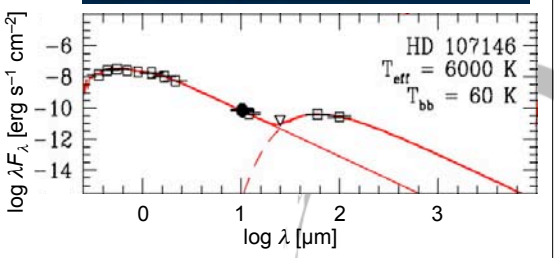
The Resolved Debris Disk around HD 107146

Stanimir Metchev (UCLA)

In collaboration with the Spitzer FEPS,
the HST ACS GTO,
and the NICMOS GO 10177 teams

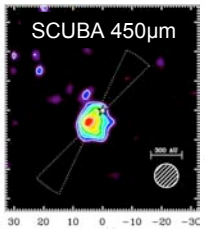
HD 107146: a Young Solar Analog with a Debris Disk

- G2 V
- 29 pc
- 80–200 Myr
- IRAS 60μm and 100μm excesses
- $L_{IR} / L_* = 10^{-3}$

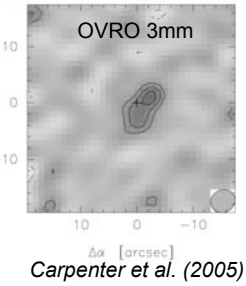


Silverstone (2000); Metchev et al. (2004) 2/12

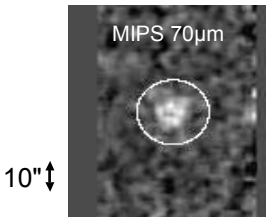
The First Resolved G-Star Debris Disk



Williams et al. (2004)

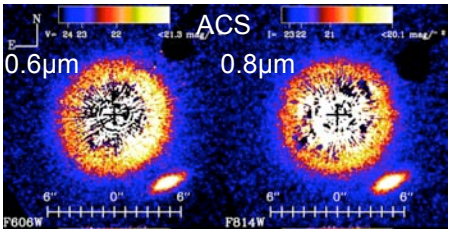


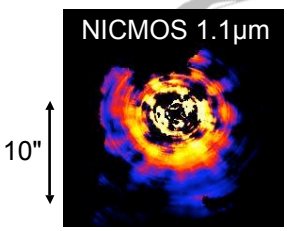
Carpenter et al. (2005)



Bryden et al.; Metchev et al.

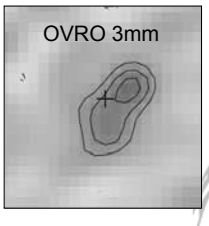
Ardila et al. (2004)



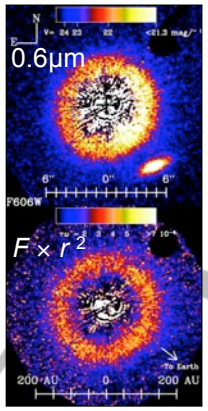


Summary of Properties

- $i \approx 20^{o}$
- azimuthally symmetric
  - forward scattering
- radial extent: 210 AU
- peak surface density: 130 AU
- inner clearing? (<60 AU)
- characteristic grain size: ~1μm



Carpenter et al. (2005)



Ardila et al. (2004)

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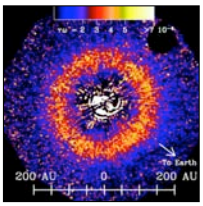
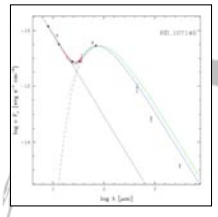
Issues of Interest

- Dust and disk properties
  - number of dust grain populations
    - larger grains in the inner disk?
  - size of inner hole
    - constraints on orbits of potential planets
- Evolutionary state
  - recent collision?





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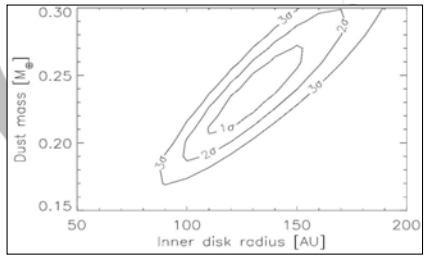
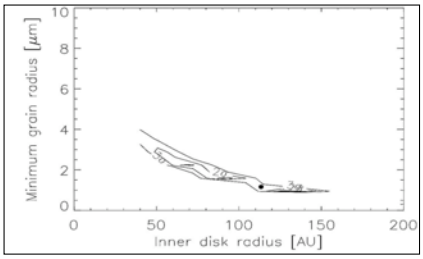
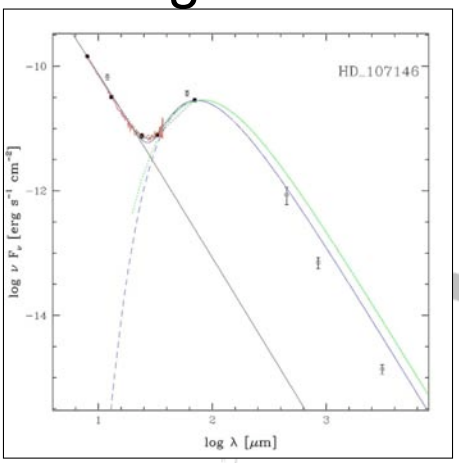
Dust Properties Derived Solely from the SED are Degenerate







