



Debris Disk Campaign Results from the Gemini Planet Imager Exoplanet Survey

Tom Esposito
(UC Berkeley)

on behalf of the GPIES team,
Disk Co-I's Paul Kalas & Mike Fitzgerald,
PI Bruce Macintosh

Science & Evolution of Gemini Observatory
2018 July 23 - San Francisco, CA, USA

How we get from GPIES to debris disk science

Science
Goal

Improve our understanding of materials available during late stages of planetary system formation



GPIES
Method

Resolve a large sample of debris disks (10-100s Myr) in scattered near-IR light to consistently determine:

DISK STRUCTURE

(where)

DUST COMPOSITION

(what)

Assets

small inner
working angle

high angular
resolution

sensitivity &
high contrast

polarimetry

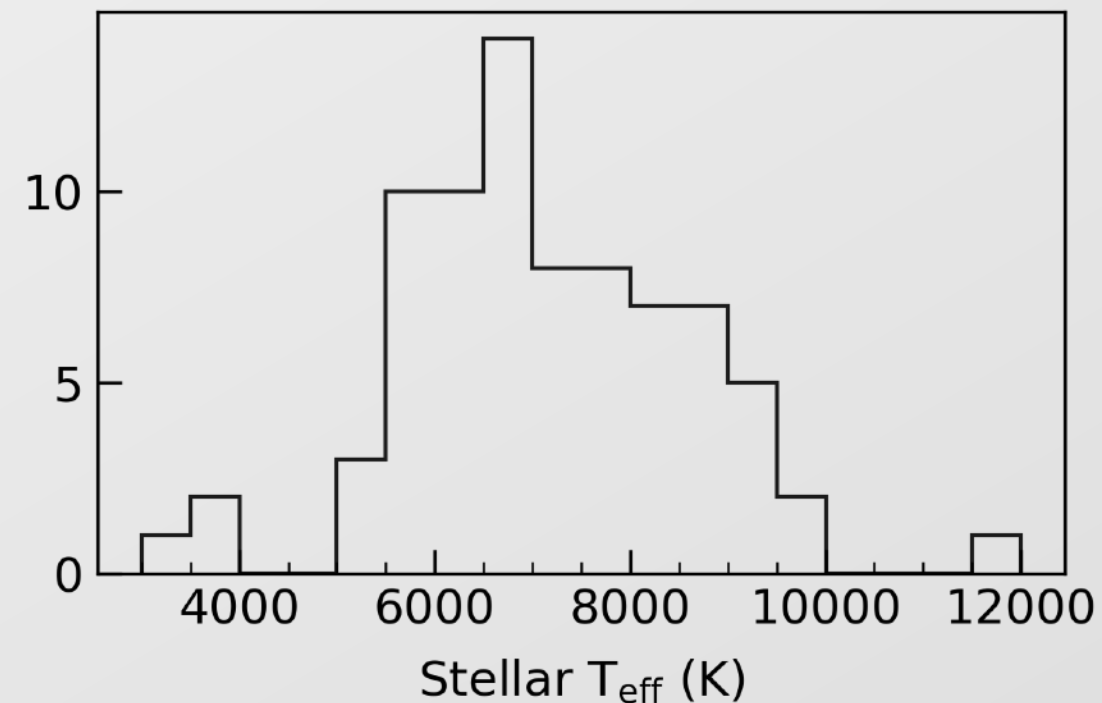
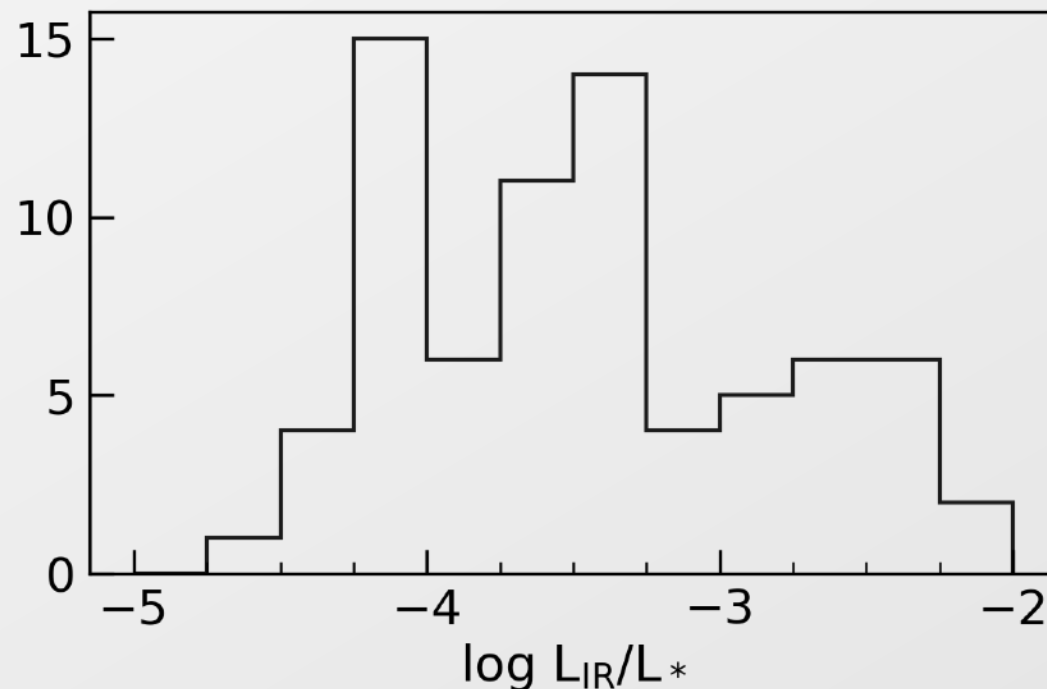
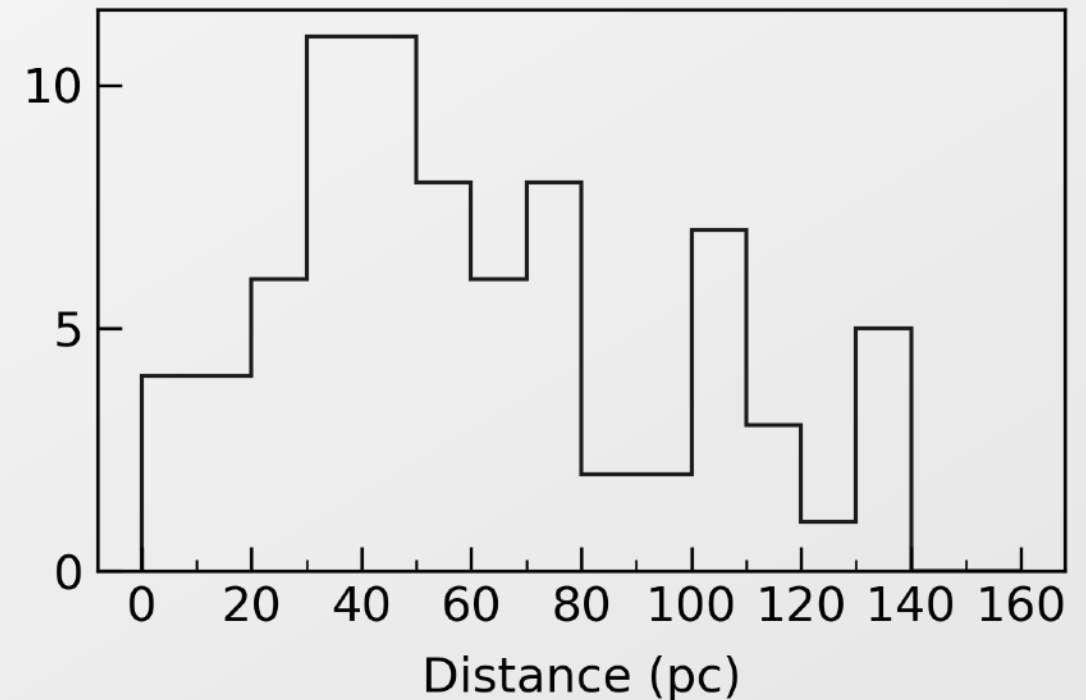
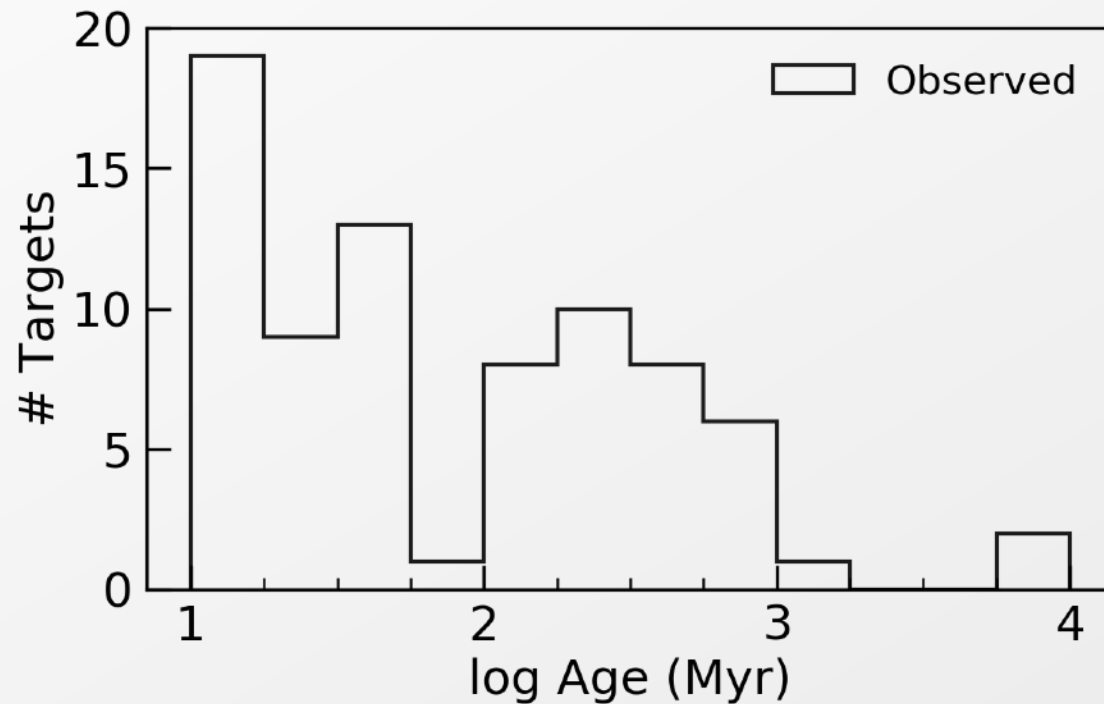
multiple
wavelengths

+ MODELING!

