Homogeneous study of Herbig Ae/Be stars from spectral energy distributions. Disk clearing by photoevaporation

J.Guzmán-Díaz, I. Mendigutía, B. Montesinos et al.

Herbig Ae/Be (HAeBes) stars are young (≤ 10 Myr), optically visible pre main-sequence stars with emission lines in their spectra, typical spectral types A and B, stellar masses usually ranging between ~ 2 and ~ 10 $M_{\odot}$, and infrared excesses associated to circumstellar disks. HAeBes are important as their properties bridge the gap between low-mass T Tauri stars and embedded Massive Young Stellar Objects.

We have contributed to the study of the HAeBe regime by providing a homogeneous characterization of the stellar and circumstellar properties of the largest sample of HAeBes based on complete Spectral Energy Distributions (SEDs) from multi-wavelength photometry and Gaia distances. We have carried out a statistical analysis which main result is that different physics probably drives disk evolution of late-type Herbig Ae (HAe) and early-type Be (HBe) stars.

1. Context of the research

Herbig Ae/Be stars have been usually studied from relatively small samples scattered in the sky. Their fundamental stellar and circumstellar properties have been derived from relatively heterogeneous approaches and techniques until Gaia.

Recent works in Vioque et al. (2018; Fig. 1) and Wichittanakom et al. (2020) are major steps towards a uniform characterization of HAeBes, and we build on their results.

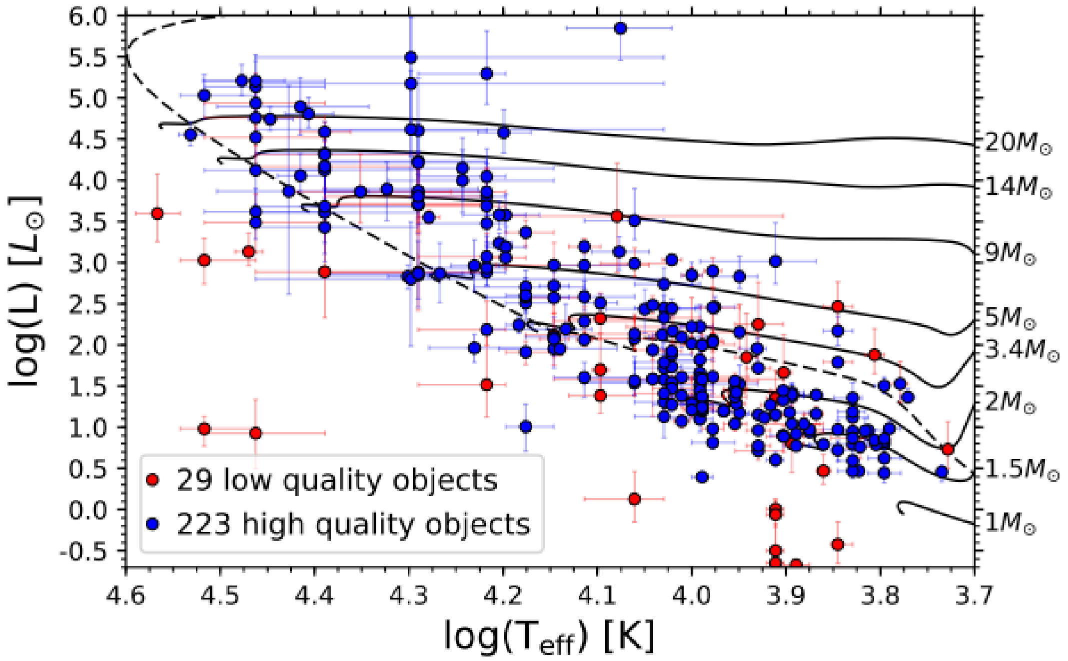

Figure 1: HAeBes placed in the HR diagram by Vioque et al. (2018) using Gaia DR2 parallaxes. We based our work on this sample of HAeBes, characterizing their stellar and circumstellar properties from SED analysis of multi-wavelength photometry.

2. Description of the work

Compiling multi-wavelength photometry for 212 bonafide HAeBe stars with Gaia DR2 distances, we characterized their stellar and circumstellar properties using *VOSA* (Virtual Observatory SED Analyzer).

- Photospheric models have been fitted to their Spectral Energy Distributions (Fig. 2).

- The circumstellar properties have been also studied: infrared excess characterizacion, accretion rates, disk masses and sizes of the dust inner holes.

