Overview of the near-IR interferometric surveys

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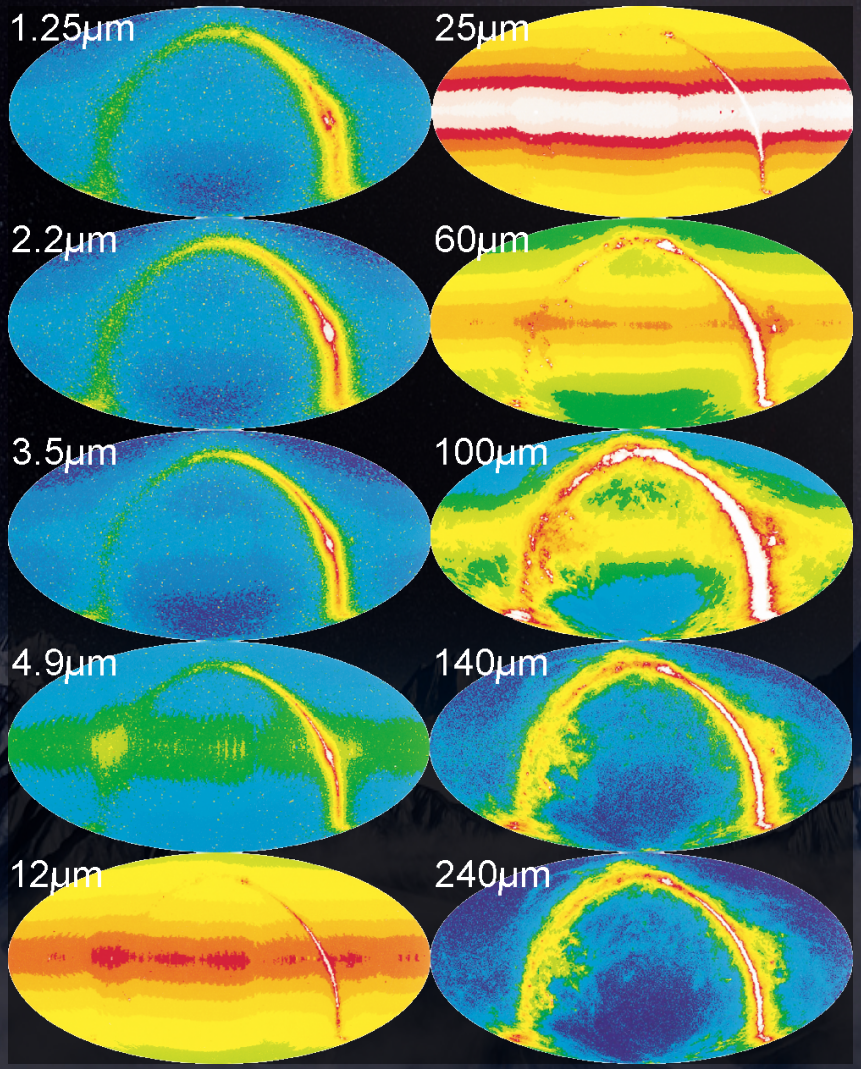
The Solar system zodiacal dust

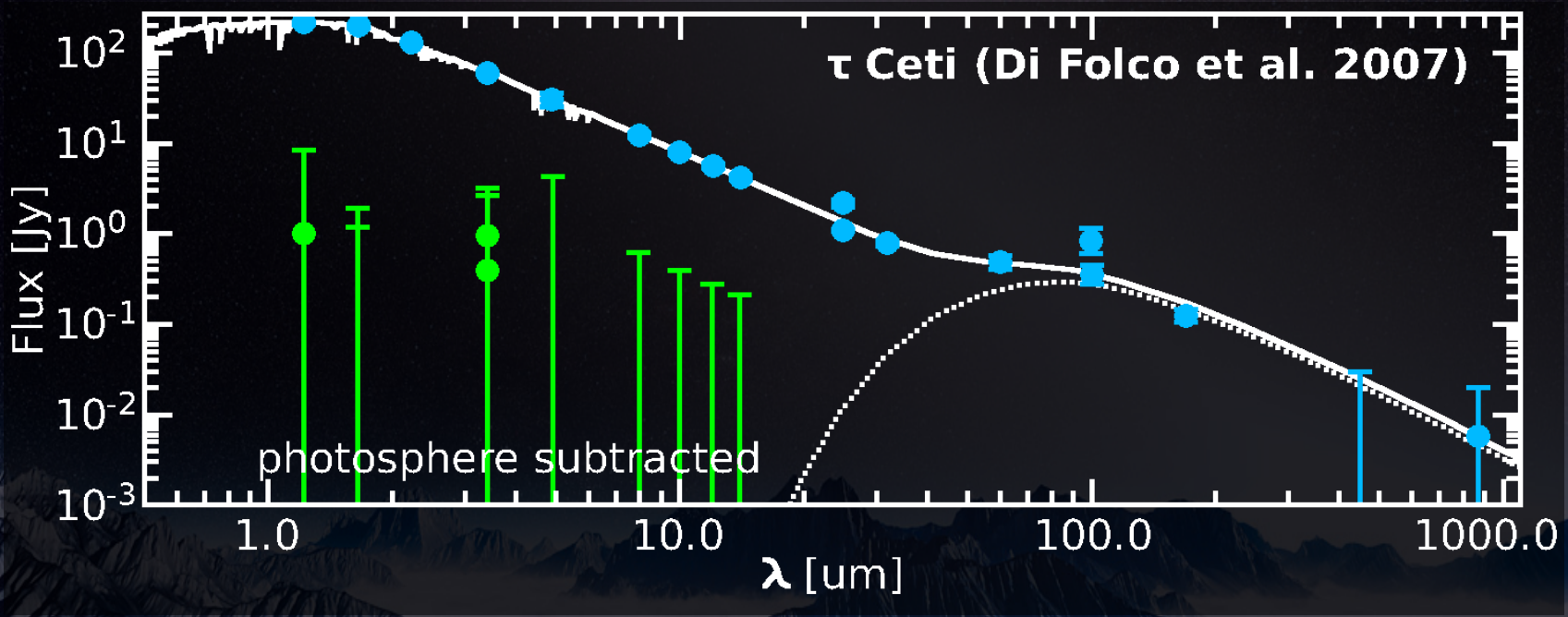


COBE/DIRBE (Kelsall et al. 1998)

- Dust inside a few AU
- Power law surface density ($\alpha \sim -0.5$)
  (Kelsall et al. 1998, Hahn et al. 2002)
- Continuous transition to F-corona at few $R_\odot$,
  T: few 100K to ~2000K
  (Kimura & Mann 1998, Hahn et al. 2002)
- Comet evaporation, asteroid collision, P-R drag
- Complex local structure (planetary interaction, local dust creation)

