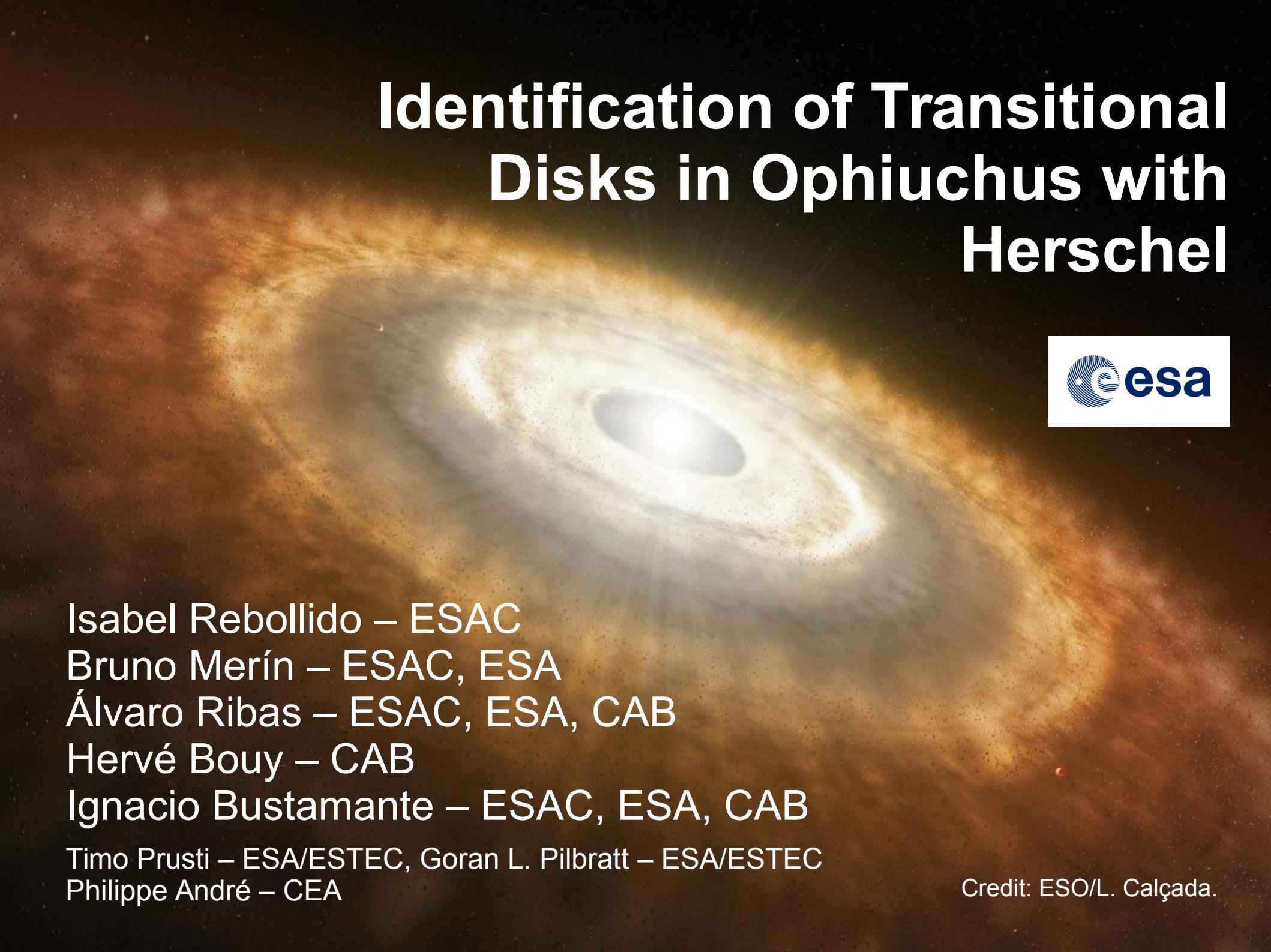


# Identification of Transitional Disks in Ophiuchus with Herschel



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Hervé Bouy – CAB

Ignacio Bustamante – ESAC, ESA, CAB

Timo Prusti – ESA/ESTEC, Goran L. Pilbratt – ESA/ESTEC

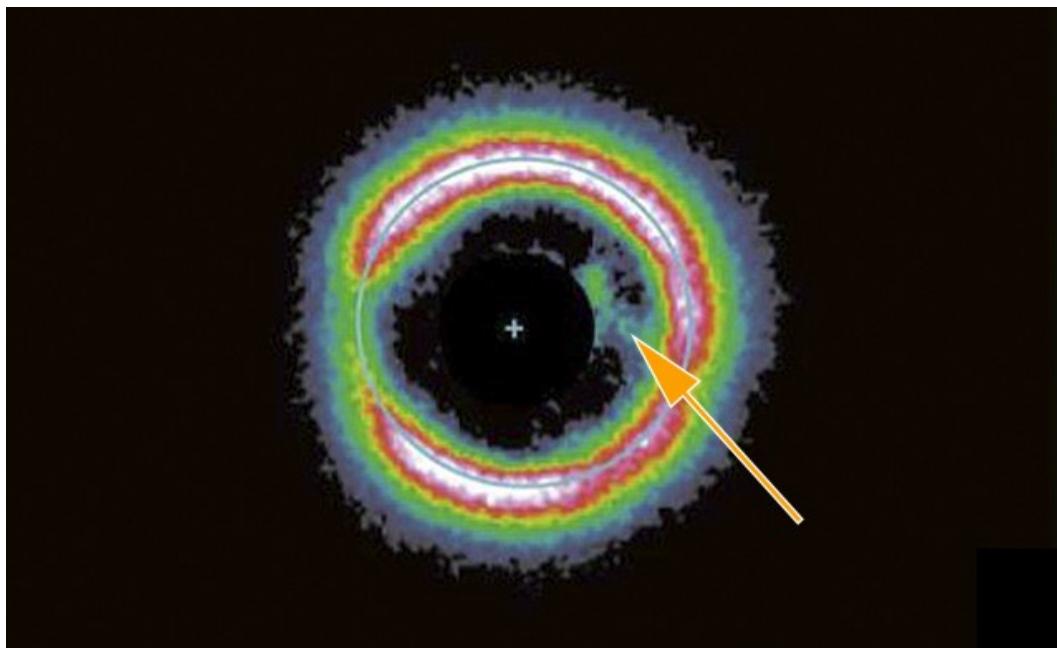
Philippe André – CEA

Credit: ESO/L. Calçada.

