Olivier Absil

University of Liège

Probing the β Pic innermost regions with NIR interferometry

What interferometry can do

COMPANIONS

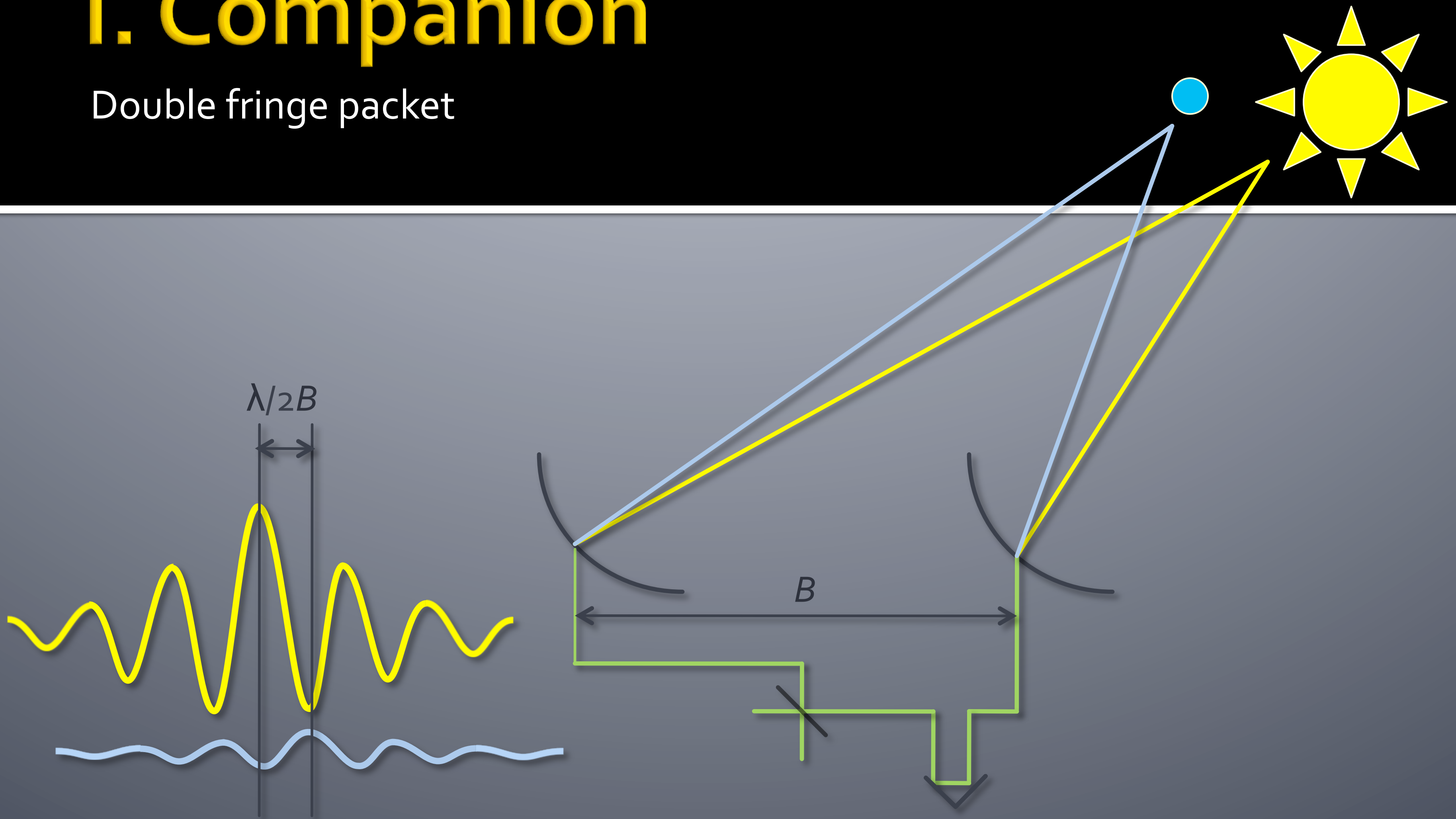
- Test the presence of additional, massive bodies
- Take over b's orbital characterisation when single aperture gives up?

INNER DISK

- Detect dust down to the sublimation radius
- Improve understanding of disk architecture and dynamics
  - eg: falling evaporating bodies

