The role of cataclysmic and continuous collisions in debris disks

A study with high resolution mid-IR imaging

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Chris Packham

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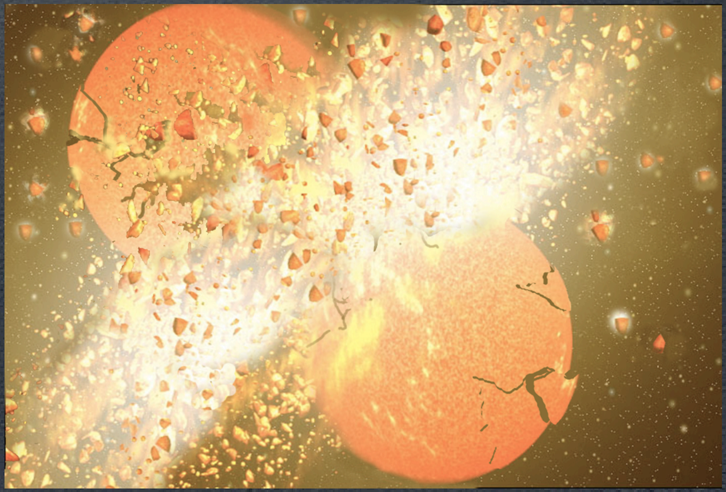
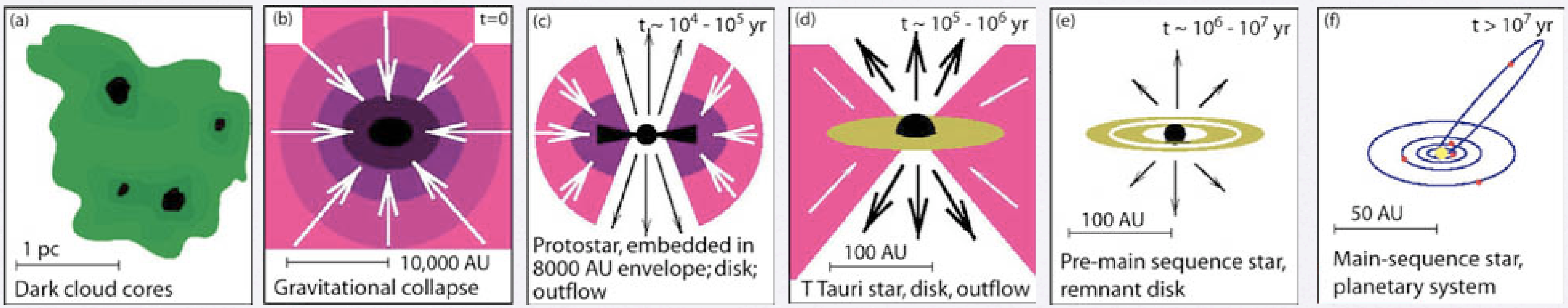


Overview

- Why study debris disks?
- What does mid-IR imaging show?
- Object selection
- Early results for zeta Lep
- Next steps: finish imaging sample and models; CanariCam coronagraphy

Debris disks & their place in planetary evolution



- >few Myr old
- identified by IR excess above photosphere
- probably optically thin (more certain with age)
- may correspond to our era of heavy bombardment: bulk of accretion processes have likely ended

