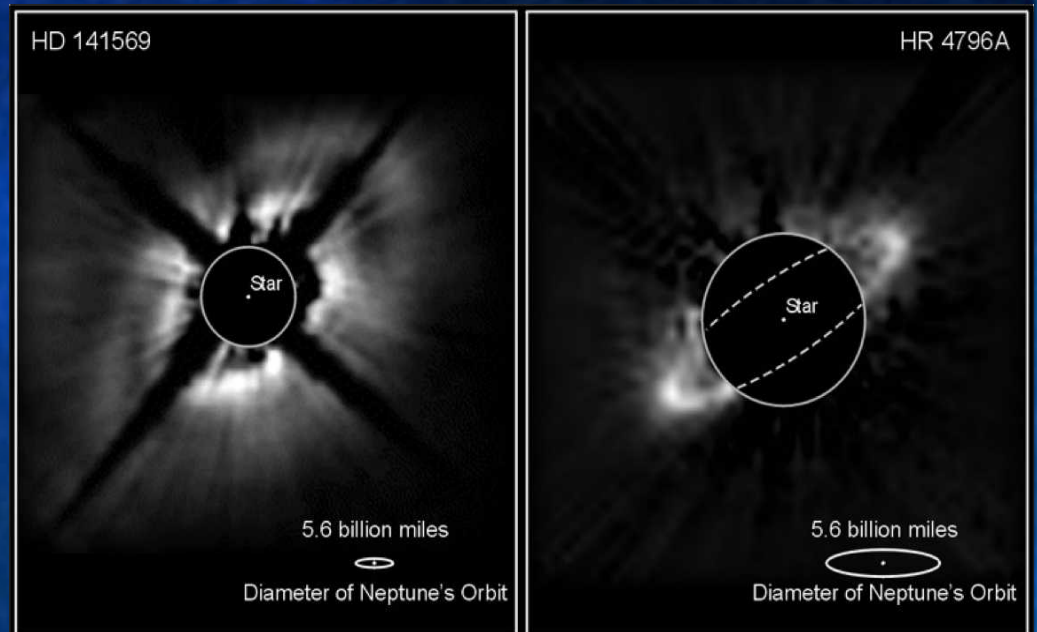


Keck NGAO  
Galactic Science Subgroup

*Debris Disk Science Case*  
Stanimir Metchev, UCLA

# Science Focuses on Optically Thin Circumstellar Disks

- structure
- composition
- evolution
  
- embedded planets?
- grain growth?