The challenge

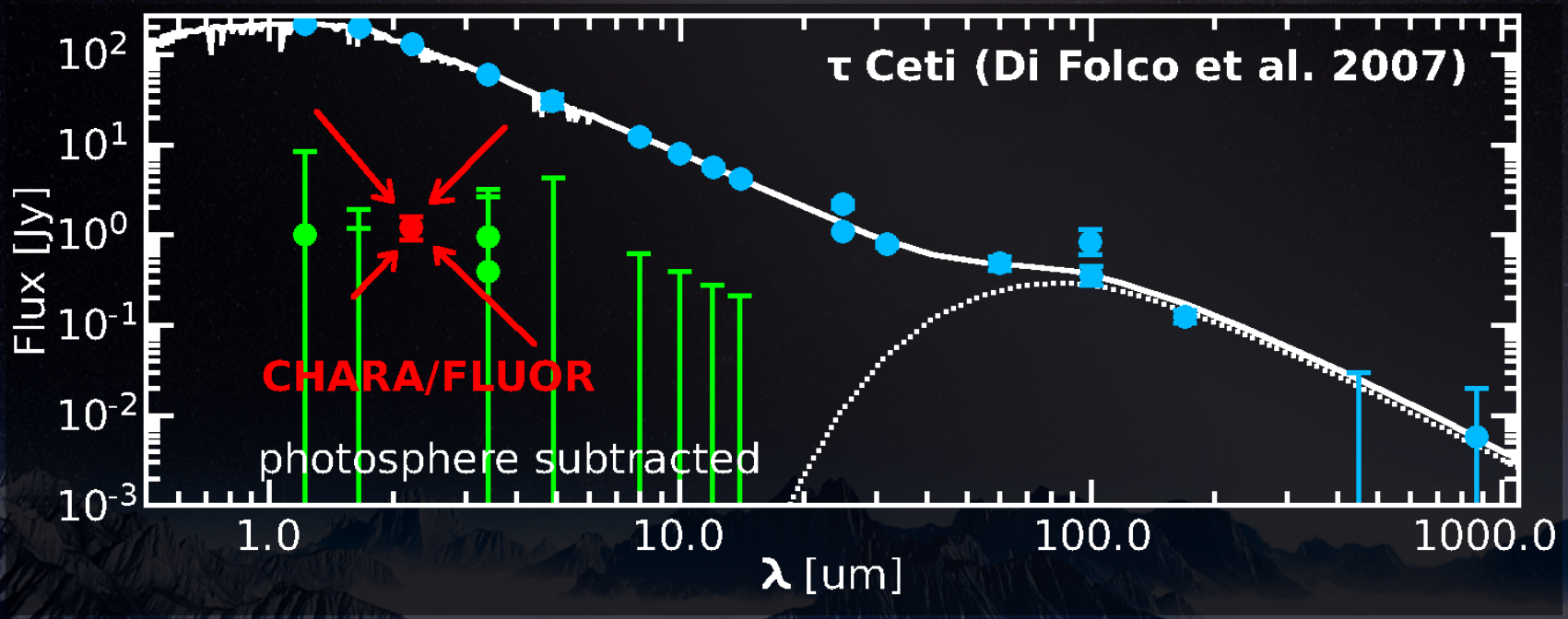
How to detect the hot dust? (in the near-infrared)



- Typical excess of ~1% in the nIR, outshone by the star
- Typical accuracy of photometric calibtration and photospheric models: few %

The challenge

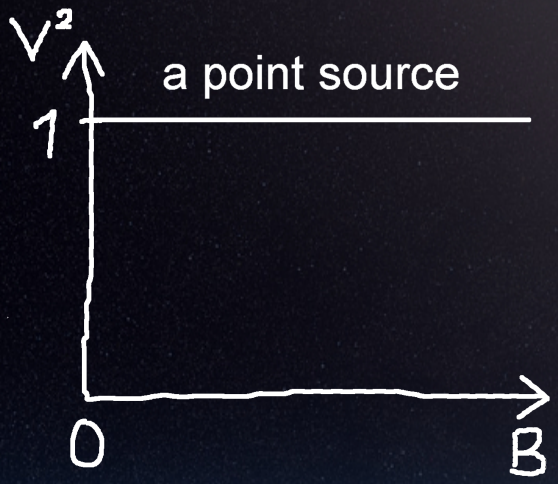
How to detect the hot dust? (in the near-infrared)

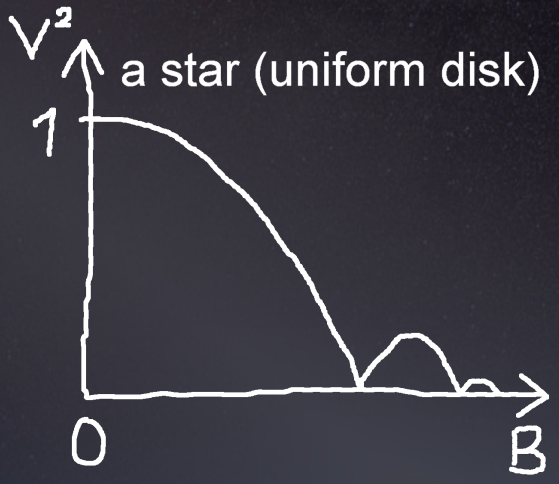


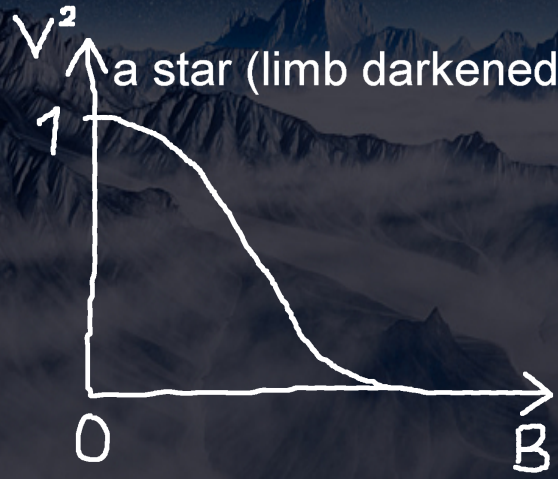
- Emission alone would be easily detectable (10 mJy to 1 Jy)
- Solution: spatially disentangle stellar emission and dust emission using near infrared interferometry

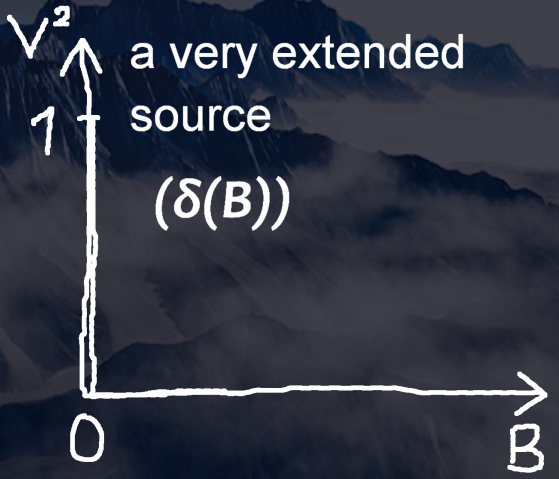
Detection strategy

The idea:









