The Era of "Faint" Debris Disks.

Rahul I. Patel @DarthPatel

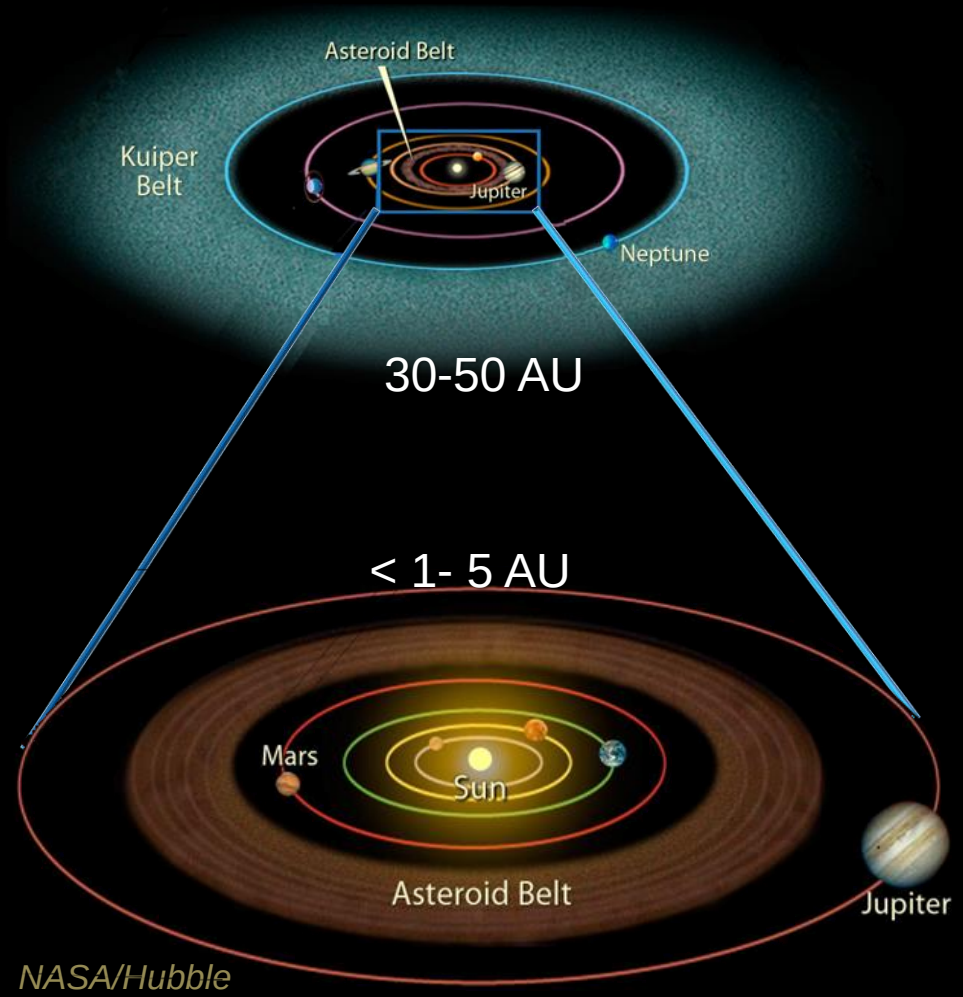
ExSoCal 2017

Current Collaborators:

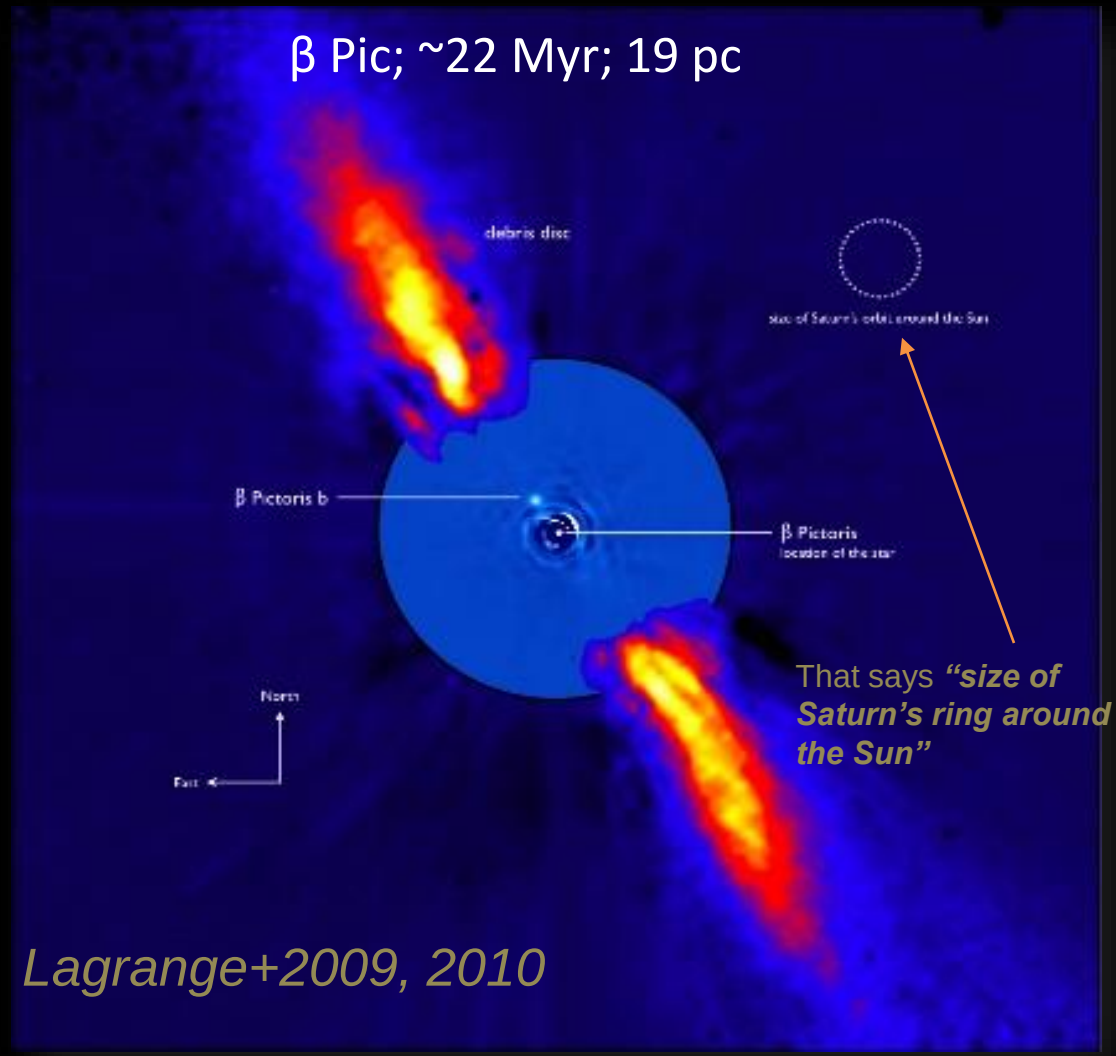
C. Beichman, B. Menneson, S. Metchev, C. Chen, P. Arriaga, M. Fitzgerald, M. Millar-Blanchaer (+ GPIES team), G. Bryden, M. Ygouf, T. Meshkat, D. Mawet, et al.