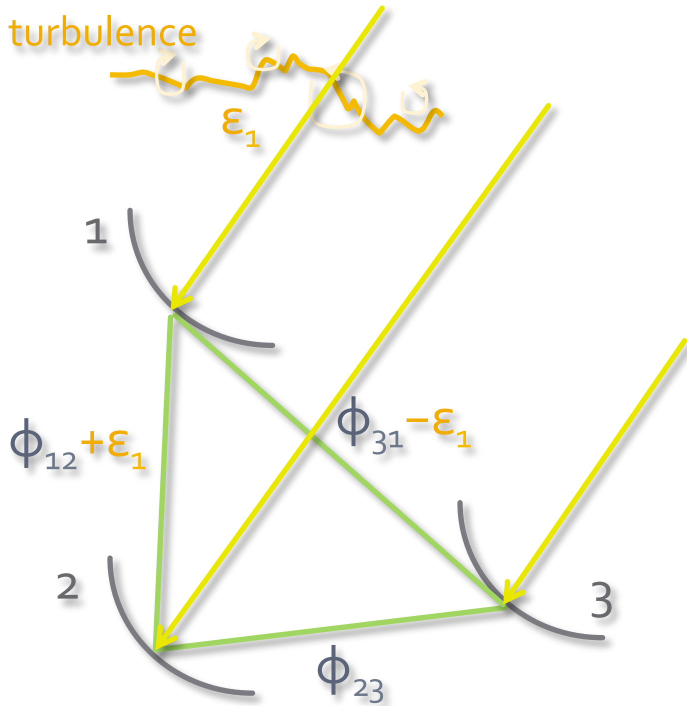
I. Companion

Double fringe packet



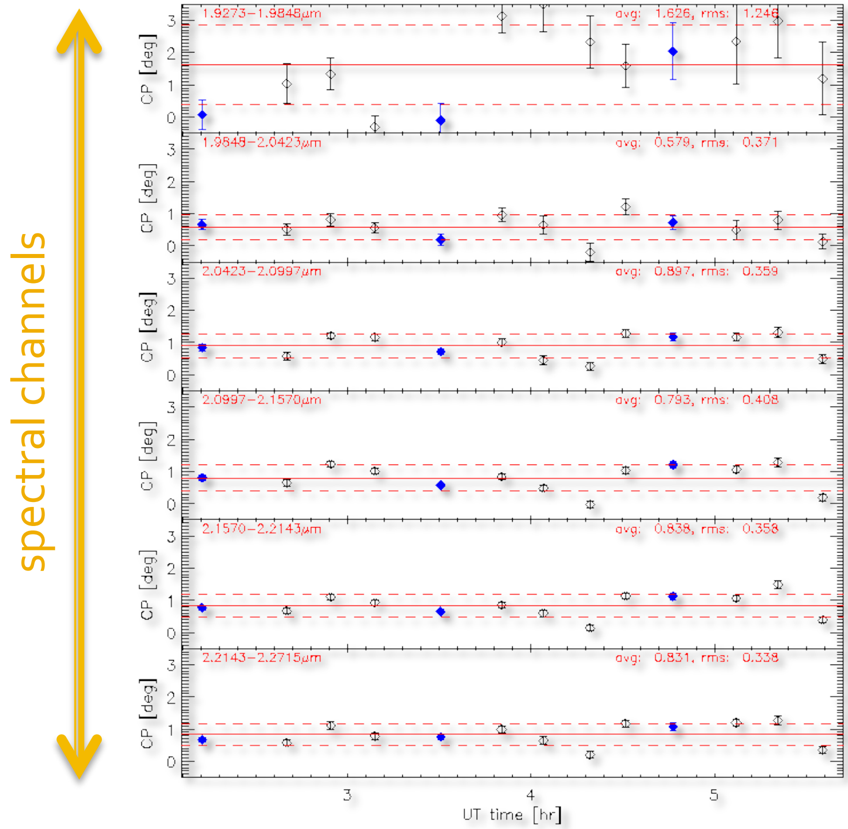
Restoring the phase: closures

- Closure phase not affected by telescope-specific errors
  - $\psi_{123} = \phi_{12} + \varepsilon_1 + \phi_{23} + \phi_{31} - \varepsilon_1$
  - Not biased by turbulence
- Asymmetric objects: $\psi_{123} \neq 0$
  - Sensitive to companions
  - $\Psi_{123} = \rho\,(\sin\alpha_{12} + \sin\alpha_{23} + \sin\alpha_{31})$
    - proportional to flux ratio
    - $\rho = 1\% \rightarrow \Psi_{123} \sim 1°$