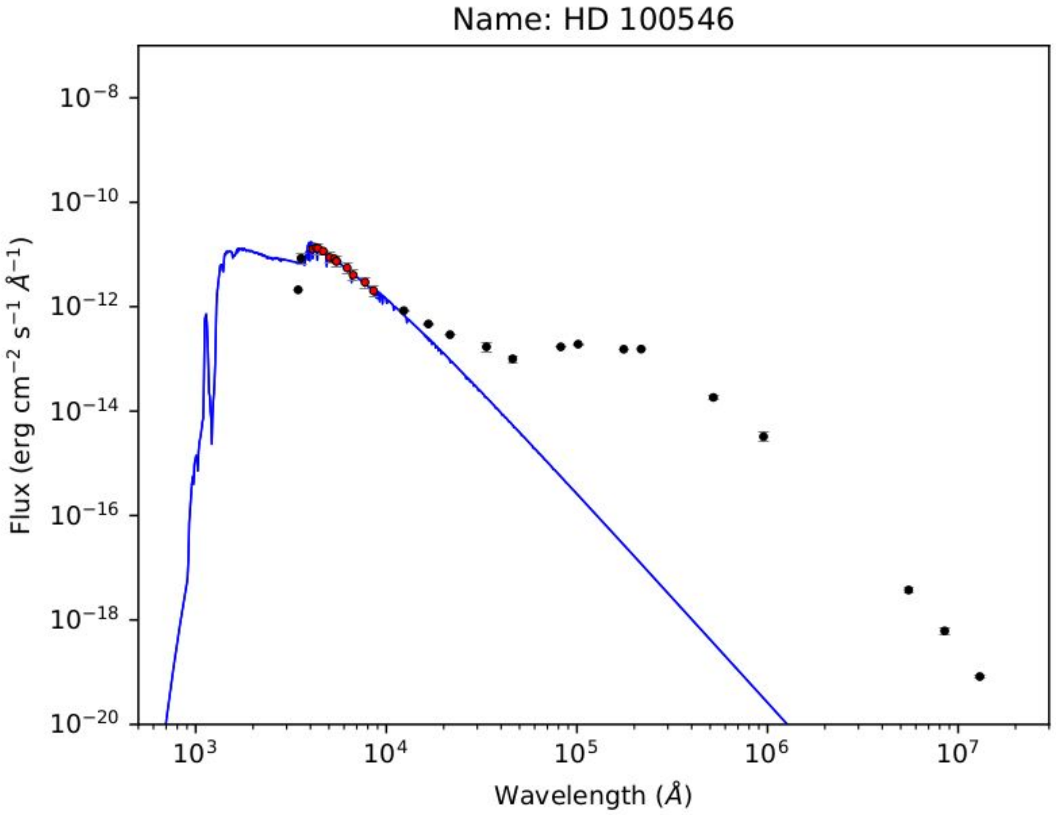

Figure 2: SED of HD 100546. The blue solid line corresponds to the best stellar photospheric model that fits the deredenned optical photometry (red dots).

1) Our statistical study does not support relatively recent claims pointing to a connection between the Meeus' Group I sources and transitional disks (Fig. 3), when these are defined as those sources with IR excesses starting at the K-band or longer wavelengths. In turn, such sources have associated larger dust inner holes and are more frequent in early type HBes than in late type HAes.