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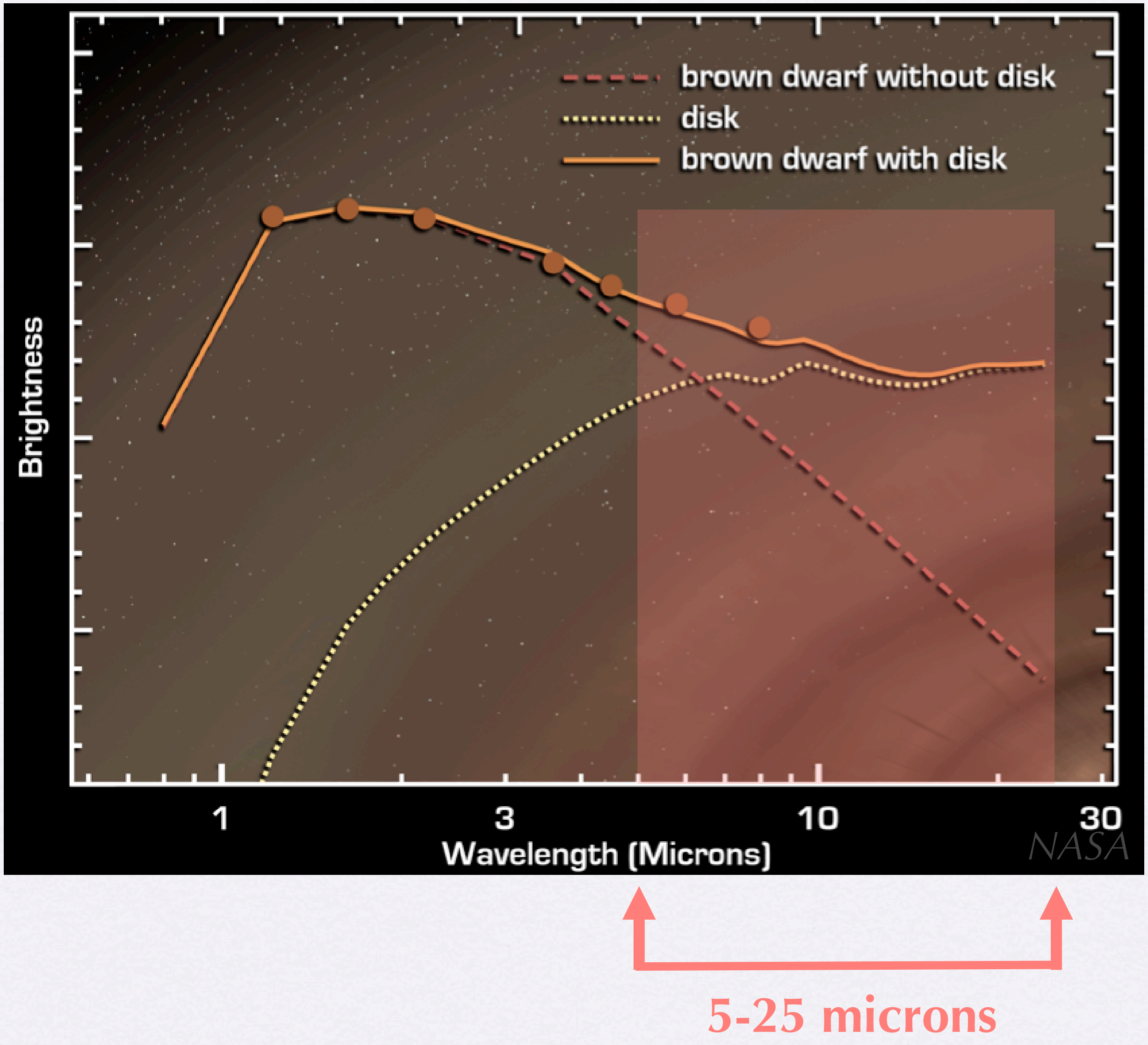
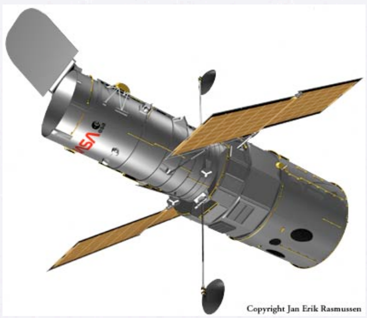
mid-IR regime