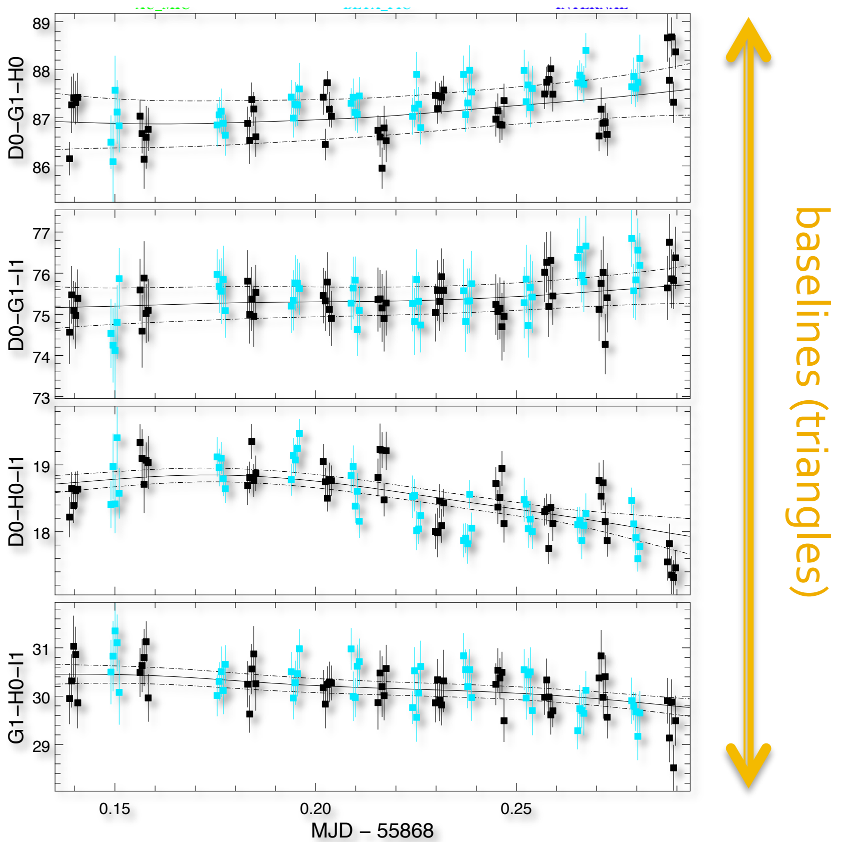


Interferometric data

VLTI/AMBER

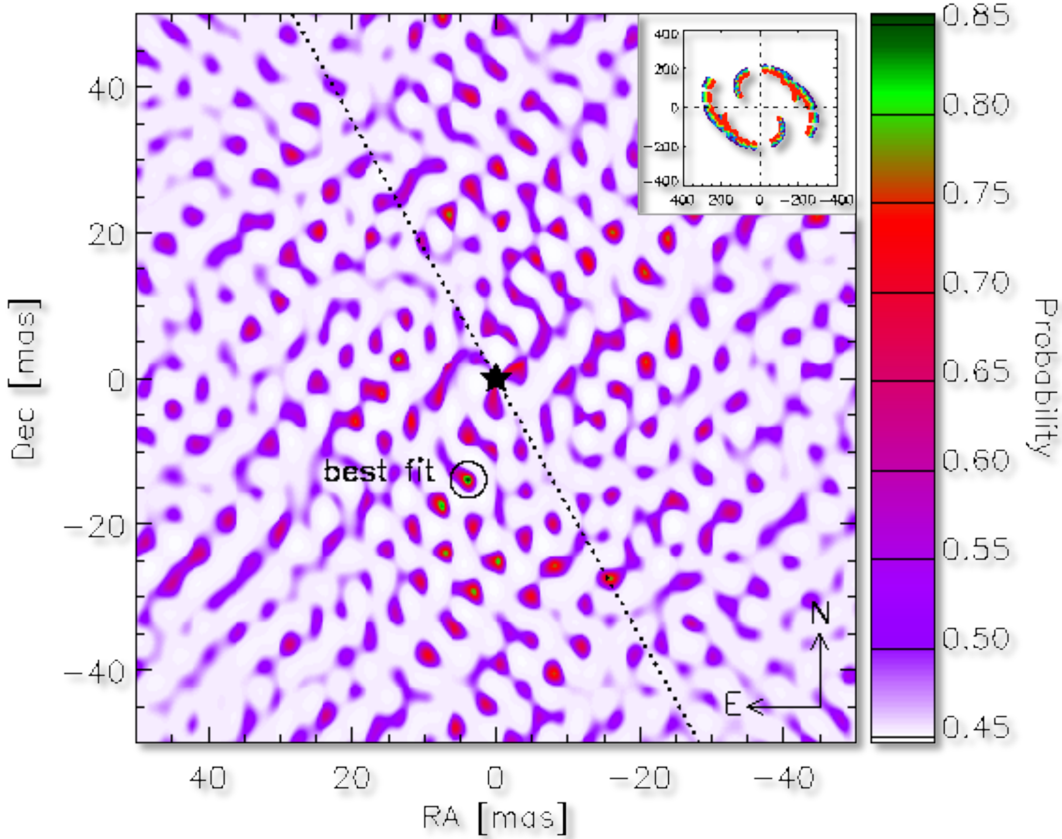


VLTI/PIONIER (1 channel)



