Figure: Emil Ivanov, Sterne und Weltraum

The EXOZODI Project

– A statistical survey for exozodiacal dust with near-infrared interferometry –

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ON BEHALF OF:

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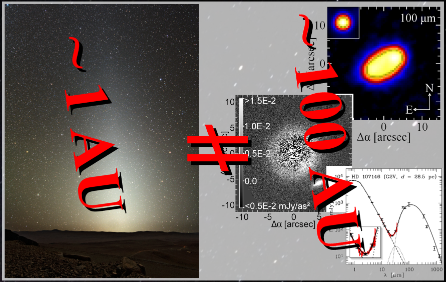
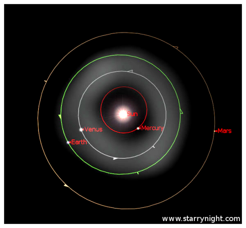
Prolog

What is exozodiacal dust?

- Dust around main sequence stars (~ 1 AU)
- **NOT** a typical debris disk (maybe related)
- Similar to our zodiacal disk



Why do we care?



- Dust in the habitable zone
- Structures might point towards planets
- **BUT:** Obstacle for imaging of earthlike planets

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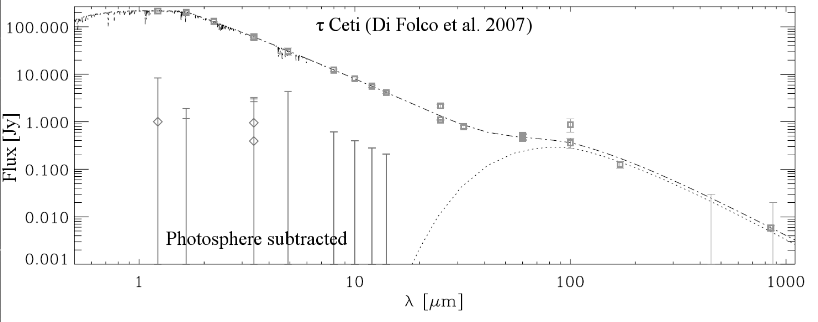
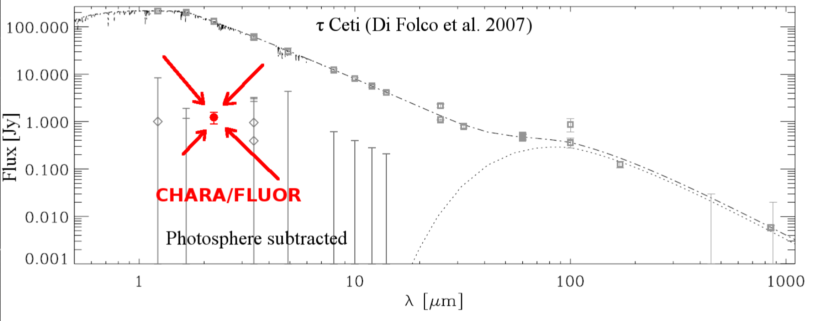
How to detect exozodiacal dust?



- Our zodiacal dust would be too faint to be detected, e.g., by *Spitzer* (more than 100 times)
- Actually, the photometric calibration uncertainty is the problem (few percent of the **total** flux of the system)

How to detect exozodiacal dust?



- Dust emission alone would be detectable (10 mJy to 1 Jy)
  ⇒ disentangle stellar emission and dust emission
- Solution: infrared interferometry