We have observed a 78 star GPIES subset in our *H*-band disk search (ongoing)

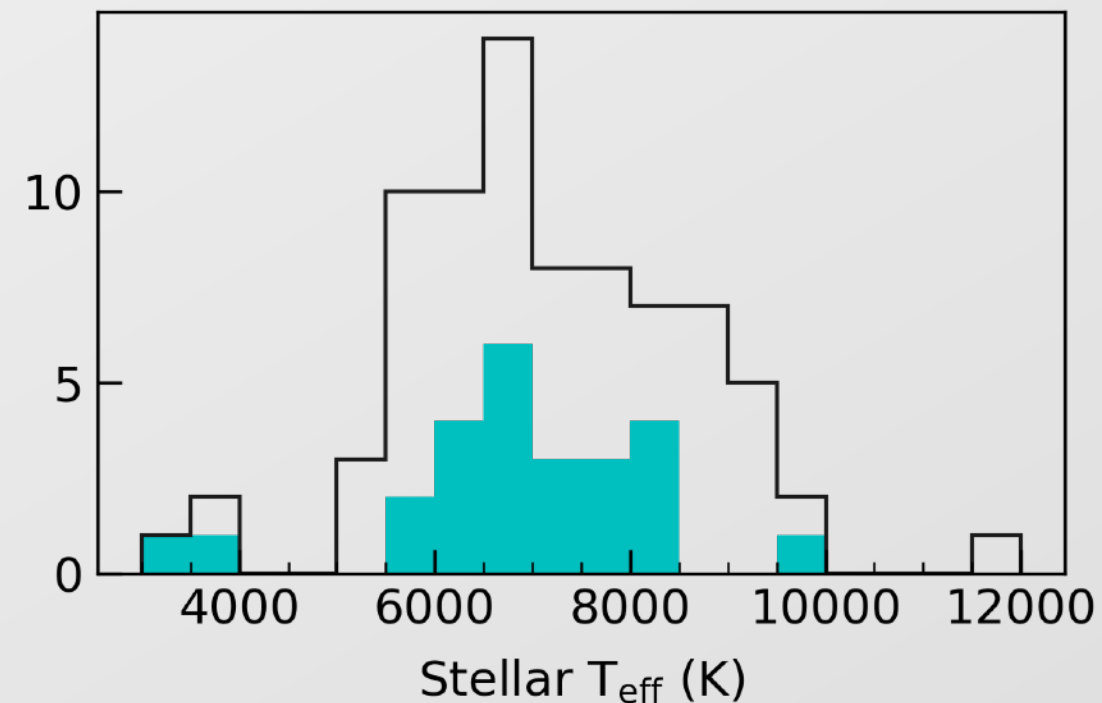