Detection strategy

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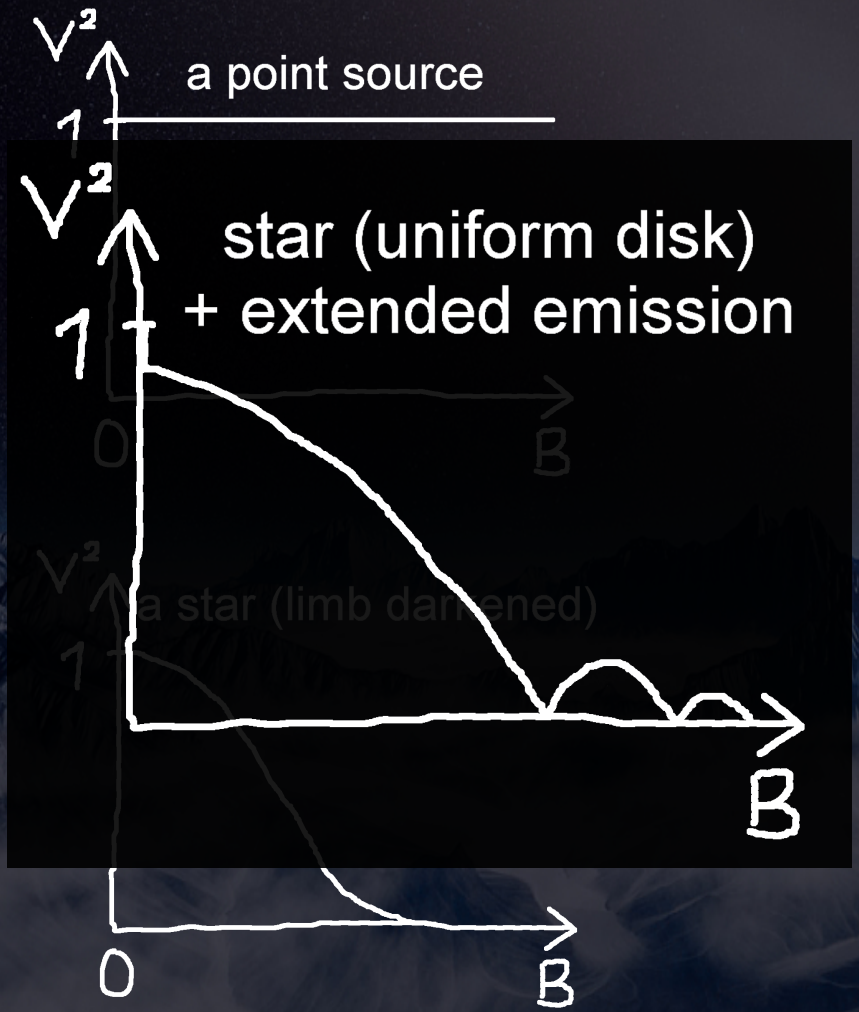
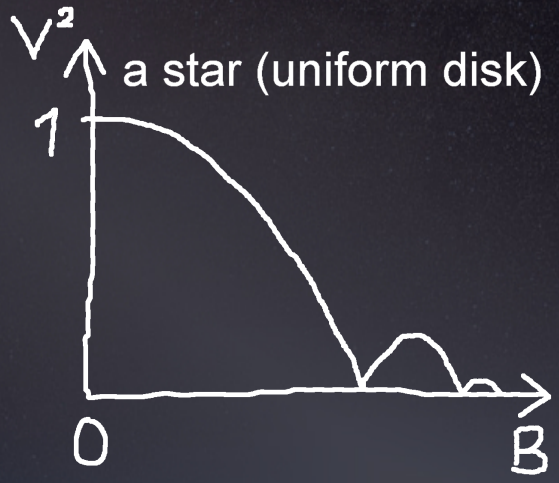
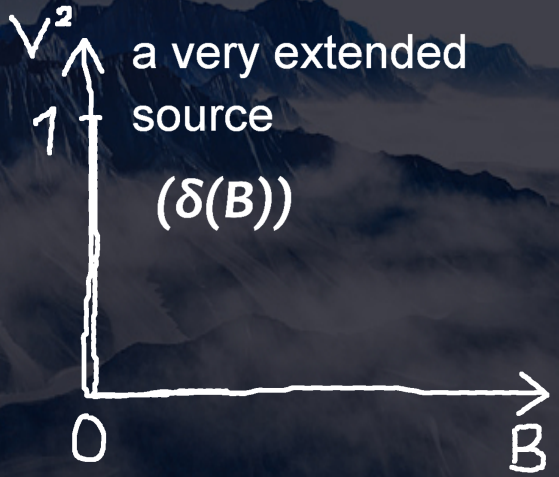
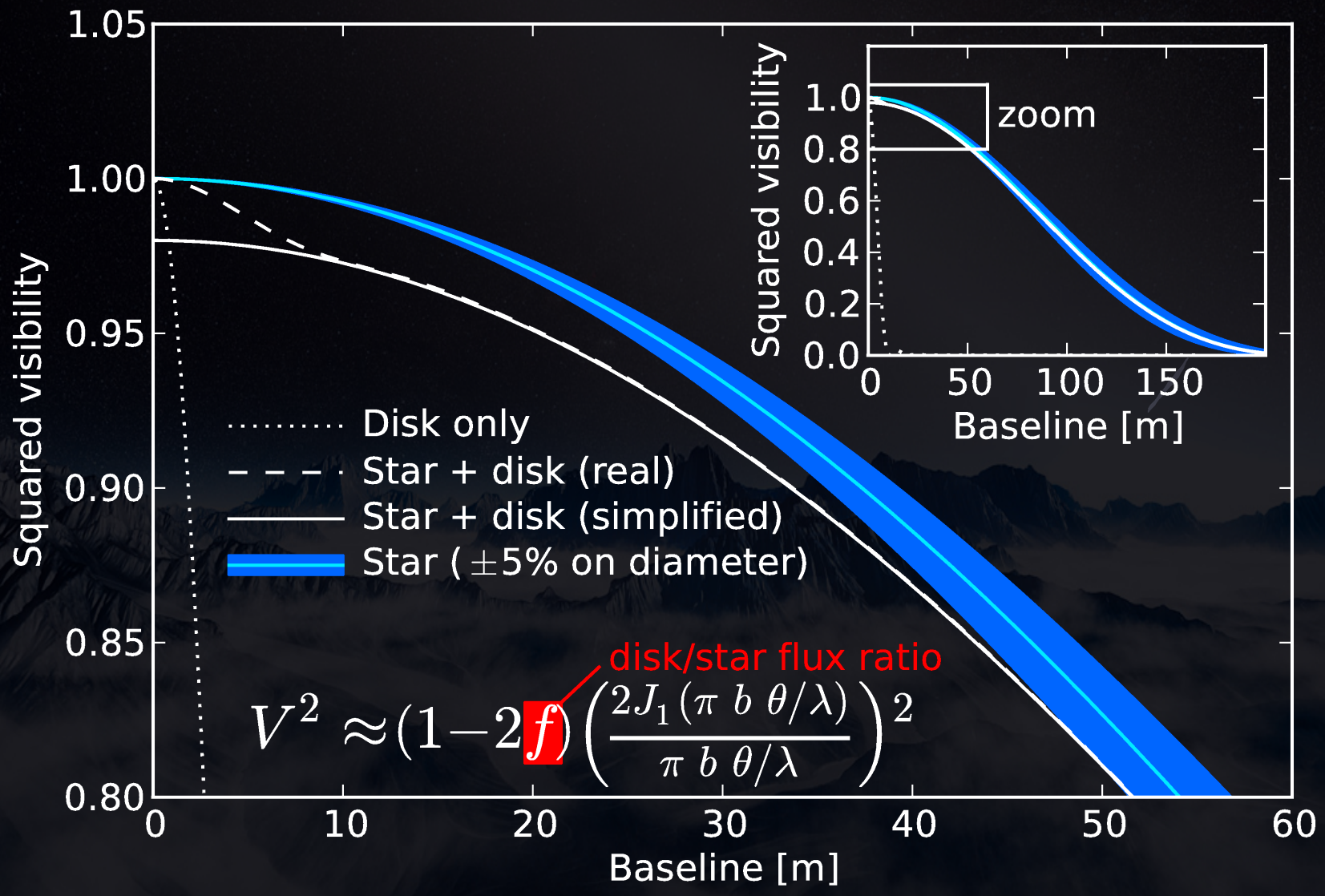