Fitting a binary model

Absil et al. 2010

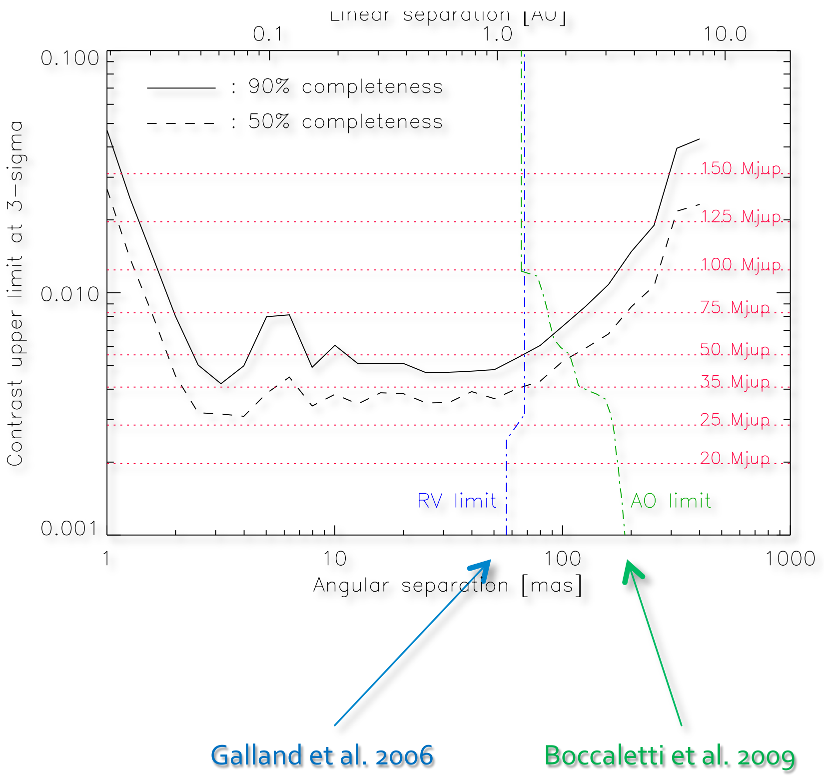


Best fit: $1.8\times10^{-3} \pm 1.1\times10^{-3}$ at 14 mas (χ_r^2=0.87)

Detection limits

Absil et al. 2010

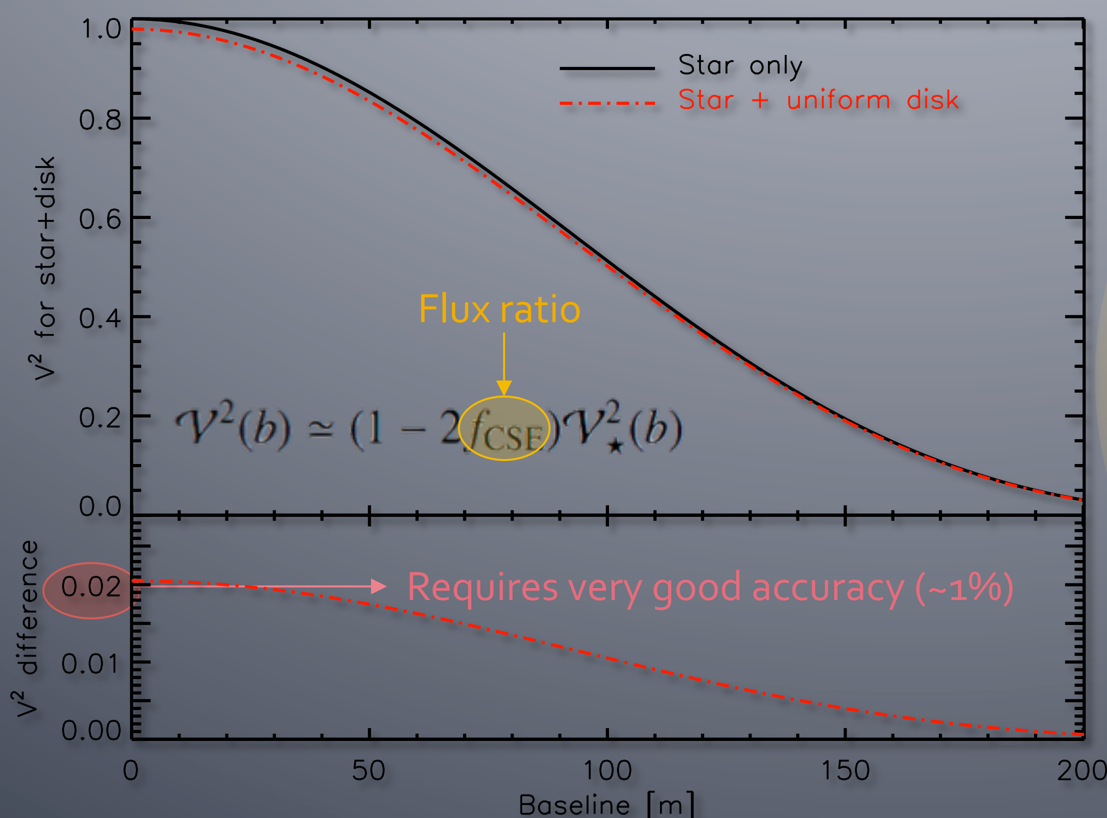
- Optimal search zone:
  2 – 60 mas
  - Median error bar = 1.2×10^{-3}
  - 3σ limit at 50% completeness
    - 3.5×10^{-3} (= 29 M_{Jup})
  - 3σ limit at 90% completeness
    - 5.0×10^{-3} (= 47 M_{Jup})
- Reduced perf → 300 mas
  - Time smearing
  - FOV limitation
- Confirmed by double-blind test

