

Review of near-IR interferometric detections

Update on PIONIER work in progress

Steve Ertel

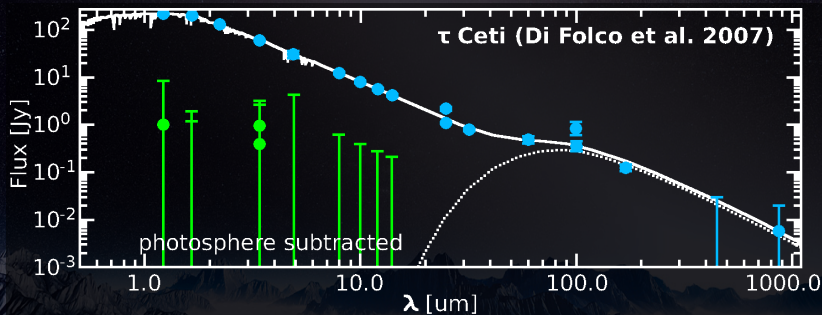
ESO Santiago, PIONIER instrument fellow

- Detection strategy
- Detections & statistics
- News from PIONIER



The challenge

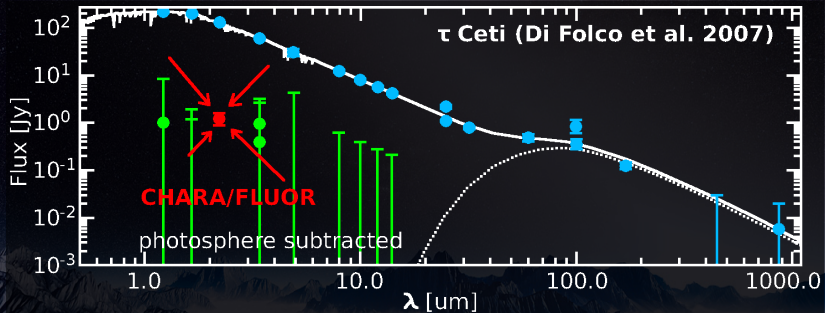
How to detect the hot dust? (in the near-infrared)



- Typical excess of $\sim 1\%$ in the nIR, outshone by the star
- Typical accuracy of photometric calibration and photospheric models: few %

The challenge

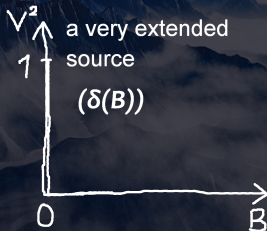
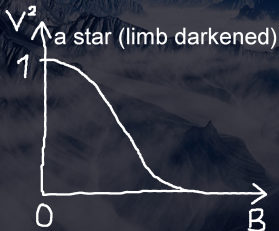
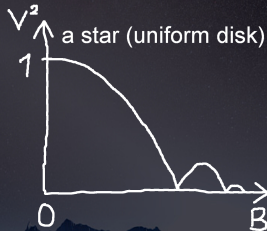
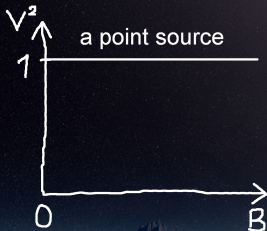
How to detect the hot dust? (in the near-infrared)



- Emission alone would be easily detectable (10 mJy to 1 Jy)
- Solution: spatially disentangle stellar emission and dust emission using near infrared interferometry