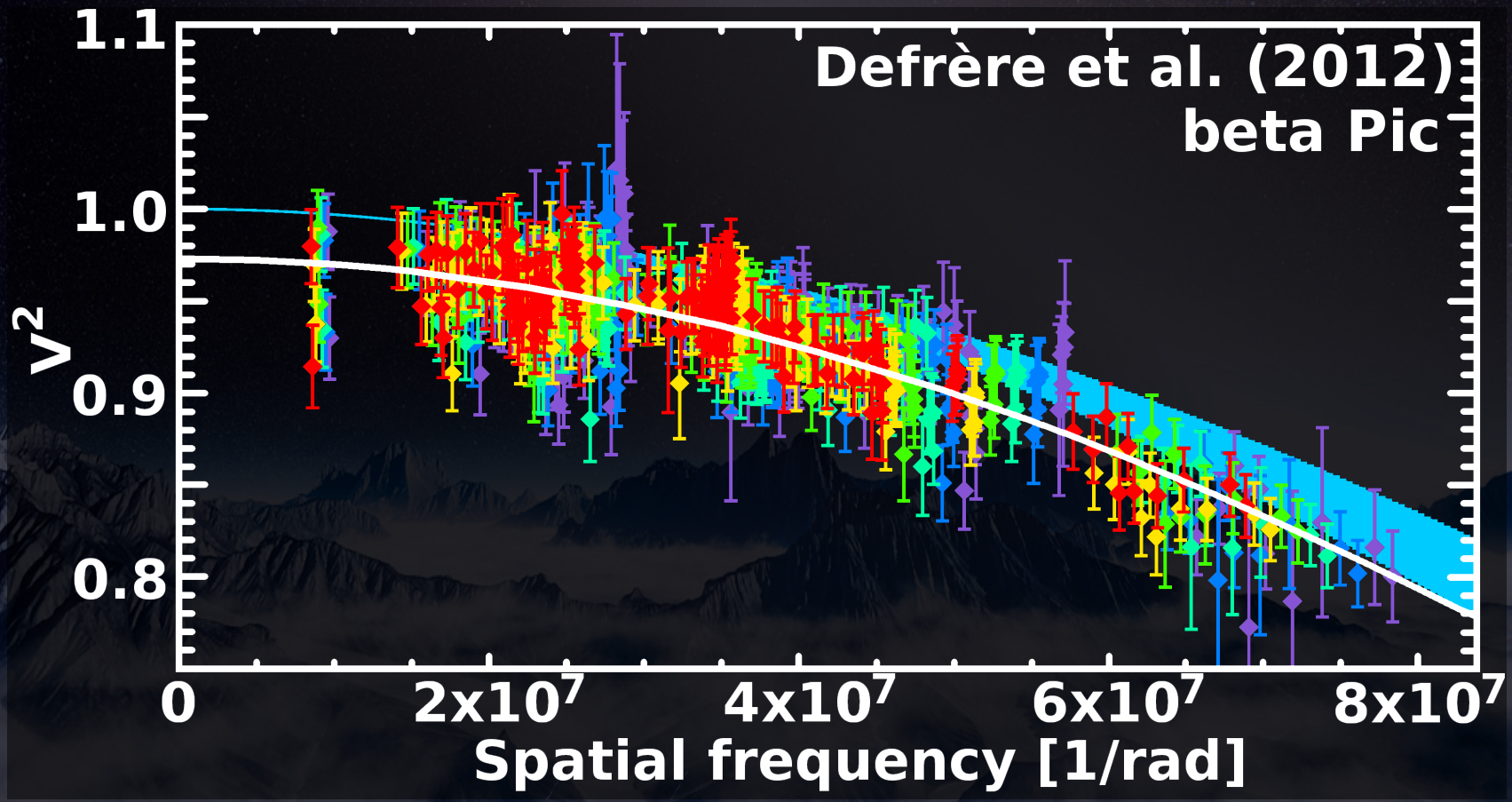
Detection strategy

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+; VLTI/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+; VLTI/VINCI, Fomalhaut