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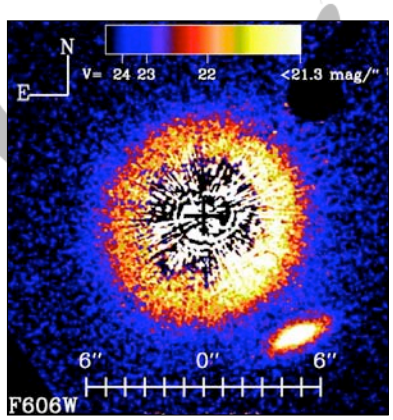
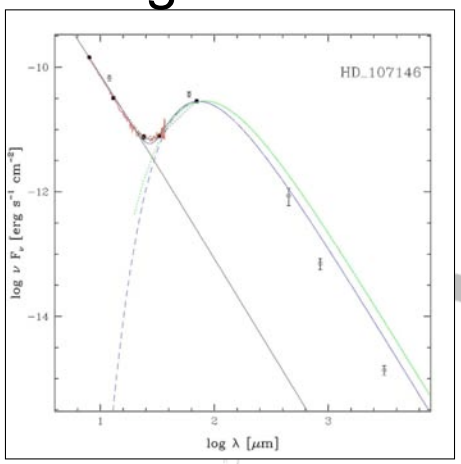
Approach: Combine SED and Resolved Images





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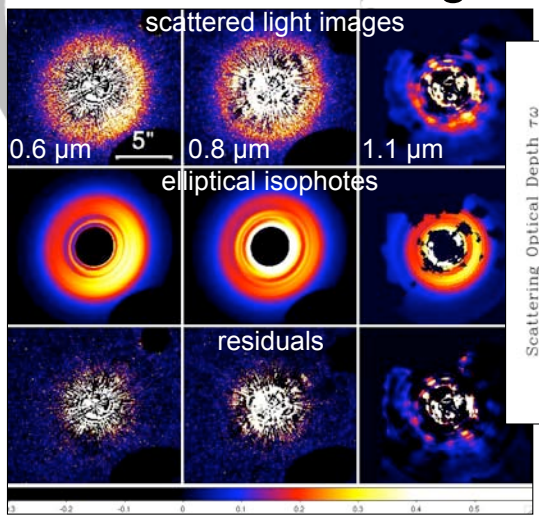
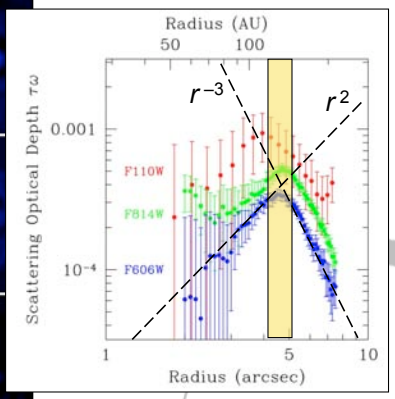
The Radial Surface Density Profile: a Birth Ring at 130 AU





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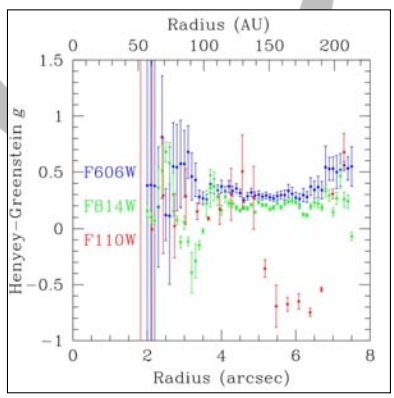
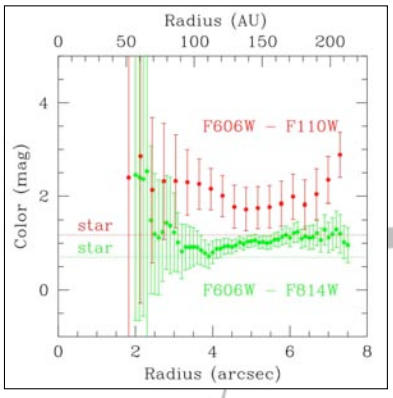
No Evidence for Distinct Grain Size Populations from the Scattered Light



