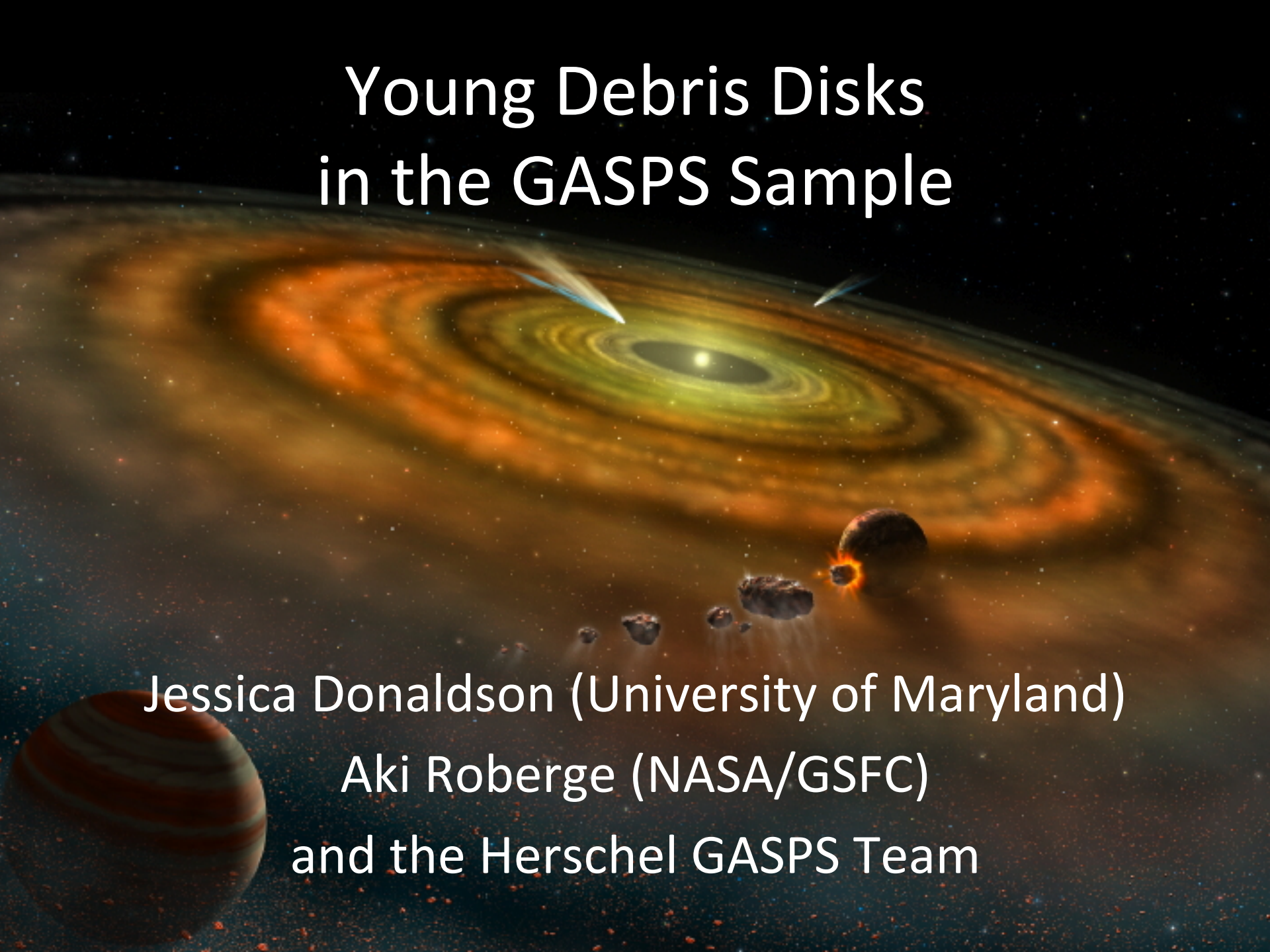
Young Debris Disks in the GASPS Sample



Jessica Donaldson (University of Maryland)
Aki Roberge (NASA/GSFC)
and the Herschel GASPS Team

Young Debris Disks in GASPS

- Survey of 68 stars, 10-30 Myrs old
  - Debris disk phase
- Goal: to look for trends in disk parameters with stellar properties and/or age
- Result: found a trend between dust location and stellar mass

Gas in Protoplanetary Systems (GASPS)

Herschel PACS Open Time Key Programme to study the evolution of gas and dust in protoplanetary and debris disks

PI – Bill Dent

240 targets

Ages: 1 – 30 Myrs

Spectral types B - M

Observations

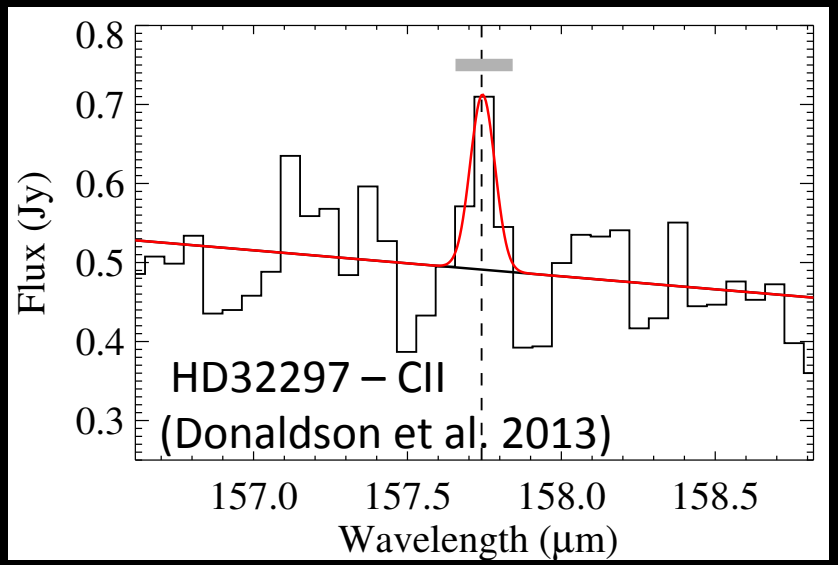
Photometry: 70 and 160 μm

Spectroscopy: [OI], [CII], ...