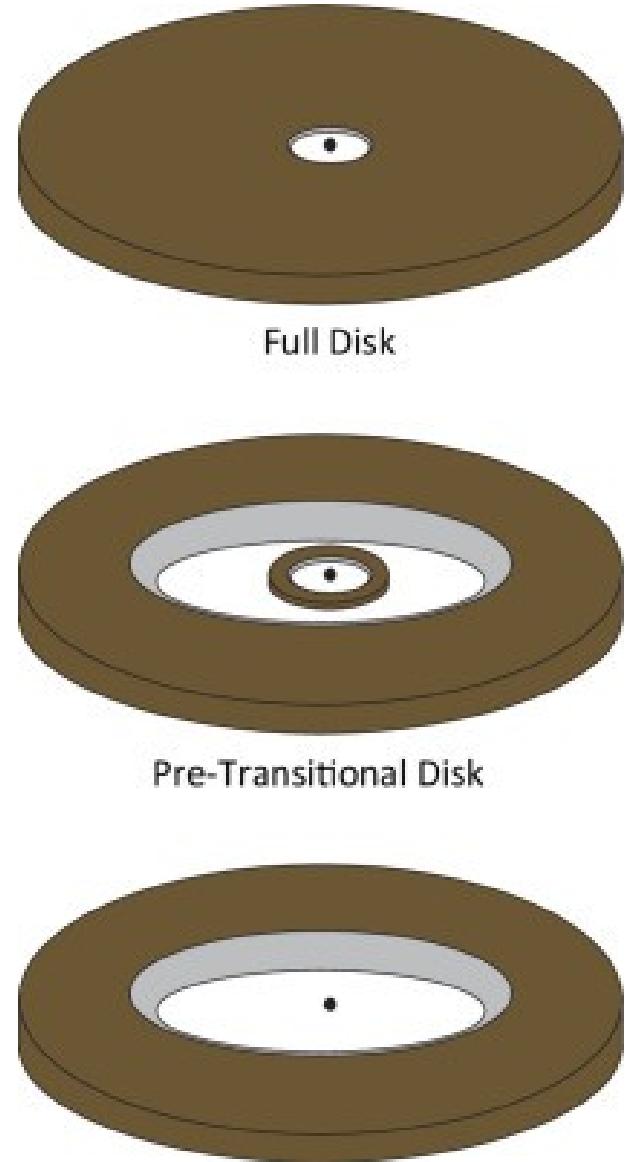
**What are transitional disks?**

Disks around young stars which have inner gaps, probably due to:

- Companions
- Strong stellar winds
- Forming planets



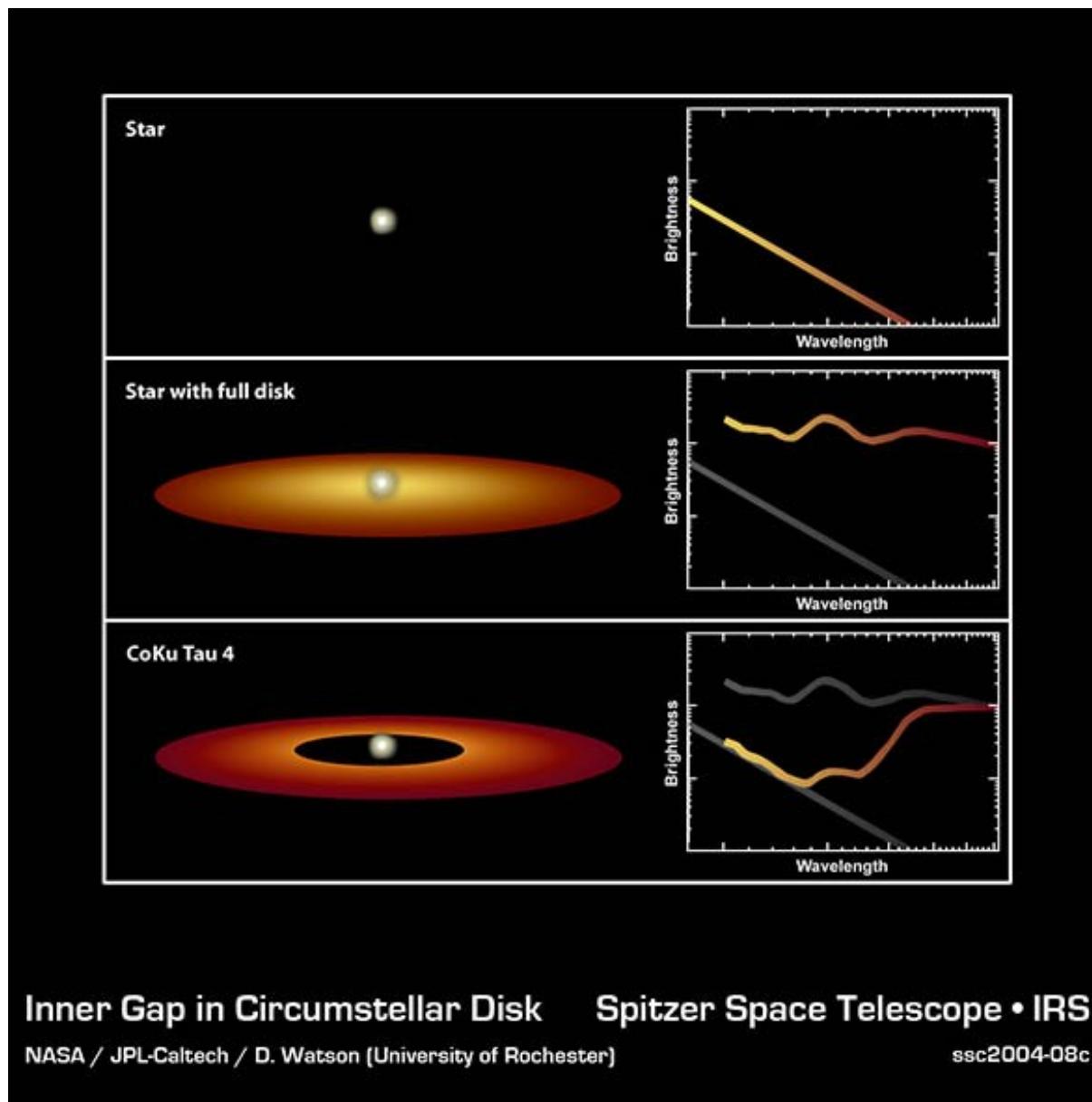
Mayama et al. (2012)



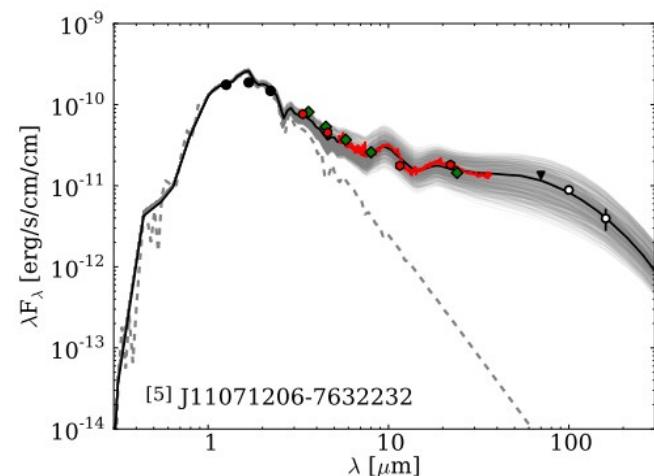
Espaillat et al. (2014)

