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HR diagram of Herbig Ae/Be stars and their infrared excesses

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Abstract. Herbig Ae/Be stars are Pre-Main Sequence objects of intermediate mass. It is expected that within their mass range, the transition between the magnetically controlled accretion process for low mass stars and the still unknown process for higher mass stars occurs. We have derived luminosities for 107 of these objects using TGAS parallaxes, thus allowing to place them in the HR diagram. The number of Herbig Ae/Be stars in the HR diagram with directly determined distances has increased by more than a factor of 5 with this study. We analysed the infrared excesses of the 107 Herbig Ae/Be stars and present an evolutionary analysis to be done in the future.

1. Construction of the HR diagram and infrared excesses

We have gathered the majority of Herbig Ae/Be stars known to date (254, see Chen et al. 2016). The cross-match of this set with TGAS resulted in 107 sources. For each star, we used an atmosphere model from Castelli & Kurucz (2004) of the appropriate Teff, log(g) and metallicity. By scaling it to the dereddened Johnson V band point, a luminosity could be obtained by means of the parallax (similar to van den Ancker et al. 1998). Luminosities were also derived for 73240 TGAS sources (taken from McDonald et al. 2012). These objects are plotted in the HR diagram in the top panel of Fig. 1.

The bottom panel of Fig. 1 presents a study of the infrared excess properties of this set of Herbig Ae/Be stars. The colour-colour diagram plots their mid-infrared WISE (W1-W4) colours, tracing cold dust, against the near-infrared J-K_s colour tracing hot dust and gas. Most A type stars have large J-K_s and mid-infrared colours indicating substantial excess emission due to dust. This is not obvious for the B type stars, which are more spread out in the diagram, while many of them have little excess. Some may be misclassified Be stars.

We plan to use the SEDs for studying the evolution of Herbig Ae/Be stars. Selecting several stars on the same Pre-Main Sequence track (see Fig. 1) provides a picture of the evolution of a Herbig Ae/Be star of that mass. Performing this for several masses will lead to a general understanding of the evolution of dust and gas around these objects.

2. Conclusions

We have produced the most complete HR diagram of Herbig Ae/Be stars to date. This work also illustrates our longer term project to search for new Herbig Ae/Be stars; for which

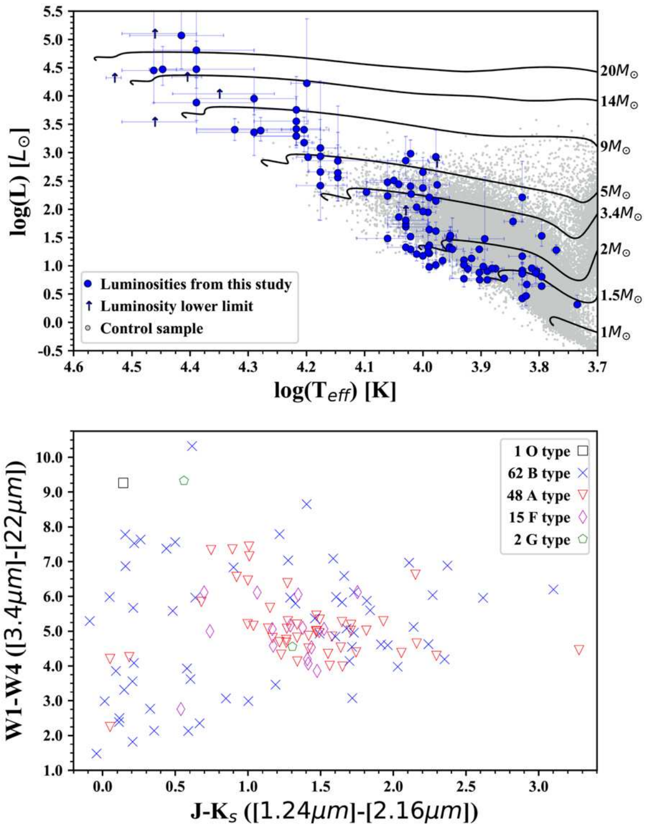

Fig. 1. *Top:* 107 Herbig Ae/Be stars in the HR diagram. Vertical error bars are dominated by parallax uncertainties. The Pre-Main Sequence tracks are from Bressan et al. (2012, MNRAS, 427, 127). By picking sources on the same Pre-Main Sequence tracks we can study how the SEDs evolve. *Bottom:* Infrared colour-colour diagram. Note that most A stars have significant infrared excess.

the study of already catalogued ones constitutes the first logical step.

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