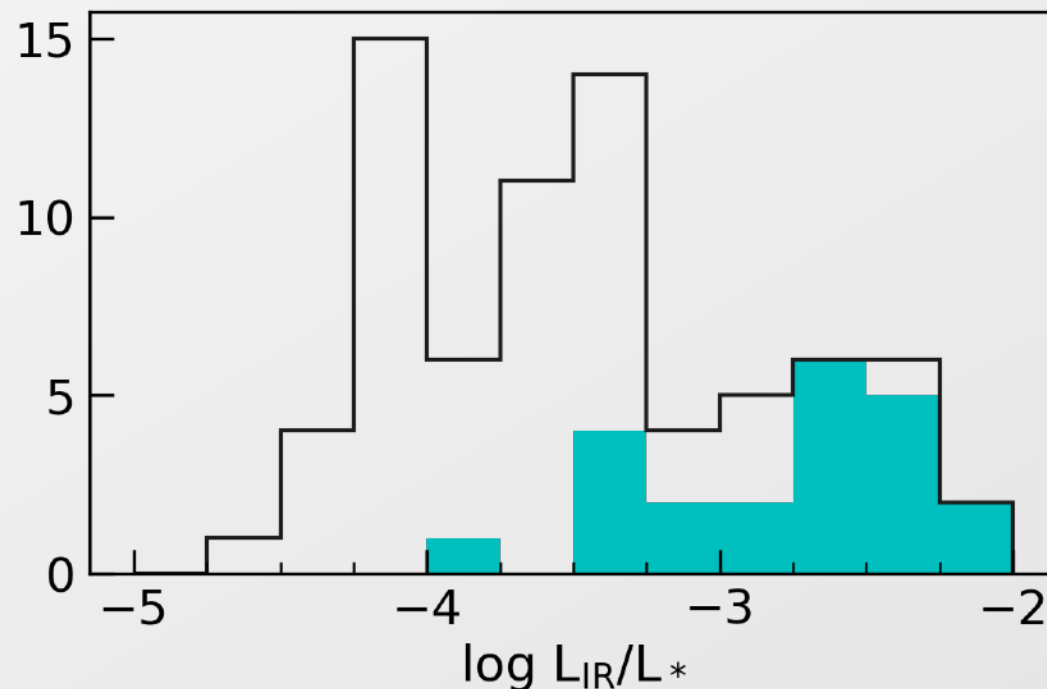
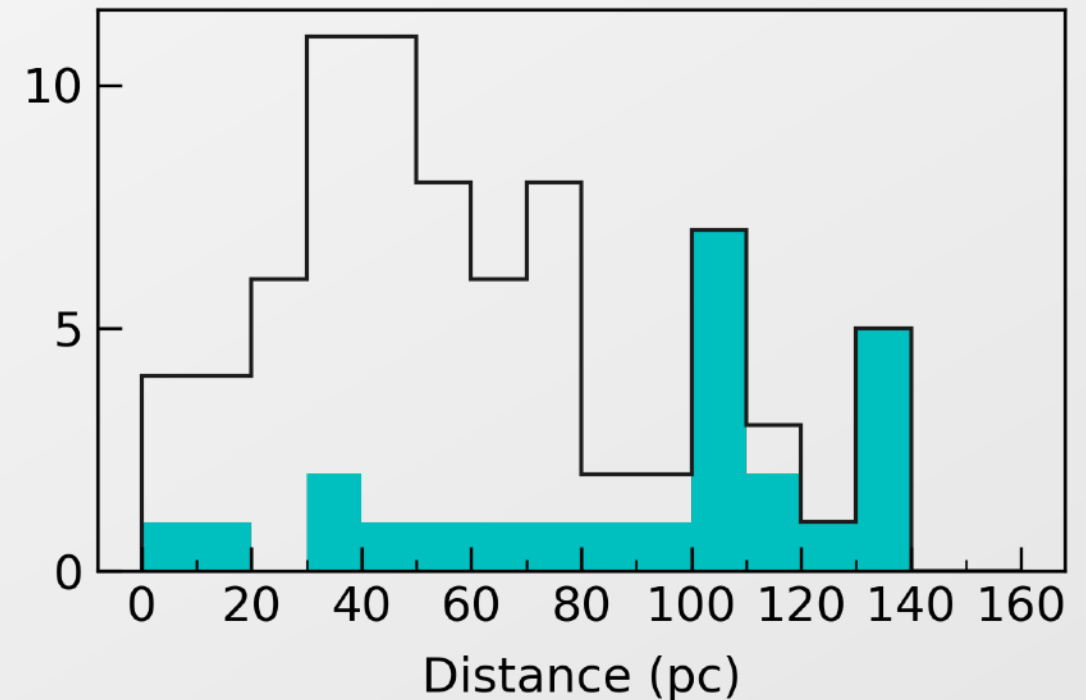
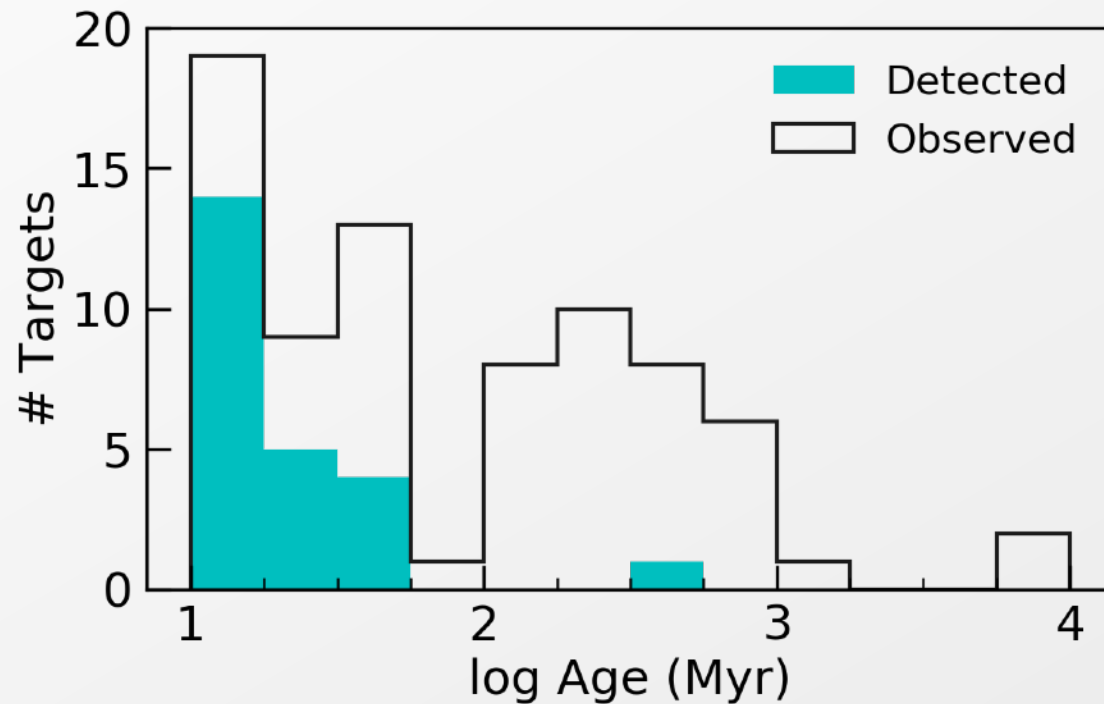
Main selection criteria:

- Large IR excess
- Dust in GPI's $r \sim 1.4''$ FoV



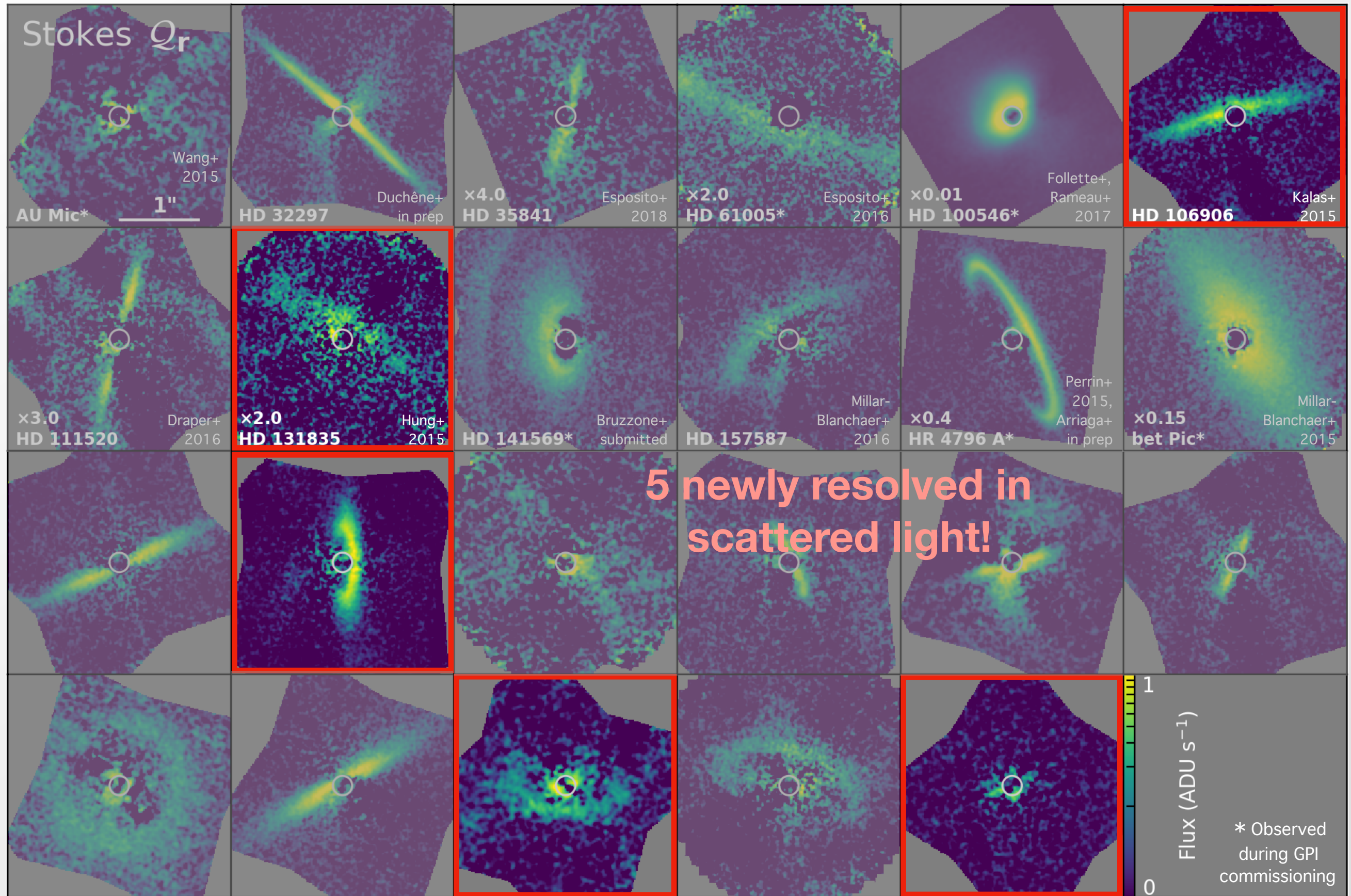
168 datasets: 93 Pol (avg~13 min, 43 min) + 69 Spec (~44 min)

We detected 25 disks in our 78 star sample; 5 resolved in scattered light for first time