# **How do we identify them?**

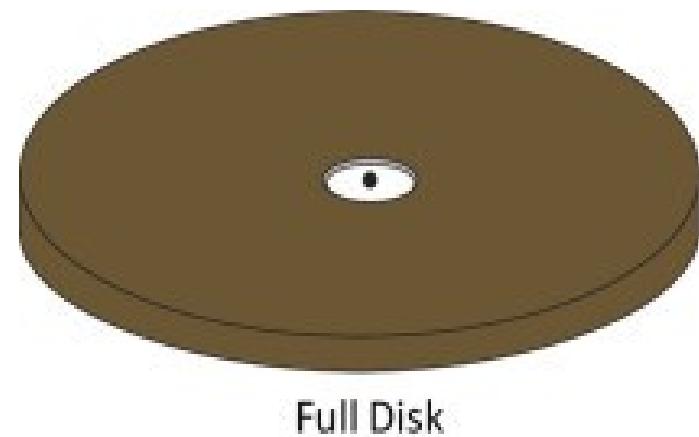
# Spectral Energy Distribution



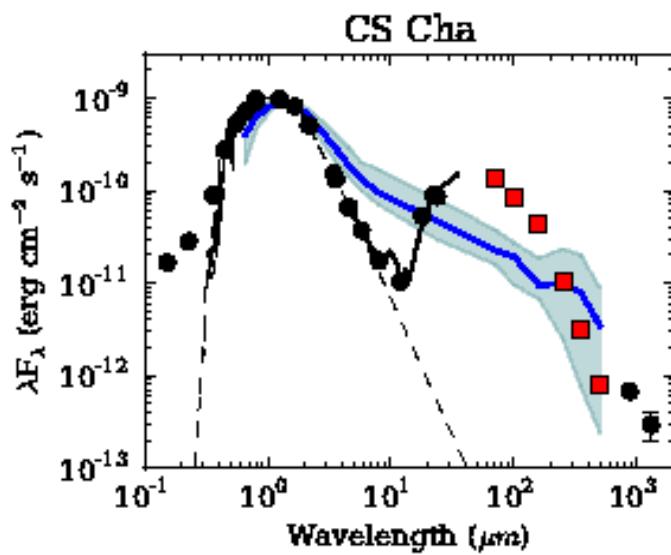
## Spectral Energy Distribution



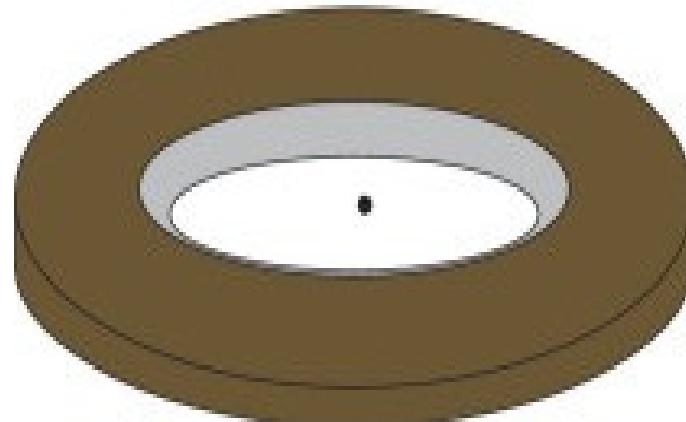
Olofsson et al. (2013)



Full Disk



Ribas et al. (2013)

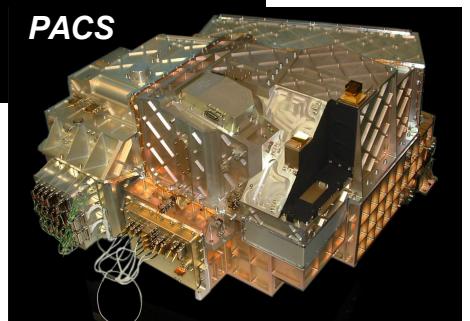
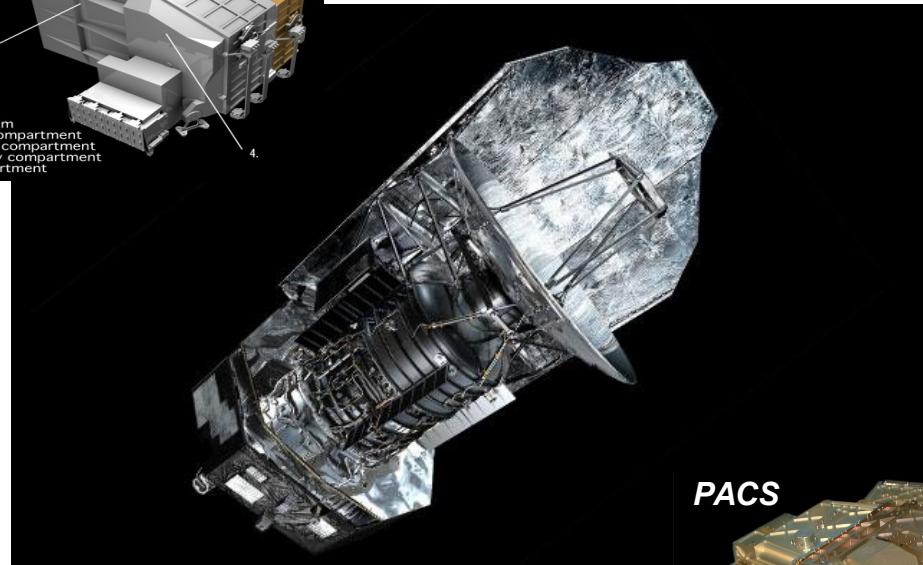
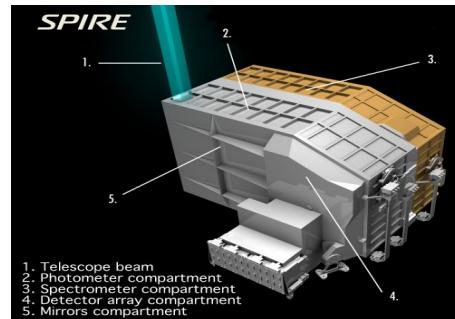