I like debris disks and I cannot lie.

Studying the architecture of debris disks places the Solar System in context.



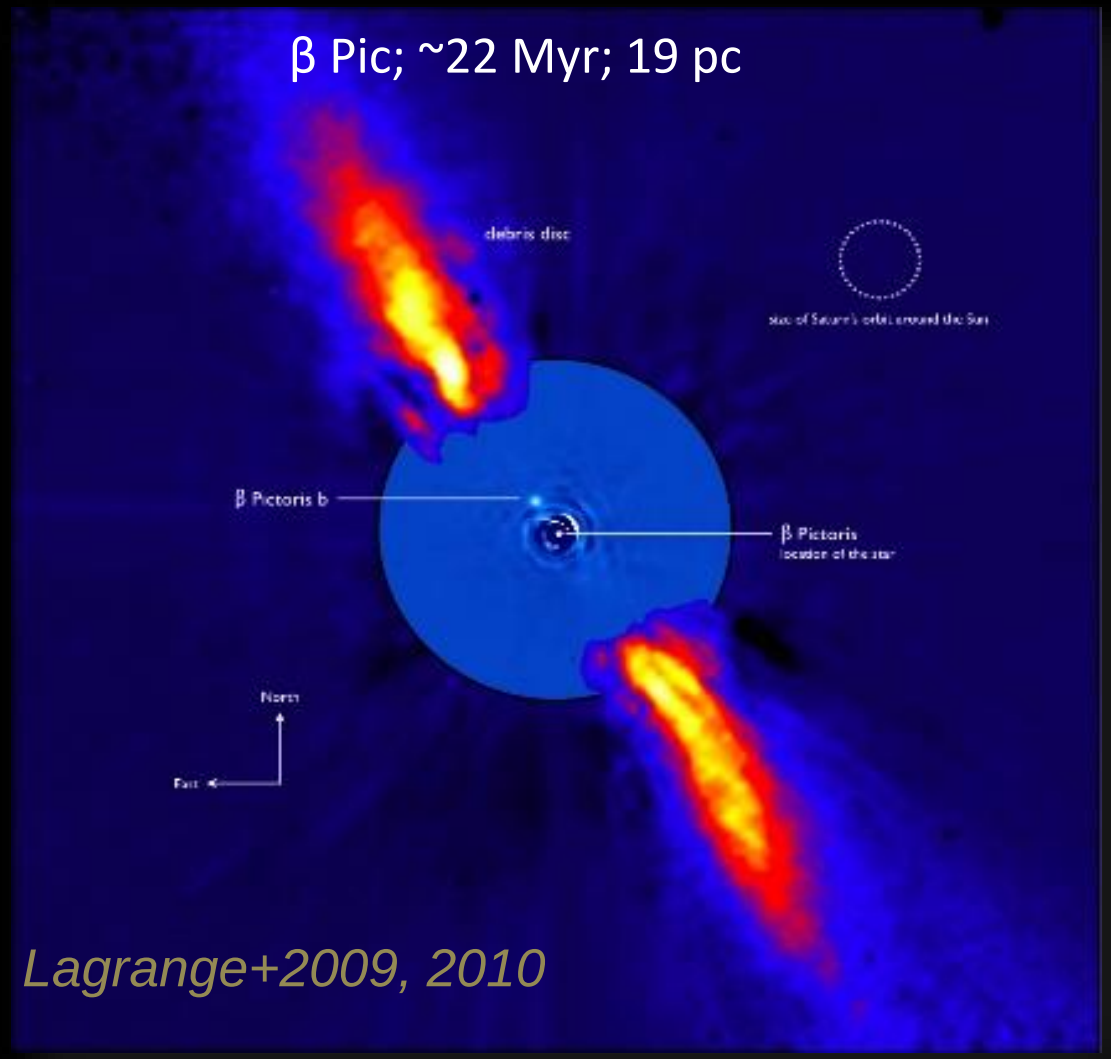
NASA/Hubble



That says ***"size of Saturn's ring around the Sun"***

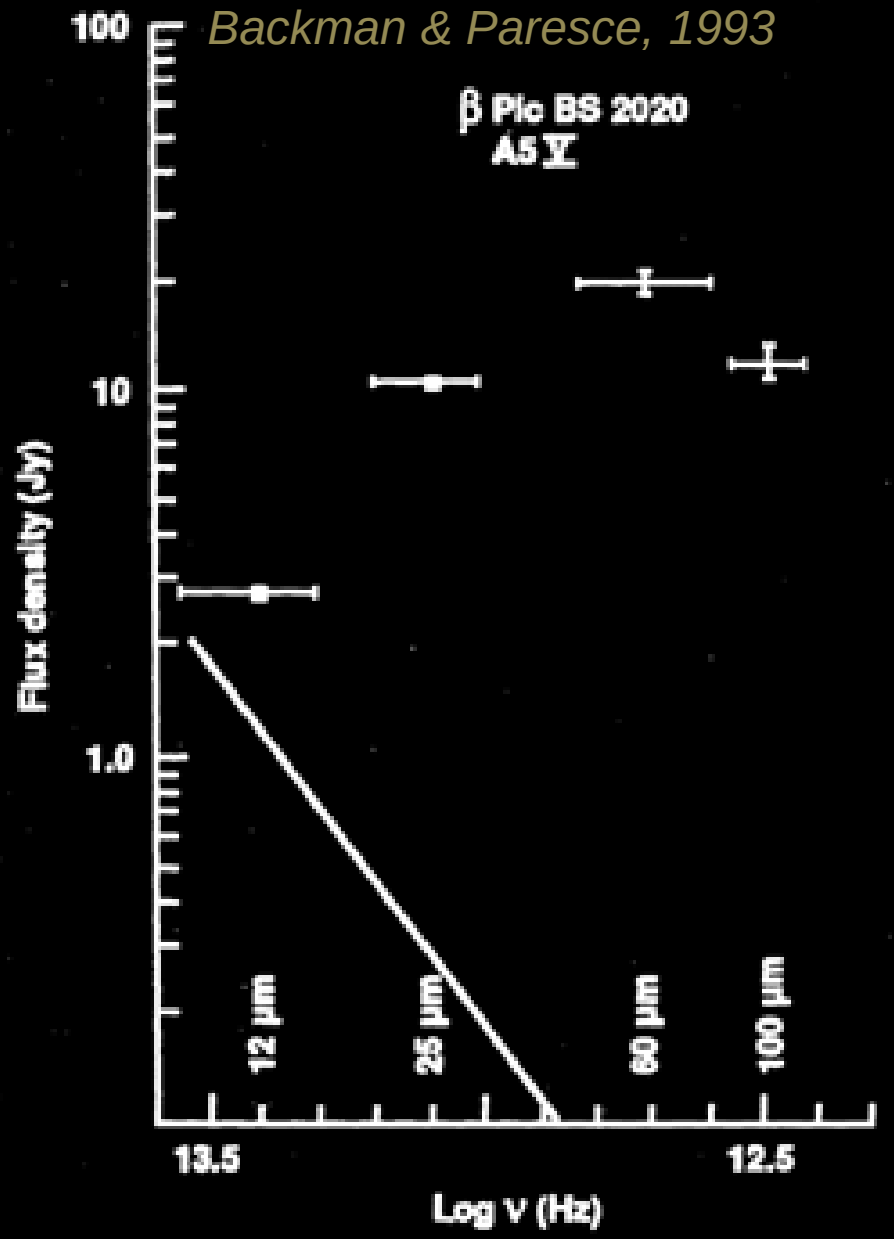
Lagrange+2009, 2010

Most resolved disks have bright IR excesses.