Radial dependence of the Henyey-Greenstein *g* parameter



Radial dependence of the *V*–*I* and *V*–*J* colors

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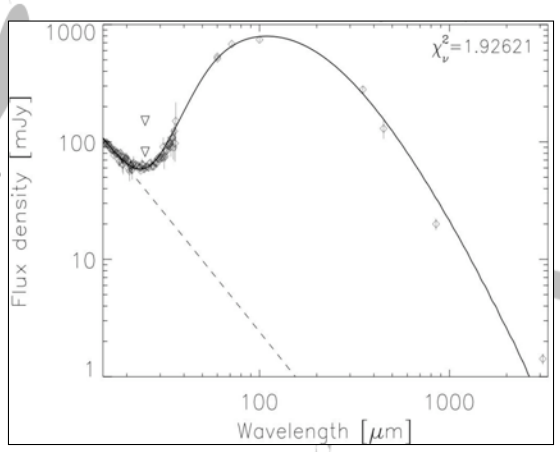
Constraints from SED + IRS Spectrum: Dust at 10 AU

- fitted parameters:
  - r_{in} = **10.0 ± 0.2 AU**
  - a_{min} = 6.5 ± 0.3 μm
  - M_{dust} = 0.18 ± 0.01$M_{\oplus}$
- fixed parameters:
  - r_{out} = 210 AU
  - $n(r) \propto r^{-1}$
  - a_{max} = 3.1 mm
  - $n(a) \propto a^{-3.5}$
  - astronomical silicate



SED fit using DSF debris disk modeling tool, courtesy of J. Rodmann (FEPS)

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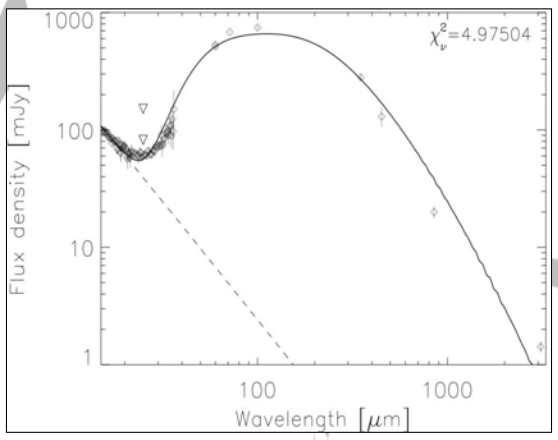
Combined Constraints: Preliminary Results

- fitted parameters:
  - a_{min} = 1.6 ± 0.3 μm
  - M_{dust} = 0.24 ± 0.01$M_{\oplus}$
- fixed parameters:
  - r_{in} = 60 AU
  - r_{out} = 210 AU
  - $n(r)$: $\propto r^{3}$, $\propto r^{-2}$
    - break at r = 130 AU
  - a_{max} = 3.1 mm
  - $n(a) \propto a^{-3.5}$
  - astronomical silicate



SED fit using DSF debris disk modeling tool, courtesy of J. Rodmann (FEPS)

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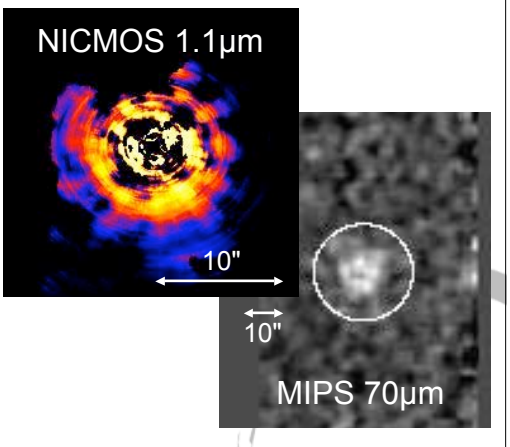
HD 107146: Conclusions

- new resolved images: 1.1 μm and 70 μm
- excellent opportunity to study a debris disk in detail
- single grain population
  - co-eval, recent collision
- significant decrease in opacity at <10 AU



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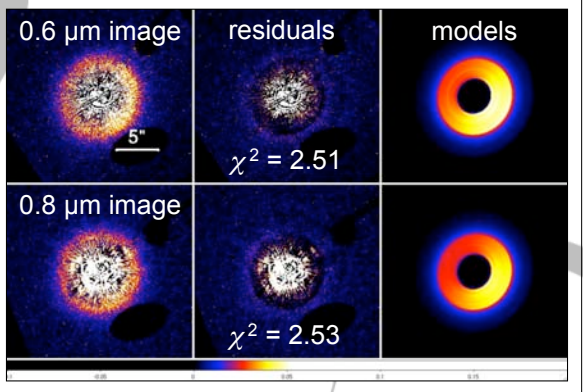
Combined Constraints: Preliminary Results

- fitted parameters:
  - $a_{min} \approx 1$ μm
  - $M_{dust} \approx 0.3\ M_{\oplus}$
- fixed parameters:
  - $r_{in} = 60$ AU
  - $r_{out} = 210$ AU
  - $n(r)$: $\propto r^{3}$, $\propto r^{-2}$
    - break at $r = 130$ AU
  - $a_{max} = 3.1$ mm
  - $n(a) \propto a^{-3.5}$
  - astronomical silicate



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