Transitional Disk

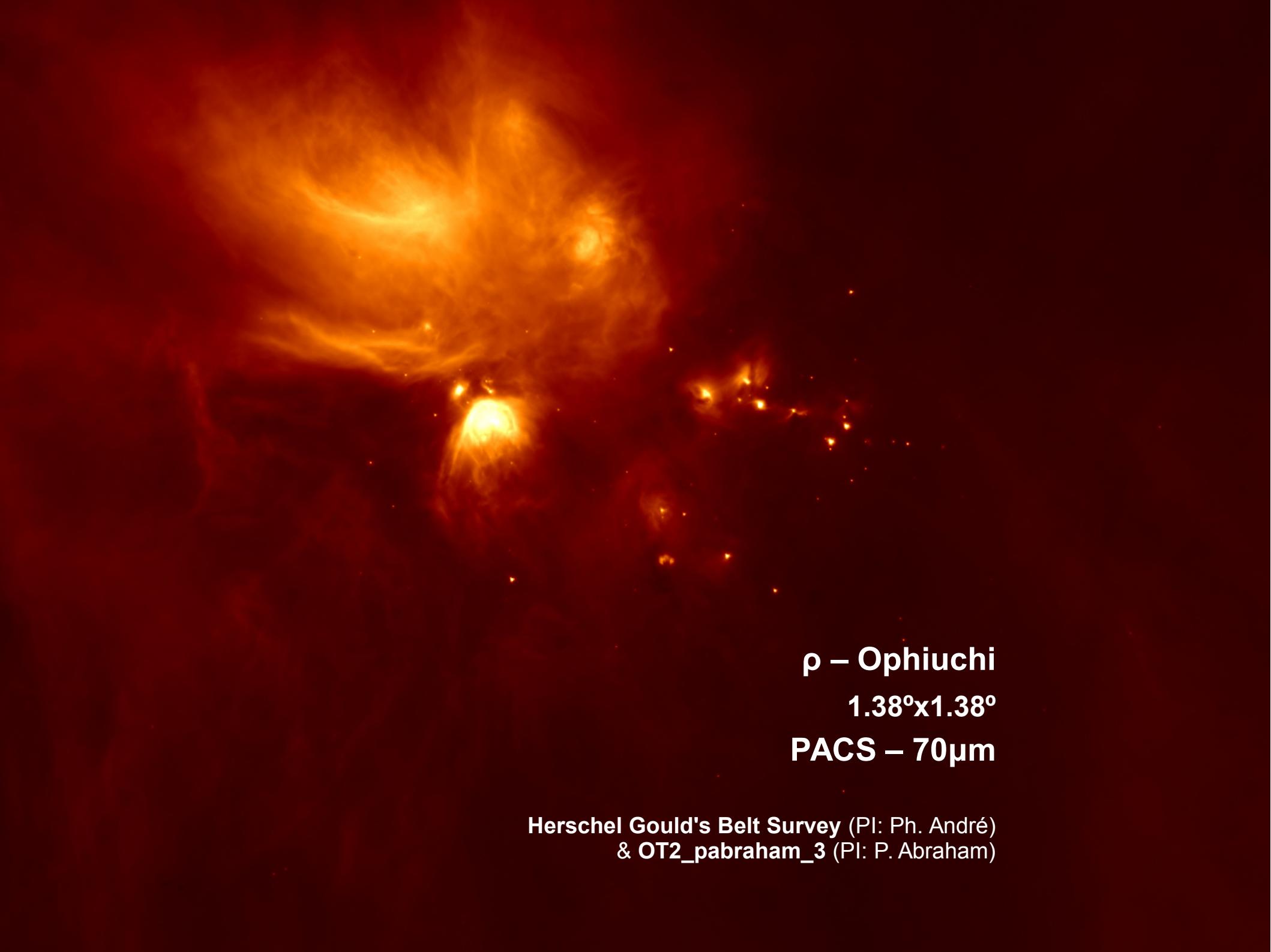
# **How do we detect them?**

## Herschel Space Observatory (2009-2013)

- 3.5 m mirror
- Covered from 55  $\mu\text{m}$  to 670  $\mu\text{m}$
- Carried
  - SPIRE
  - PACS
  - HIFI



Imaging Instruments	PACS	SPIRE
Wavelengths( $\mu\text{m}$ )	70, 160	250, 350, 500



**ρ – Ophiuchi**  
**1.38°x1.38°**  
**PACS – 70μm**

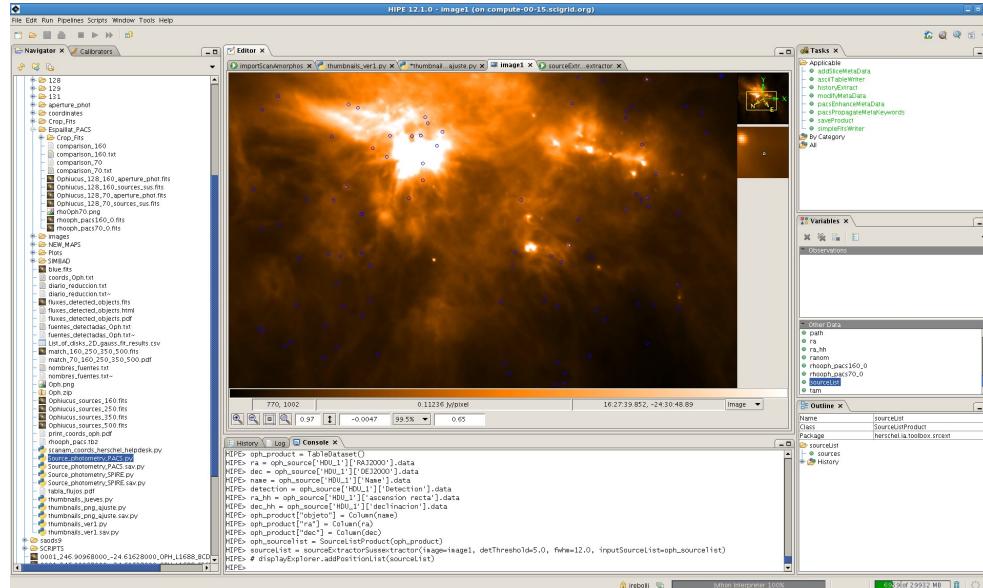
**Herschel Gould's Belt Survey (PI: Ph. André)**  
**& OT2\_pabraham\_3 (PI: P. Abraham)**

**How do we find them?**

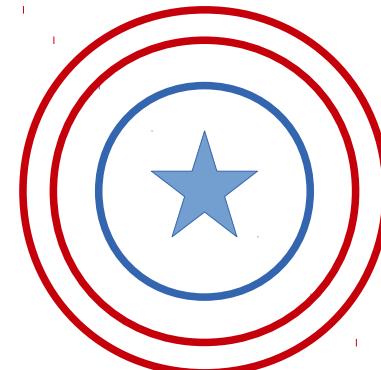
**HIPÉ** (*Herschel Interactive Processing Environment*)