**Dust Disks around Stars**

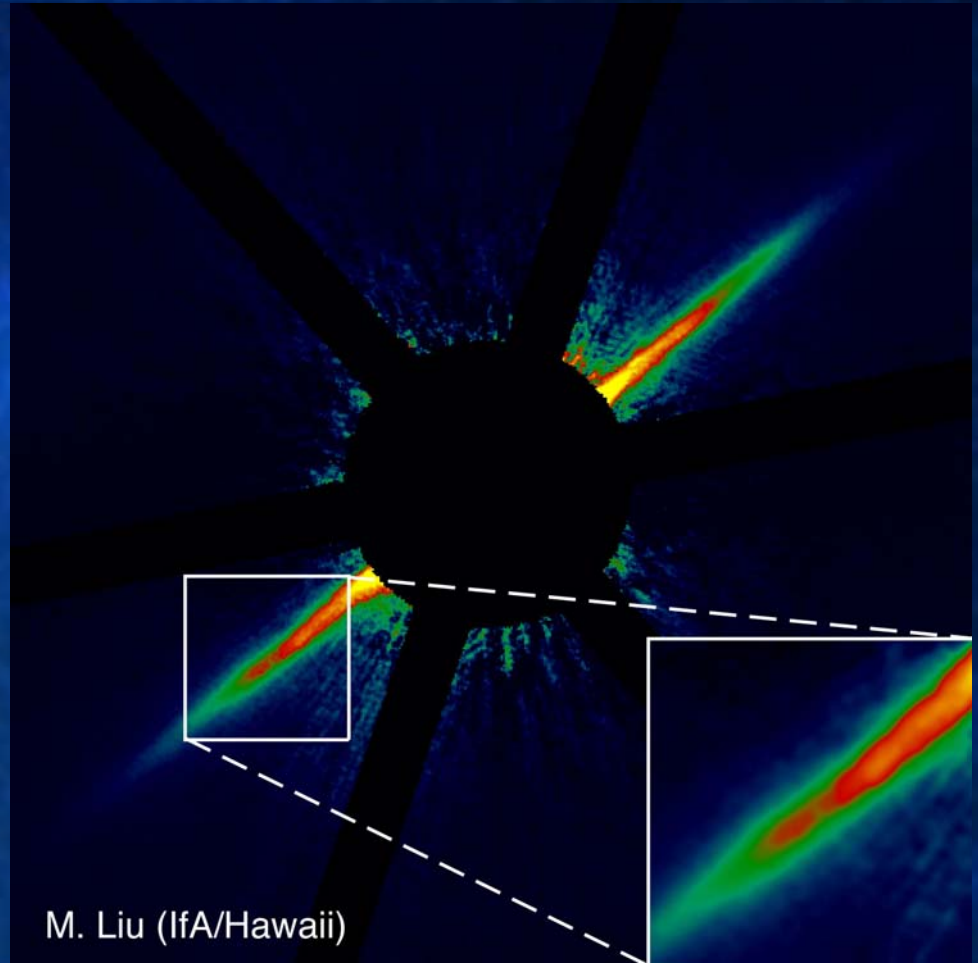
PRC99-03 • STScI OPO • January 8, 1999

B. Smith (University of Hawaii), G. Schneider (University of Arizona),  
E. Becklin and A. Weinberger (UCLA) and NASA