2011: Defrère+; IOTA/IONIC detection around Vega

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

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

2013: Absil+; CHARA/FLUOR survey paper

2014: Ertel+; VLTI/PINOIER survey

2014: Marion+; VLTI/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

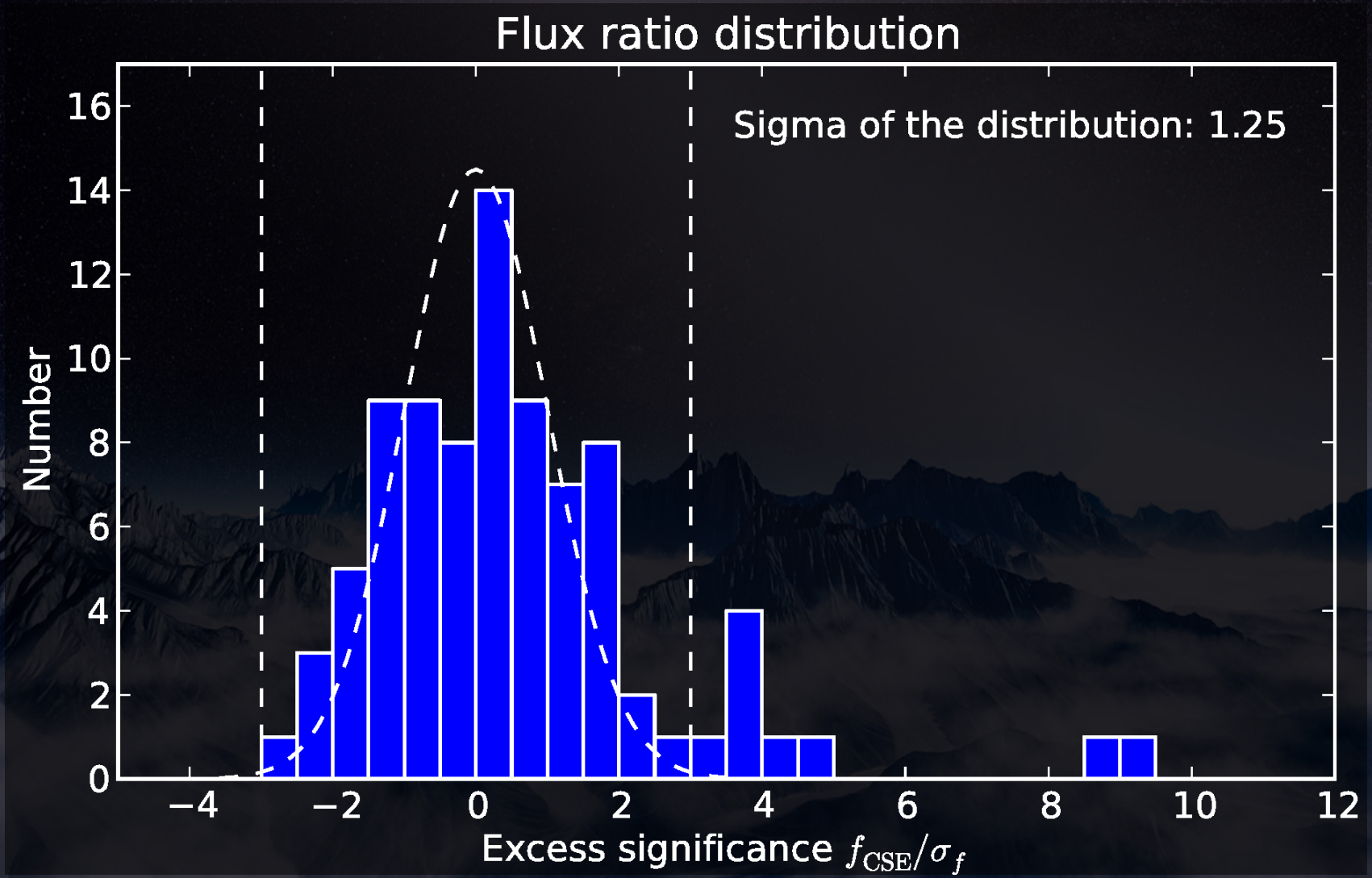
PIONIER survey

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

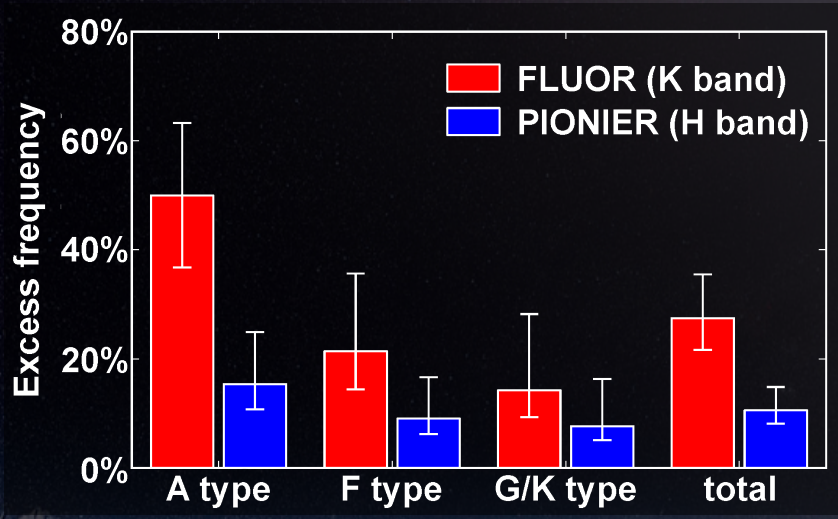
The Survey(s)

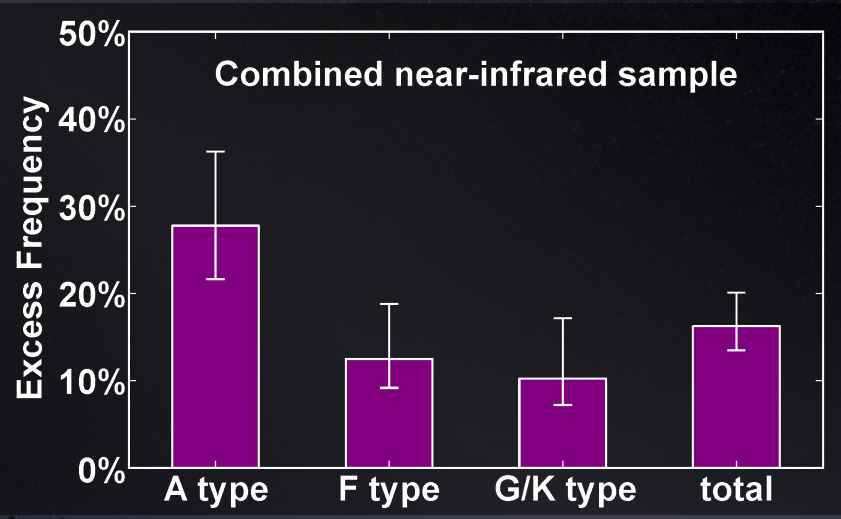
Excess distribution (PINOIER sample):



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)

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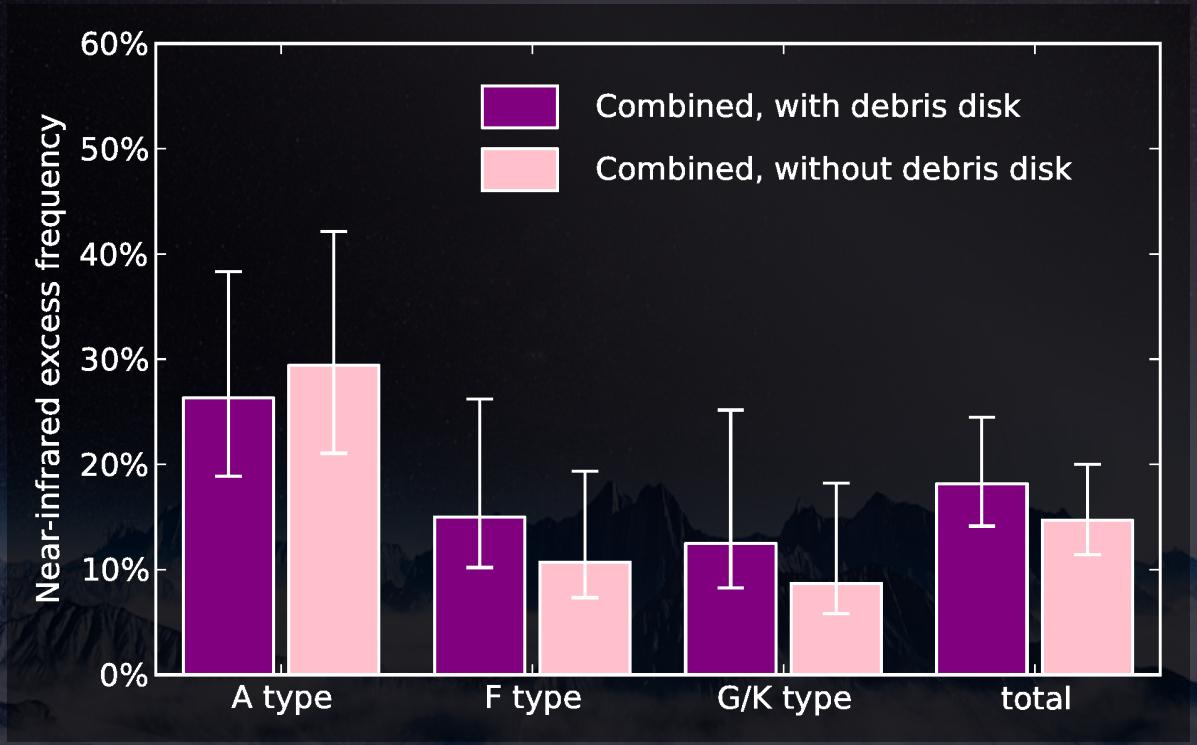
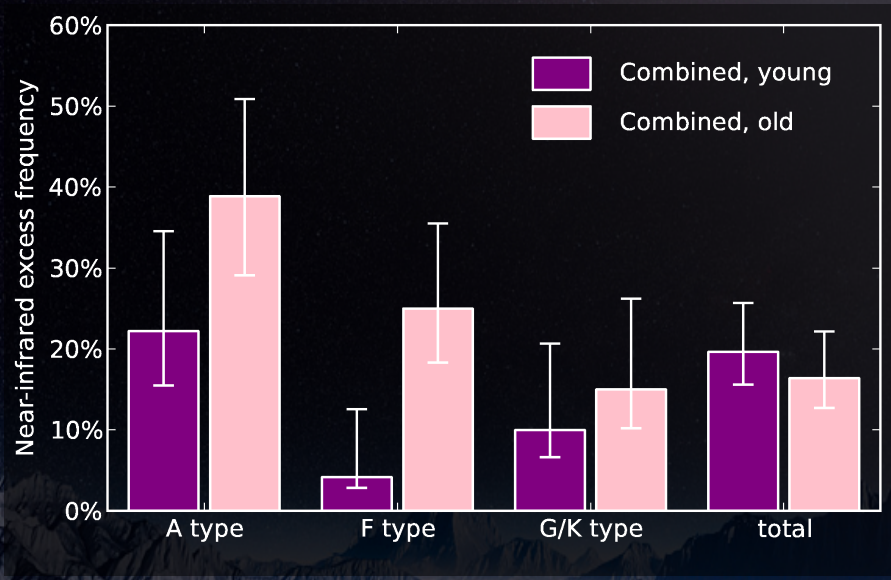
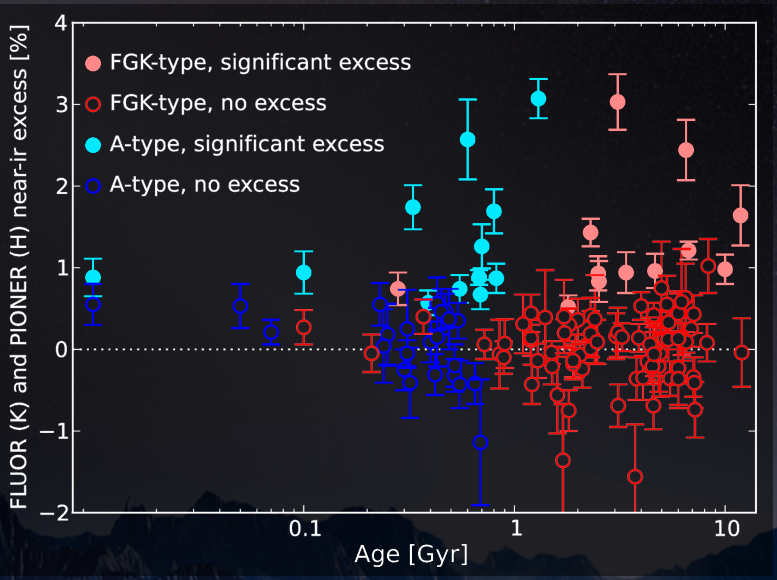