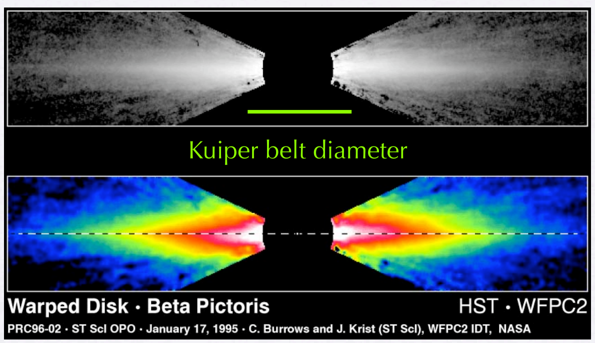


advantages of mid-IR imaging with T-ReCS

using the example of beta Pic

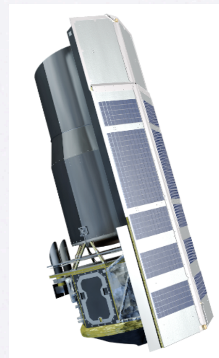
HST + WFPC2





λ ~ 100-1000 nm
D = 2.4 m

Spitzer + MIPS



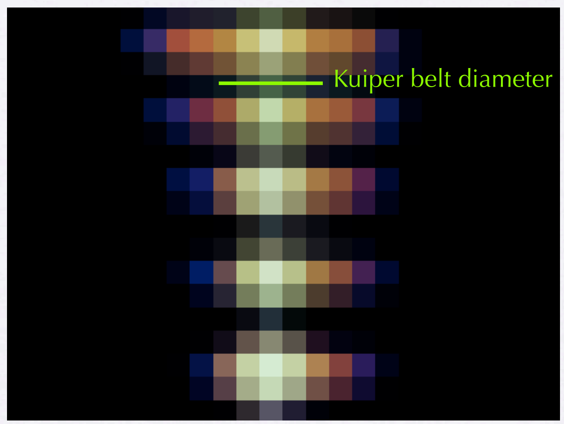
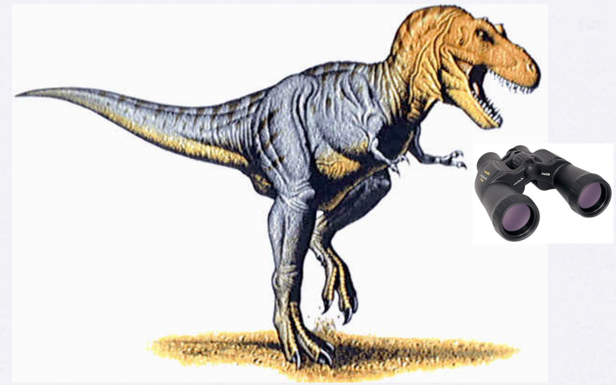
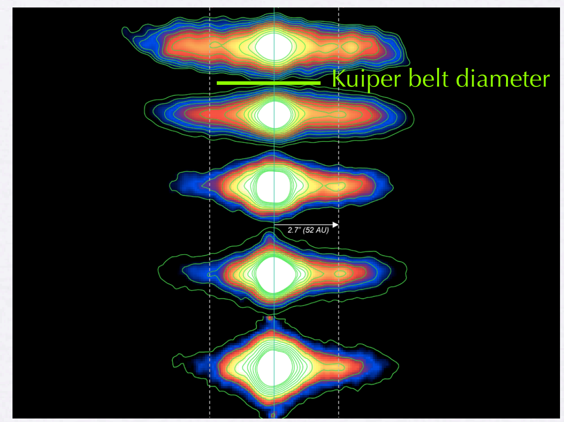


image at right, degraded to nominal MIPS resolution

λ ~ 25-160 μm
D = 0.85 m

Gemini + T-ReCS





λ ~ 5-25 μm
D = 8.1 m

all diffraction limited

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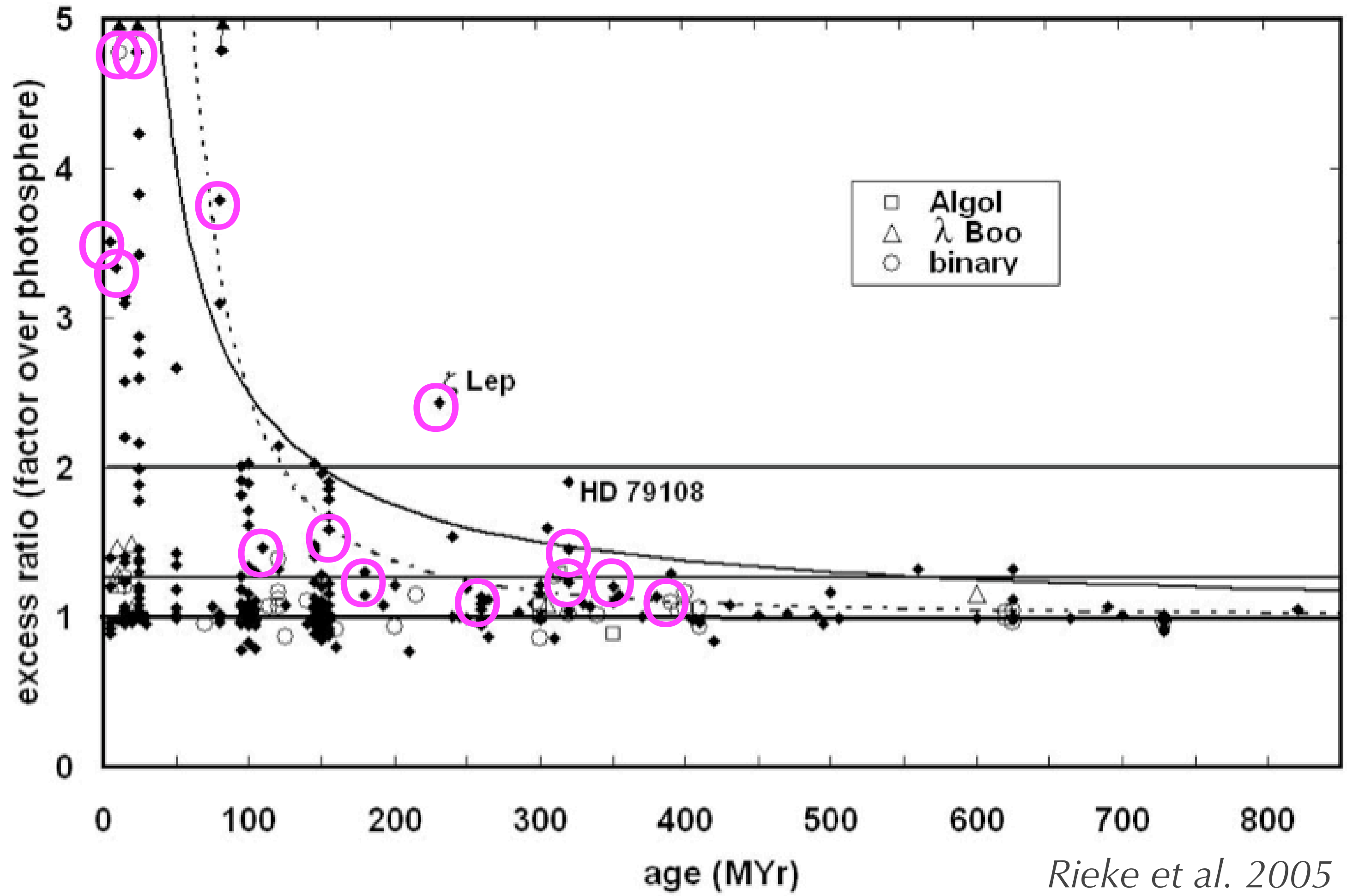
initial debris disk sample (south)