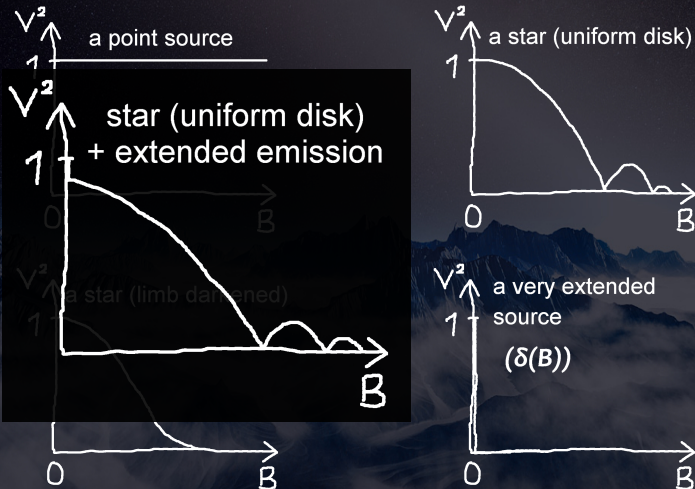
Detection strategy (long baseline interferometry)

The idea:



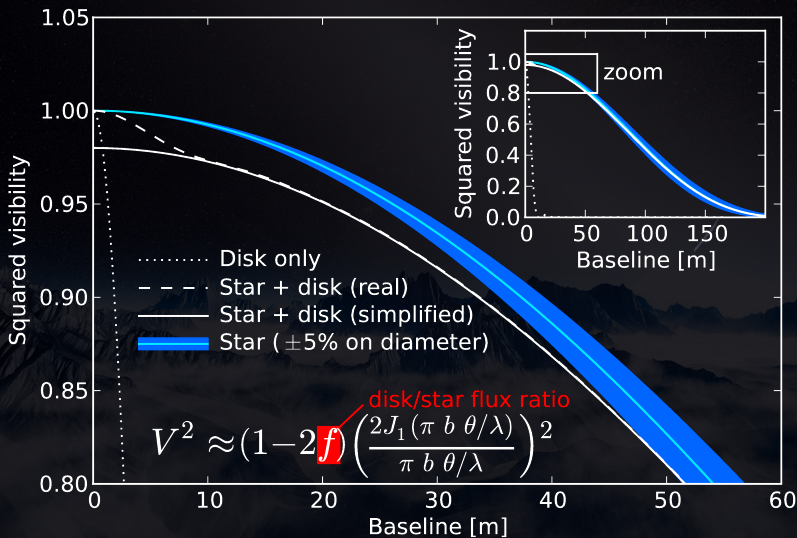
Detection strategy (long baseline interferometry)

The idea:



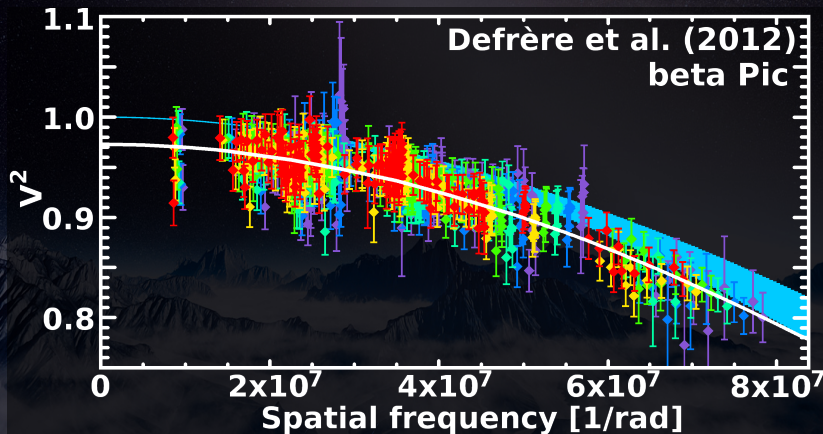
Detection strategy

More exact:



Detection strategy

An example:



Near-IR interferometric detections

A little history

2001: Ciardi+; Detection around Vega with PTI, but not real (?)

2004: Di Folco+; VLT/VINCI, upper limits, developed detection method

2006: Absil+; CHARA/FLUOR detection around Vega, $1.29 \pm 0.19\%$

2007: Di Folco+; FLUOR, eps Eri (no detection) & tau Ceti (detection)

2008: Absil+; 5 non-detections + zeta Aql

2009: Akeson+; beta Leo & zeta Lep detections (?)