Python-based analysis software specifically designed for Herschel data analysis

## 1) Source extraction

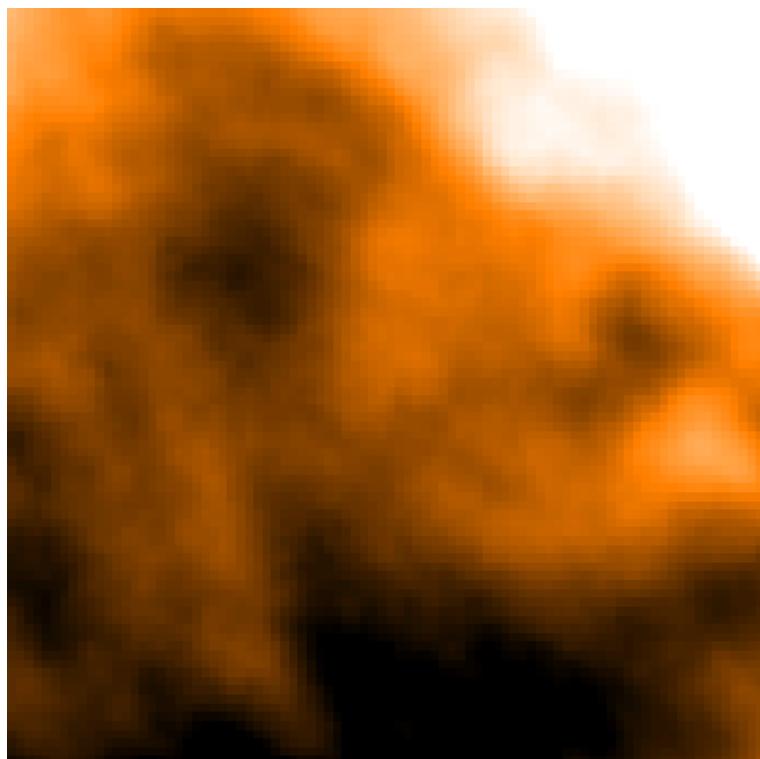


## 2) Aperture Photometry

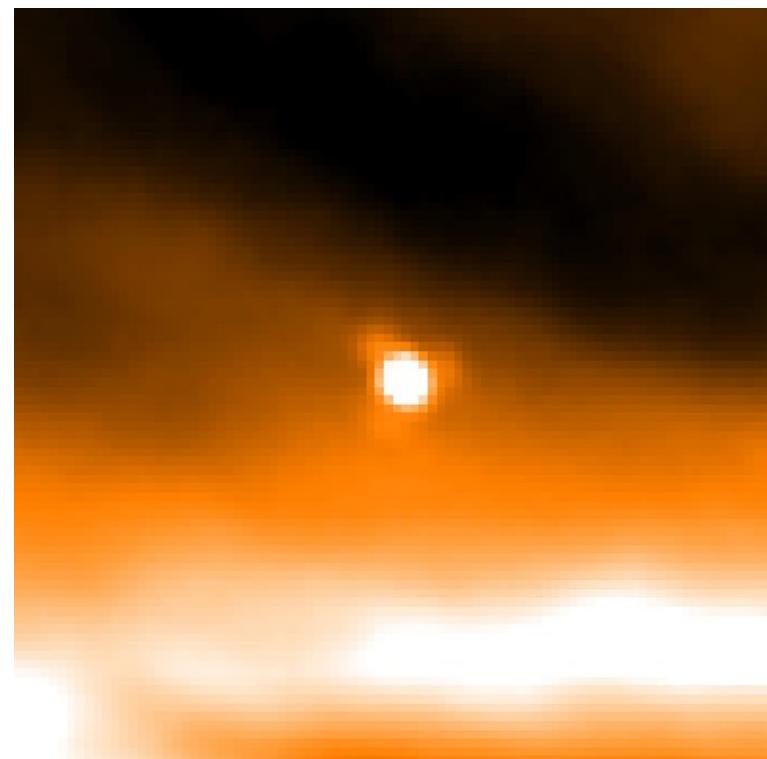


	Total (Jy)
Target	1.693829e+01
Background	1.420138e+01
Target (bg subtr)	7.595771e+00

### 3) Visual inspection

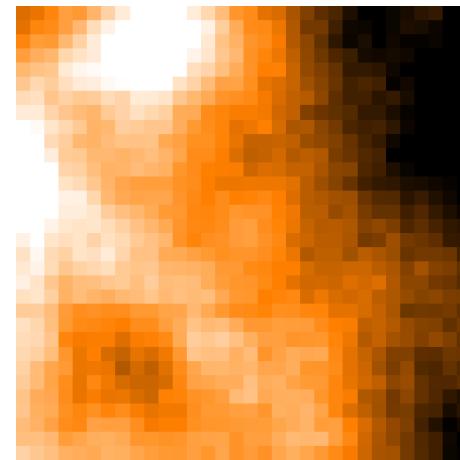
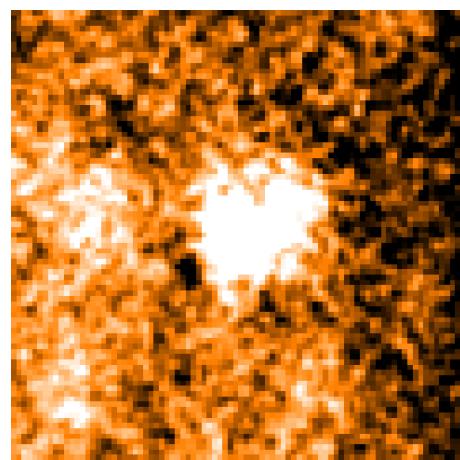
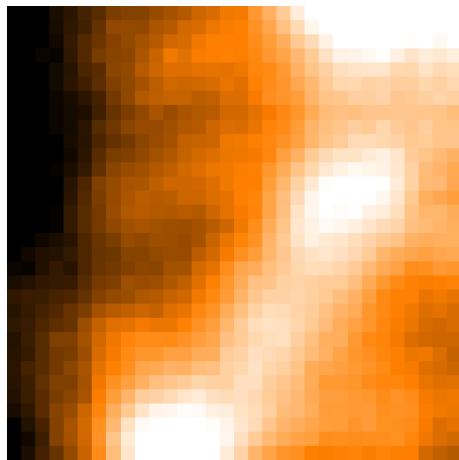
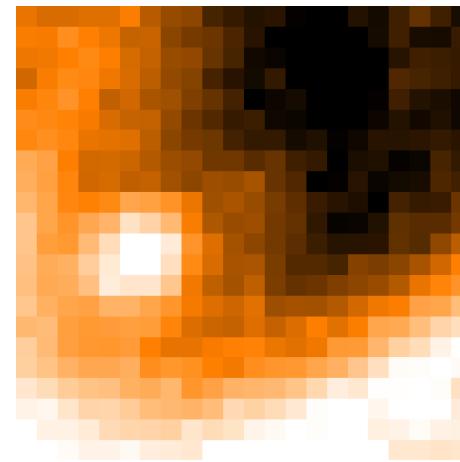
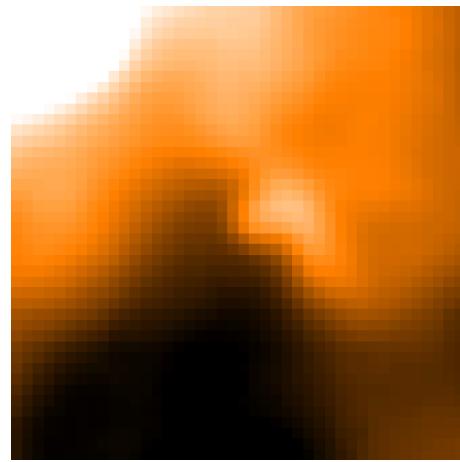
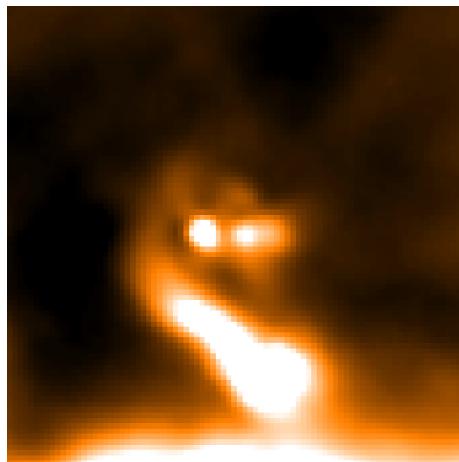