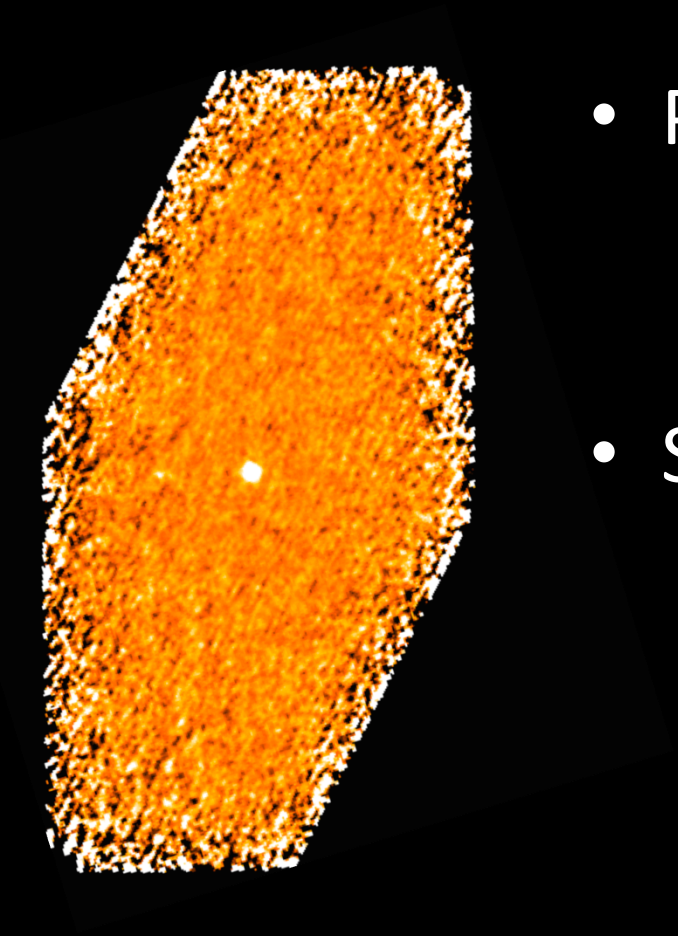
Gas in Debris Disks

- Gas detected in 3 debris disks
  - HD172555, [OI] (Riviere-Marichalar 2012)
  - 49 Ceti, [CII] (Roberge et al. 2013)
  - HD32297 [CII] (Donaldson et al. 2013)
  - (See Poster #66 – A. Roberge)