taken from Spitzer survey



Rieke et al. 2005

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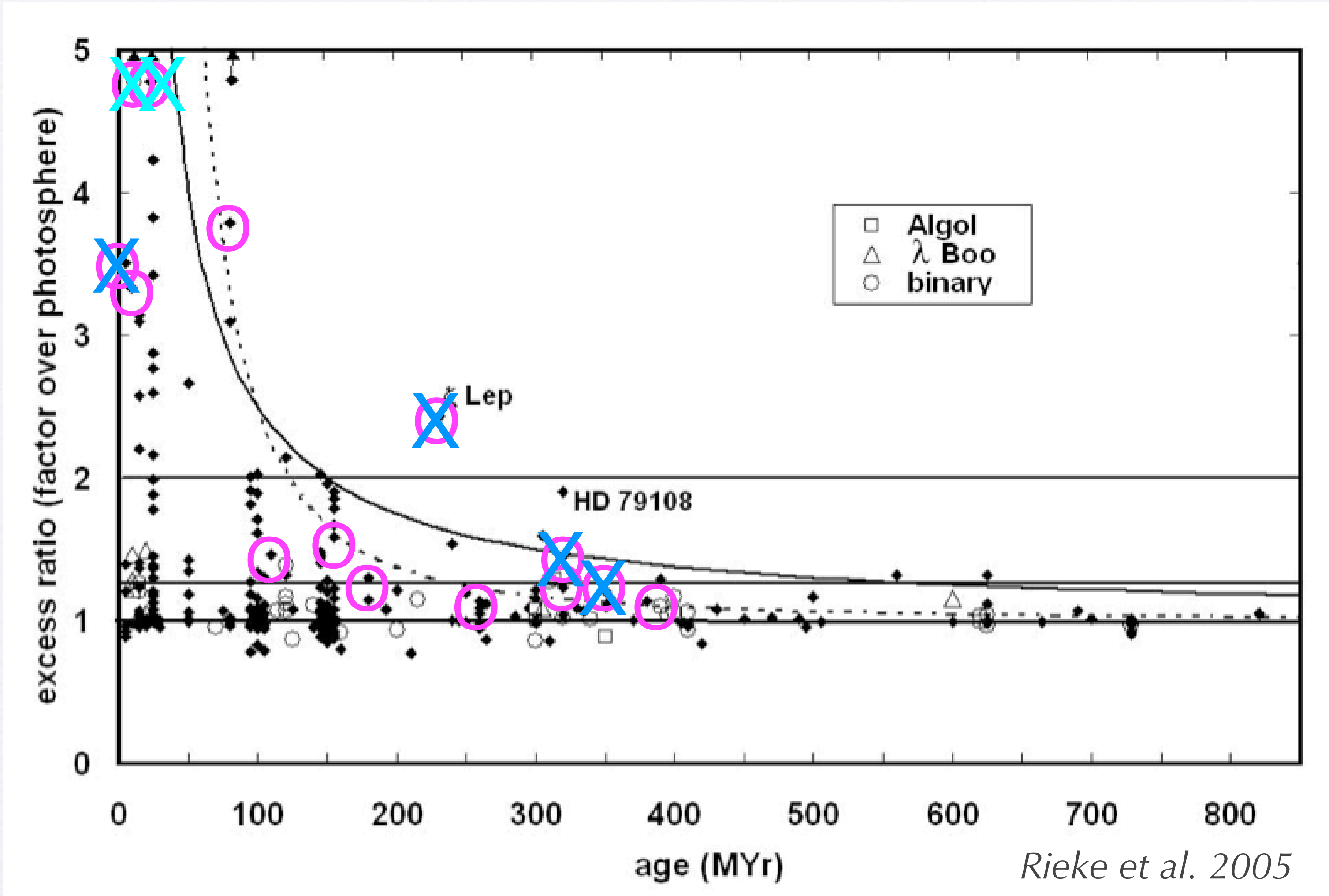