False Positive



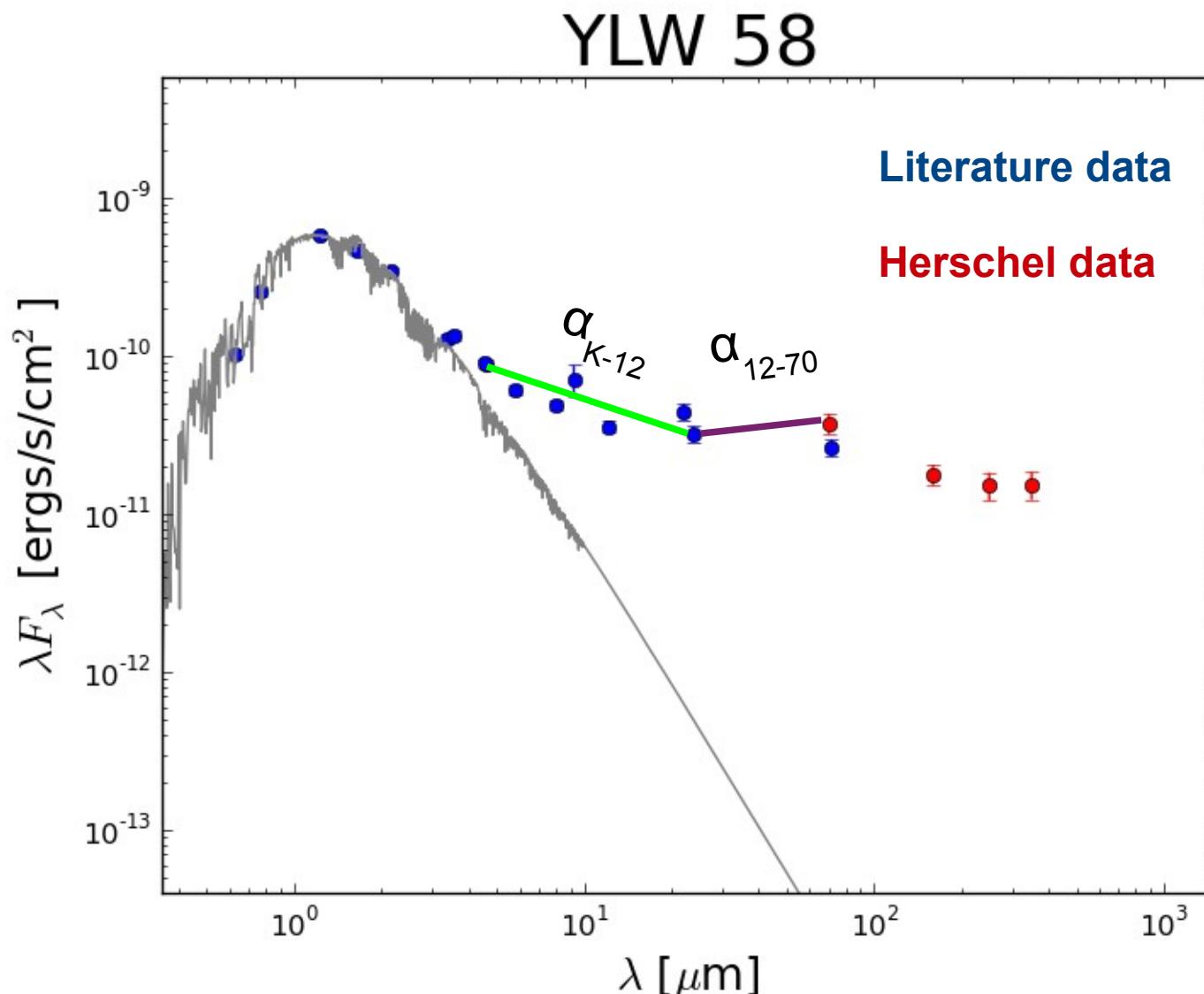
Good detection

### 3) Visual inspection

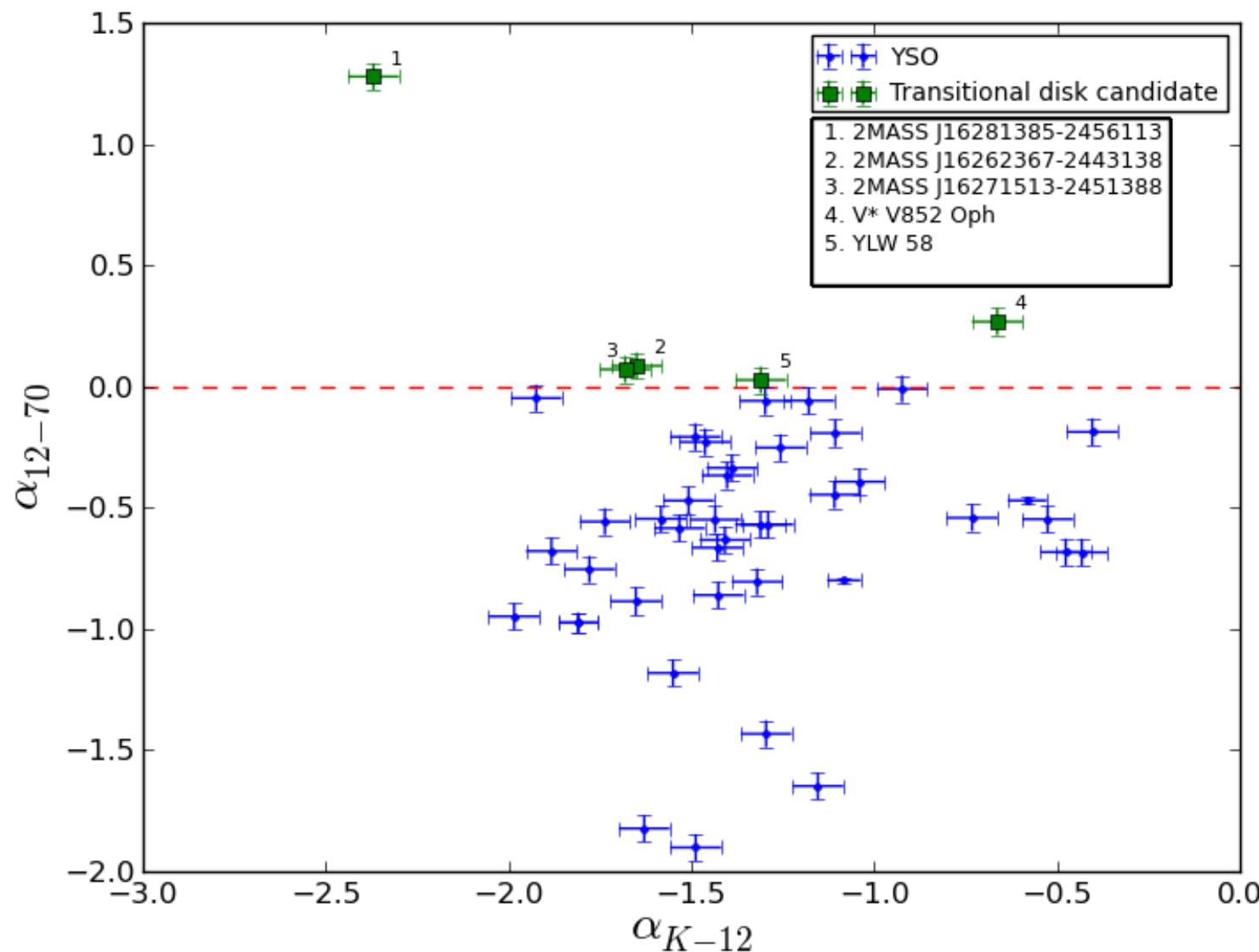


**Which ones are transitional?**

Applying the method described in Ribas et al. (2013)



## Applying the method described in Ribas et al. (2013)

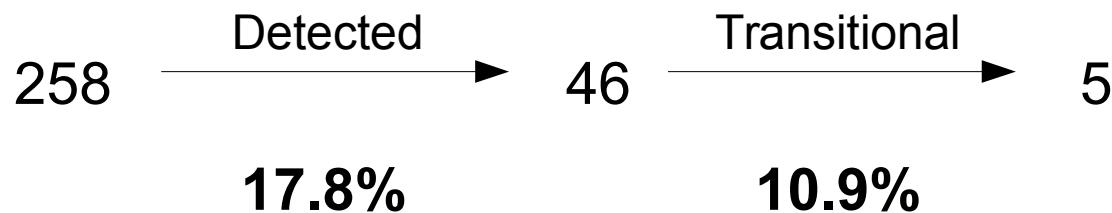


Results to be published in Isabel Rebollido et al. (in prep.)