- Focus on photometry



Photometry Data

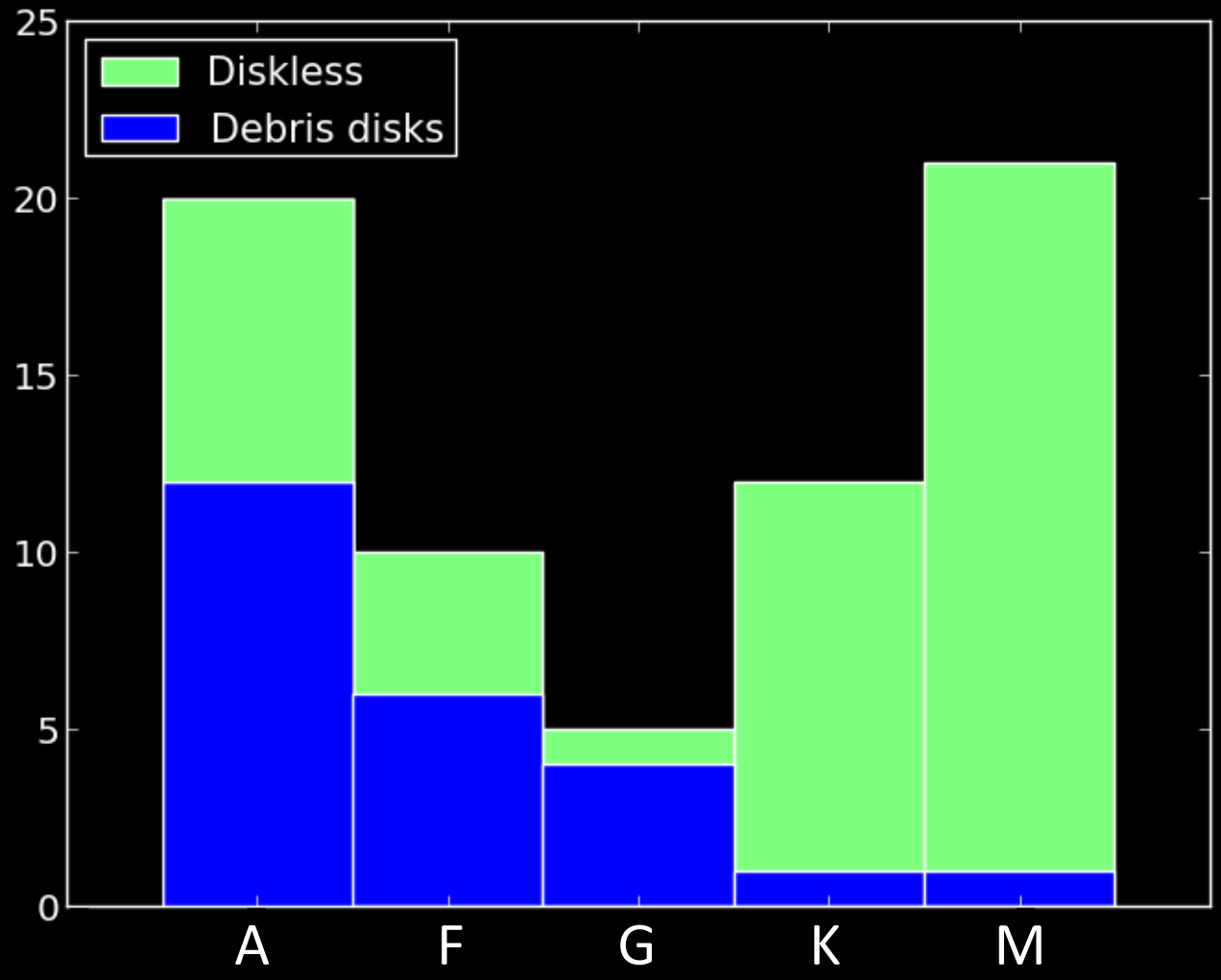


- PACS 70, 100, 160 µm
  - All targets
- SPIRE 250, 350, 500 µm
  - Follow up of disks detected by PACS
    - (OT2: PI A. Roberge)
  - Detected ~1/4

Observed stars come from 4 stellar associations

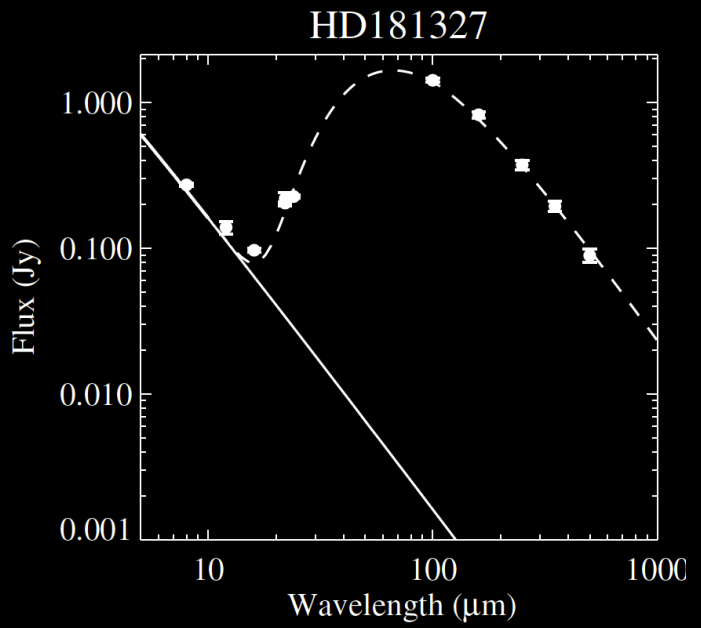
- TW Hydrae Association
  - 8-10 Myrs, ~ 48 pc away
- Upper Scorpius
  - 5-11 Myrs, ~ 140 pc away
- Beta Pictoris Moving Group
  - 12 Myrs, ~ 37 pc away
- Tucana-Horologium Association
  - 30 Myrs, 46 pc away