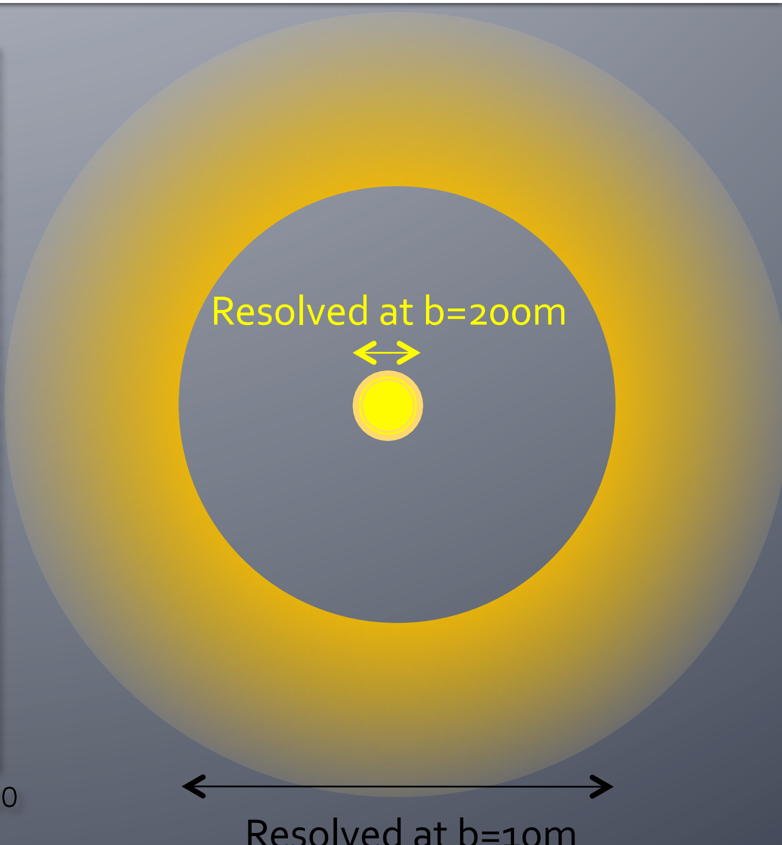


II. Disk

Disk larger than λ/b → visibility loss

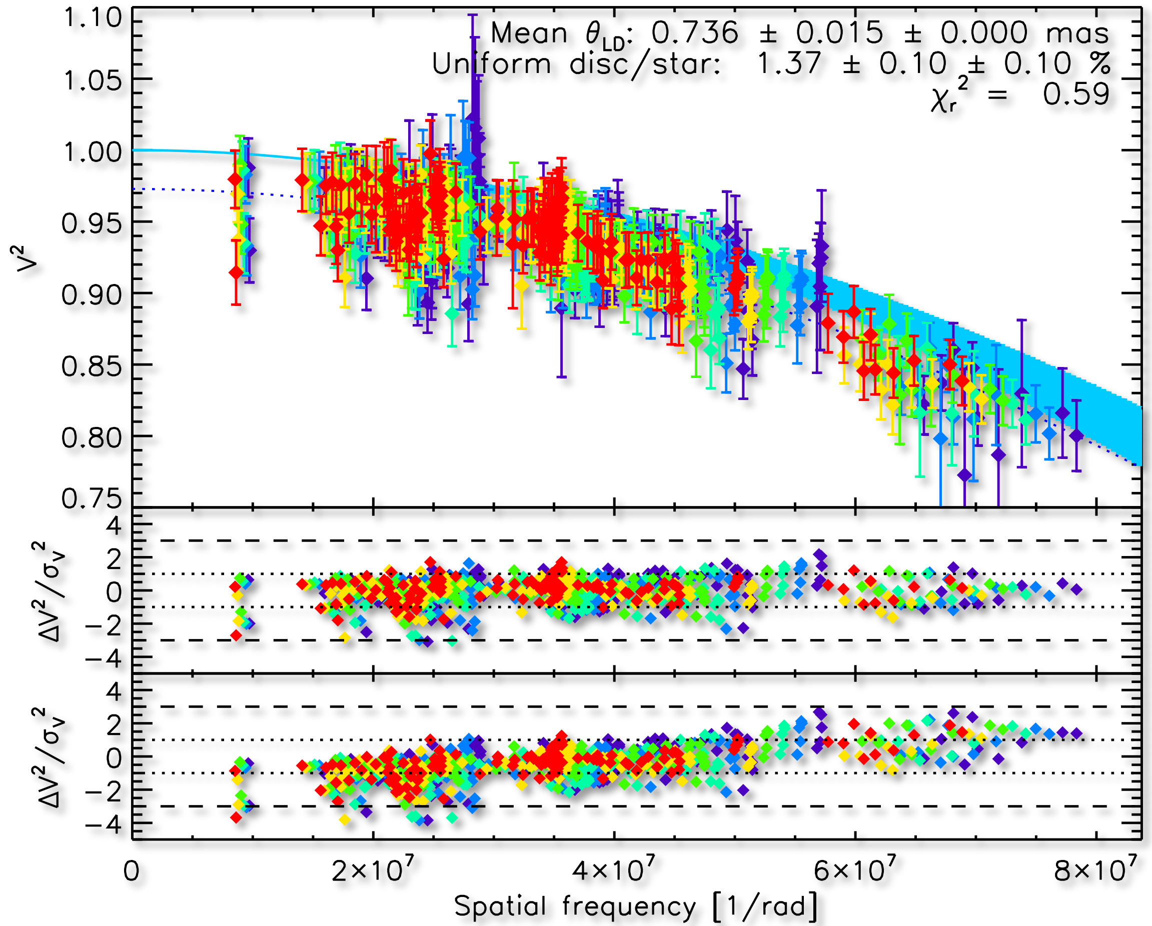
Best detected at short baselines (~10-30m)