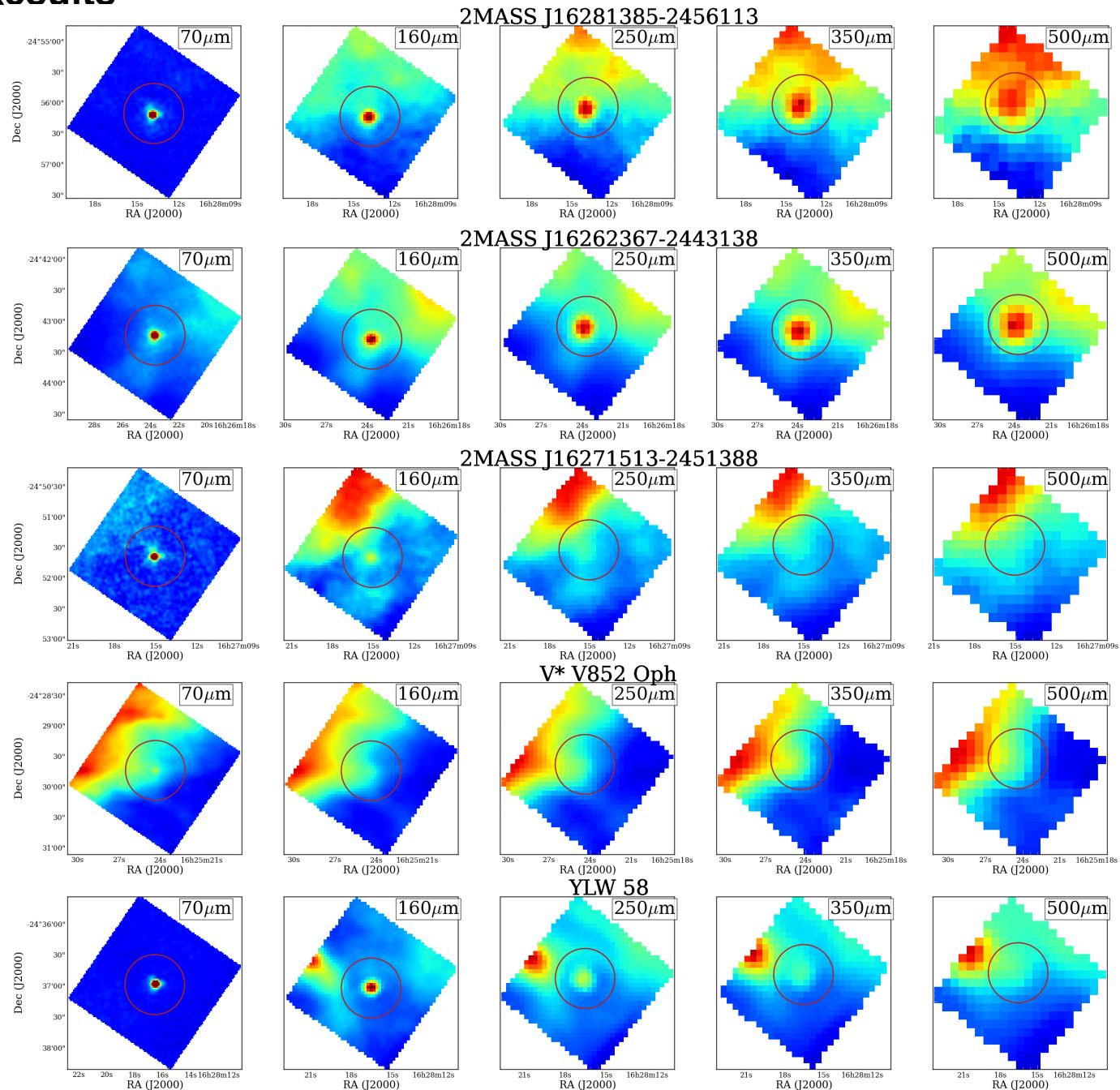
## Analysis Results

Number of detected sources per band				
70 µm	160 µm	250 µm	350 µm	500 µm
46	25	17	15	9
17.8%	9.7%	6.6%	5.8%	3.5%