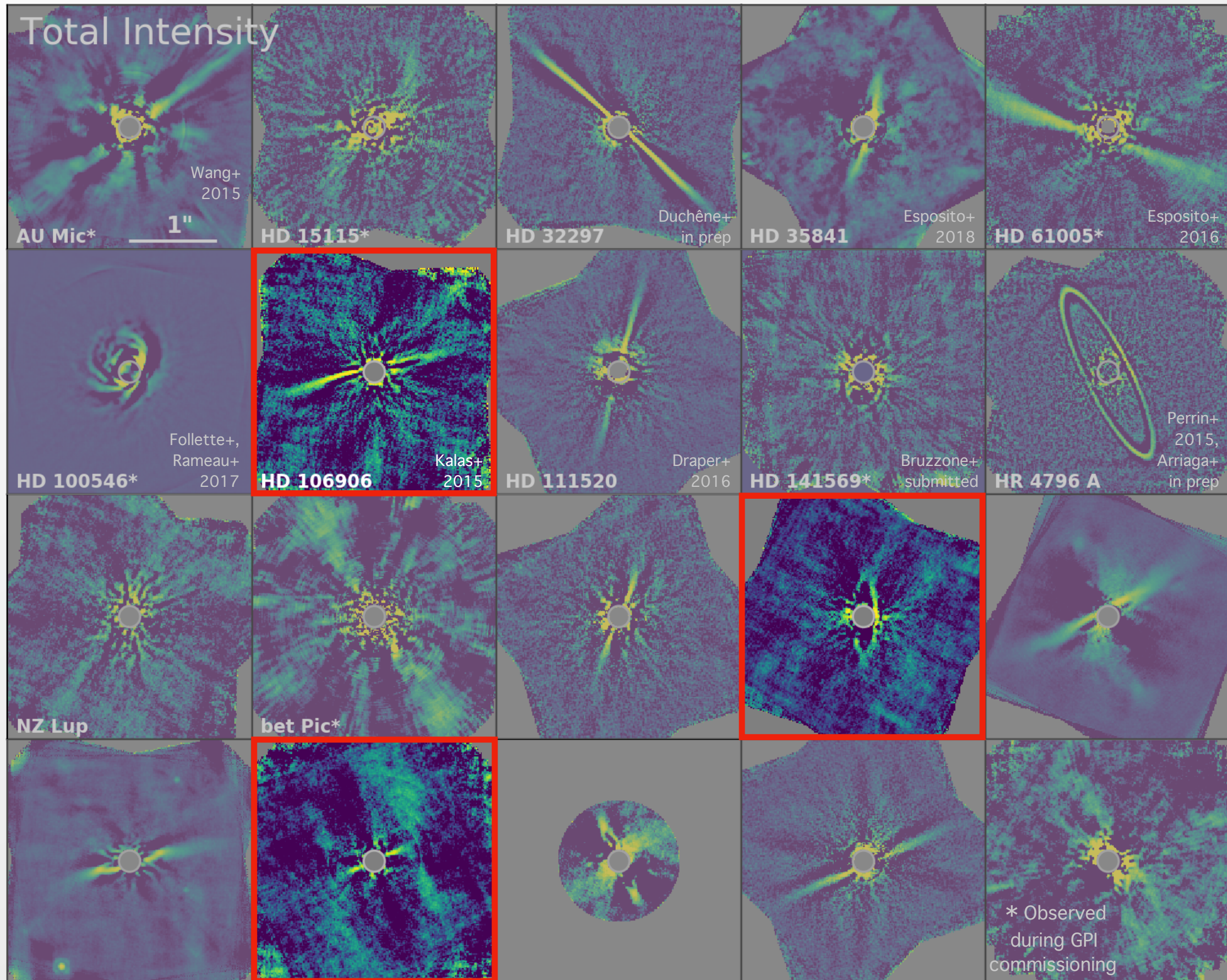


Detection rates: prev. resolved = 31%; prev. unresolved = 9%

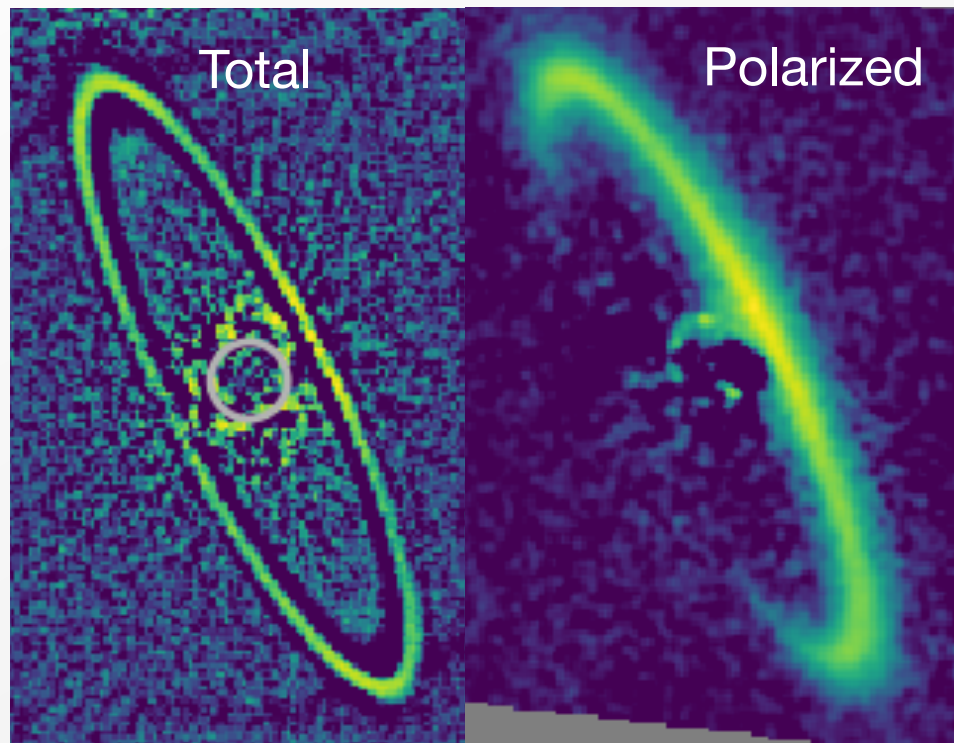
23 GPIES disks in polarized light



20 GPIES disks in total intensity

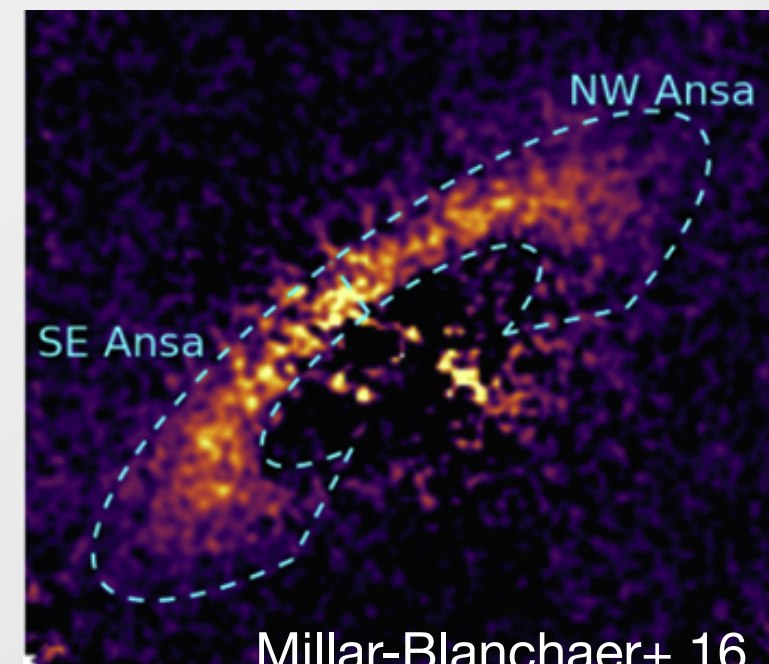