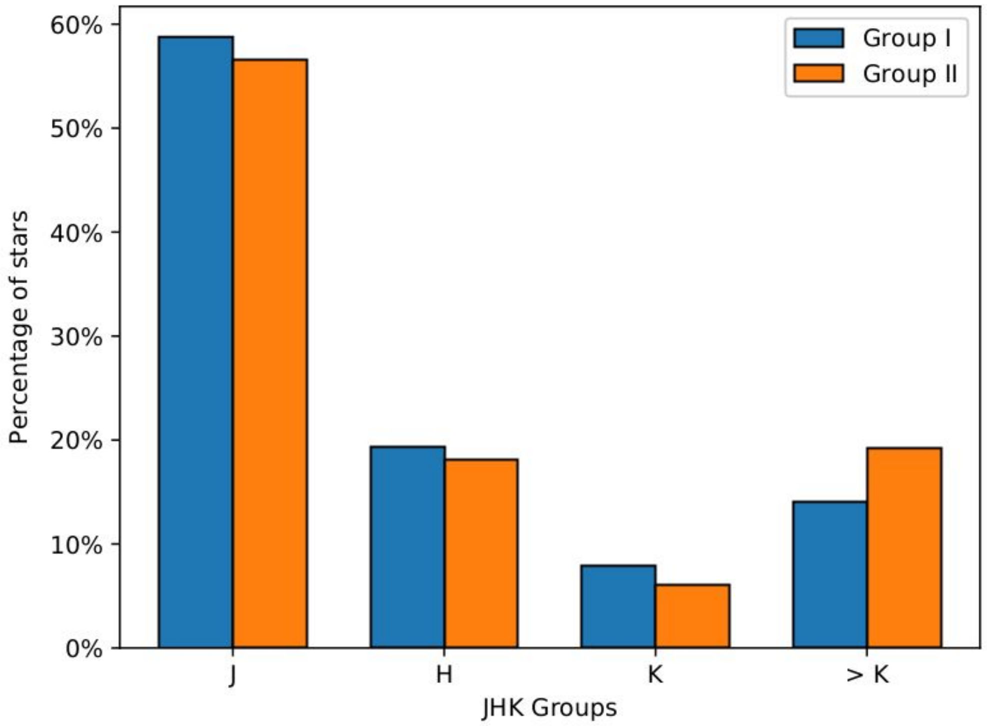

Figure 3: Distributions of the JHK and Meeus groups, as indicated in the x-axis and the legend. HAeBes belong to the J, H, or K groups if the shortest wavelength where the IR excess is apparent corresponds to the these near-IR bands (1.24, 1.66, and 2.16 μm, respectively), and to group > K if the IR starts at λ > 2.16 μm.

3. Results

2) We provide compelling evidence suggesting that photoevaporation is the main mechanism driving disk dissipation in HBes, but not in lower-mass HAes (Fig. 4).

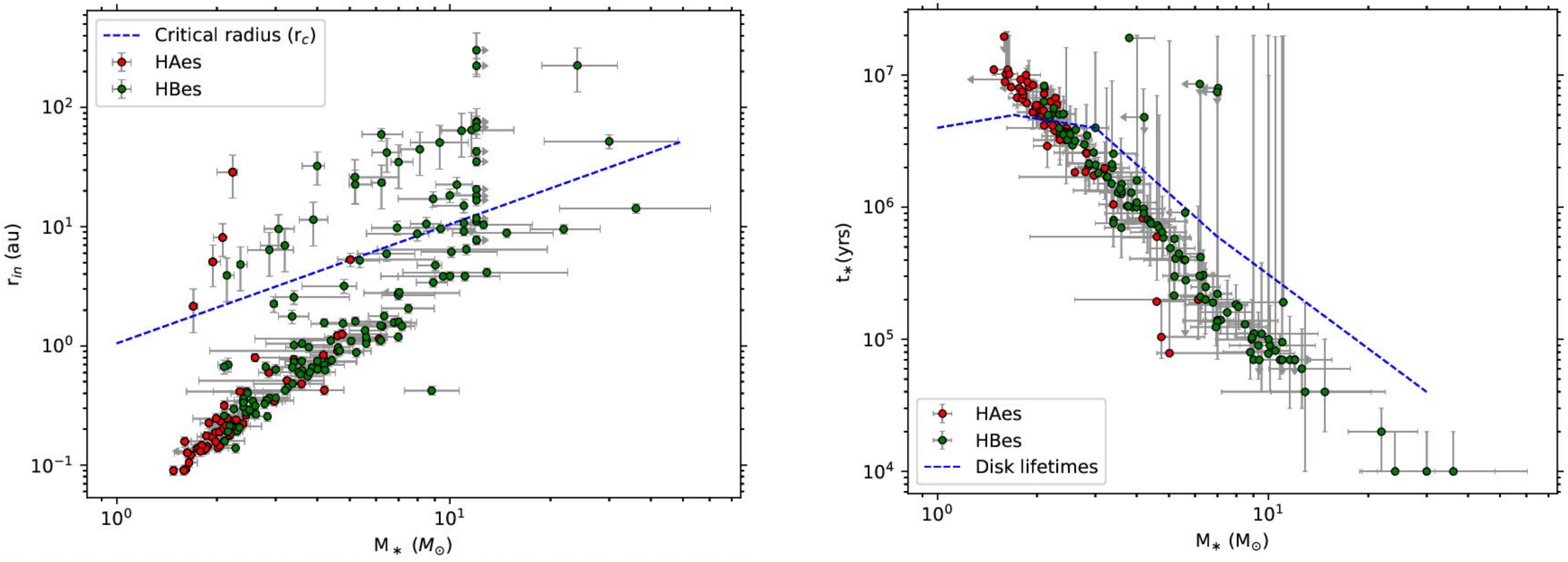

Figure 4: Sizes of the dust inner holes (left) and stellar age (right) as a function of the stellar mass for HAes and HBes.. The blue dashed lines represent the critical radius (distance from the star from which a gap opens due to photoevaporation; left), and the disk lifetime as expected from photoevaporation (right). Both plots show that the sizes of the inner holes and the ages of many HBes are consistent with photoevaporation, which is not the case for most HAes.

4. Impact and prospects for the future

- All data will be collected in an online archive of HAeBes, which will be updated to include new HAeBes. This constitutes a unique tool for the study of such type of objects.

http://svo2.cab.inta-csic.es/projects/harchibe/

- SED analysis with VOSA is a complementary tool for the future characterization of thousands of newly identified HAeBe candidates (Vioque et al. 2020).