VLTI/PIONIER data set

Defrère et al. 2012



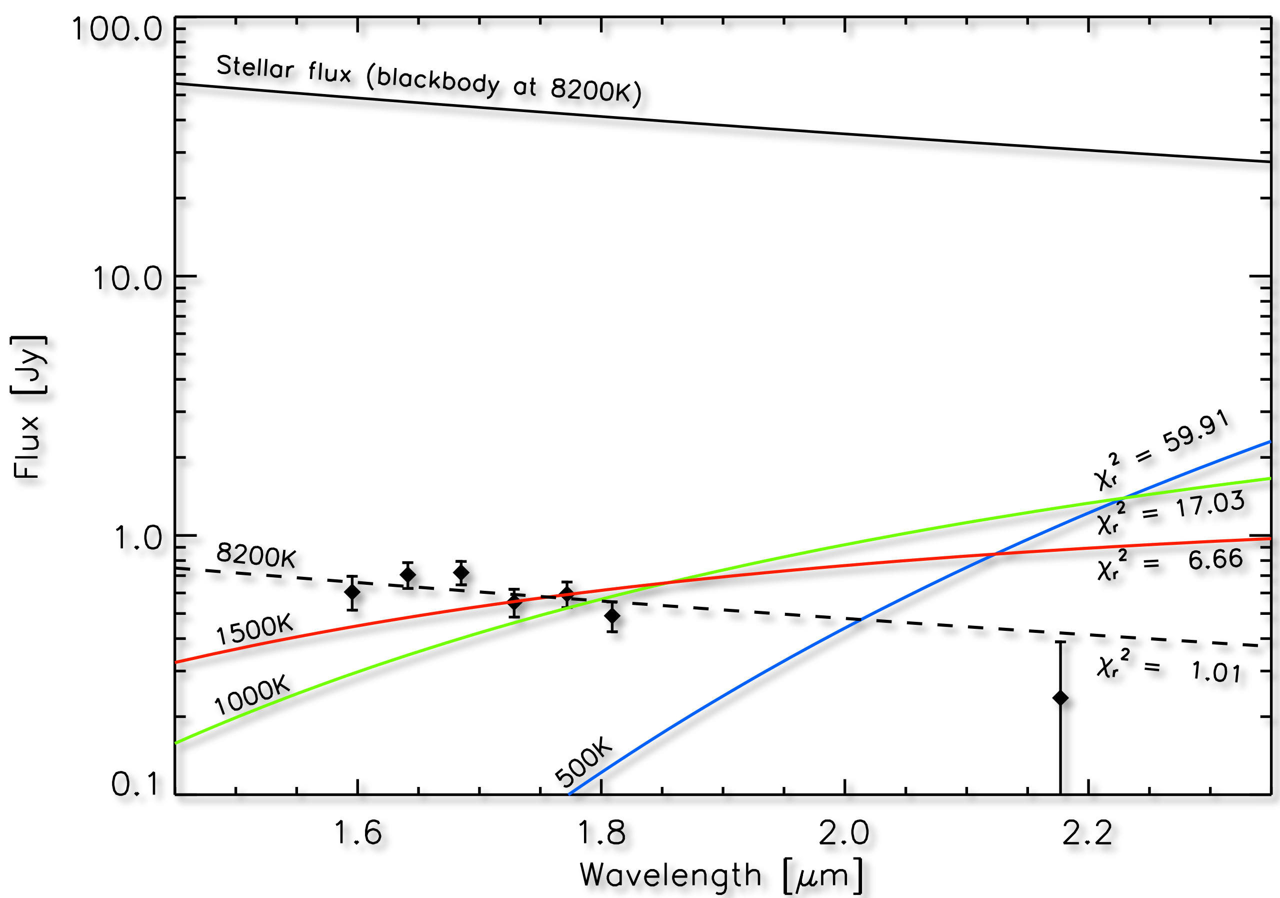
FOV: 4 AU in radius

Star + disk

Star only

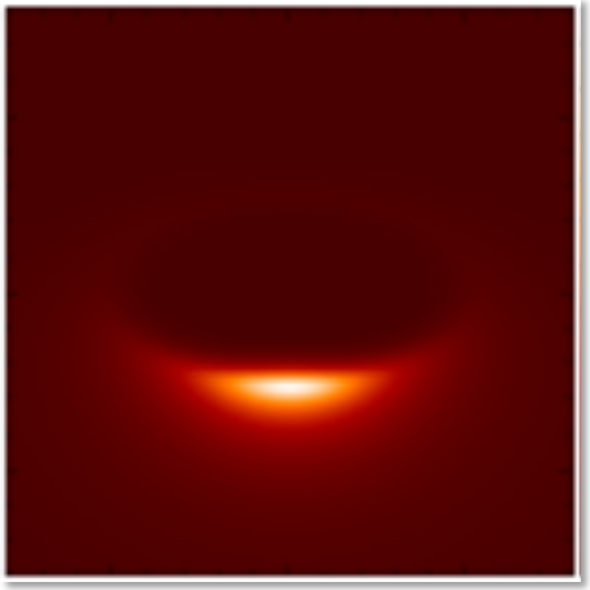
NIR contrast vs wavelength

Defrère et al. 2012



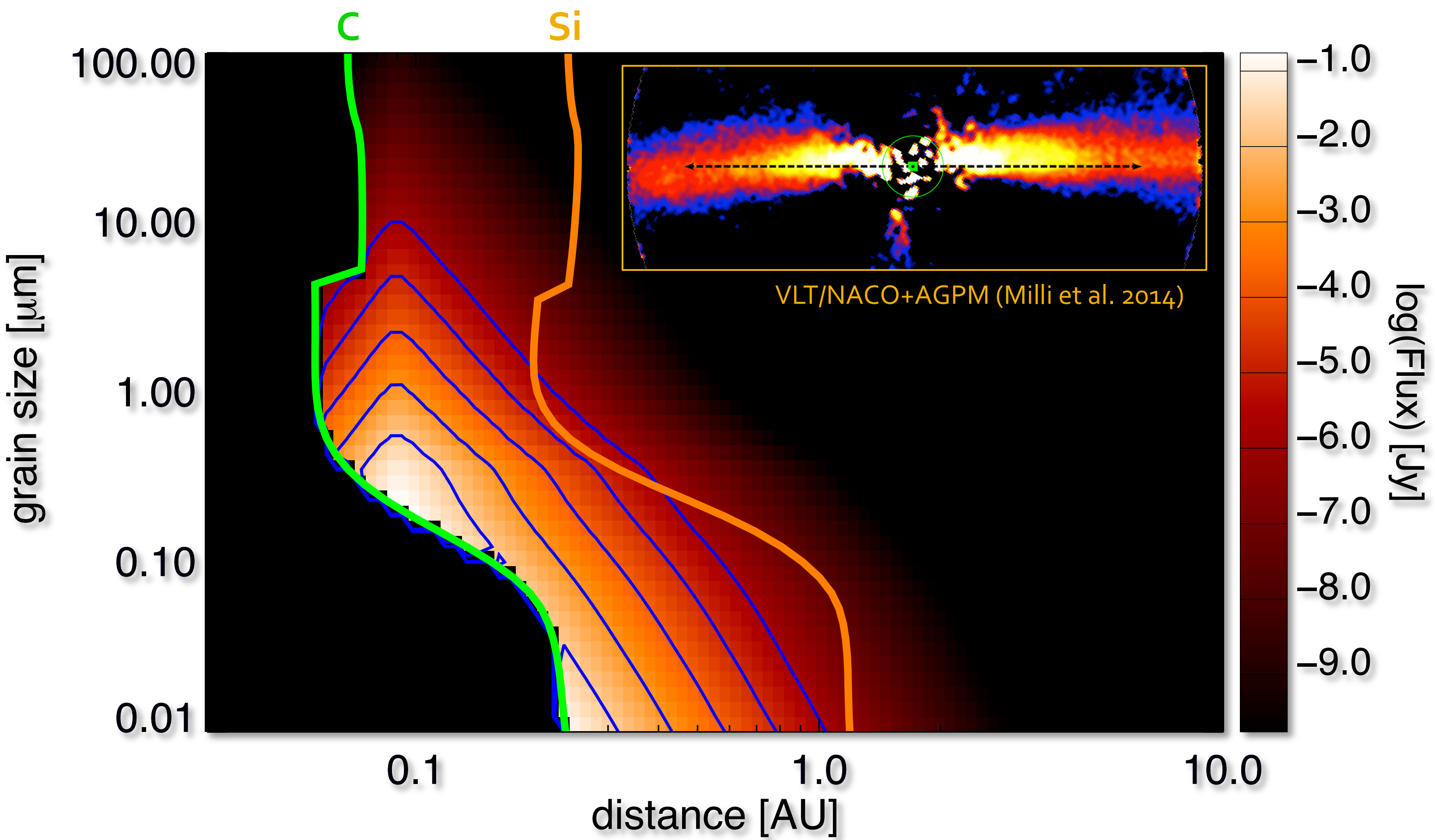
Origin of circumstellar excess

- Spectral behaviour indicative of very hot dust/gas or scattering
- Forward-scattering by edge-on disk can produce up to 70% of measured excess
  - Conservative estimation based on Mie theory
- Probably a mix of hot dust/gas and forward-scattering



