Towards statistical samples of accretion rates

Results from the IPHAS photometric H-alpha survey in Cepheus OB2

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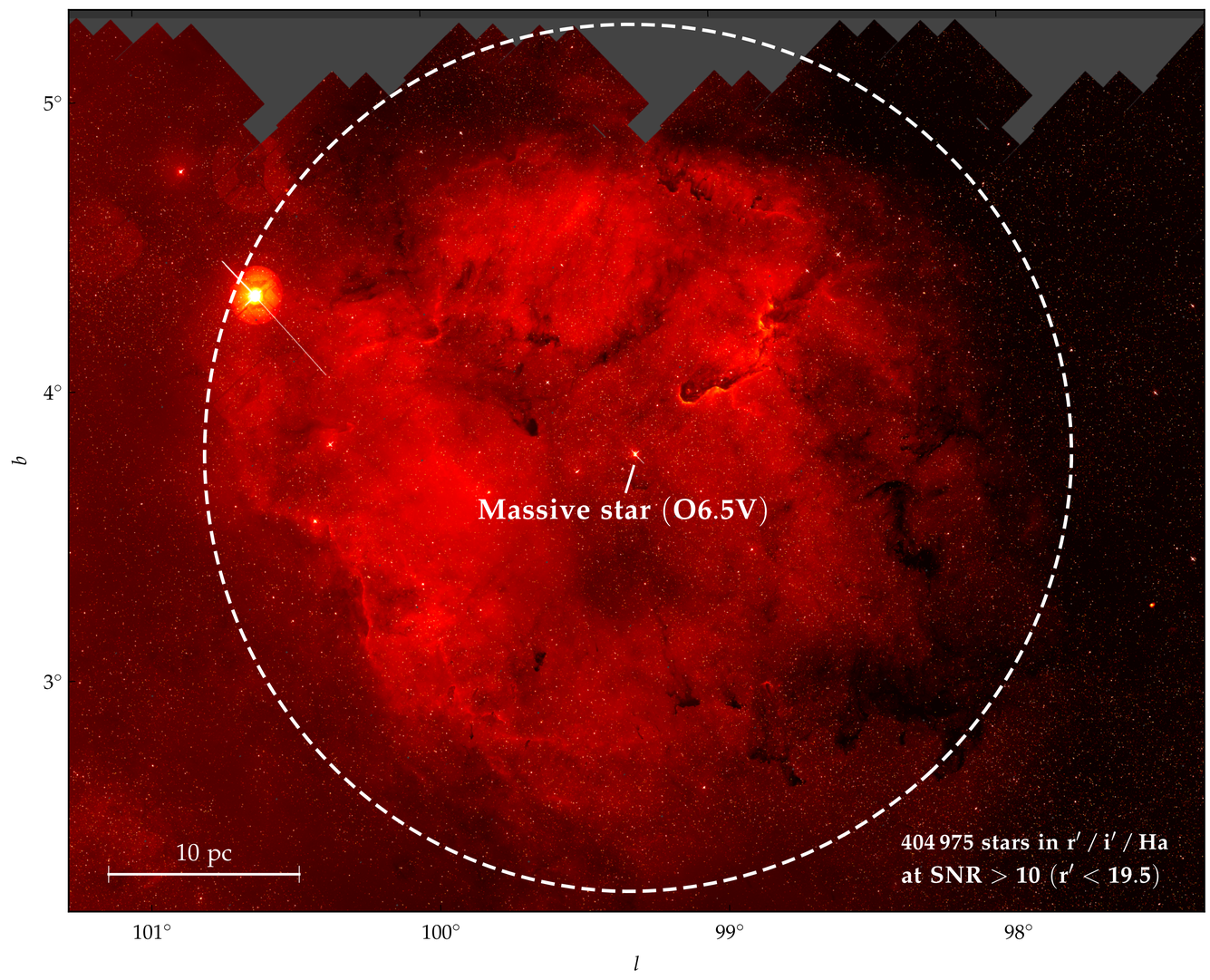
1. Introduction

Studies of spectroscopic mass accretion rates are hampered by small-number statistics and inhomogeneous datasets.

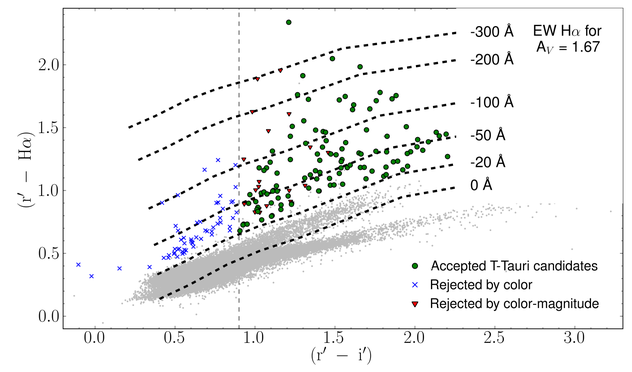
(De Marchi et al. 2010) recently showed that accretion rates may be measured using Hα narrow-band photometry, allowing large samples to be obtained with a better handle on the selection effects.