68 Star, 24 Disks, 10-30 Myrs old

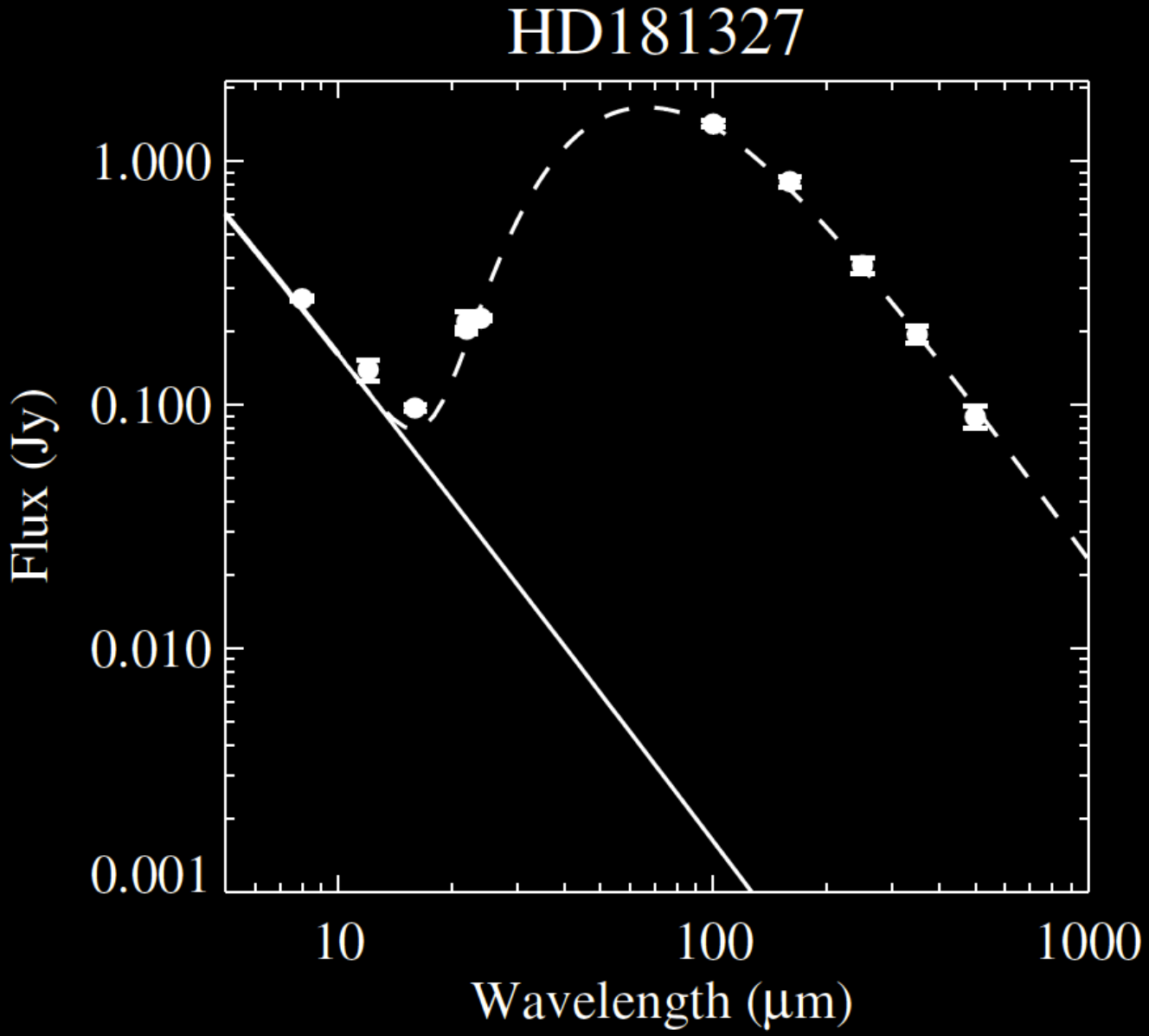


Archive Data & Photosphere Fitting

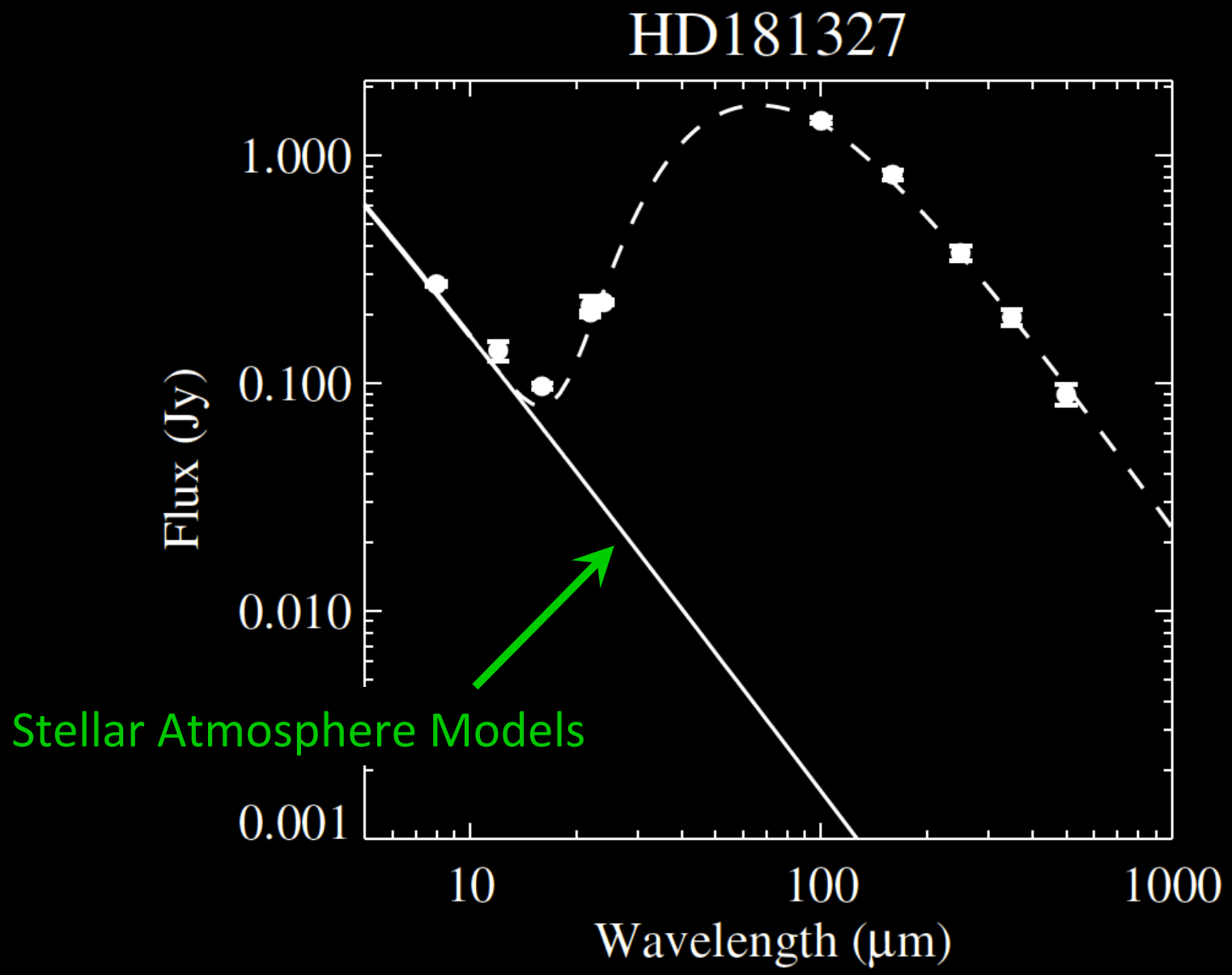
- Collected Archive Data
  - Hipparcos
  - 2MASS
  - WISE
  - Spitzer
- Stellar Photosphere Fitting
  - Kurucz or NextGen Stellar Atmosphere models