Lagrange+2009, 2010

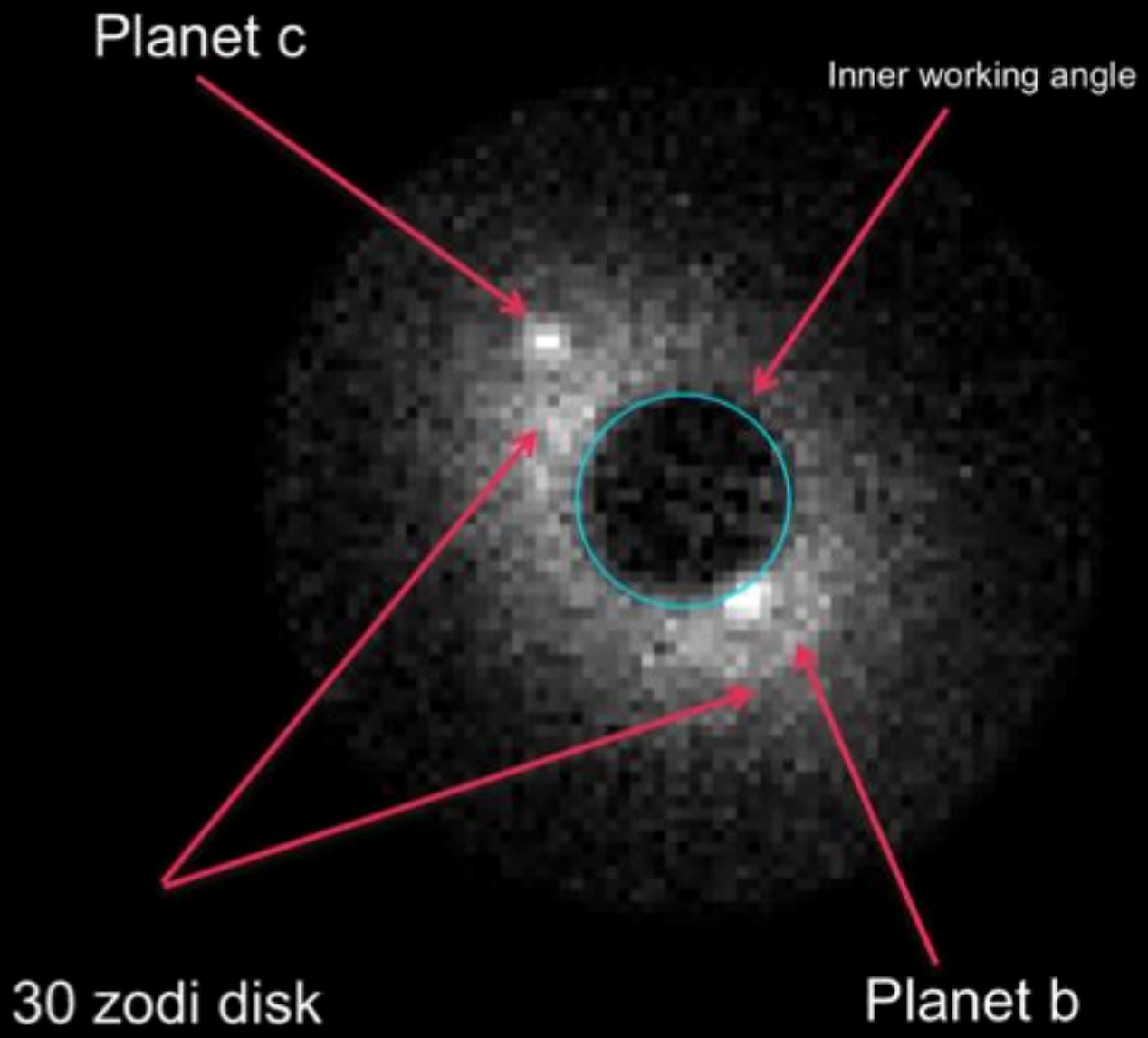
Backman & Paresce, 1993



Faintest disks will hinder and help exoplanetology.

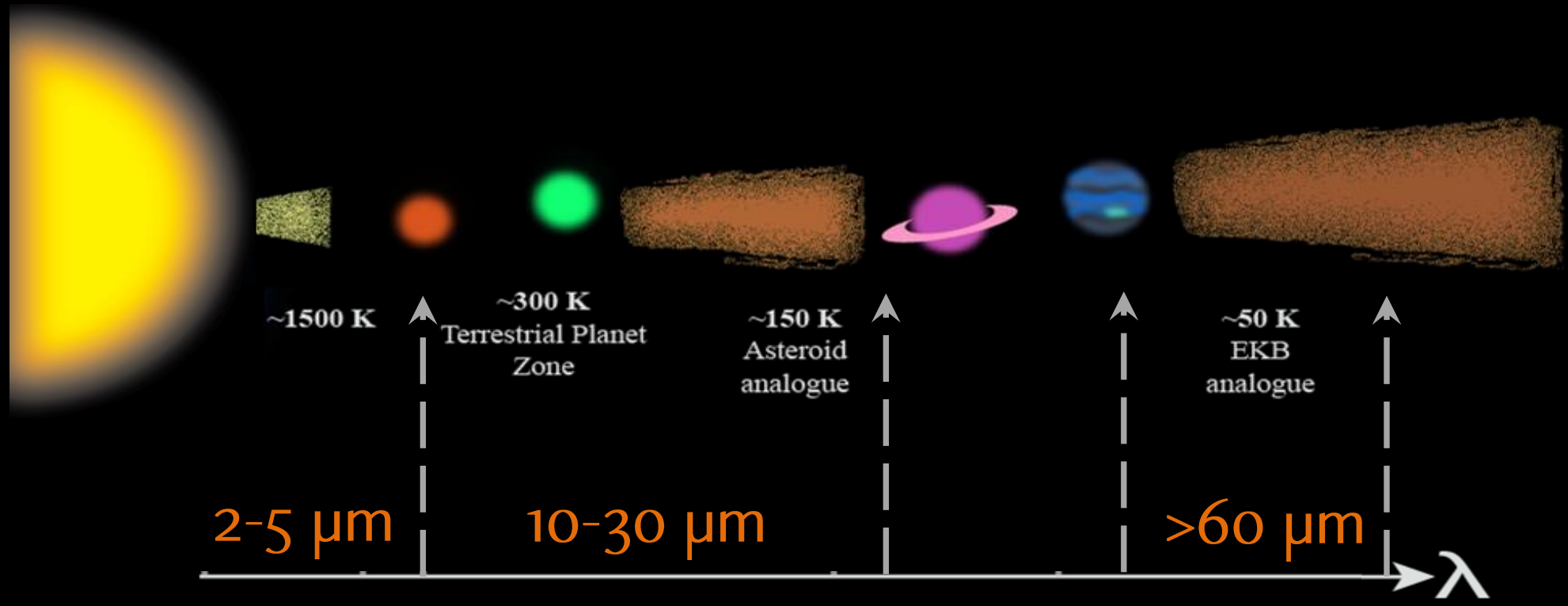
Simulated **WFIRST** coronagraph image of observations of **47 Ursa Majoris by John Krist, JPL**

