

Revealing the inner structure of protoplanetary disks: *A PIONIER-VLTI Large Program*

Jean-Philippe Berger

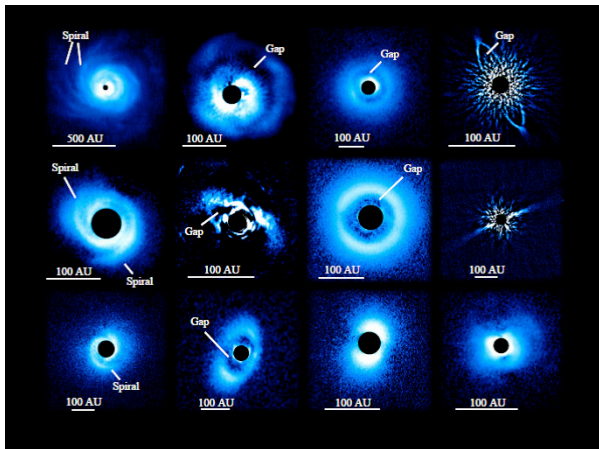


B. Lazareff, J. Kluska, J.-B. Le Bouquin, F. Malbet, M. Benisty, J. Monnier, F. Baron, E. Thiébaud, F. Soulez, C. Dominik, A. Isella, A. Juhasz, S. Kraus, R. Lachaume, F. Ménard, R. Millan-Gabet, C. Pinte, M. Tallon, W.-F. Thi, G. Zins.

Planet formation and evolution 2014
Kiel Sept 8-10



Reaching out the inner astronomical units



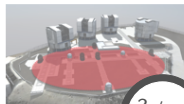
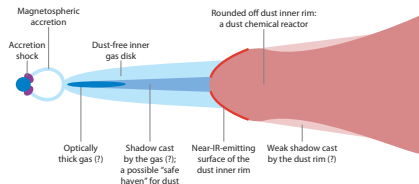
SEEDs collaboration



A VLTI-PIONIER large program

Goals:

- Constraining the shape of the inner disk;
 - Vertical structure;
 - Non-axisymmetry
- Constraining the nature of the emission (gas,dust)
- Determining the temperature;
- Relation with central star outer disk;
- Signposts of planet formation;



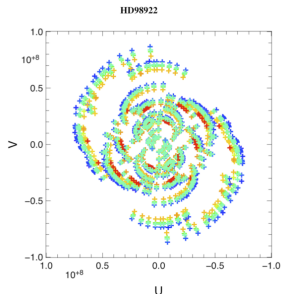
A PIONIER large program

Sample:

- The brightest Herbig AeBe stars
(Hillenbrand+ 92, Thé+ 94, Malfait+ 98)
- 55 targets selected
- B0 to G stars

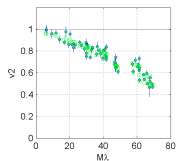
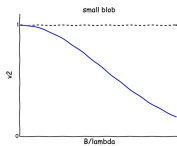
Strategy:

- Snapshot survey: parametric modelling of emission morphology.
- Aggressive uv coverage and image reconstruction on best resolved objects

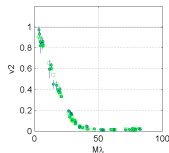
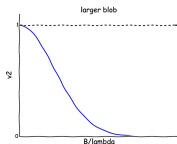


Examples of visibility distributions (I)

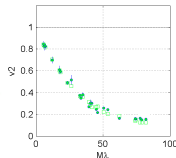
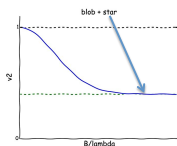
Examples of visibility patterns 1



HD 85587



MWC297



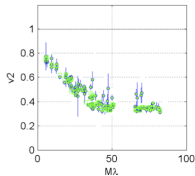
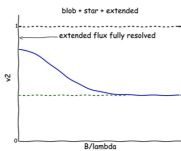
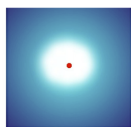
HD150197

B. Lazare

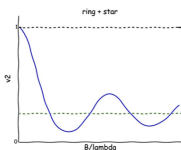
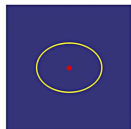


Examples of visibility distributions (II)

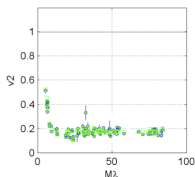
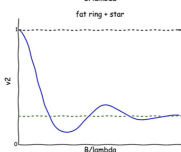
Examples of visibility patterns 2



HD100453



No source in the sample shows this V2 pattern



HD45677

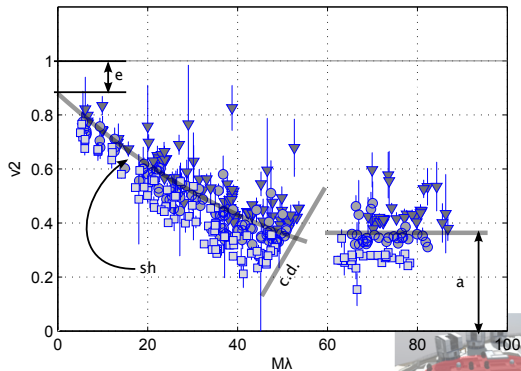
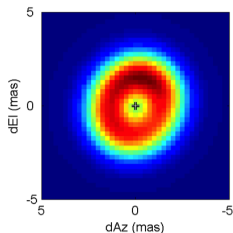