- No correlation with presence of cold dust
  ⇒ ***Not (simply) the hot inner rims of debris disks!***

The Survey(s)

Statistics based on 123 stars observed:

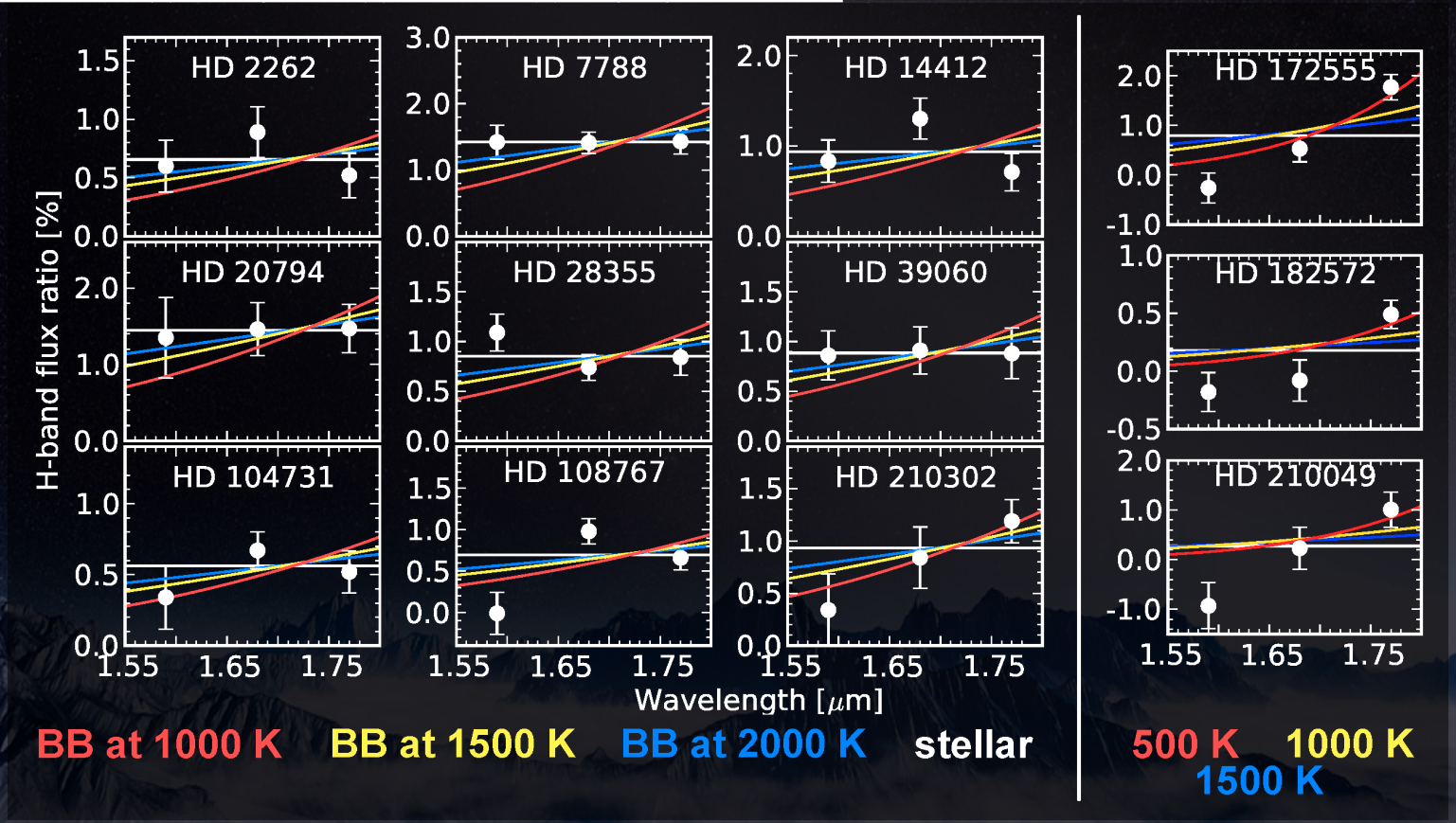




- If any, slight increase of excess with age?
  ⇒ ***No (simple) collisional equilibrium!***
- Tentative ***increase*** of detection rate with age
  ⇒ ***Some trapping mechanism?***

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**?

