Photomethric identification of Hα emitters within the IPHAS field of view

Matteo Fratta, Dr. Simone Scaringi – Texas Tech University

TEXAS TECH UNIVERSITY™

Abstract

I present a list of likely Hα emitters among the sources in the Isaac Newton Telescope Photometric Survey of the Northern Galactic Plane (IPHAS) field of view.

Out of 7,373,236 objects, 17,272 have been highlighted as emitters, in the Hα narrow band. For each of these objects, I calculated a significance parameter which provides a quantitative degree of confidence that the given source is a true emitter. In this way, future users can choose between applying a more conservative cut when sampling our catalog rather then opting for completeness, or vice versa.

In this study, I used a cross-matched catalog between Gaia DR2 and IPHAS DR2; this provided me with the r, i and Hα IPHAS bands, and also the Gaia Bp, Rp and M_G colors, along with the distances to the sources.

I could then build the Bp-Rp VS M_G Color-Magnitude Diagram, which allowed me to identify which population each source most likely belongs to.

Methods

- Partition creation: In order to discern the different populations of stellar objects, I looked at the sources in the Color-Magnitude Diagram. I iteratively allocated them to rectangular cells whose sizes increased in each iteration. I thus created 9135 partitions, each containing objects that most likely belong to the same population.
- Detrending procedure: Main Sequence stars and reddened Red Giants show an intrinsic linear trend in the Color-Color space. I removed it from each partition by iteratively fitting a linear model to the data, subtracting this model from the data, and finally applying Chauvenet's criterion.
- Outliers identification: I applied again the iterative Chauvenet's criterion to the previously detrended data, in order to select the positive r-Hα outliers in each partition. I then assigned a "significance" to each source, namely how many standard deviations away from the mean its detrended r-Hα is.

References:

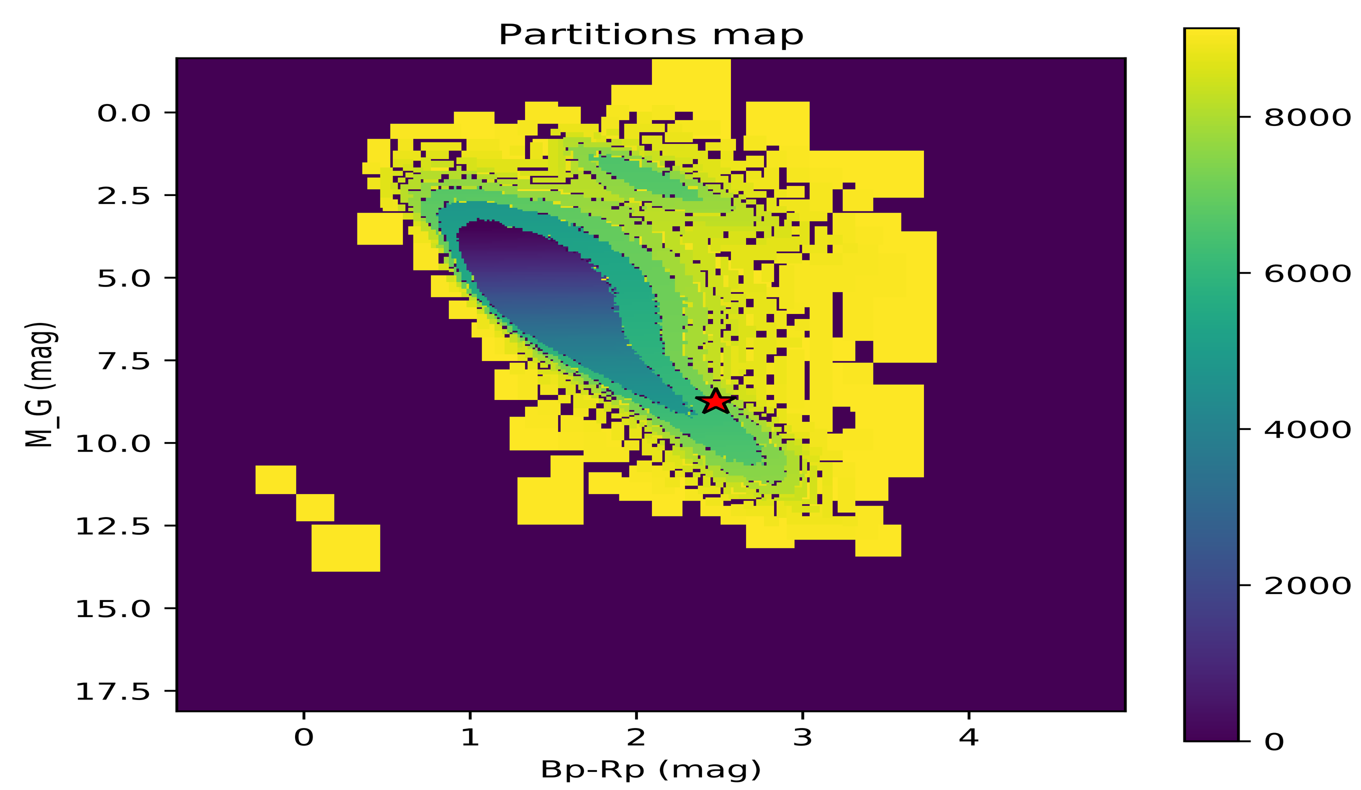
Scaringi et al. 2018, MNRAS, 481, 3357

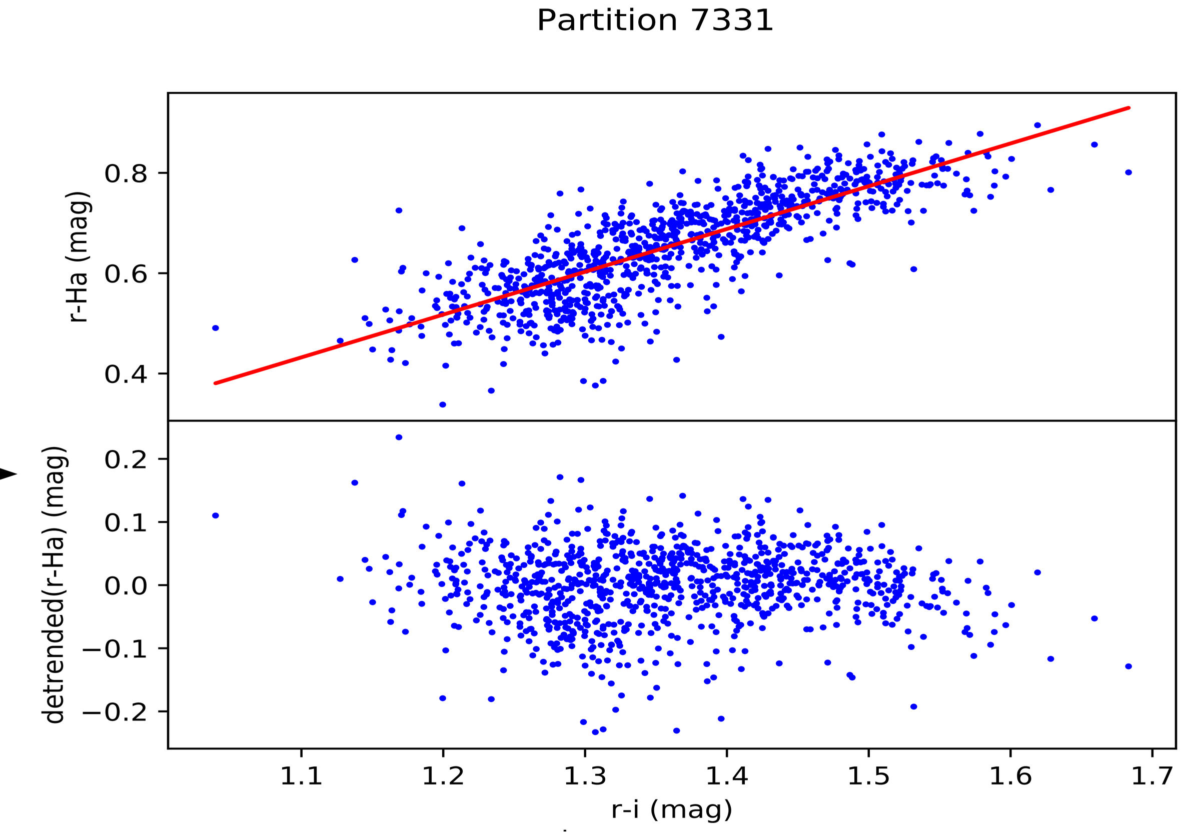
Barentsen et al. 2014, MNRAS, 444, 3230

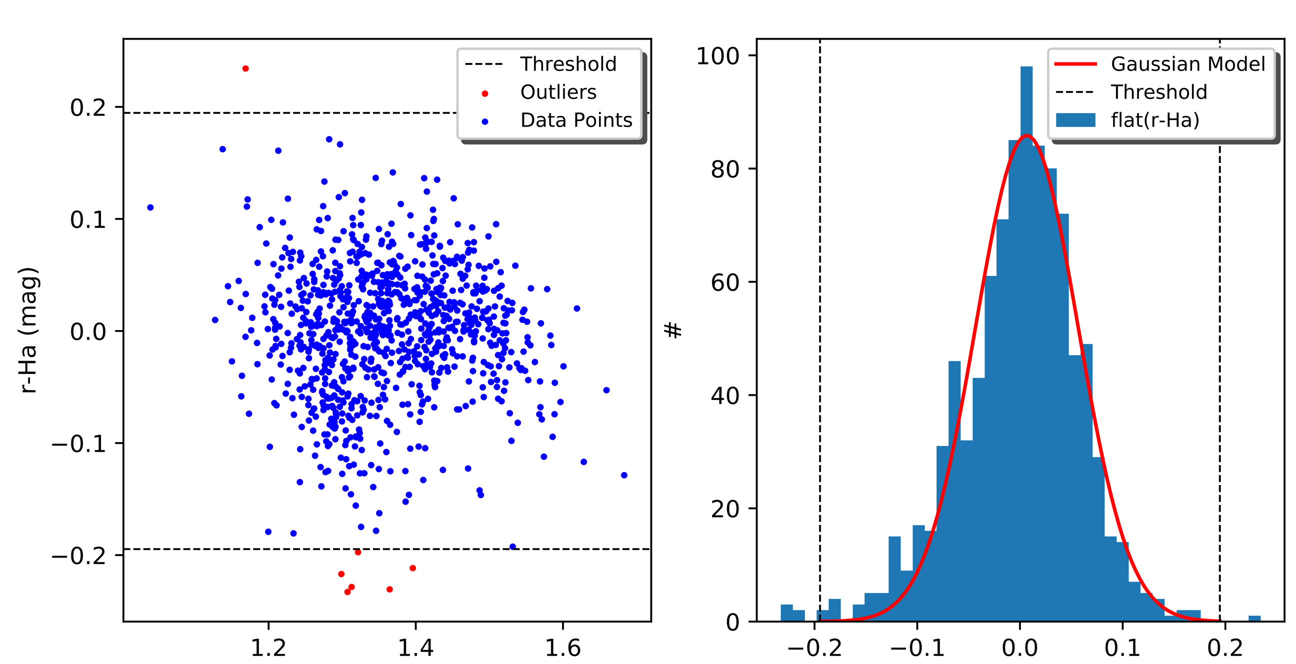
Introduction

Hα emission is strongly connected to accretion processes in Astrophysics: Young Stellar Objects (YSOs) and Cataclysmic Variables (CVs) constitute two good examples of Hα sources. This narrow band emission is due to the de-excitation of hot atomic Hydrogen (present in the accretion disk, for the aforementioned cases in particular).

To increase the sample of known and classified Hα emitters, we implemented a photometric identification of outliers among the sources in the IPHAS field of view. Through a crossmatch with the Gaia data set, we were able to perform a *population-based* selection, without the need perform a spectroscopic study.