Parametric modelling

Visibility and Closure-Phases

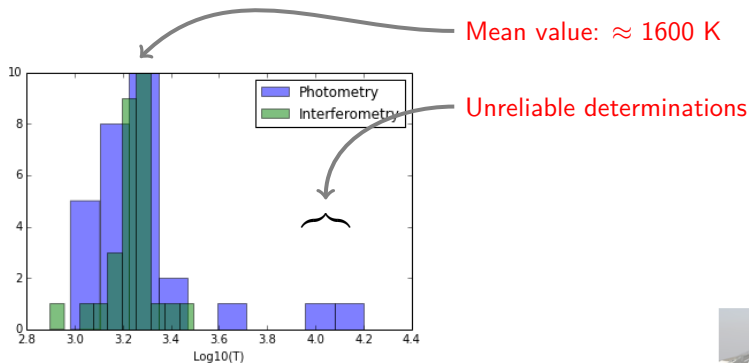
Aim: Providing morphological parametrisation of the H band emission

Method: Point source + Thin elliptical ring + Azimuthal modulation + Blurring + Halo (11 parameters)



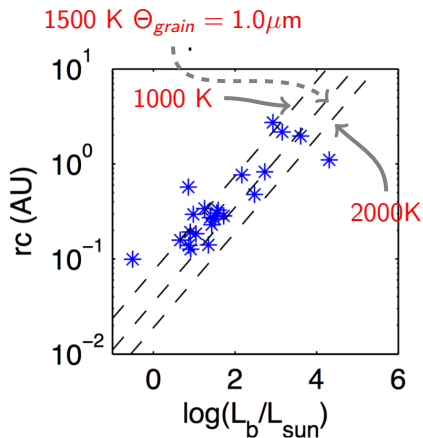
Temperature distribution

On average consistent with silicate dust grain sublimation.
Good correspondance between interferometry and photometry
except for a few cases.

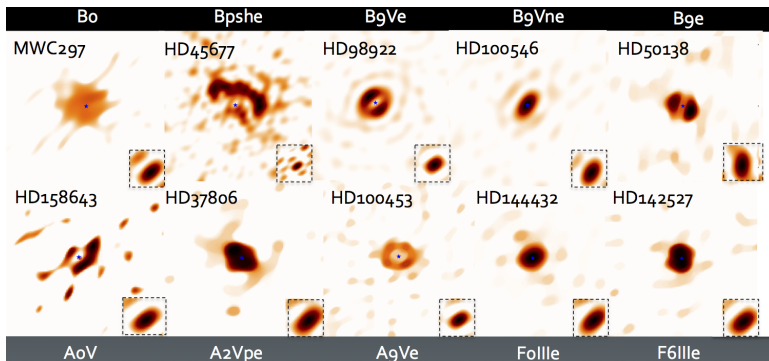


Size - Luminosity relation

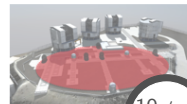
Confirmation of previous studies e.g. Monnier+ (2002,2005)



Reconstructed images



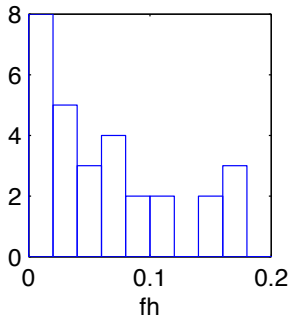
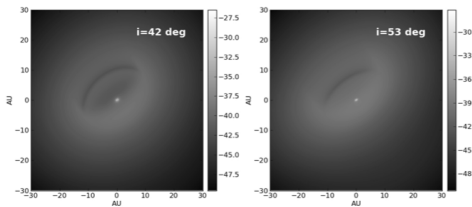
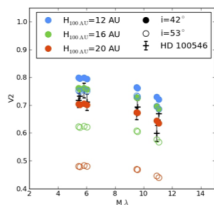
In most cases: not sharp "inner edge" detected.



The origin of the "halo"

The case of HD 100546

Are we seeing the inner rim of transitional outer disks?



Conclusion

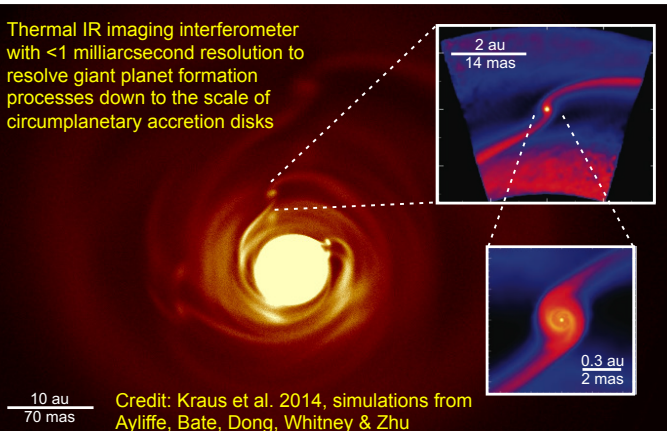
1. VLTI is an operational, efficient, "imaging" interferometer;
2. PIONIER LP allows the morphology of the inner rim to be constrained;
3. Temperatures measured consistent with sublimation but...
4. inner RIM very smooth (no sharp transition)?
5. evidence for external inner rim ?
6. Image reconstruction still in progress: simultaneous photometry requests
7. The combination of PIONIER, GRAVITY and MATISSE: a unique insight shed on the structure of protoplanetary disks



Planet Formation Imager Concept

planetformationimager.org

Thermal IR imaging interferometer
with <1 milliarcsecond resolution to
resolve giant planet formation
processes down to the scale of
circumplanetary accretion disks



Credit: Kraus et al. 2014, simulations from
Ayliffe, Bate, Dong, Whitney & Zhu