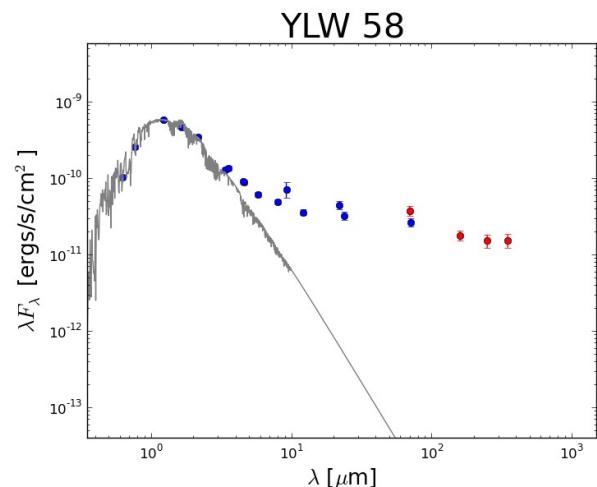
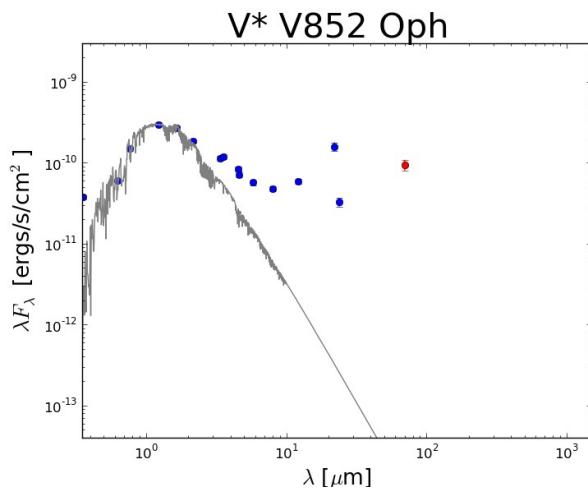
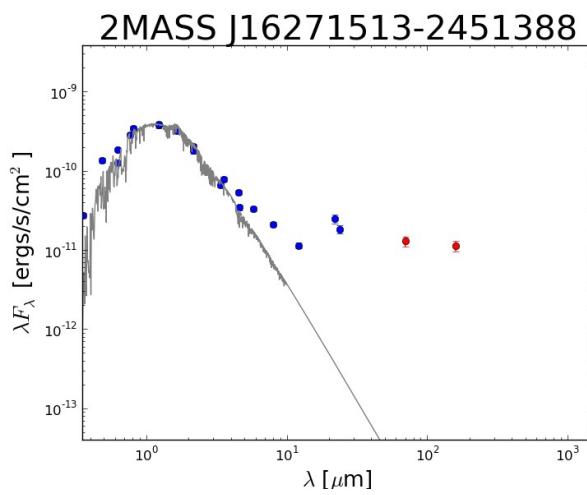
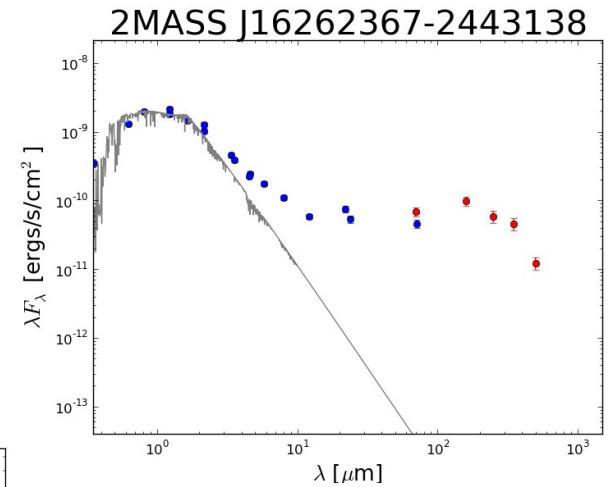
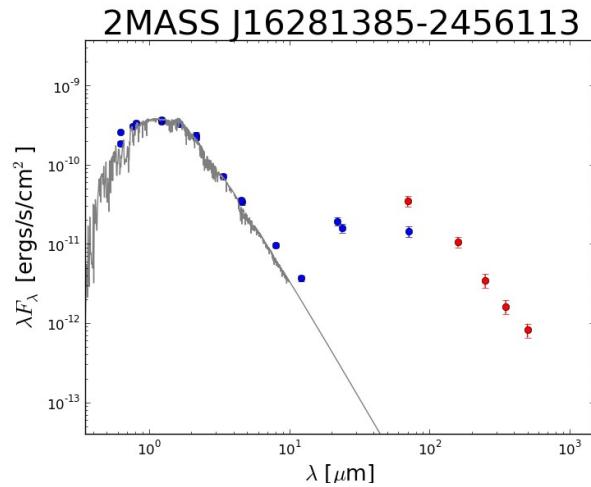
From **258** initial objects, we detected **46** objects in at least one Herschel band, and from those, **5** of them fulfil the criteria to be considered as transitional disks.



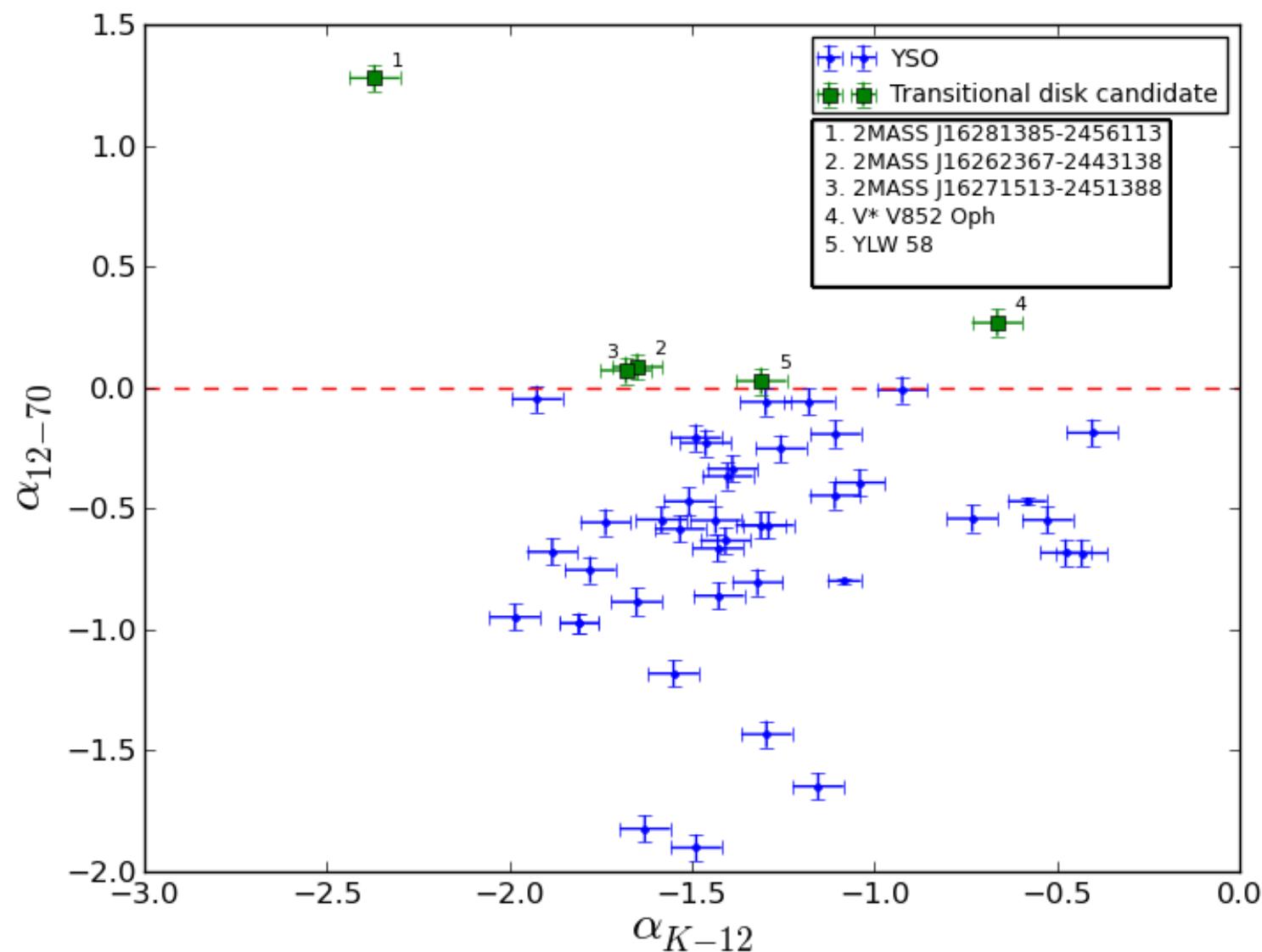
# Analysis Results



# Analysis Results



## Analysis Results



## Summarizing

- We have found **46 disks** from an initial list of 258 in the region of ρ – Ophiuchi in at least one band with Herschel data.
- **Five** of them fulfil the criteria to be considered transitional disks.
- All of them are new to the literature.
- Herschel data has been proved to be very useful to complete SEDs in the range of mid-infrared.



**Thanks for your attention!**