Update on PIONIER observations

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Two main programs

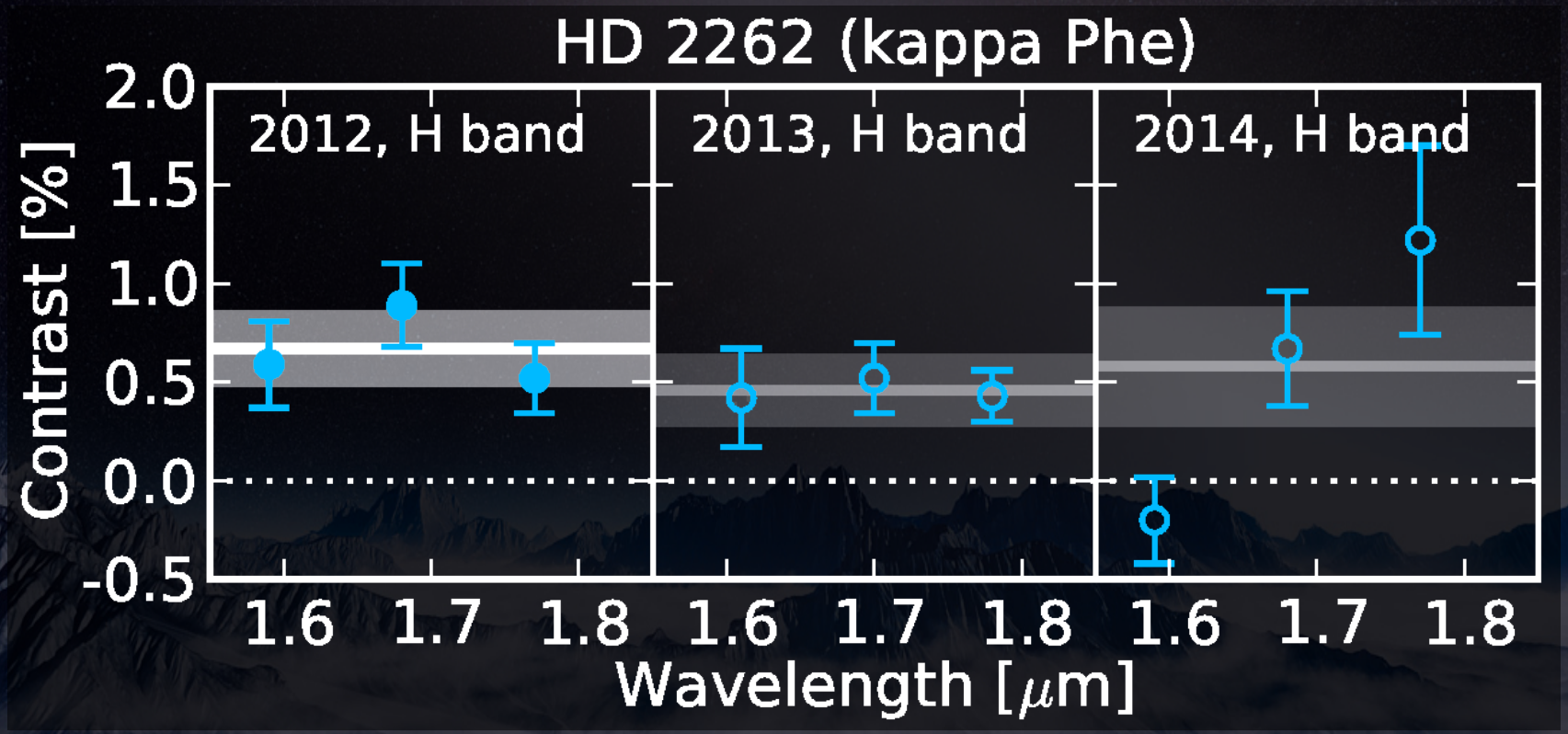
Warm dust systems

- 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



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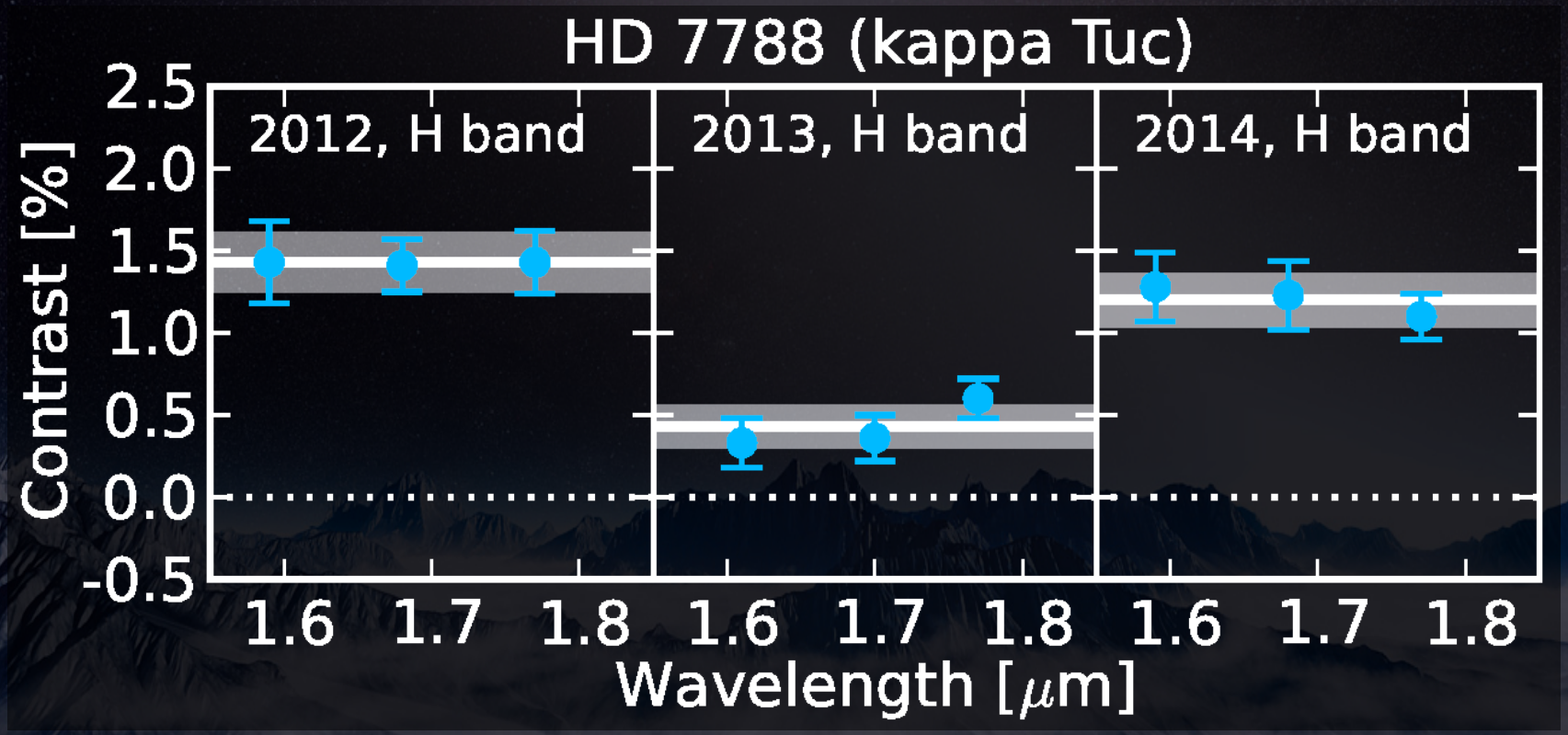