X observations carried out at Gemini semester 2004A

X previously observed; HR 4796 & beta Pic

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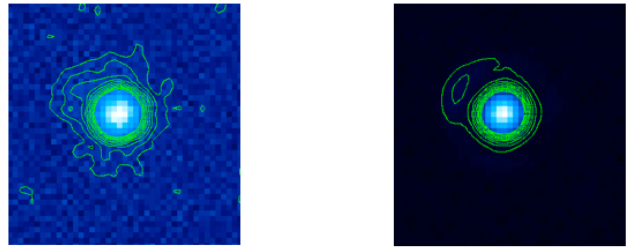
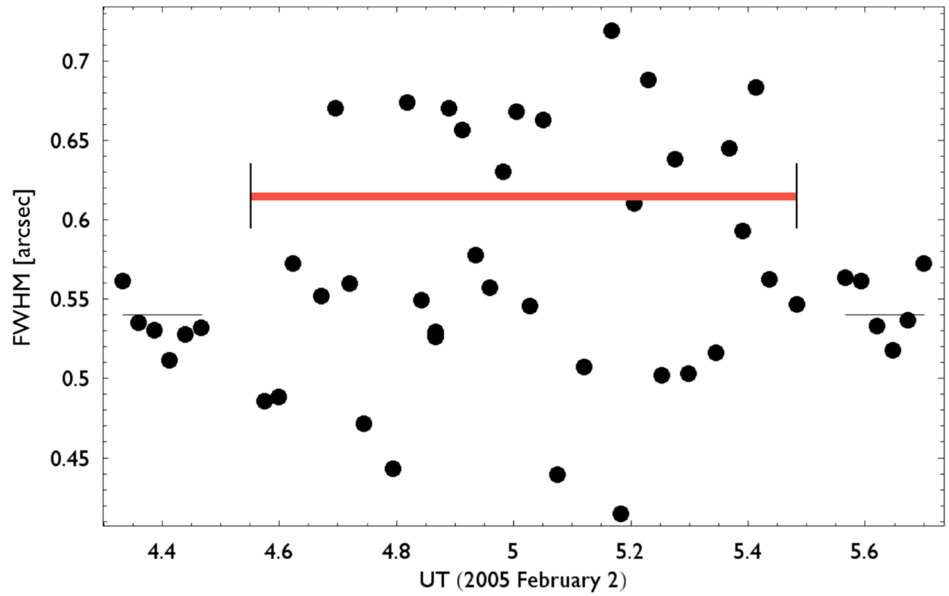
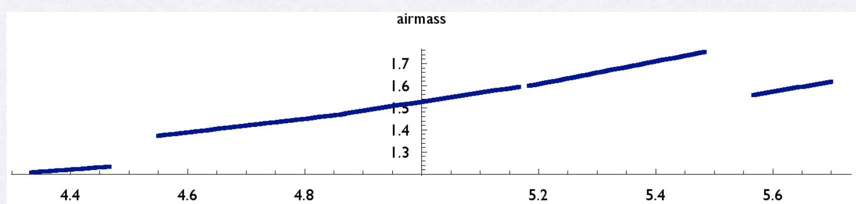
ζ Lep data

(at 18.3 μm)