2009: Absil+; VLT/VINCI, Fomalhaut

2011: Defrère+; IOTA/IONIC detection around Vega

2011: Mennesson+; PFN non detection of Vega: new constraints on location

2012: Defrère+; VLT/PIONIER detection around beta Pic

2013: Absil+; CHARA/FLUOR survey paper

2014: Ertel+; VLT/PIONIER survey

2014: Marion+; VLT/PIONIER survey – binary companions

The survey(s)

FLUOR survey

K band
40 (42) targets observed
11 detections

SpT	A	F	GK	total
w/ dd	7	7	4	18
w/o dd	5	7	10	22
total	12	14	14	40

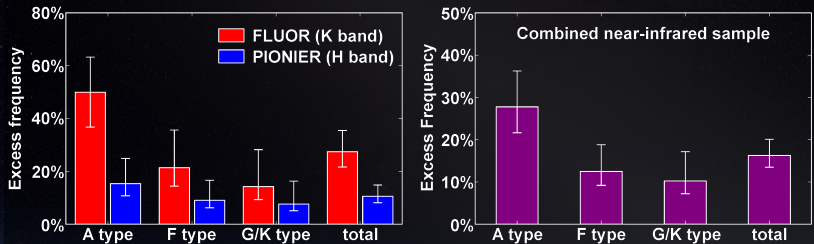
PIONIER survey

H band 85 (92) targets observed
9 (+3) detections

SpT	A	F	GK	total
w/ dd	13	16	15	44
w/o dd	13	17	11	41
total	26	33	26	85

The Survey(s)

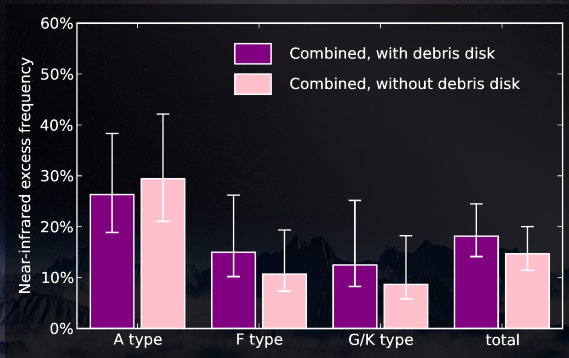
Statistics based on 123 stars observed:



- Detection rate with FLUOR (K band) by factor of ~ 2.5 higher than with PIONIER (H band)
- Correcting for this factor all statistics consistent between the two samples
- Detection rate decreasing with later spectral type
⇒ ***Like a normal debris disk?***

The Survey(s)

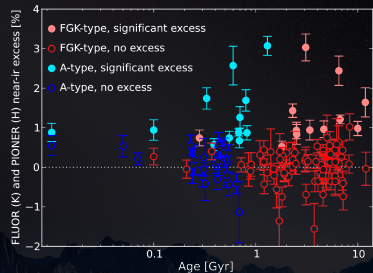
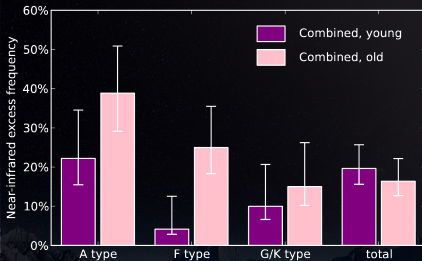
Statistics based on 123 stars observed:



⇒ No correlation with presence of cold dust
⇒ ***Not (simply) the hot inner rims of debris disks!***

The Survey(s)