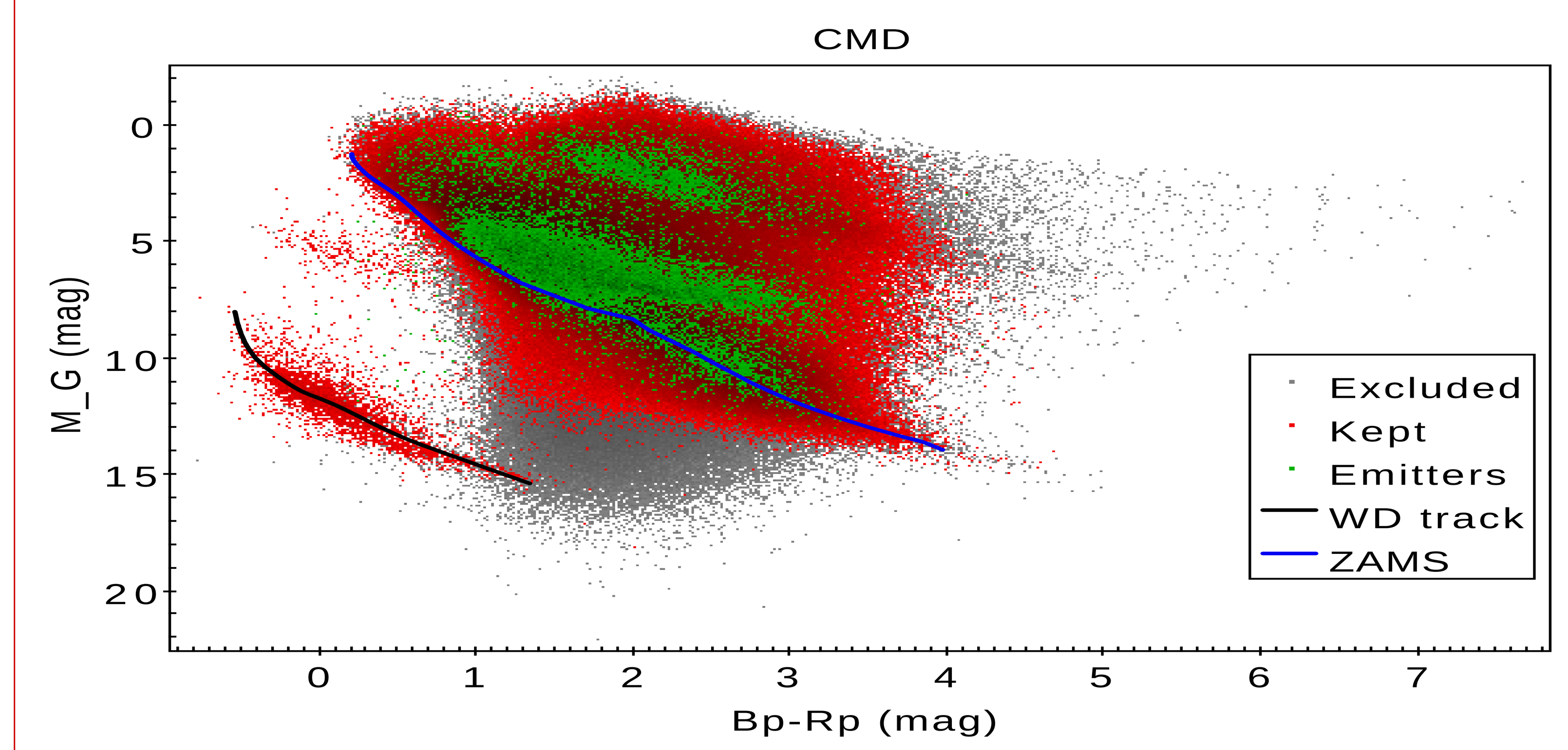


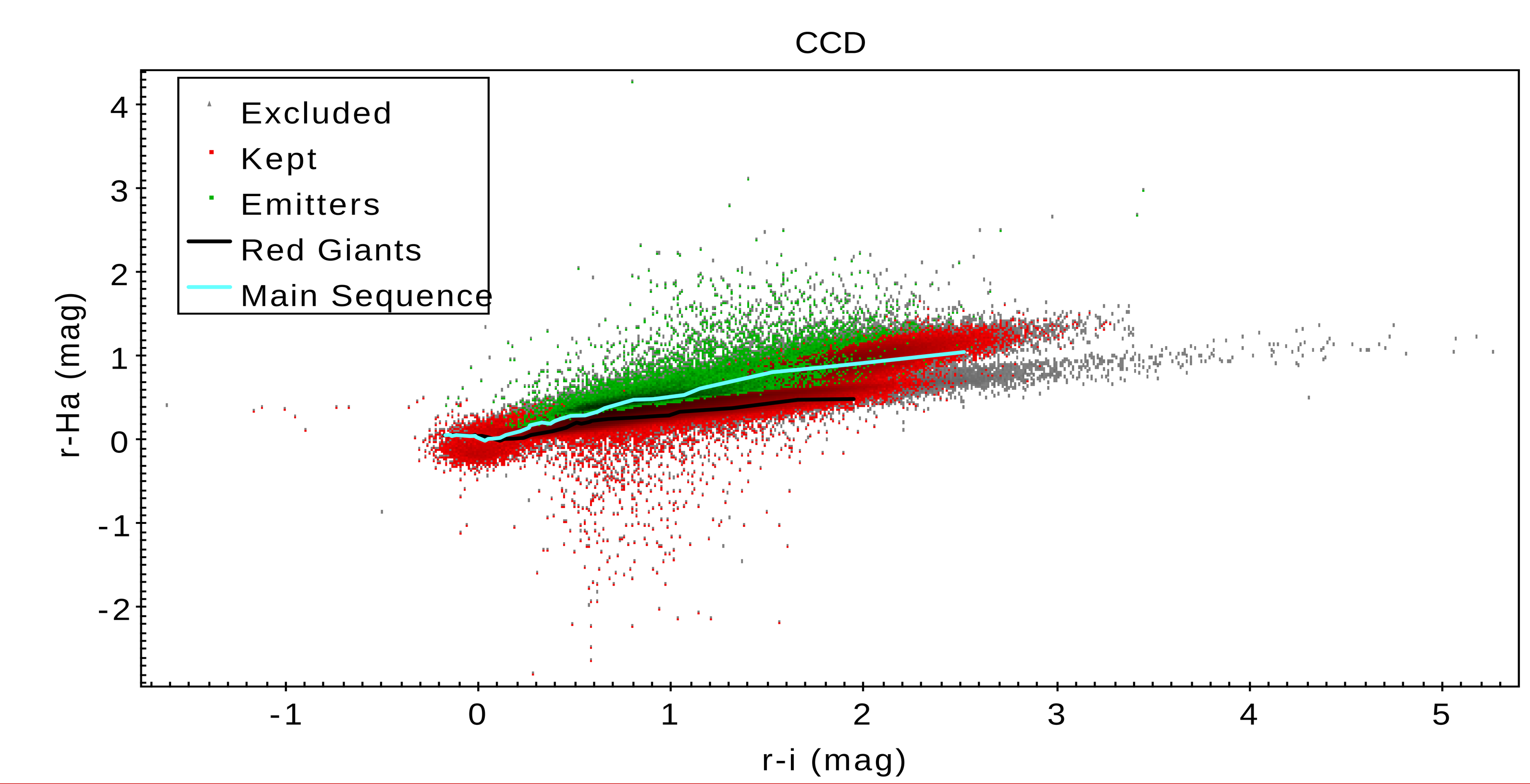




Data presentation

The data sample I used is the result of a cross-match between the IPHAS and the Gaia data. I could retain only the sources that satisfied the following criteria: 1) we had to have a valid measurement in each band of interest; 2) $f_c<0.98$ and $f_{fp}\leq0.02$ (as suggested by Scaringi et al. 2018); 3) the brightness had to be 0.5 mag higher than the saturation limit for each band.





Conclusions

I have developed a method to statistically identify the Hα emitters from a list of sources. I first partitioned the sources based on their position in the Color-Magnitude space, and I then detrended the data in each partition, in the Color-Color space. Finally, I Selected the outliers in the $(r\text{-}H\alpha)_{detrended}$ distribution by iteratively applying the Chauvenet's criterion.

Out of 7,373,236 objects, I identified 17,272 sources to be potential Hα emitters.

Future work

I have selected a subset of the most interesting sources from my list of emitters (i.e. the ones with a significance greater than or equal to 6). The next step will be to analyze their available spectra, to check whether my photometry-based identification algorithm is in fact effective. These spectra will come from an analysis of archival Gemini data, which is currently ongoing.