ζ Lep PSF star





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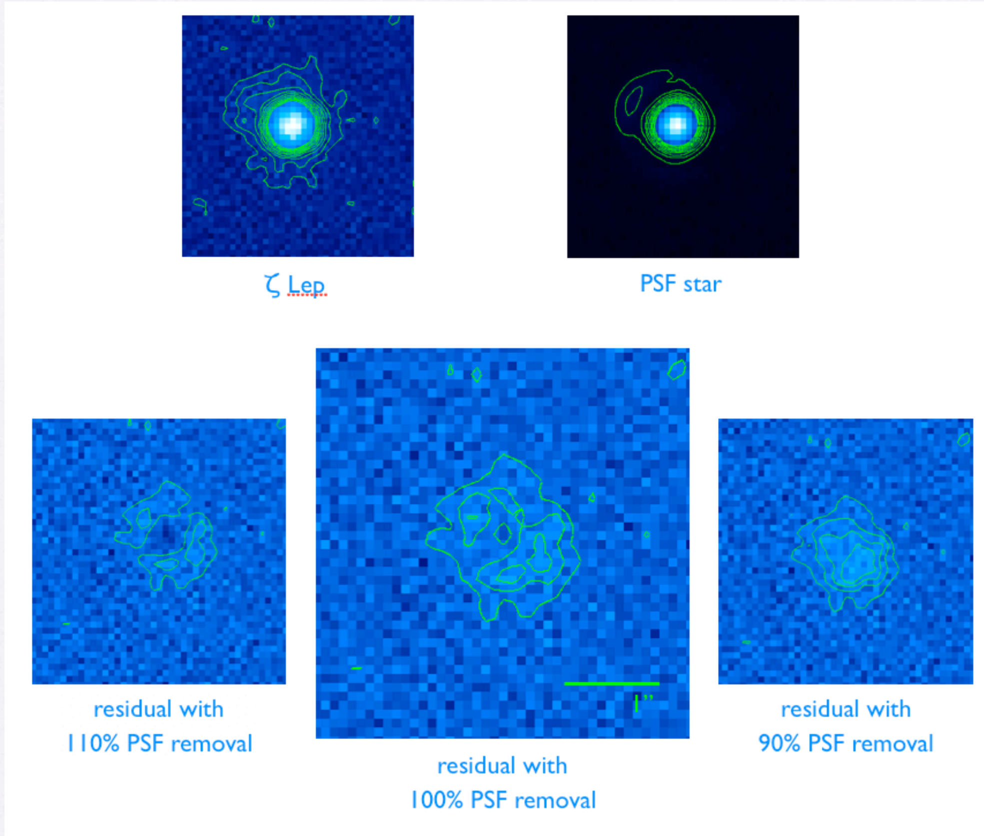
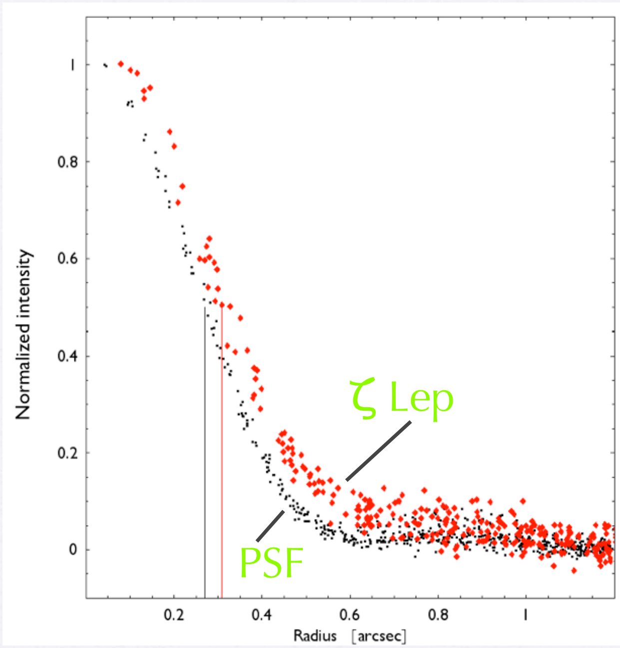
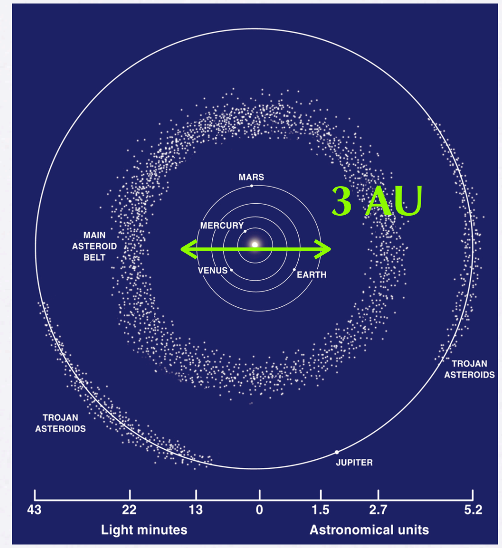


ζ Lep analysis



quadratic subtraction at FWHM implies emitting disk width ~3 AU



ζ Lep d = 21 pc

β Pic d = 18 pc

→

so why such a difference in extent?

age ? (β Pic younger by >250 Myr)

stochastic processes ?

both/related ?