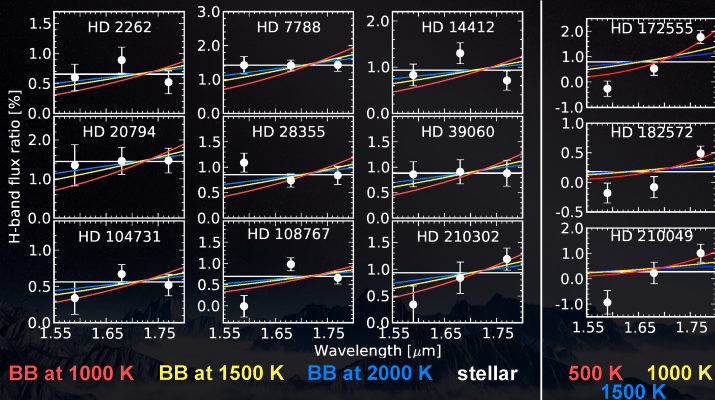
Statistics based on 123 stars observed:



- ☞ If any, slight increase of excess with age
⇒ **No (simple) collisional equilibrium!**
- ☞ Tentative **increase** of detection rate with age
⇒ **Some trapping mechanism?**

The Survey(s)

H band colors from PIONIER:



- ☞ Scattered light / extremely hot for some targets, others thermal emission – **diversity**
- ☞ K band vs. H band detection rate:
Dust warm, H dominated by **scattered light**?

The near-IR brightness distribution:

- ☞ Recent work by Lindsay Marion
- ☞ Trying to derive physical conclusions on the nature of the emission from # detections vs. brightness
- ☞ Well fitted by a Gaussian, truncated Gaussian, or log normal distribution
- ☞ No physical constraints possible

Update on PIONIER observations

Two main programs

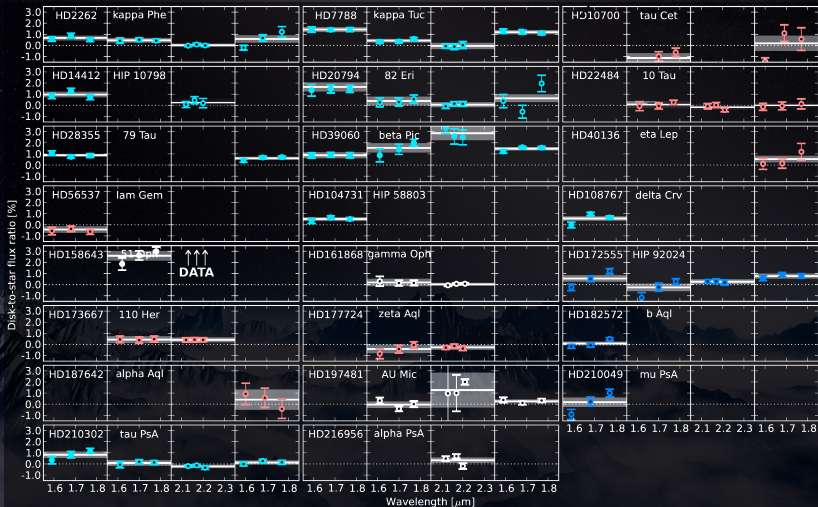
Warm dust systems

- ☞ New survey among targets with *WISE* (+) excesses
- ☞ Similar strategy as before, fainter targets ($H < 7$)
- ☞ 62 targets observed in 2014 (9 nights), analysis in progress

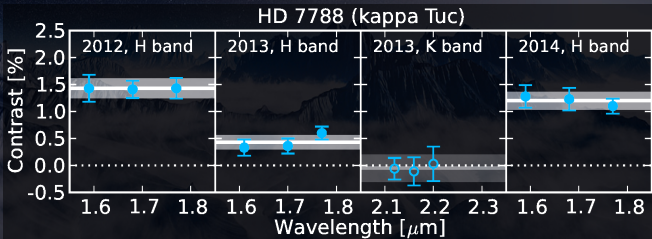
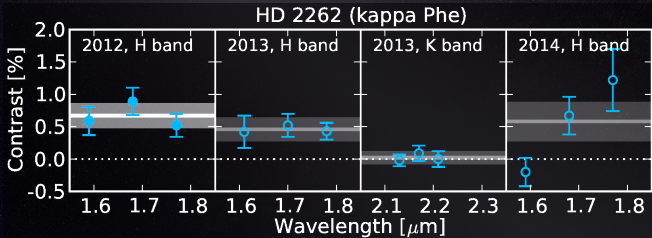
Color & variability