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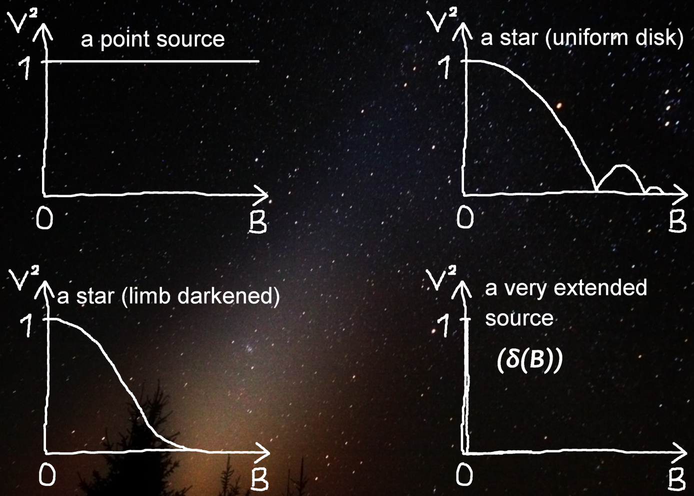
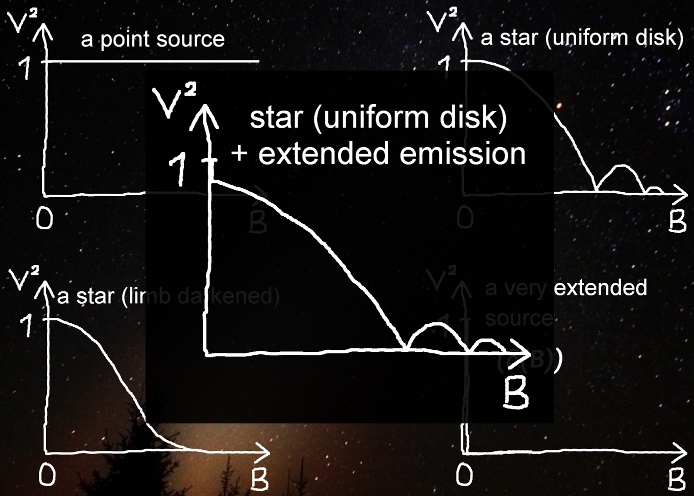
Solution: infrared interferometry!



Solution: infrared interferometry!



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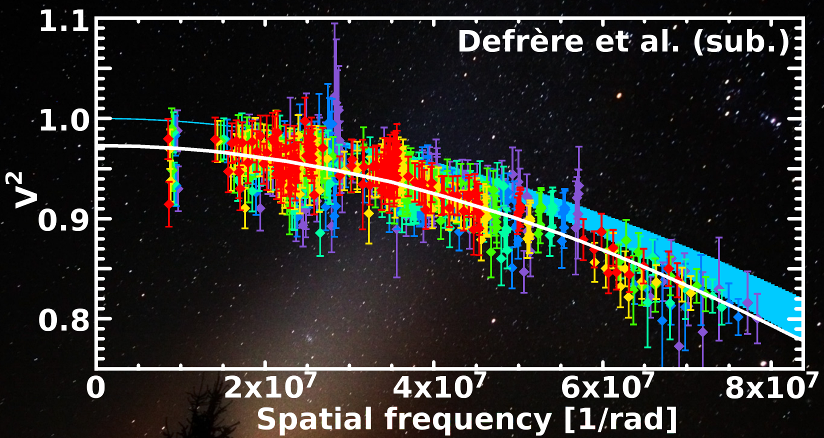
Solution: Interferometry!



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Several possible origins of exozodiacal dust, but all have problems (details: see talk by A. Bonsor):

- Local collisions of large bodies
  - High amount vs. short lifetime of the dust
  - ⇒ **Statistics** of frequency/dust mass vs. age
- Recent planetary collision
  - Low probability vs. high detection rate?
  - ⇒ **Statistics** of frequency among stars in general
- Evaporation of comets from outer disk
  - Large number of comets required (LHB?)
  - ⇒ **Statistics** of correlation between exozodis and exo-Kuiper belts

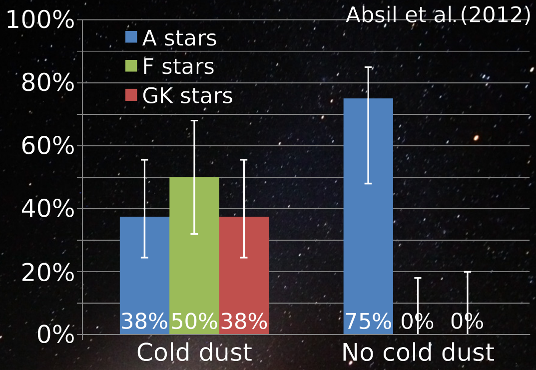
The EXOZODI Project

The project:

- First **statistical** survey for exozodiacal dust
- Northern (CHARA/FLUOR) and southern hemisphere (VLTI/PIONIER)
- $\sim$ 100 stars ($K < 5$) with debris disks, same number of stars without (known) cold dust, unbiased sample
- Observation, statistics + detailed modeling & theoretical investigation (**see talk by A. Bonsor**)
- Development of next-generation debris disk modeling tools (**see poster by Q. Kral (26)**)
- Direct contribution to instrument development (e.g., PIONIER: First 4-telescope beam combiner on the VLTI)

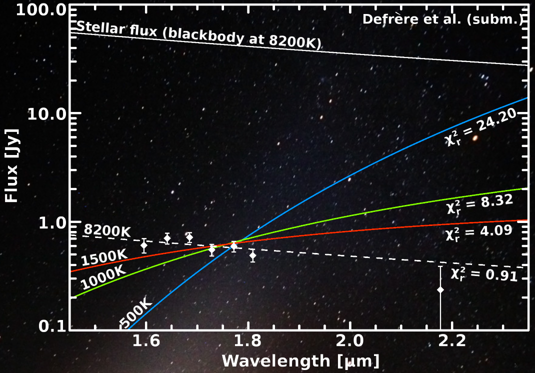
First results

Statistics (CHARA/FLUOR):



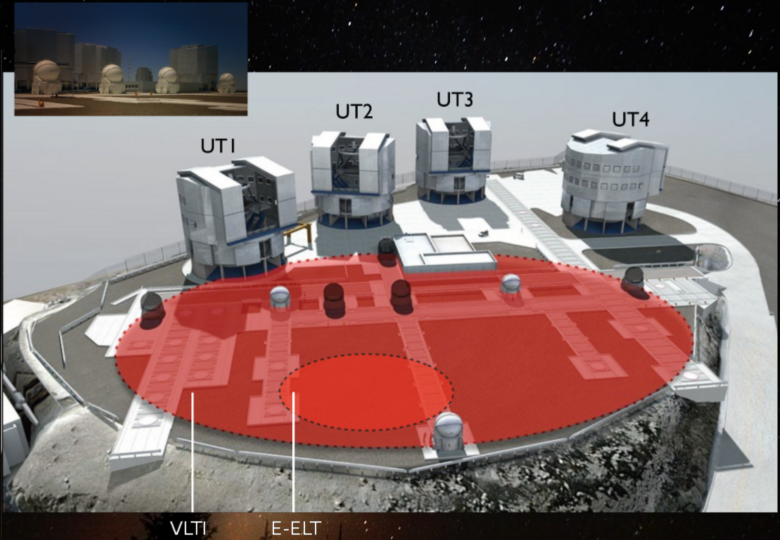
- So far 12 detections out of 41 stars (29^{+8}_{-6} %)
- Cold & hot dust correlated for late type stars, for early type stars not
- **Note low statistical significance so far!**

A detailed study on β Pic (VLTI/PIONIER):



- Clear detection ($\sim 8.5\sigma$, 4 independent epochs)
- Companion ruled out to be responsible (closure phases)
- Emission very hot (sublimation relevant – Lebreton et al., in prep.) or dominated by scattering of stellar light

The EXOZODI Project



VLTI/PIONIER

Instrument	Available	# Tel.	λ range	V^2 accuracy
MIDI	2003	2	N	5%
AMBER	2006	3	H, K	20%
PIONIER	2010	4	H, K	1%
MATISSE	2014?	4	L, M, N	(?)
GRAVITY	2014?	4	K	(1% ?)

- Have a 4 telescope beam combiner available in short time (2 years!!!)
- Low budget: 200,000 Euro + man power + used detector
- Trade-offs for quick availability, low price
- Experience with integrated optics beam combiner

Summary

- Understanding origin of exozodis is **crucial** for understanding **evolution of planetary systems**
- Knowing frequency, abundance is **crucial** for future **direct imaging of earthlike planets**
- We carry out the **first statistical, interferometric survey**
- First statistics: Exozodis **present around many main sequence stars**, maybe related to debris disks (around solar-type stars)
- Not every detection of hot excess necessarily an exozodi, **scattering can result in false detections** in systems with edge-on seen debris disks

Thank you very much*!

* **Must-see:** Talk by A. Bonsor, posters by Q. Kral (26), V. Faramaz (14)