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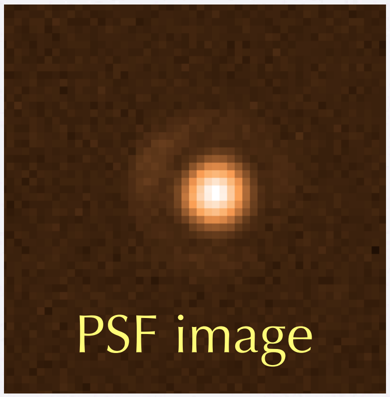
what next?

convolve PSF data with disk and ring/belt models >> see which models could yield the observations of ζ Lep



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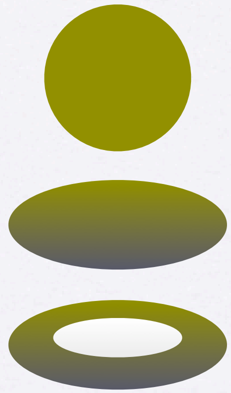

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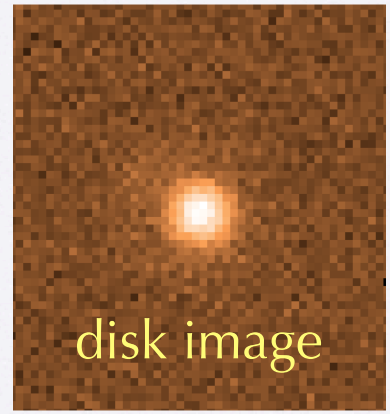

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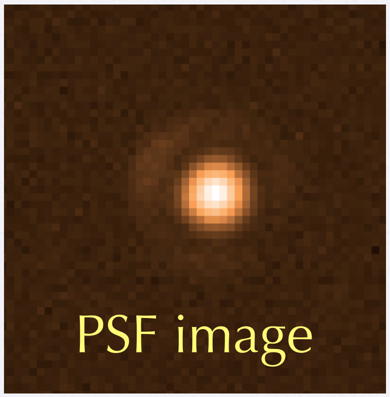

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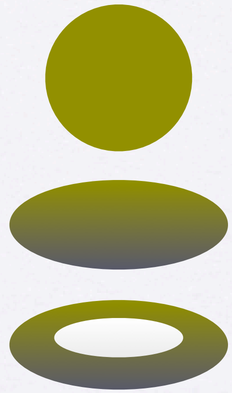

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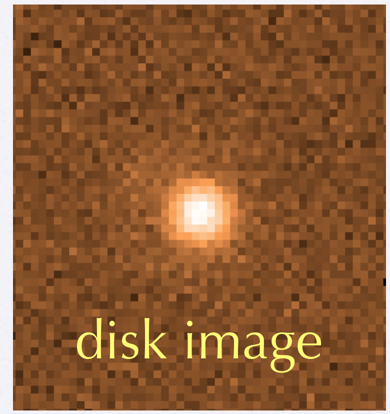
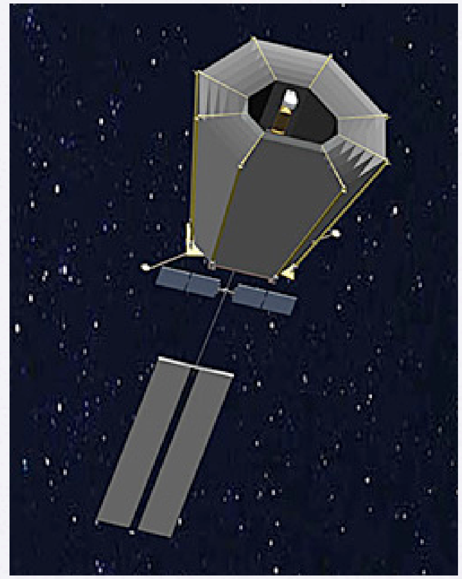
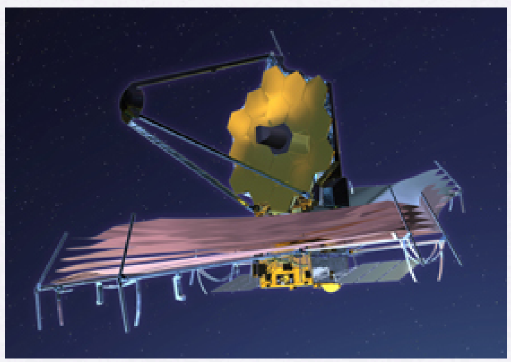
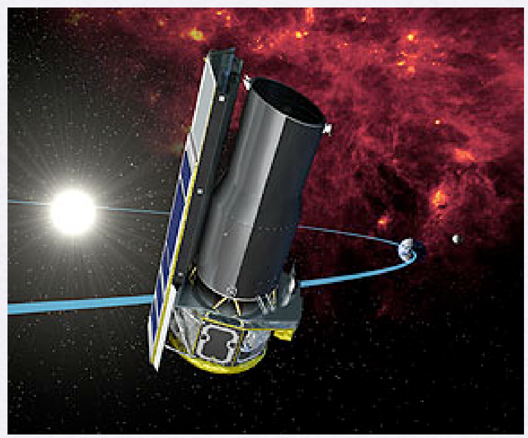