- ☞ Re-observe PIONIER and FLUOR detections (and few others)
- ☞ Original detection + 2 runs in *H* band, more proposed
- ☞ ~ once per year for variability
- ☞ 1 run with PIONIER in *K* band

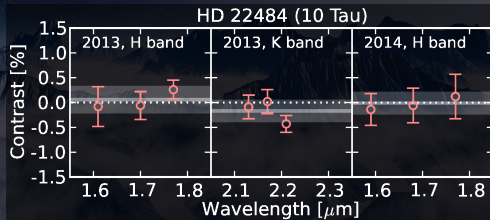
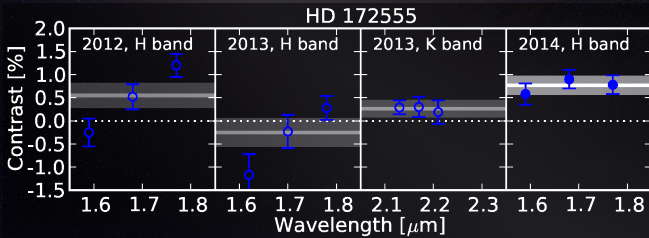
Color & Variability



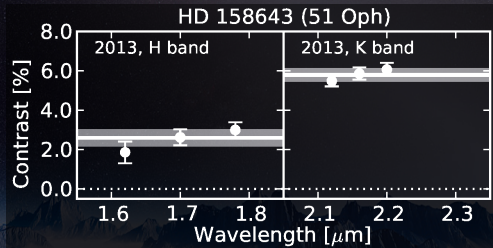
Color & Variability



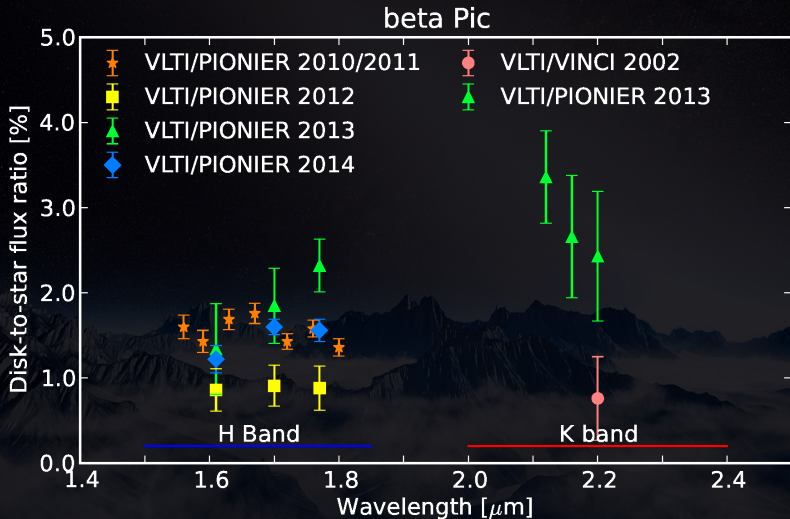
Color & Variability



Color & Variability



Color & Variability



PIONIER detector upgrade:

- ☞ Since Dec 2014: New RAPID detector
- ☞ Very fast, low noise
- ☞ Limiting mag (ATs): H=8–9, 6–7 for high accuracy data
- ☞ More important: on bright targets (even) less affected by observing conditions
- ☞ 6 spectral channels
- ☞ No more K band!

Thanks a lot!