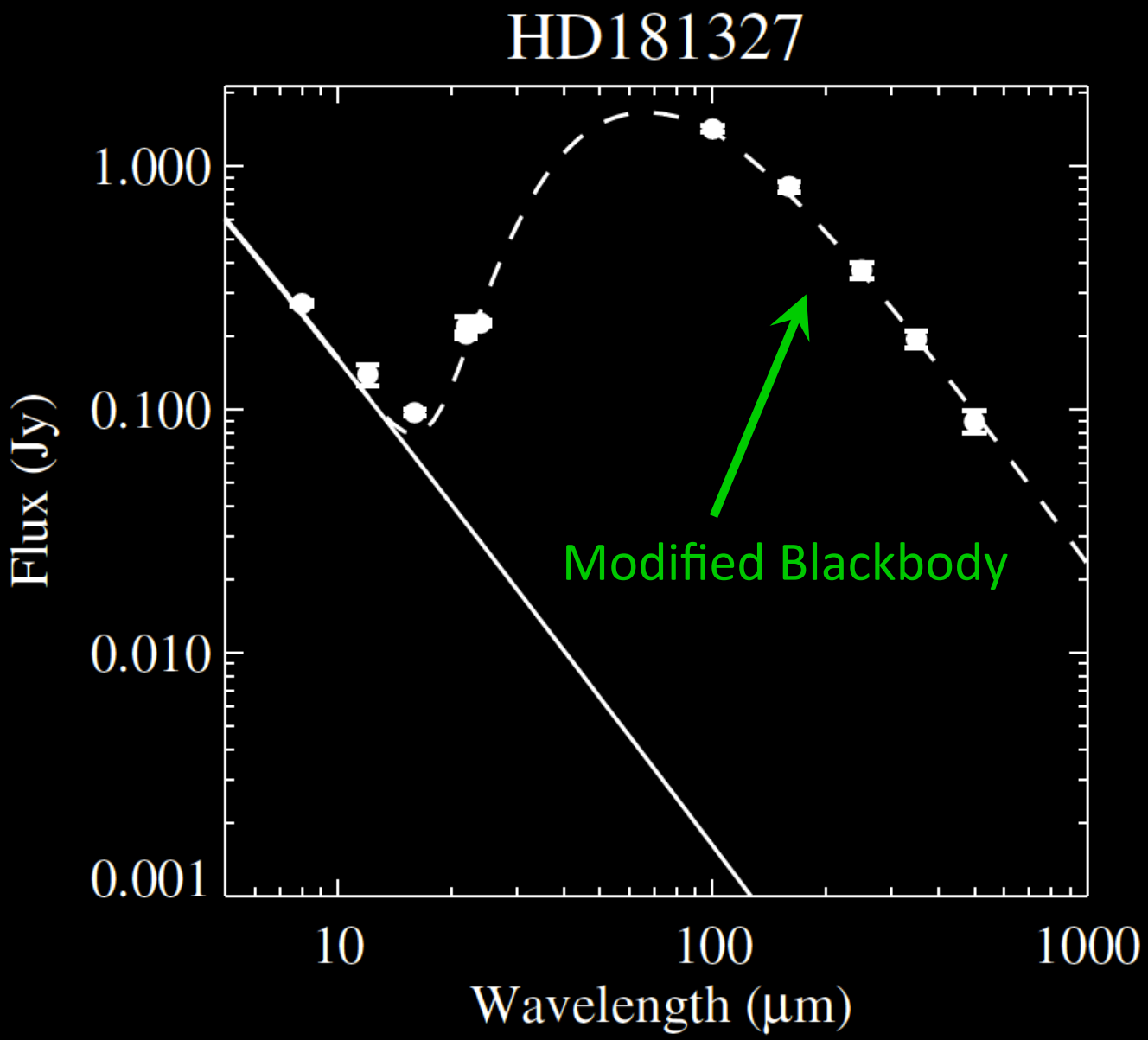
Spectral Energy Distribution Fitting

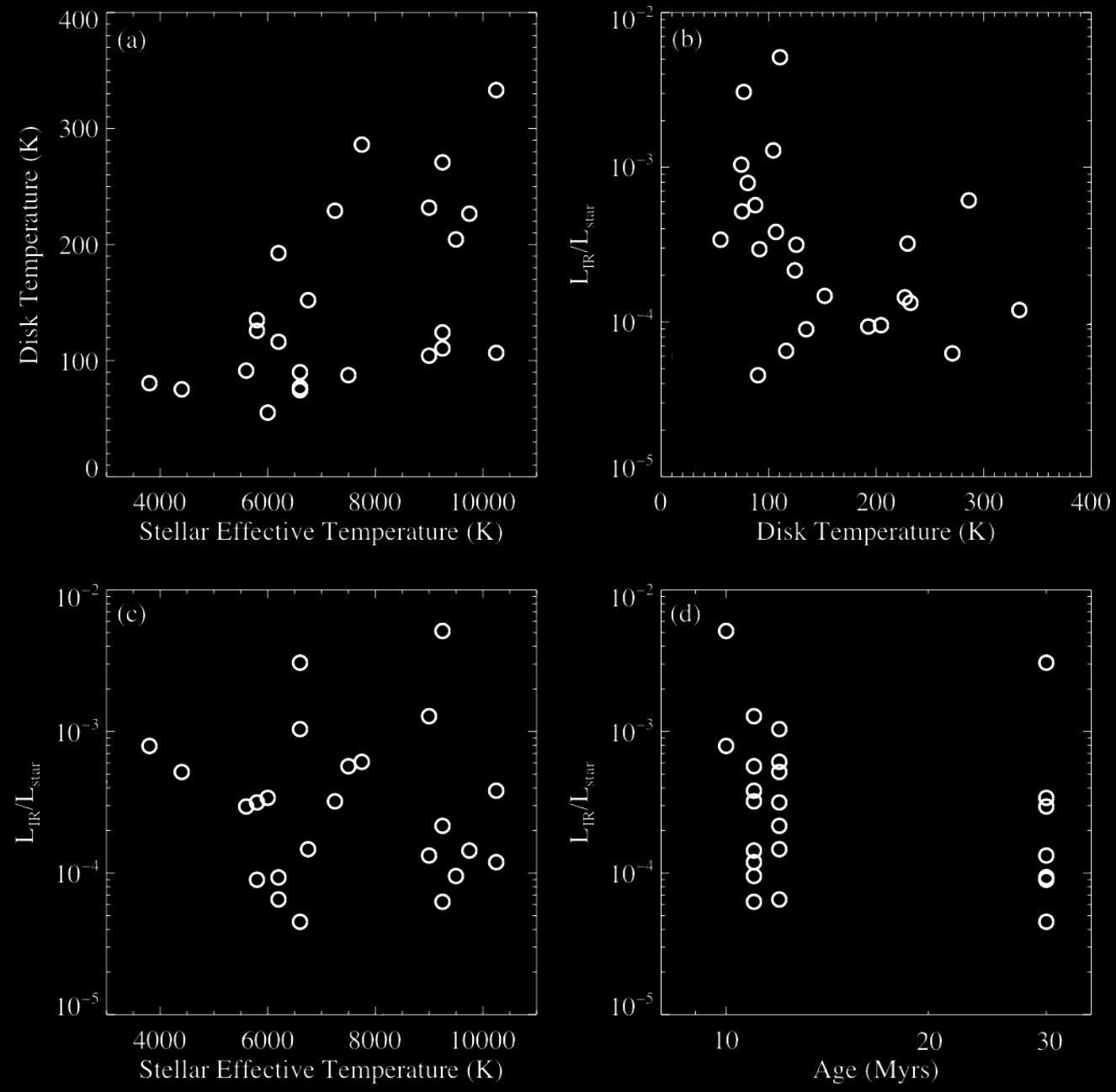