Disk brightness + models constrain location and composition of materials



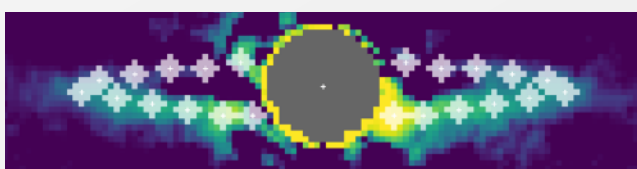
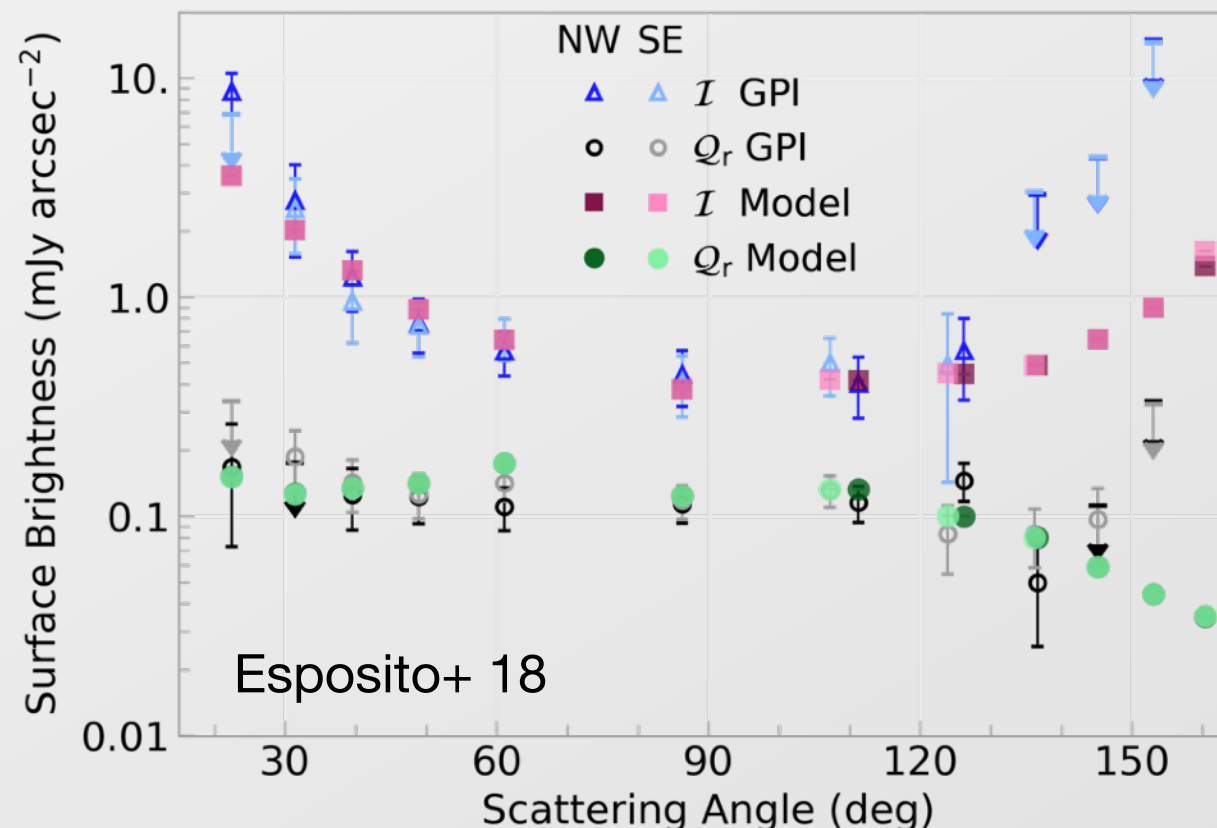
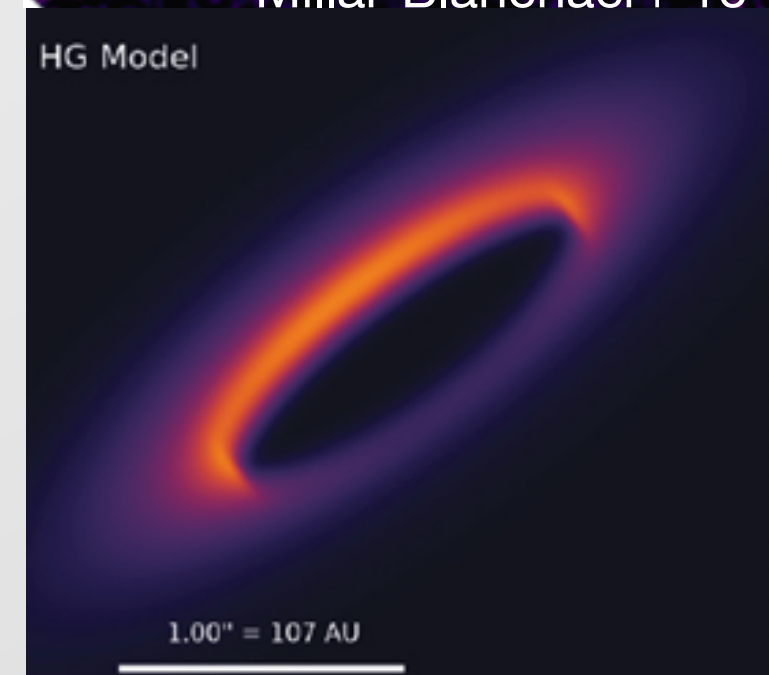
HR 4796 A:
polarized vs. total
intensity asymmetry
implies an **optically
thick ring of larger
grains** (Perrin+ 15).