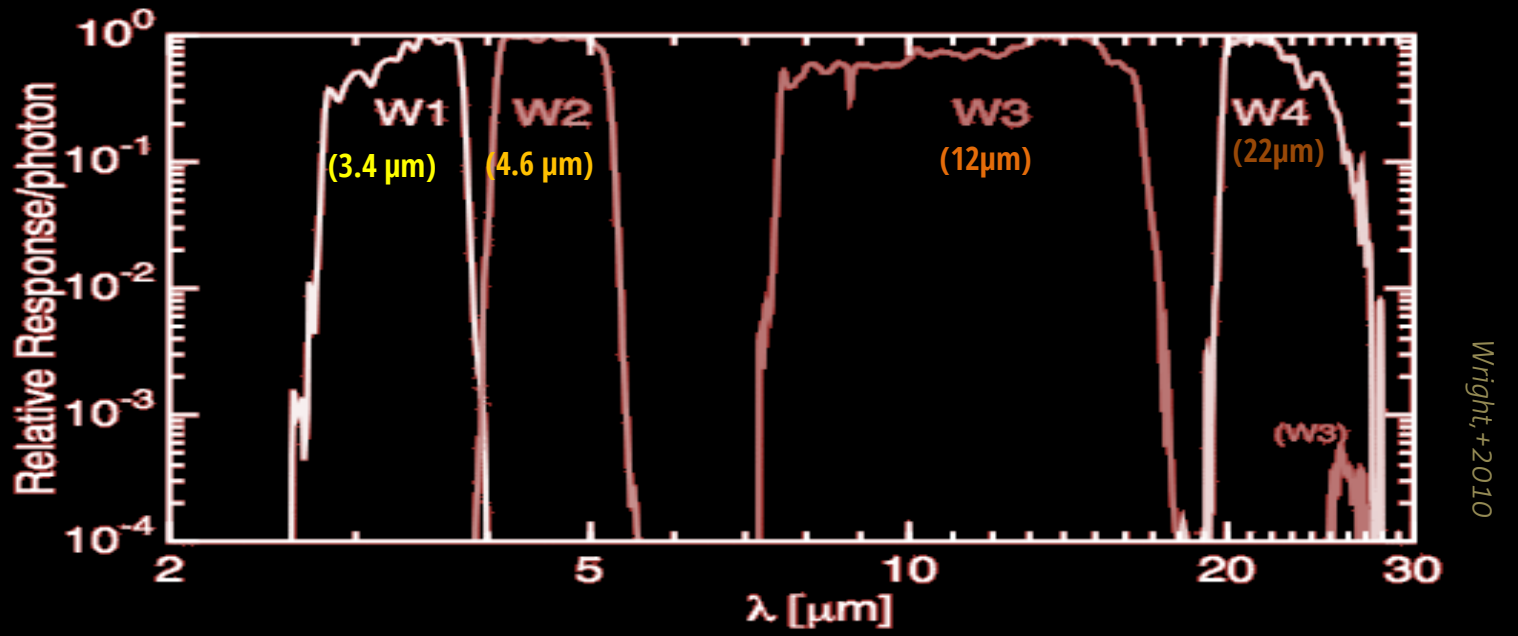
- 10 hr exposure
- 525-580 nm

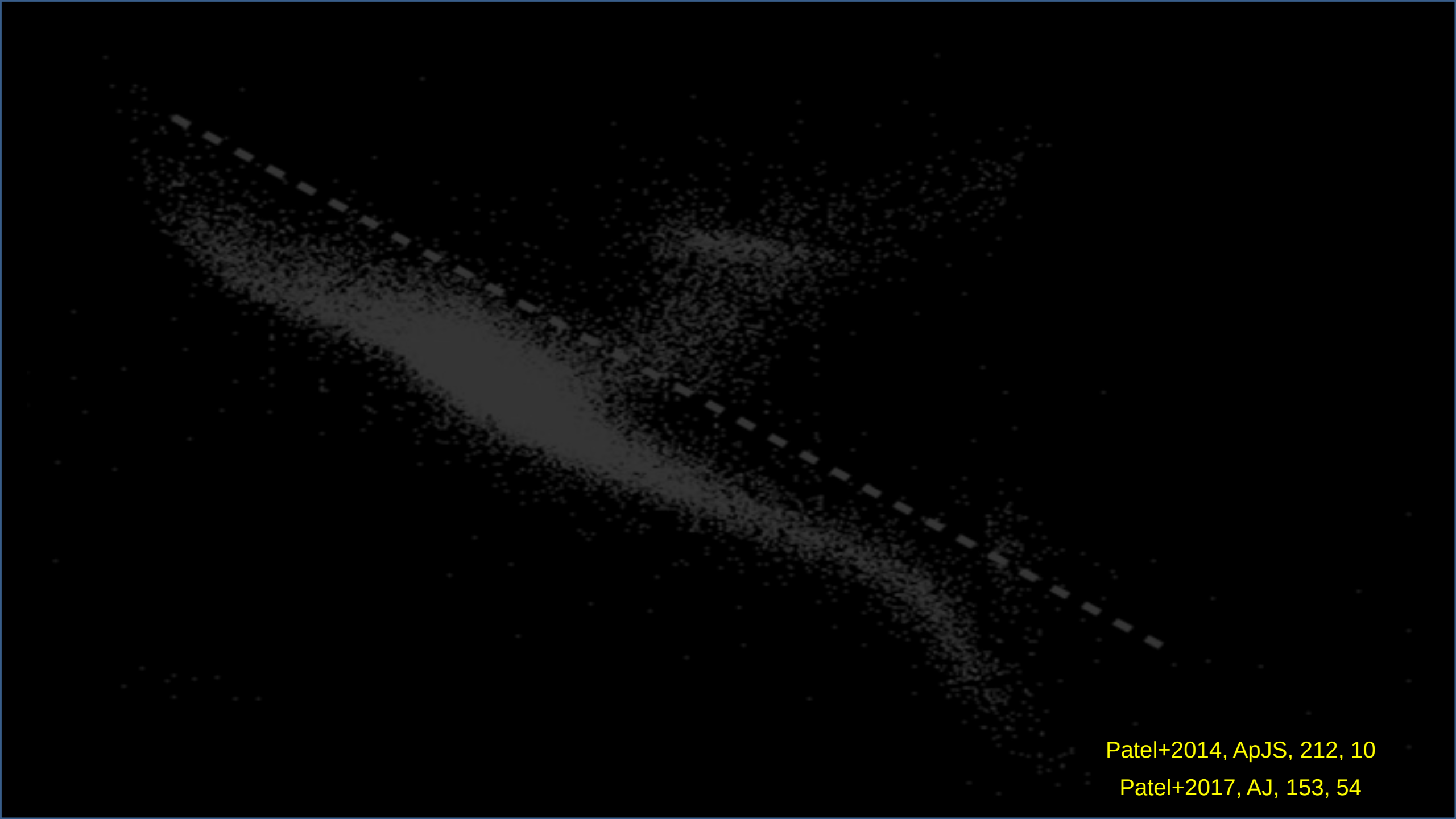


It’s wise to look for debris disks with WISE… badoonsh.

WISE is back… alright!


~1500 K
~300 K
Terrestrial Planet
Zone
~150 K
Asteroid
analogue
~50 K
EKB
analogue
2-5 μm
10-30 μm
>60 μm
λ


Relative Response/photon
10^0
10^-1
10^-2
10^-3
10^-4
W1
(3.4 μm)
W2
(4.6 μm)
W3
(12μm)
W4
(22μm)
(W3)
2
5
10
20
30
λ [μm]
Wright+2010



Patel+2014, ApJS, 212, 10

Patel+2017, AJ, 153, 54

- Accurately measuring empirical photospheric colors.
  - Leverage contemporaneous WISE photometry

Patel+2014, ApJS, 212, 10

Patel+2017, AJ, 153, 54

- Accurately measuring empirical photospheric colors.
  - Leverage contemporaneous WISE photometry
- Correct photometric saturation
  - Include brighter (closer) stars previously “inaccessible” in WISE

