Disk evolution in the solar neighborhood

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To better understand...

1) evolution of protoplanetary disks
2) formation of exoplanets

We have...

1) ...studied outer regions of planet-forming disks with the Herschel Space Telescope (Ribas et al. 2013a, A&A, 552, A115)
2) ...compiled a lot of information to study disk evolution coherently (Ribas et al. 2013b, in press)
Evolution of protoplanetary disks

- Protoplanetary disk
- Transitional disk
- Debris disk
Herschel data allows to discard/reclassify transitional disk candidates

Designed a new method to identify transitional disks

Transitional disks in Chamaeleon are brighter than protoplanetary disks at PACS wavelengths

We have built a large and homogeneous database...

2340 sources in 22 star-forming regions:
- close (<400pc)
- young (<100Myr)

One order of magnitude larger than previous studies!
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Spectroscopical spectral type
From O to M stars

30%!!
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Quality-check process
- Astrometry
- Photometry from 8 surveys
- Visual inspection of each Spectral Energy Distribution

From optical to mid-IR: 35 photometric bands!
…that can be used to study the evolution of the disk at different radii

- Colder range: 3.5-4.5 microns (~1 AU)
- Intermediate range: 8-12 microns (~5 AU)
- Long range: 22-24 microns (~20 AU)
Evidence of inside-out disk dispersal

~1 AU

~5 AU

Fraction (%)

3.4–4.6 μm
Short

8–12 μm
Intermediate

Age (Myr)

Ribas et al. 2013b, in press
Protoplanetary disks disappear at 10 Myr, and only debris disks are found after that.

How many disks?

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Ribas et al. 2013b, in press
We will continue exploiting the database in the future.

Other dependencies?
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Other dependencies? + Herschel data
We will continue exploiting the database in the future

Other dependencies? + Herschel data + Modeling
ALL 786 KNOWN PLANETS TO SCALE

(46 of June 2022)

SOME PLANET SIZES ESTIMATED BASED ON PRESS.

THIS IS OUR SOLAR SYSTEM.

THE REST OF THESE ORBIT OTHER STARS AND WERE ONLY DISCOVERED RECENTLY.

MOST OF THEM ARE HUGE BECAUSE THOSE ARE THE KIND WE LEARNED TO DETECT FIRST, BUT NOW WE'RE FINDING THAT SMALL ONES ARE ACTUALLY MORE COMMON.

WE KNOW NOTHING ABOUT WHAT'S ON ANY OF THEM WITH BETTER TELESCOPES, THAT WOULD CHANGE.

THIS IS AN EXCITING TIME.
Extra slides
Transitional disk identification

![Graph showing spectral energy distribution for SZ Cha with logarithmic axes for wavelength and flux density. The graph includes data points and fitted lines to illustrate the spectral characteristics of the disk.]
Astrometric curation process
Excess definition

\[ \chi_\lambda = \frac{F_{\text{observed}} - F_{\text{photosphere}}}{\sigma_{\text{Total}}} \]

\[ \sigma_{\text{Total}} = \sqrt{(\sigma_{\text{Observed}})^2 + (\sigma_{\text{Calibration}})^2} \]

If \( \chi_\lambda > 5 \) \quad \text{excess!}