Revisiting disk demographics in the emerging paradigm of MHD disk winds

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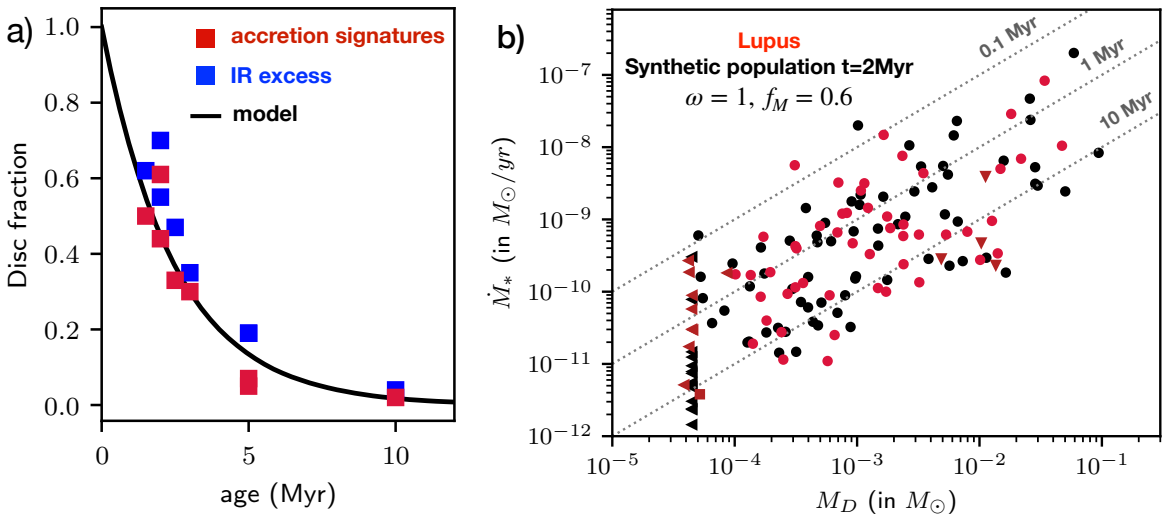
The final architecture of planetary systems depends on the extraction of angular momentum and mass-loss processes of the disks in which they form. Recently, there has been a growing recognition that magnetic outflows launched from disks (aka ”MHD disk-winds”) could control the extraction of angular momentum (e.g., Béthune+2017, Lesur+2021). If so, planet formation would be profoundly impacted as wind-driven accretion can enhance the growth rate of planetary cores, affect the migration pattern of forming planets, and control disk dispersal. However, the presence of MHD disk-winds remains an open question.

Now, near-complete surveys of multiple star-forming regions with ALMA and VLT provide us with an unprecedented statistical sample of stellar masses, mass accretion rates, and disk (dust) masses that can be used to test disk evolution models. In this contribution, we analyze these data from the new vantage point of wind-driven accretion. The paradigmatic viscous model of Shakura-Sunyaev is extended to include MHD disk-winds (Tabone+2022a), and a synthetic disk population approach is developed to compare our model to the recent surveys of star forming regions. We show for the first time that wind-driven accretion can naturally explain disk dispersal and the observed correlation between accretion rates and disk masses (Tabone+2022b, see figure below). We will finally discuss the new avenues opened by our ALMA large program AGE-PRO that will give access to the secular evolution of disk (gas) sizes and improve our estimates of disk total masses. This work constitutes a first step toward the construction of realistic planet formation models in the emerging paradigm of MHD disk-winds.



MHD wind-driven accretion models (black) compared to the observed disk demographics (red and blue). Our synthetic disk population model based on new disk evolution solutions (Tabone+2022a) reproduce disk dispersal, as unveiled be the decline of disk fraction with cluster age (panel a)), and observed correlation between stellar accretion rates and disk masses recently unveiled by VLT and ALMA surveys of the Lupus star-forming region (red dots, Tabone+2022b). Note that our simple model reproduces the large scatter in the correlation, a feature that is difficult to reconcile with viscous accretion.