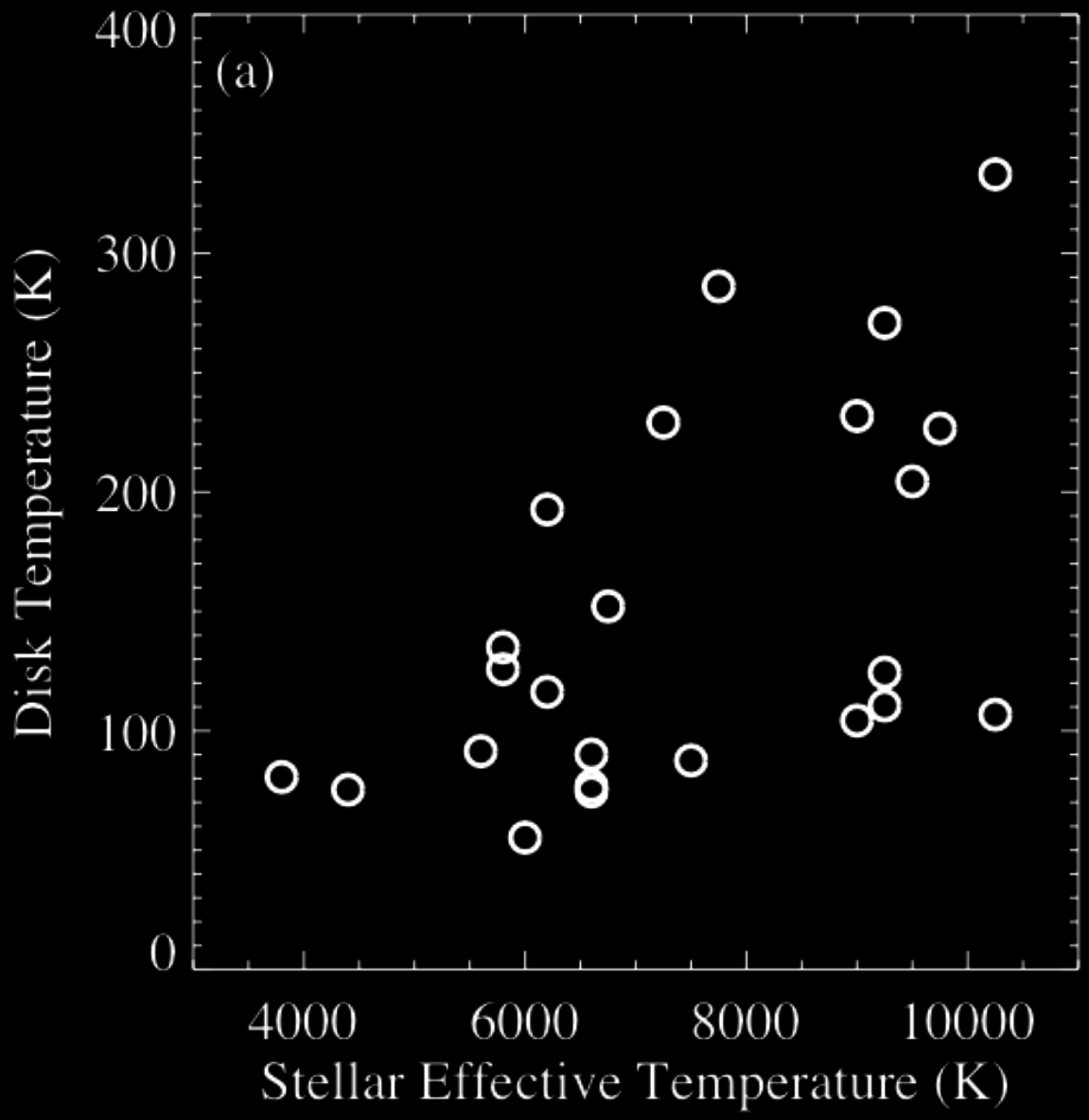
SED Fitting

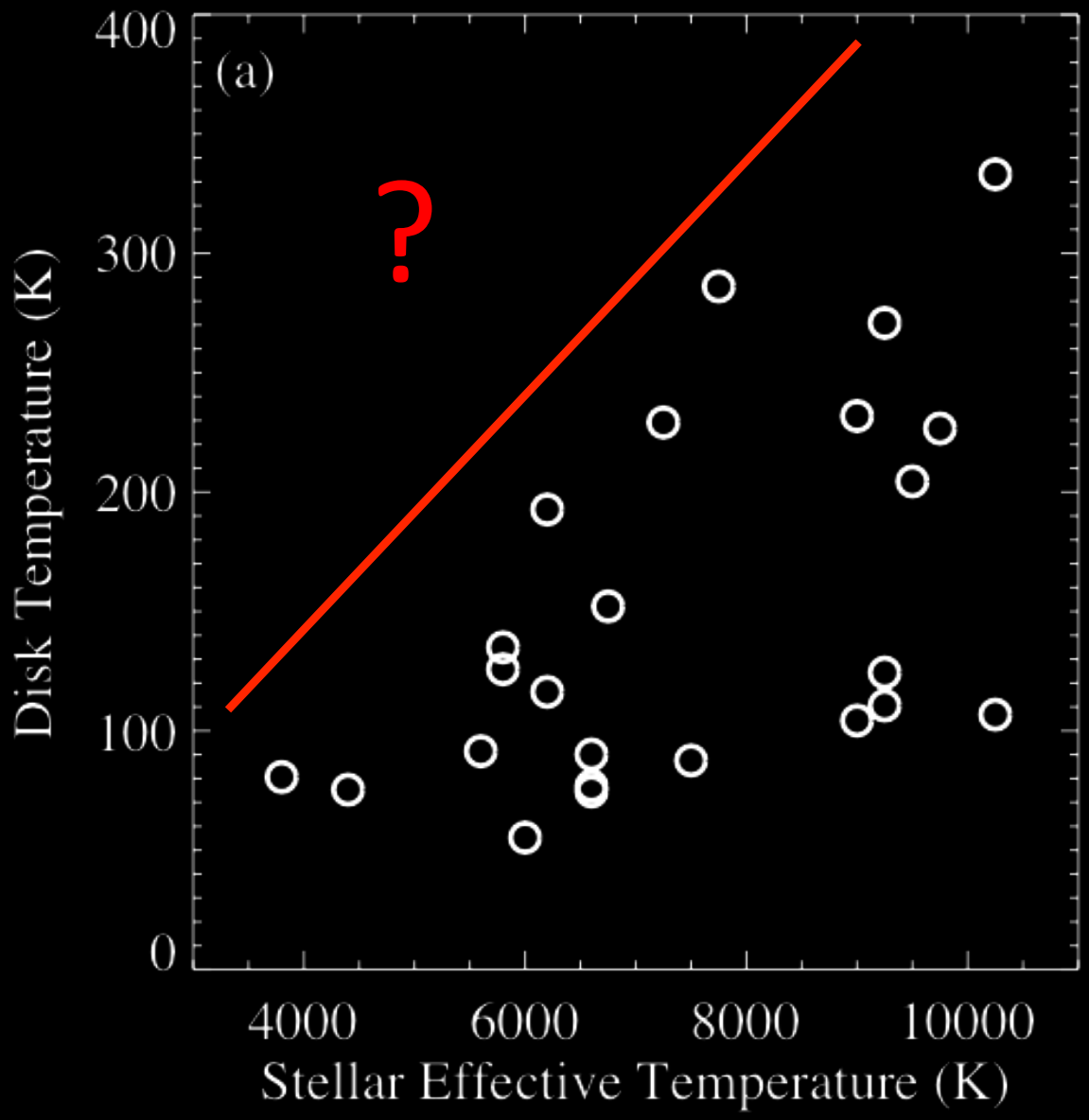

HD181327
1.000
0.100
0.010
0.001
Flux (Jy)
10
100
1000
Wavelength (μm)
Stellar Atmosphere Models

