely rare. Discovering "isolated" very young stars with ages of around 10 Myr is extremely important for studying phenomena related to planet formation, especially in the gap between 3 and 50 Myr respectively covered by star-forming regions (SFRs) and open clusters near the zero-age-main sequence.
Thanks to statistical multivariate analysis methods, developed for the automatic classification of XMM-Newton X-rays sources (Pineau et al. [2011]), we have constructed the RASS-Stars catalogue (RSC). The RSC encompasses the RasTyc sample and extends it by a factor 3 or so, with good identification of active young stars down to $V = 18$ mag. Moreover, the correlation of the RSC with the AKARI/IRC mid-infrared (IR) all-sky survey (S9W filter) (Ishihara et al. [2010]) offers the opportunity to search for "isolated" and possibly accreting stars.

Searching for accreting "isolated" very young stars

We used colour-colour diagrams to select, a priori, young stellar objects from the cross-correlation of the RSC and AKARI catalogues. In the $(B-V)$ vs. $(V-S9W)$ diagram (Fig. 8.7, left panel), stars showing IR excess (red dots) which could originate from dust emission (see an example in Fig. 8.7, middle panel) are clearly visible on the right side of the major sequence. Among those ones with no reference in the literature, we identified 13 stars visible from the north hemisphere. Although some of them are close to known SFRs whose they could be accreting TTS members, a few of them are located in sky region devoid of dense interstellar matter. We also note that TW Hya and TYC4496-780-1 (Guillout et al. [2010]) were part of the selection, which makes us confident regarding the effectiveness of our selection method.

High-resolution optical spectra were acquired to discriminate young stars from older ones thanks to spectral features. Among the 13 field stars initially selected, 5 exhibit a large Hα emission profile and high-lithium abundance (see an example in Fig. 8.7, right panel) typical of TTSs. High-lithium content is now widely accepted as a youth criteria and according to the concept of the magnetospheric accretion model, the large Hα line width (several hundred km/s) is indicative of large-scale gas flow while the inverse P Cygni profile traces gas infall. They also show strong Hα variability like observed in TTSs. Based on these observational criteria, they are classified as likely accreting TTSs and their ages estimated to be 5 - 10 Myr. Although not strictly isolated, all are located several degrees apart from the cores of SFRs in their vicinity. Additional photometric observations will better constrain the SED. SED modelling will

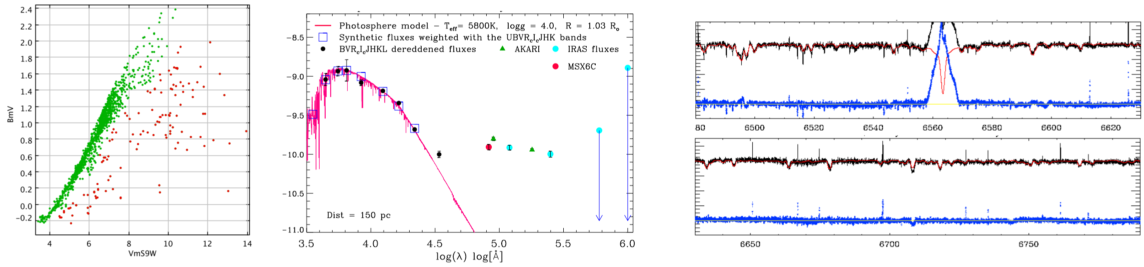

Figure 8.7: *Left panel*: 13 stars showing IR excess (red dots) were selected from colour-colour diagram. *Middle panel*: Spectral energy distribution (SED) for one of the targets. *Right panel*: High-resolution spectra in the Hα (upper panel) and Lithium (lower panel) regions. The blue line displays the spectrum resulting of subtraction of the synthetic star (red line).

then allow us to constrain the stellar parameters and the properties of the circumstellar disc, and derive an age from evolutionary tracks. Finally, the kinematics should shed light on their origin and possible relation with the closest SFRs, young associations or moving groups.

Bibliography

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