In this work, we evaluate the method using r′/i′/Hα-band data from the INT Photometric H-Alpha Survey (IPHAS) of the North Galactic Plane. Our testbed is IC 1396 in Cepheus OB2; a 7 deg^2 H II region at 900 pc (Hα mosaic below).

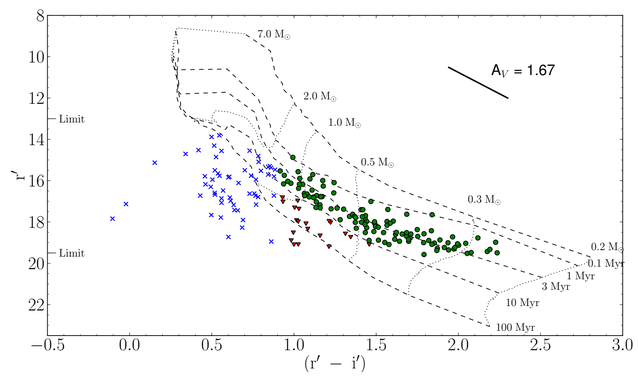


2. Method

A) T-Tauri candidates and Hα line luminosities are obtained using synthetic tracks in the (r′-Hα/r′-i′) diagram:



B) Stellar parameters ($\tau_* / M_* / R_*$) are obtained from (Siess 2000) model tracks in the (r′/r′-i′) diagram:



C) Hα luminosity is converted to accretion luminosity using an empirical relation from spectroscopic literature data:

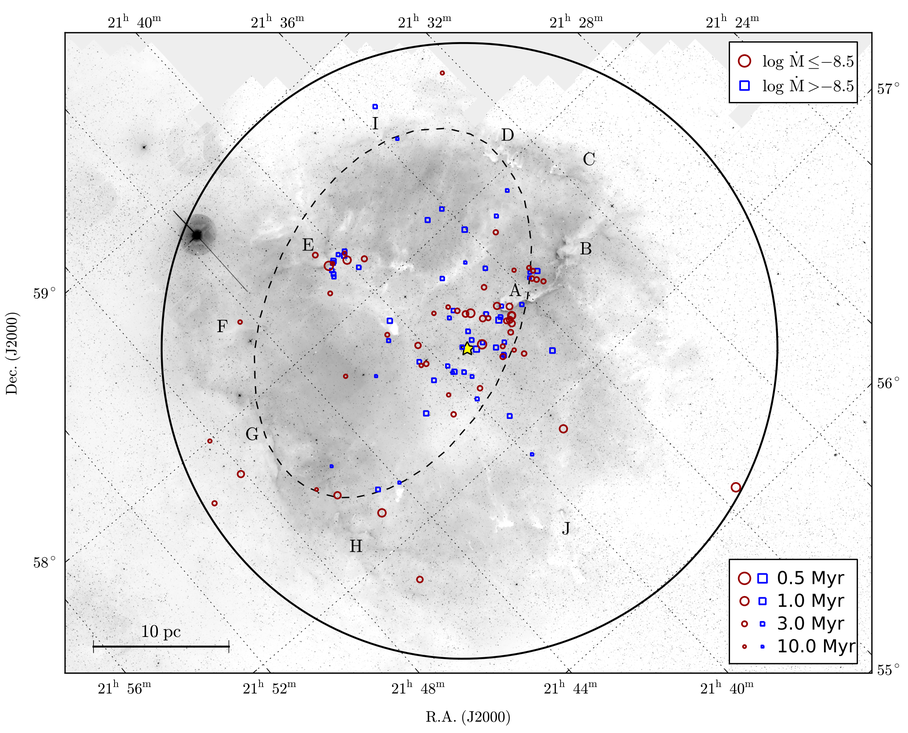
$$\log \mathrm{L_{acc}} = (1.00 \pm 0.07) \log \mathrm{L_{H\alpha}} + (1.53 \pm 0.24) \quad (1)$$

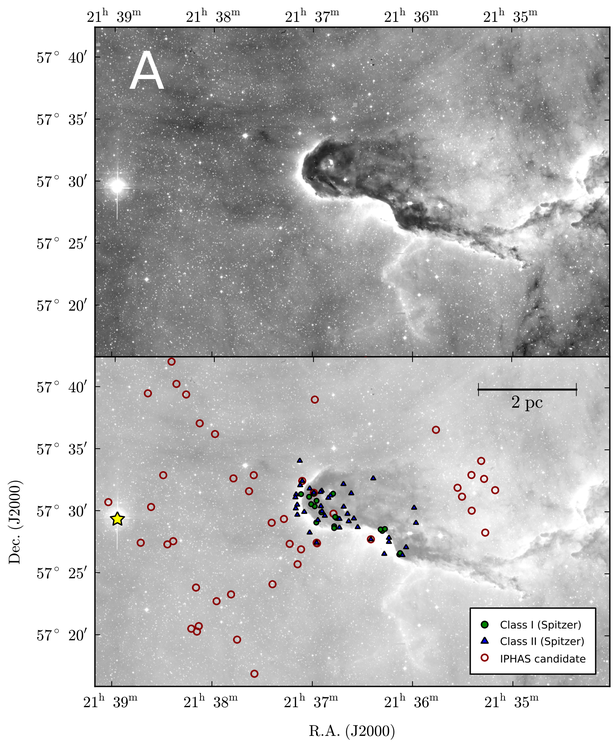
Finally, the accretion rate is obtained:

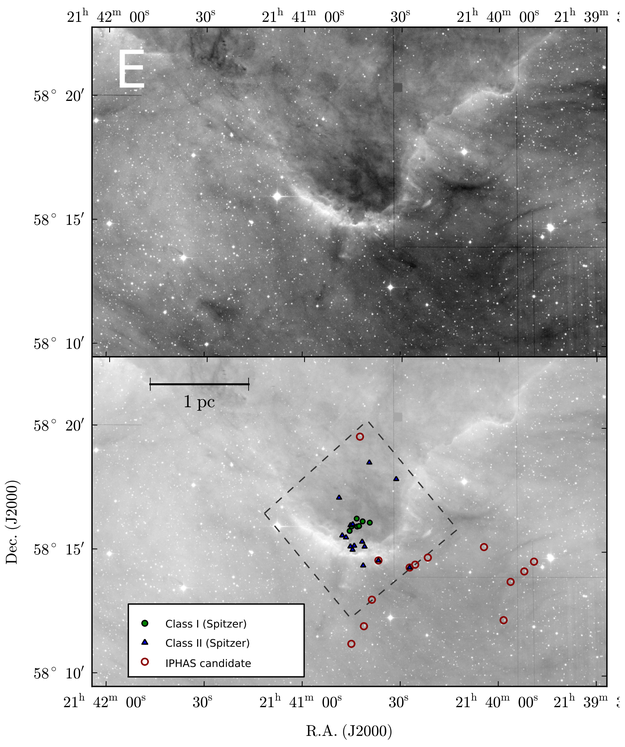
$$L_{\mathrm{acc}} \simeq \frac{G M_* \dot{M}}{R_*} (1 - \frac{R_*}{R_{\mathrm{in}}}) \quad (2)$$

3. Results: sequential star formation triggered by the central massive star

We obtain 110 T-Tauri candidates with accretion rates > $10^{-9.5}$ $M_\odot yr^{-1}$ $\pm$0.5 dex. 74% of the bright candidates in the central region are confirmed in previous work by (Sicilia-Aguilar et al).
In addition, we discover 50 new faint candidates ($r' > 18.0$; $M_* < 0.5\ M_\odot$) which are densely clustered near the molecular clouds A and E (figure middle and right).
The distribution of sources suggest that these clouds are sites of ongoing sequential star formation, driven by the central massive star (yellow star symbol).



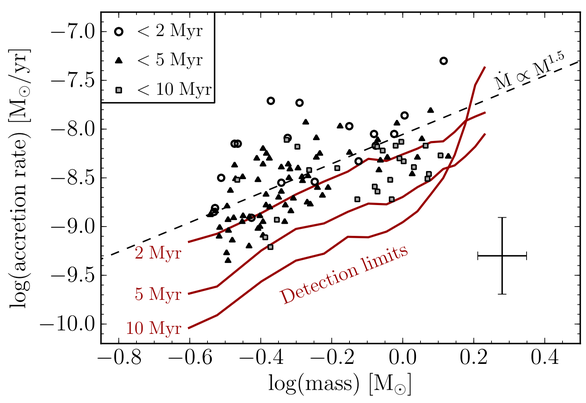




4. Discussion: do accretion rates depend on mass or position?

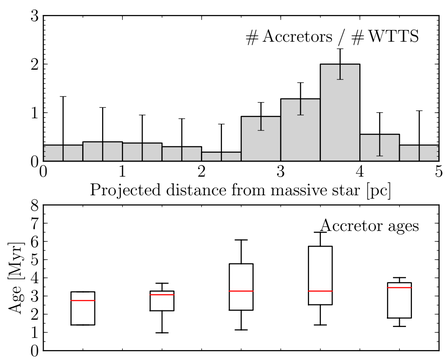
Mass dependence

We use our sample to test recent claims on the steep dependency of accretion rates on stellar mass ($\dot{\mathrm{M}} \propto \mathrm{M}_*^{1.5-3.0}$). We find that the dependency is severely affected by the detection limits (red lines), which can be constrained precisely when using the photometric method.



Position dependence

Relative to the number of non-accreting T-Tauri stars from (Sicilia-Aguilar 2006), we find a lack of accretors at < 2.5 pc from the massive star. This may be due to the destructive effects of UV-photoevaporation. Alternatively, the stars closer to the massive star may be older, although this is not reflected by the model ages.



5. Conclusions

- Large and homogeneous samples of accretion rates can be obtained at 0.5 dex accuracy using photometry.
- The apparent dependence of accretion rates on stellar mass is strongly driven by selection effects.
- In future work, we will apply the method to other regions in IPHAS ($30^o < l < 220^o$, $-5^o < b < +5^o$) and include He I narrow-band photometry from a follow-up survey.

Acknowledgements

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