NEXT: Analyze the remaining objects in the sample similarly

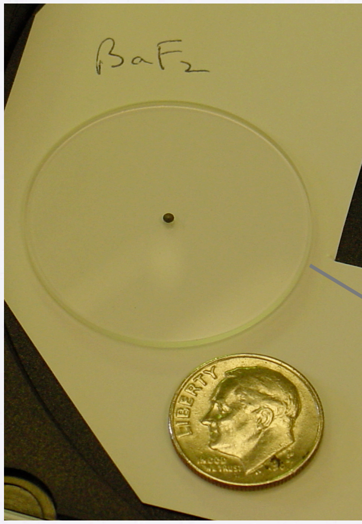
- If the debris disks are not resolved, why not?
  - emitting dust particles are large
  - optically thick, inner ring heating
  - continuous production from innermost dust
  - disk truncated by binary companion star (e.g. HD 98800)



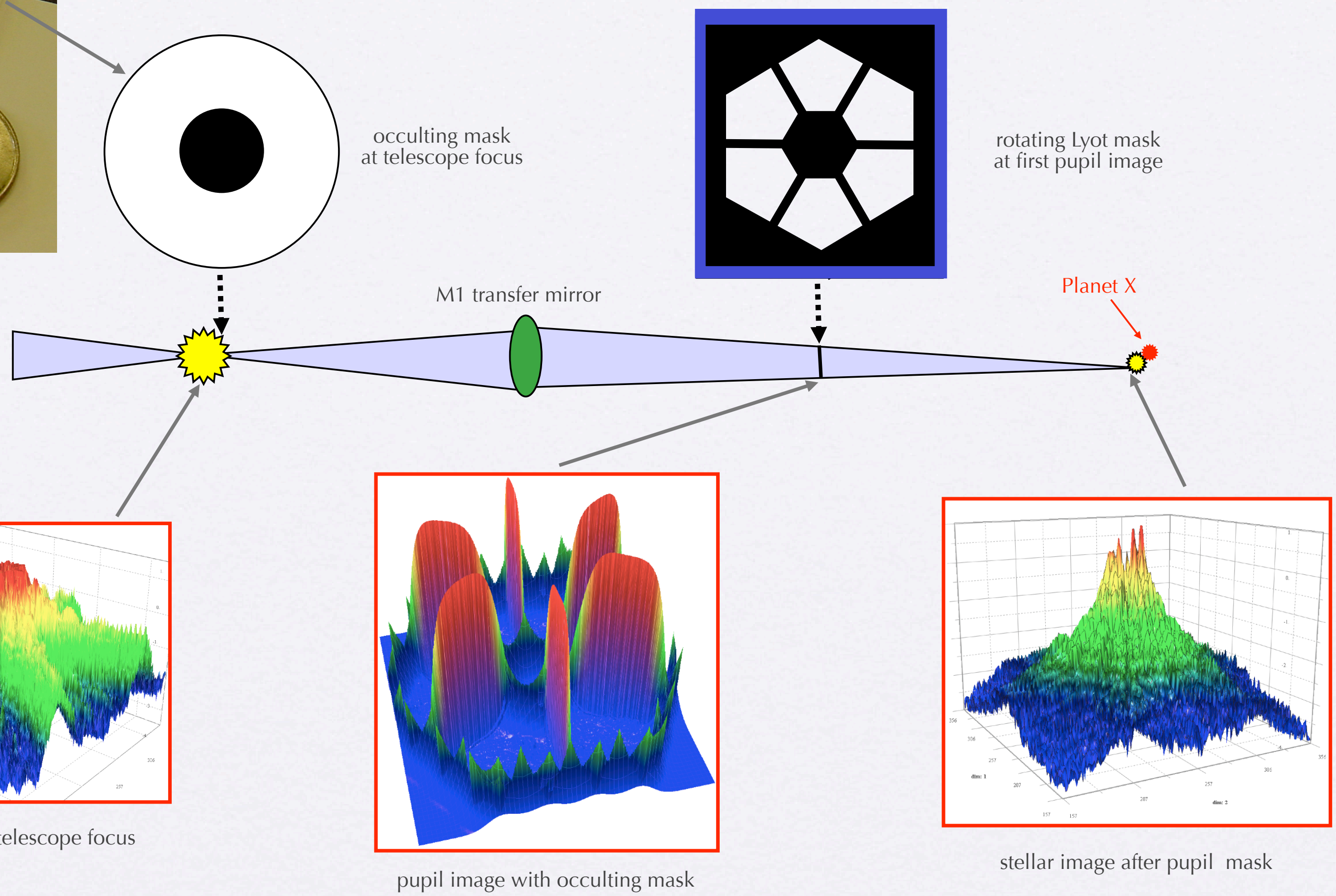




the end



CanariCam coronagraphy at the GTC



models by C. Ftaclas (U. Hawaii) & C. Telesco

gain with CanariCam coronagraphy