HD 157587: ring offset from star
causing brightness asymmetry
→ **forced eccentricity?**



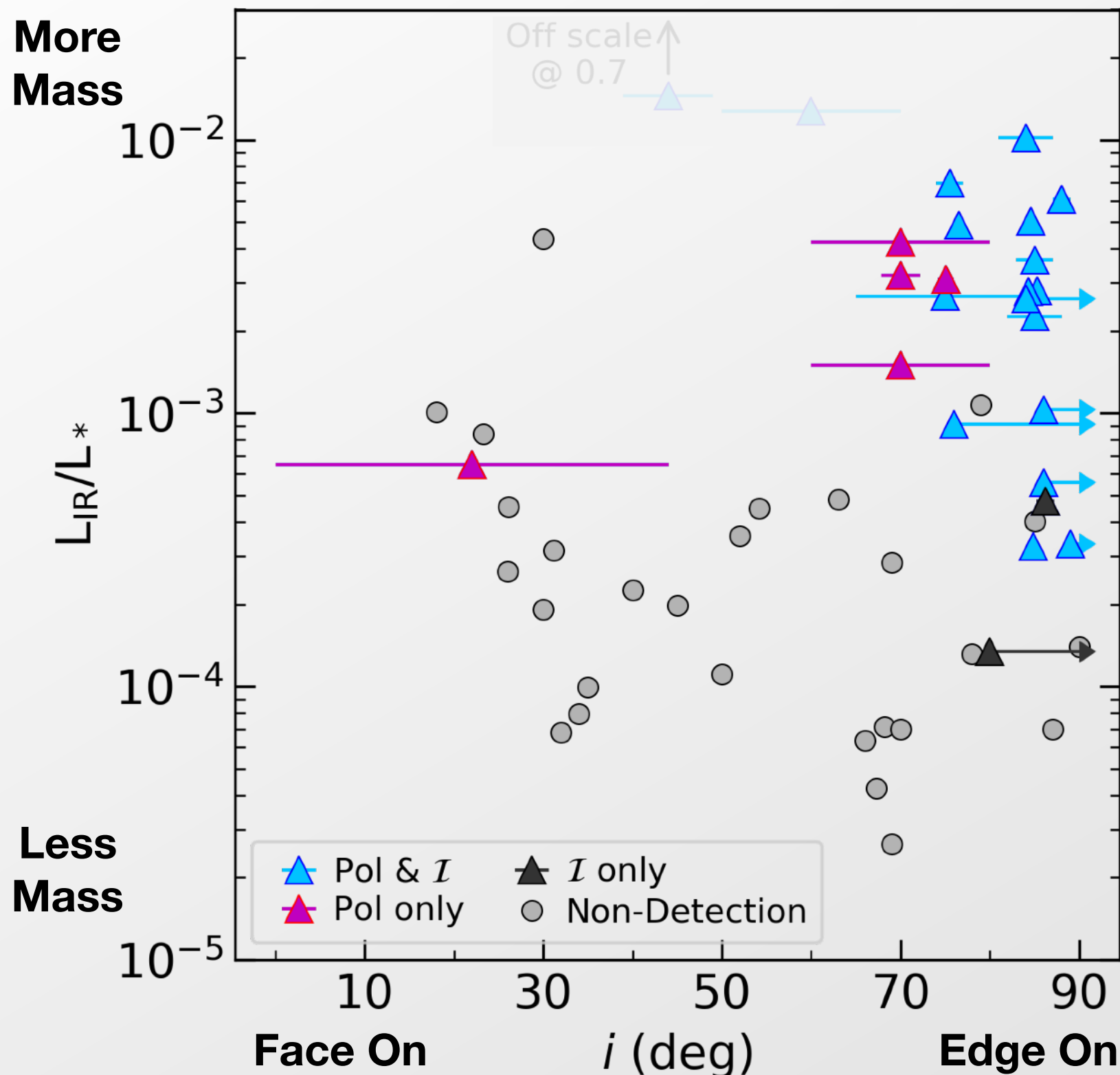
Millar-Blanchaer+ 16

HG Model



HD 35841: scattering
phase function and
polarization fraction
consistent with
**carbon & water ice
grains** (*Mie theory*)

Detections appear biased towards highly inclined disks for all excess levels



- Implies dust's scattering phase function is important to detectability
- Lower i detected in polarization more than total intensity
 - forward-scattering grains but pol fraction peaks near 90° scattering angle?

Summary of the GPIES Debris Disk Survey



- **Nearly complete!** 78 stars observed; end date in 2018B
- **25 debris disks resolved** in *H*-band scattered light
 - 4 are new scattered-light detections!
 - Many are first polarized intensity detections
 - **11 papers published**; more on the way
- **Large, uniform survey** to guide future missions and provide data for statistically meaningful population studies
 - fainter stars and northern targets with GPI 2.0?
- Combining multi-faceted data with models is beginning to **constrain planetary system architecture & composition**
- Look for initial survey results soon! (Esposito et al.)