The VLTI/PIONIER Survey of Southern TTauri stars

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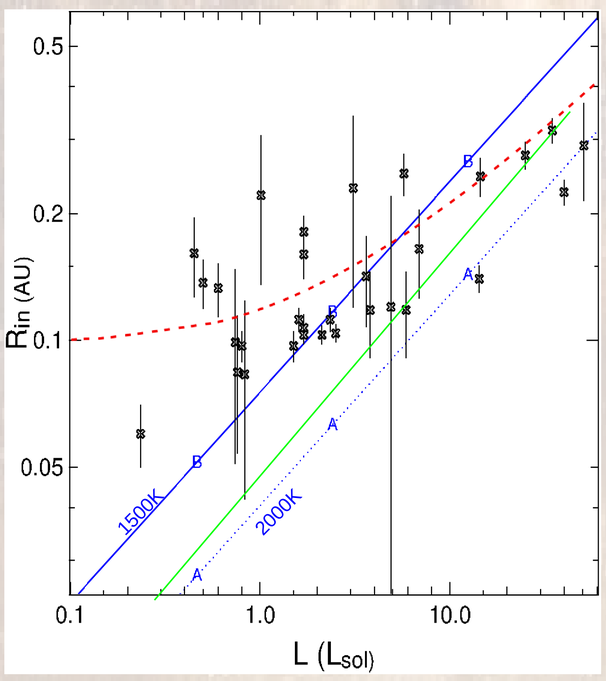
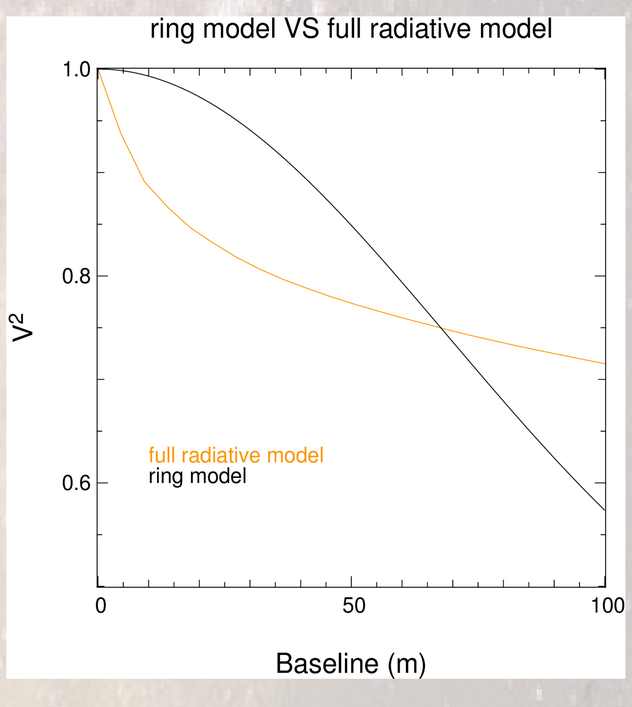
BEFORE

- The early interferometers had a limited number of baselines and limited sensitivity. Data sets were rare for young stars, except for the Herbig AeBe stars. Simple geometrical model were used to fit the data t(e.g., the ring model)
- The ring model is based on the assumption that all the NIR emission comes from the hot inner rim. **Calculated inner rim radii** deviate from the expected correlation between **sublimation radius vs luminosity** for lower luminosity T Tauri stars.
- Pinte et al 2008 argued that **light scattering** is important (sometime dominant) for lower luminosity stars.
- Taking scattered light into account yields inner rim radii that are coherent again with the expected sublimation radius vs luminosity correlation.
- A interesting observable of light scattering is a rapid decrease of visibilities at short baselines (a « drop-off » as can be seen in the figure below). Detecting such drop-offs requires a good u-v coverage (baseline length).





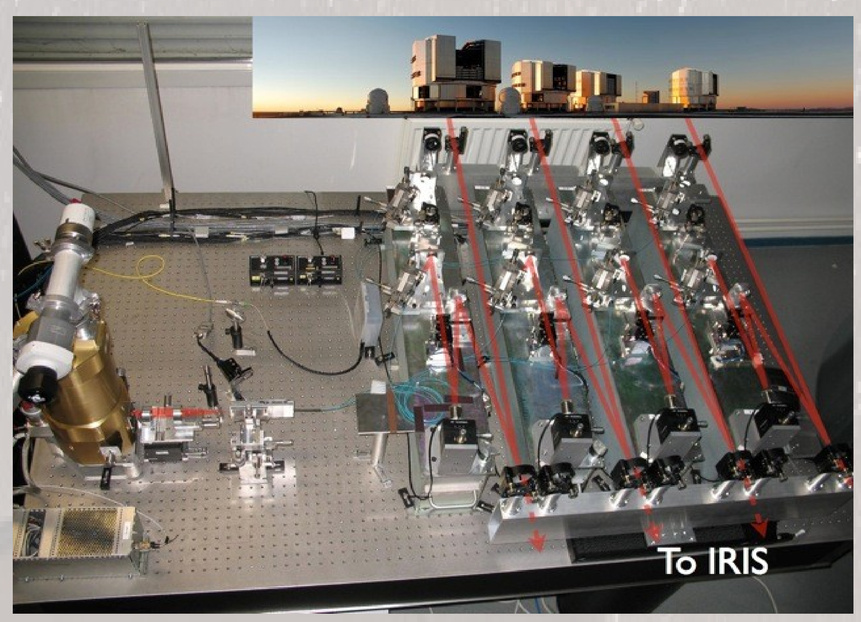
OUR SURVEY WITH THE PIONIER RECOMBINER

The instrument:

- PIONIER is a 4-telescope combiner interferometric instrument which can work with the 1,8m relocatable Auxiliary Telescopes (4) or the 8m Unit Telescopes of the VLT or VLTI arrays.
- It provides 6 simultaneous baselines measurements + 3 independant closure phases)per observation.
- It is a sensitive instrument, able to observe objects down to H=8.5 with the ATs.