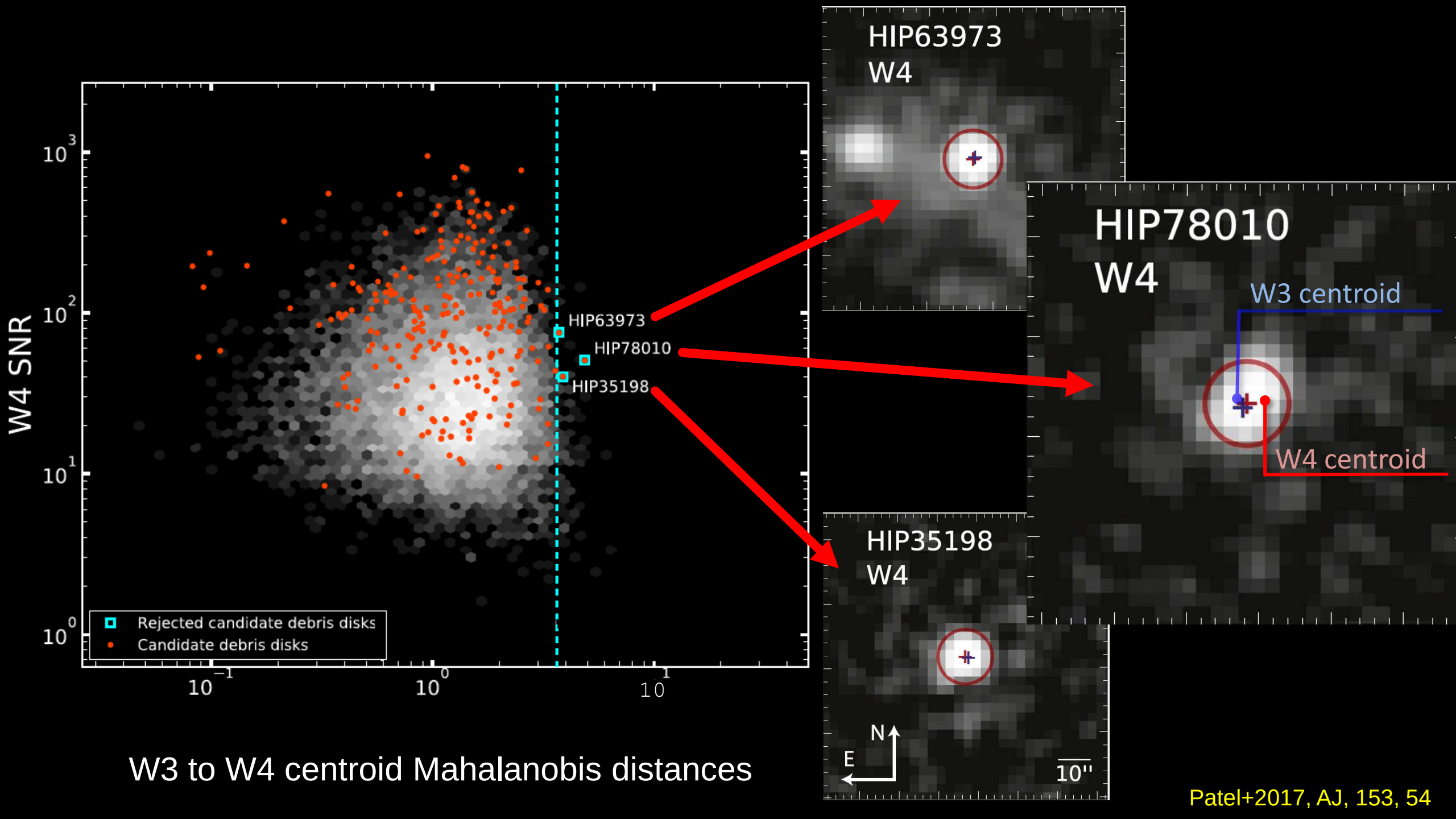
Patel+2014, ApJS, 212, 10

Patel+2017, AJ, 153, 54

- Accurately measuring empirical photospheric colors.
  - Leverage contemporaneous WISE photometry
- Correct photometric saturation
  - Include brighter (closer) stars previously “inaccessible” in WISE
- Verification of Excesses
  - Weighted combination of WISE colors to verify excess
  - Statistical centroid analysis to identify unresolved contaminants