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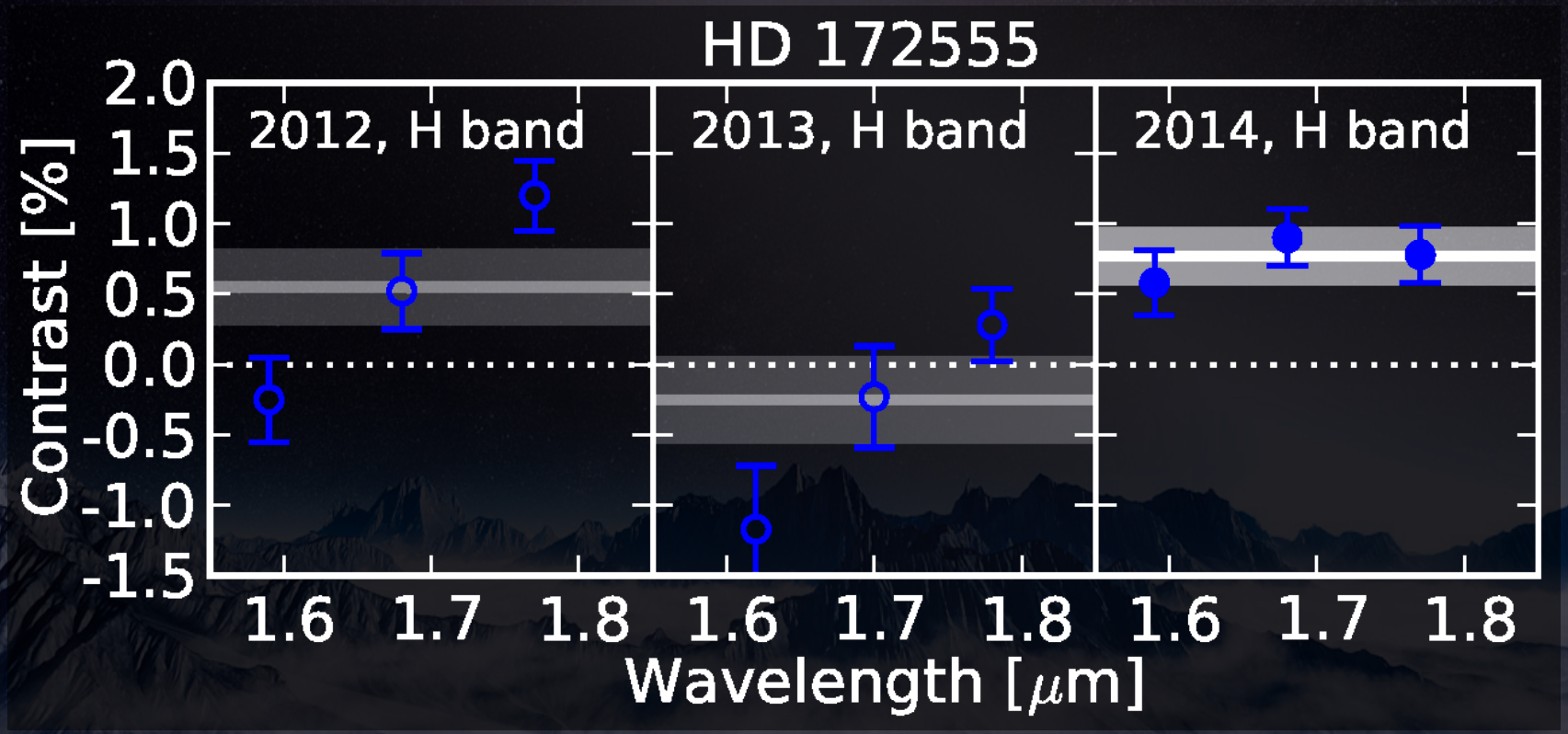

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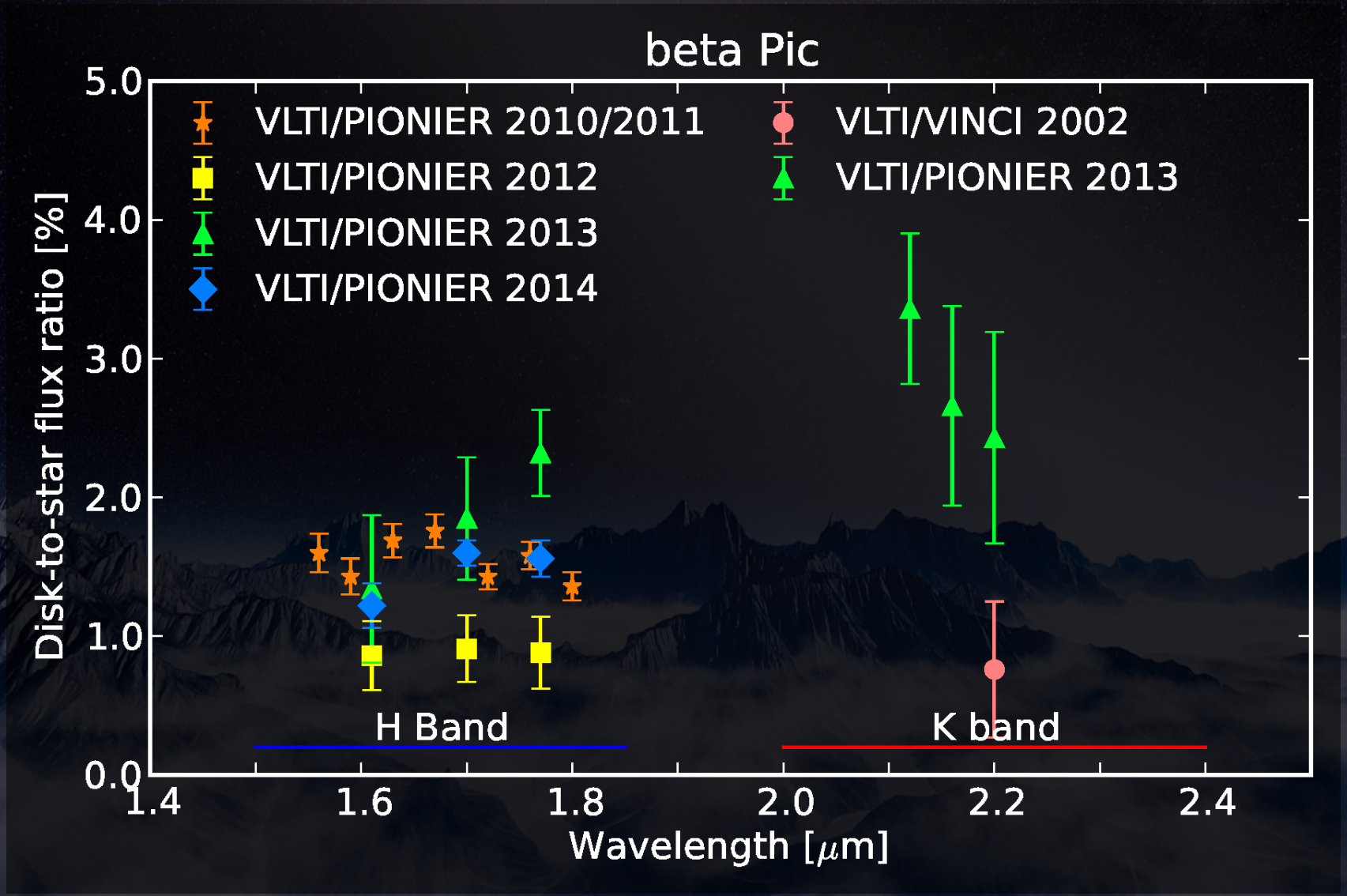

Thanks a lot!