HST • NICMOS

# Science Focuses on Optically Thin Circumstellar Disks

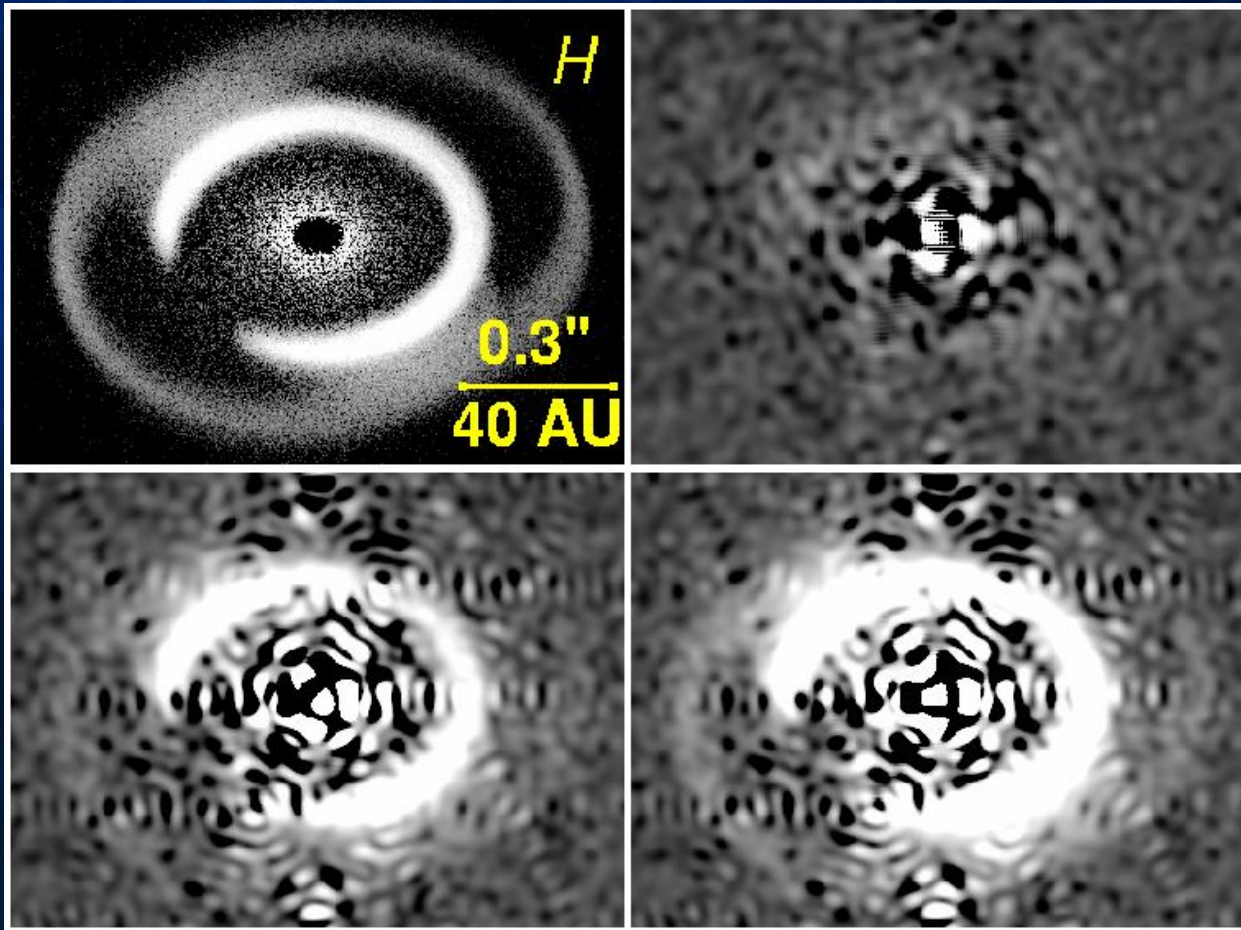
- structure
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- grain growth?