Patel+2014, ApJS, 212, 10

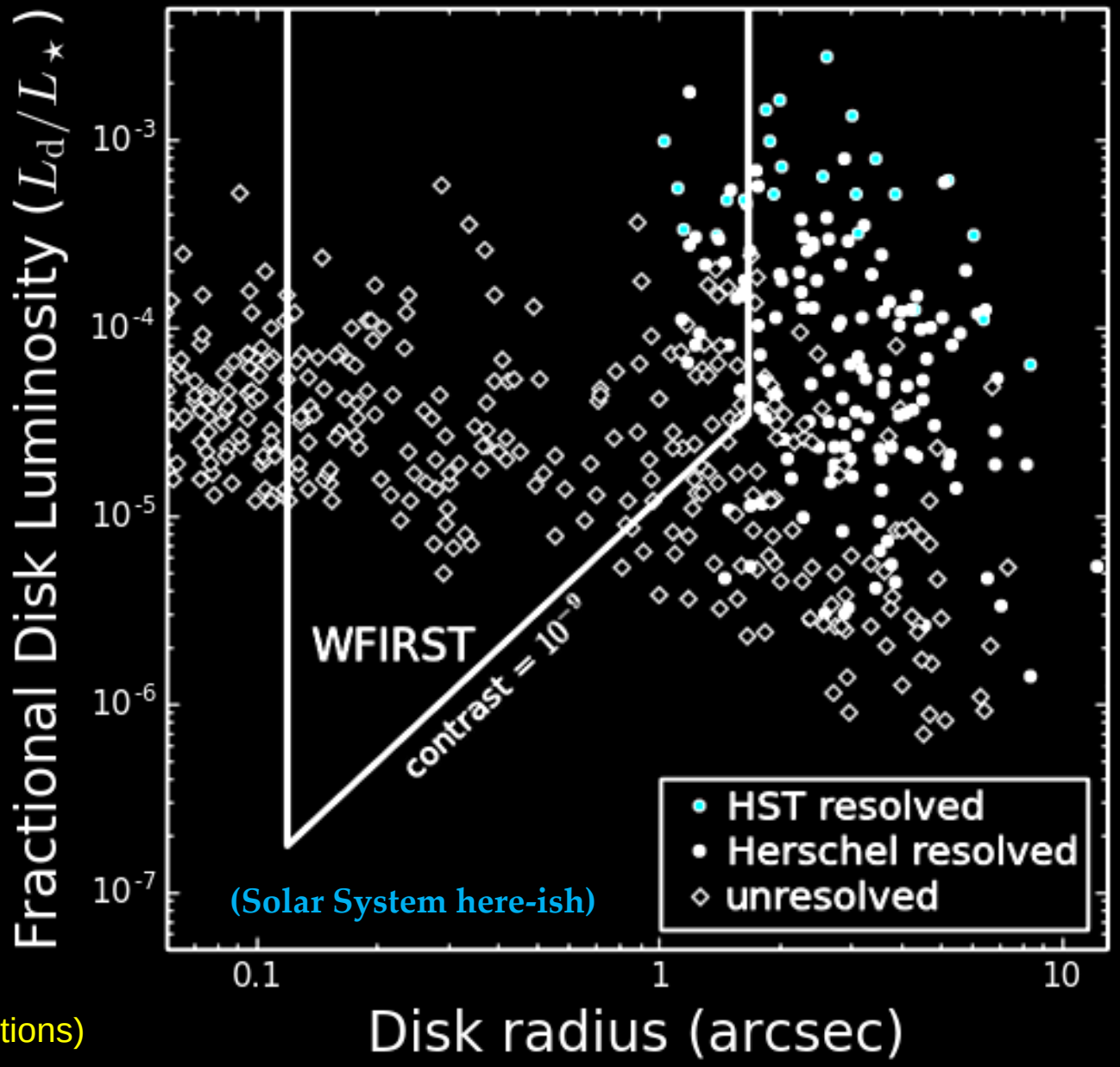
Patel+2017, AJ, 153, 54



W3 to W4 centroid Mahalanobis distances

Patel+2017, AJ, 153, 54

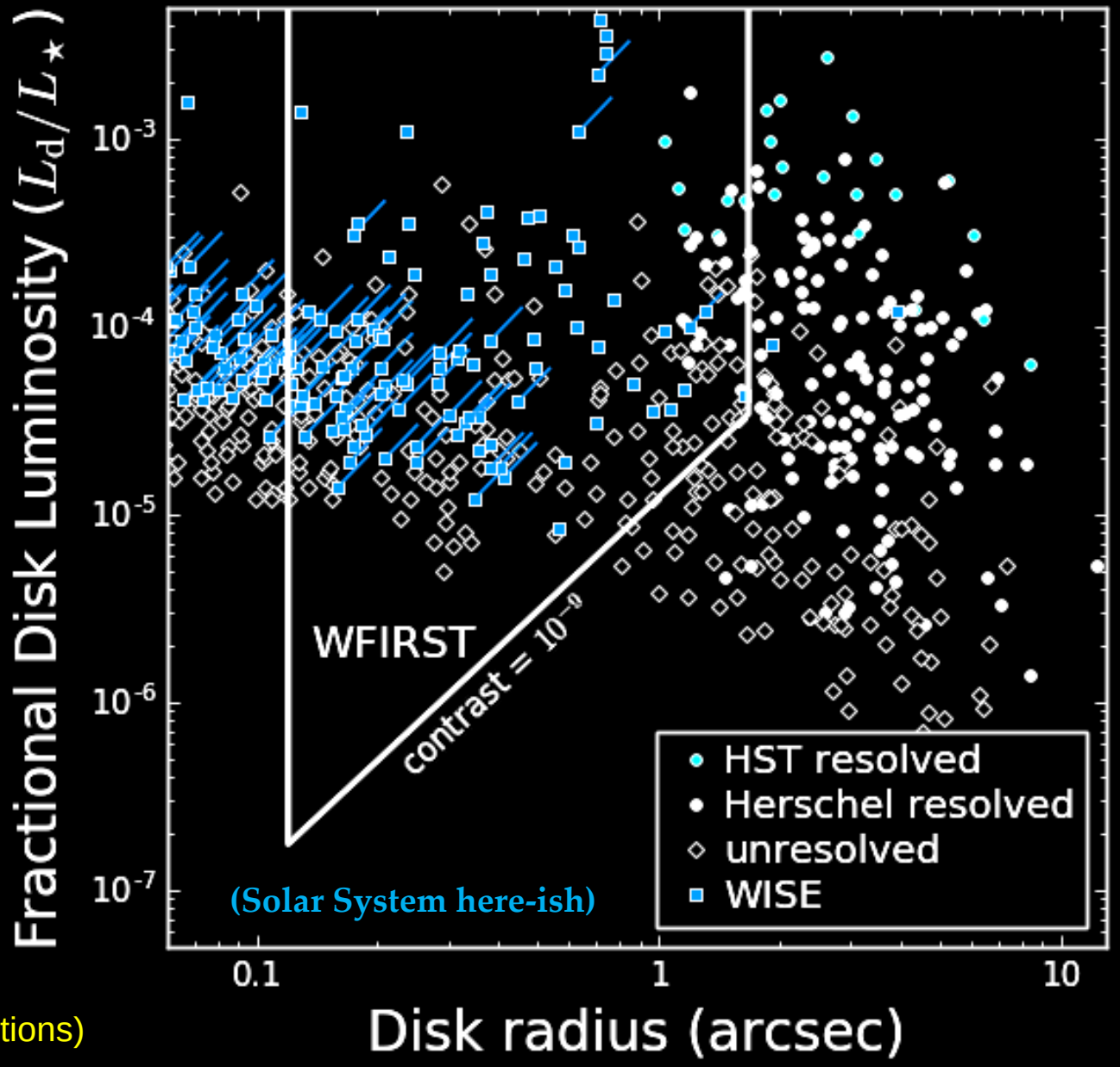
I'll tell you what I want, what I really really want...



Plot by Geoff Bryden

Unresolved data from Chen+,2014 (IRS detections)

… more targets for future missions.



Plot by Geoff Bryden
Unresolved data from Chen+,2014 (IRS detections)
WISE detections from Patel+2014,2017

Wrap Up.

- Fainter disks will be accessible to missions like WFIRST
  - Dust will both impede and aid in study of these planetary systems
- W3 and W4 excesses can be used to identify warm disks overlooked by past studies.

- Careful consideration of photospheric colors & unseen contamination leads to less false-positives and “fainter” disks.

- Other ongoing work:
  - WFIRST – CGI speckle stability and post-processing analysis
  - High-contrast imaging of nearby disks and young stars here at Caltech
  - Follow-up imaging and analysis of interesting K2 candidate systems