Hot dust scenario (here: Fomalhaut)

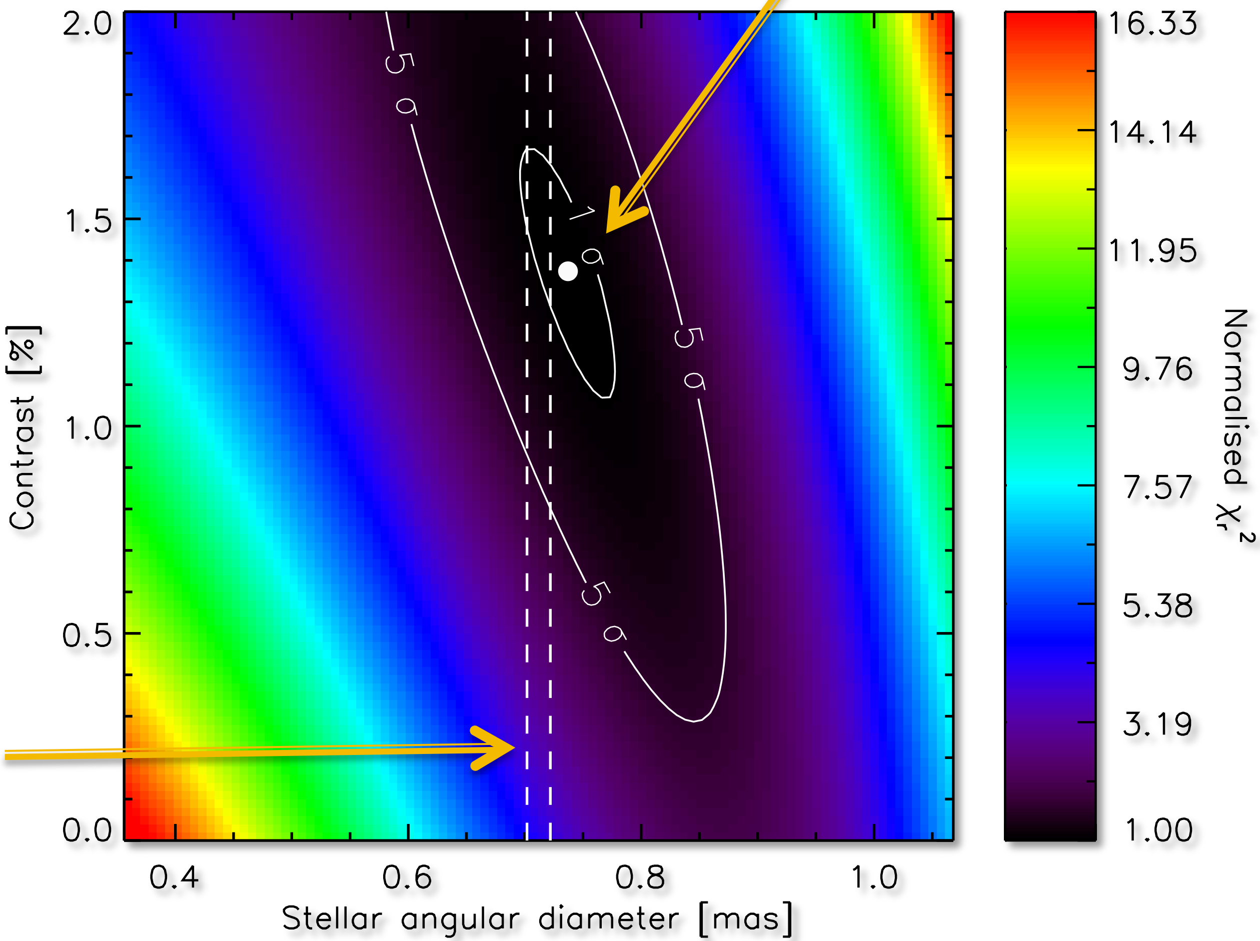
Lebreton et al. 2013



By-product: stellar diameter

Defrère et al. 2012

Best fit: 0.736 ± 0.019 mas



Predicted by photometry

Conclusions / Perspectives

- Population of hot dust grains or hot gas close to the sublimation radius
  - Signpost of the FEB phenomenon?
  - Production rate and accumulation to be investigated
- Possible constraint on outer disk scattering properties (need more data / simulations)
- No massive, inner companion at 30 Mjup level
- Interferometry not sensitive enough to follow b's orbit within 100 mas from β Pic
  - Need to push the dynamics in future instruments