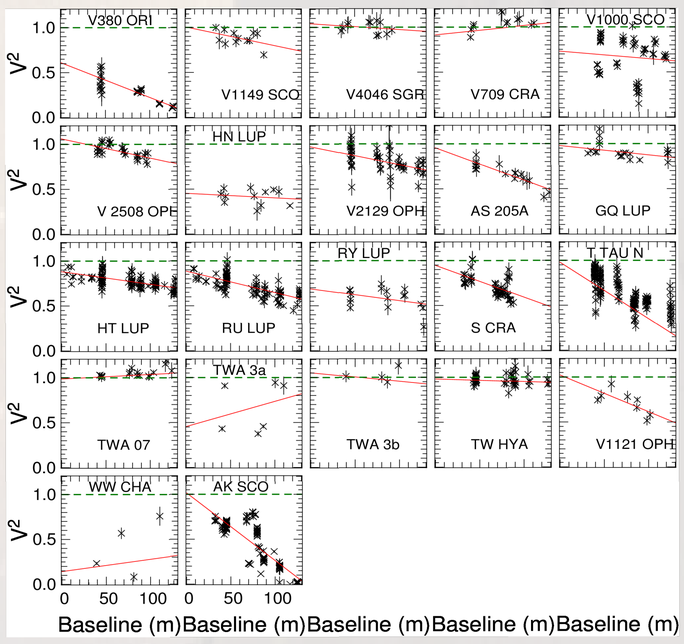
The survey:

- We observed 22 Ttauri star up to Hmag=8.5 with the ATs during 17 nights in long baseline configuration, and 7 in compact configuration (we lost 6/17 and 5/7 nights due to bad wheather).
- Observations have been made at H-band ($1.6\,\mu m$).



RESULTS

Characterising the visibility curves



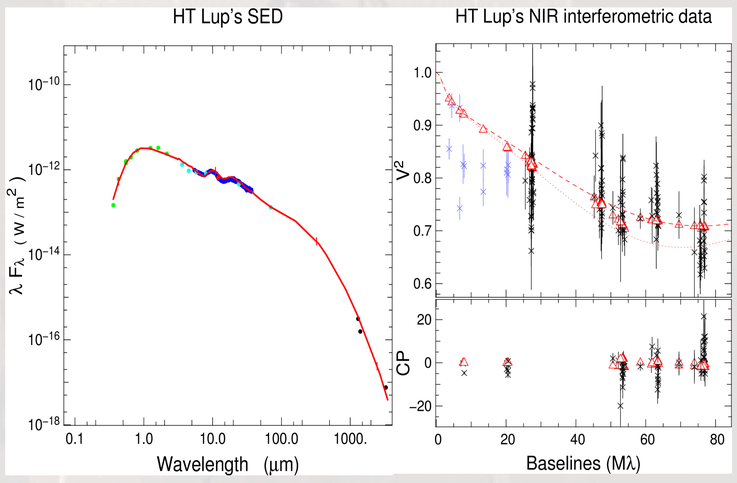
- For baselines between 11 and 136 meters, the Visibility data vary roughly as a straight line (as we do not see the initial variation at short baseline, nor the fully resolved range).

=>We perform a linear regression to obtain a ***qualitative*** estimate of the value of intercepts (expectations: intercept < 1 with scattering and >1 with pure ring model).

- A significant fraction of the resolved stars (i.e. with declining visibility profile) has an intercept at null frequency, $V^2(0)$, below 1 !!!

=> ***This is evidence that an extended component, that we associate with scattering, is present AND varies greatly from one TTauri to another.***

A case study: HT Lupi



- As an example of quantitative results, we modelled the SED and PIONIER visibility data with the radiative transfert code MCFOST. The resulting model is composed of:
  - An inner disk filled with small astrosilicate grains
  - A gap, to take into account the clearing due to the close companion
  - A massive outer disk

The visibility profile also allows to estimate the inclination and the disk PA.

The original model successfully fits the SED and the visibility profile at long baselines. New data (in blue, right panel) show that the drop-off is more pronounced than estimated by the simple linear regression. Further modelling will allow to characterise better the extended component.

Preliminary Results and Conclusions

- The results of our survey show that extended emission at H-band is **common** in T Tauri disks, and that it varies greatly in surface brightness from one disk to another.
- We associate this extended component with **scattered light**. More modelling is underway (PhD Thesis). It should help constrain the surfce brightness distribution (the size) of the emission region for each star in the sample.
- To derive accurates properties (Rin, Σ(r), i, PA…), full radiative transfert model and visibilities are combined with a wide range of other data sets.

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