M. Liu (IfA/Hawaii)

*Predominantly around <100 Myr-old stars*

# Disk Structure & Embedded Planets: Need High Strehl



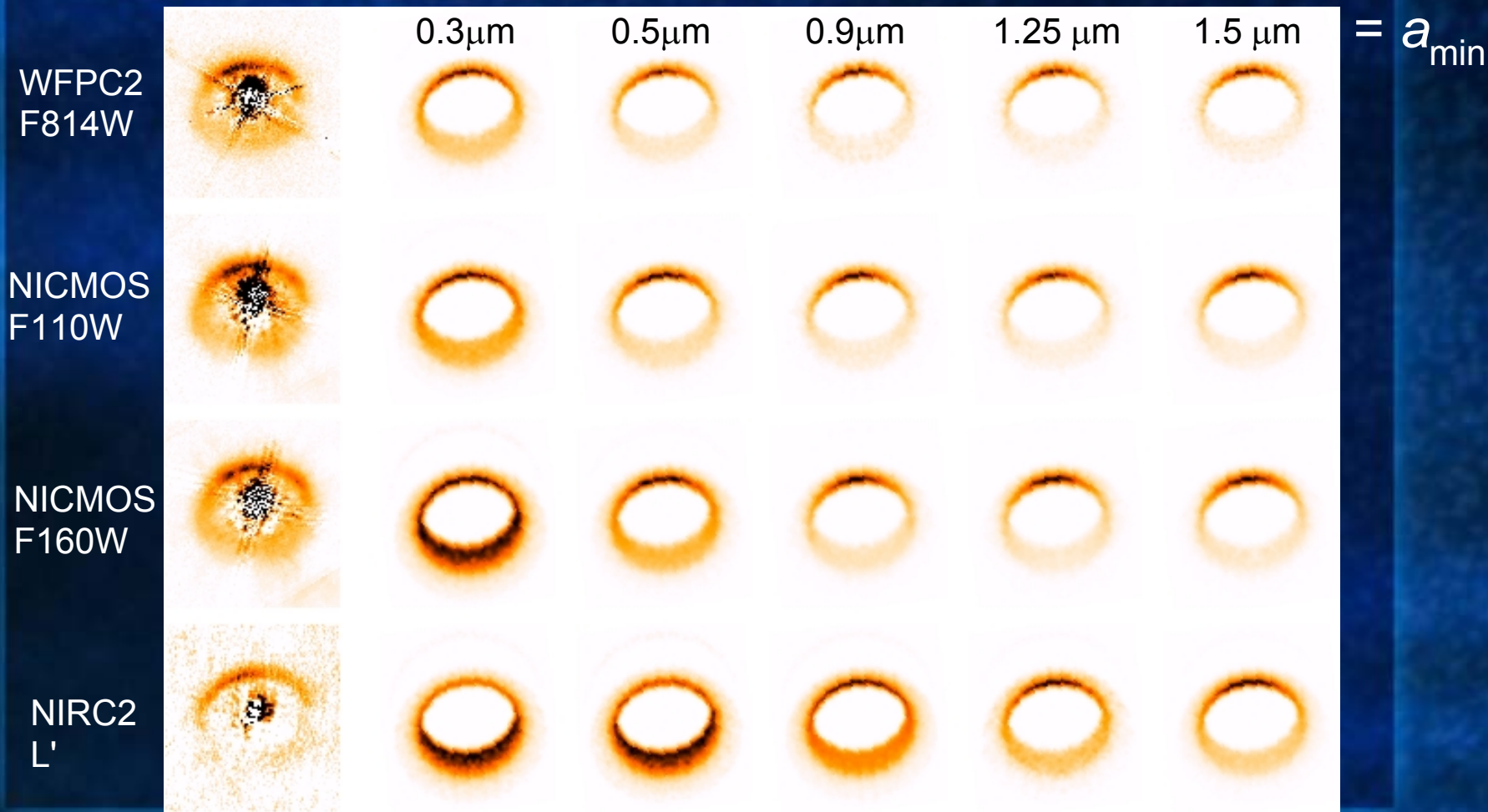
$S=27\%$   
 $\sim$ today

$S=82\%$   
 $120 \text{ nm r.m.s.}$

$S=90\%$   
 $90 \text{ nm r.m.s.}$

$L_{\text{IR}}/L_* = 10^{-4}$  debris disk in the Pleiades, G2 star,  $a = 40 \text{ AU}$  planet  
*S. Wolf, priv. comm.*

# Grain Growth: Need High Strehl over Large Wavelength Range & Polarimetry



Observations

Models

*Duchene et al. (2004)*

# Requirements for Keck NGAO: Narrow-Field High-Strehl AO

- Strehl ratio  $\geq 80\%$  at  $1.6 \mu\text{m}$ :
  - comparable to HST
- isoplanatic field  $r \sim 20''$  at  $\geq 1.6 \mu\text{m}$  :
  - AU Mic disk:  $r = 21''$
- operability in the visible:  $\geq 0.6 \mu\text{m}$
- IR tip/tilt sensor:
  - disks around M stars, brown dwarfs(?)
- real-time telemetry:
  - enhanced contrast through PSF reconstruction

# Requirements for Keck NGAO: Science Instruments

- coronagraphic capability:
  - hard-edged spot? Gaussian transmissivity?
- speckle suppression:
  - differential polarimetry: speckles are not polarized
  - IFU: speckles have known chromaticity
- polarimetry:
  - grain properties
- low detector readnoise ( $\leq 5 e^-$ ):
  - attain sky background-limited imaging
- FOV  $\geq 20''$  diameter

# Needed Simulations/Measurements

- realistic 0.6 – 3.4  $\mu\text{m}$  PSFs:
  - also coronagraphic PSFs
- PSF stability over periods of 0.5 – 5 hrs:
  - 1 – 60 sec exposures
  - library of simulated PSFs with varying seeing conditions
  - static errors
- attainable contrast at wavelengths 0.6 – 3.4 microns