SED Fitting

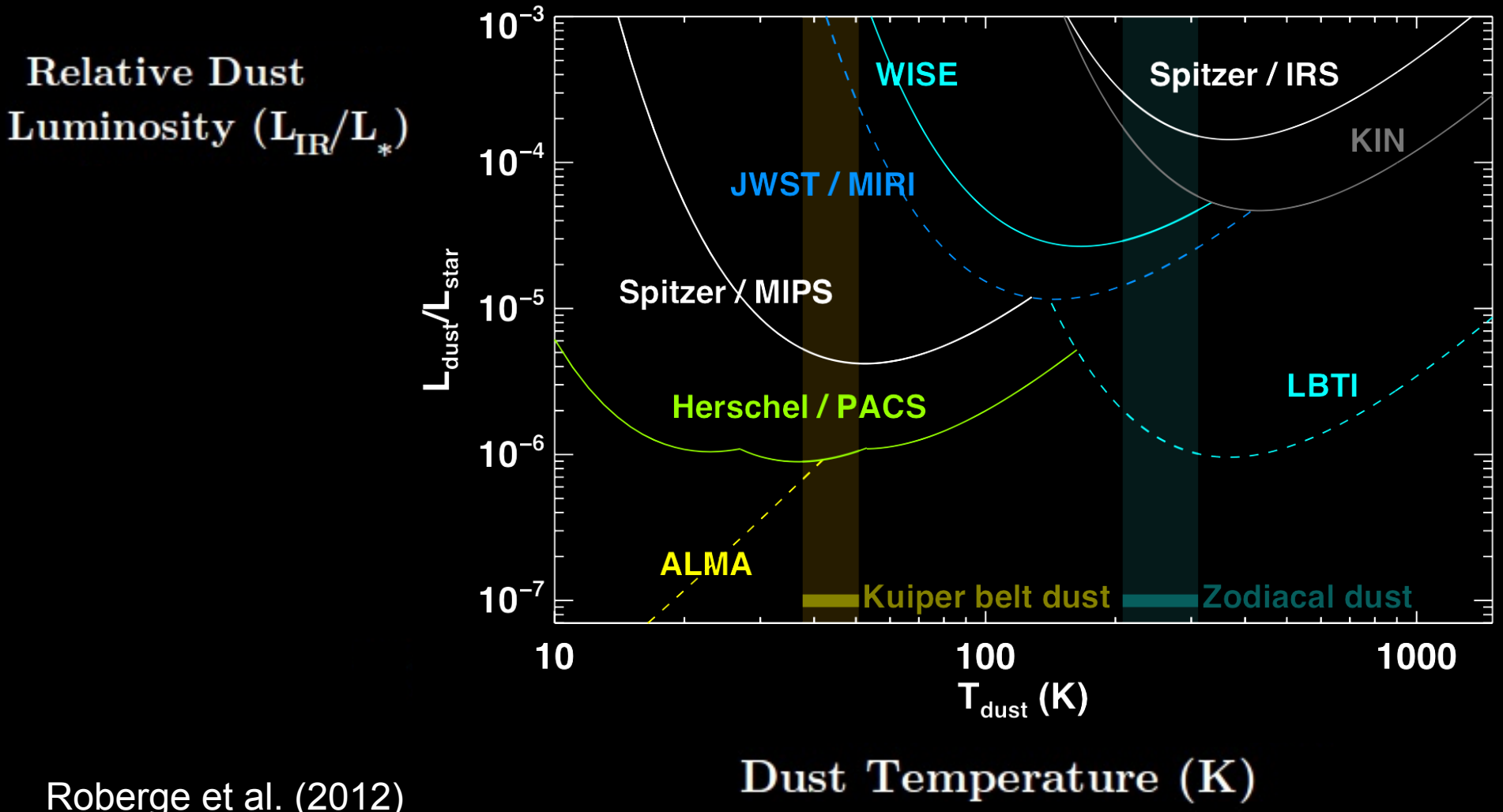

HD181327
1.000
0.100
0.010
0.001
Flux (Jy)
10
100
1000
Wavelength (μm)
Modified Blackbody


(a)
Disk Temperature (K)
Stellar Effective Temperature (K)
(b)
L_{IR}/L_{star}
Disk Temperature (K)
(c)
L_{IR}/L_{star}
Stellar Effective Temperature (K)
(d)
L_{IR}/L_{star}
Age (Myrs)


(a)
Disk Temperature (K)
0
100
200
300
400
4000
6000
8000
10000
Stellar Effective Temperature (K)

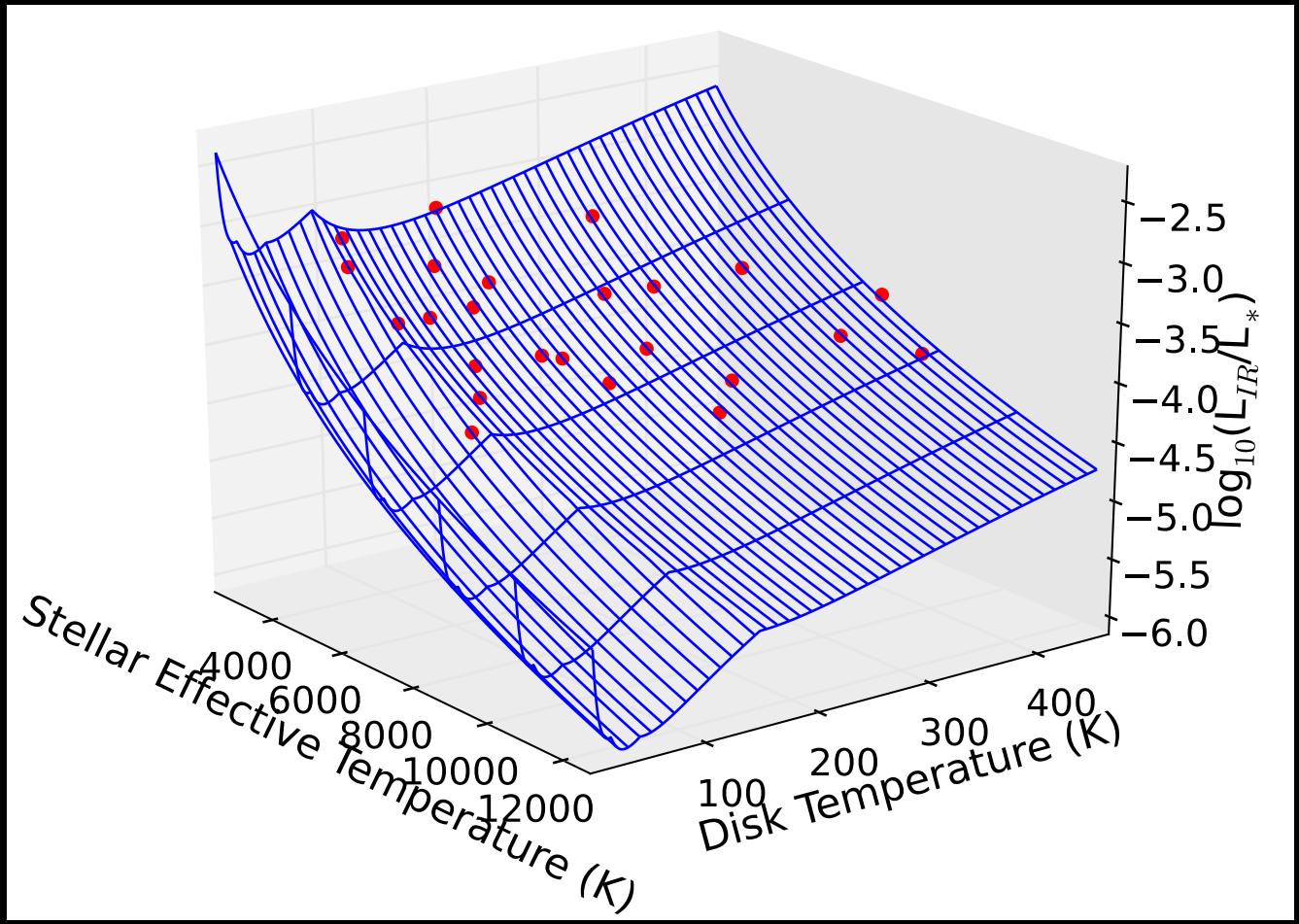

(a)
?
Disk Temperature (K)
400
300
200
100
0
4000
6000
8000
10000
Stellar Effective Temperature (K)

Is the deficit due to detection limit?



Roberge et al. (2012)

We should be able to detect disks in the empty region



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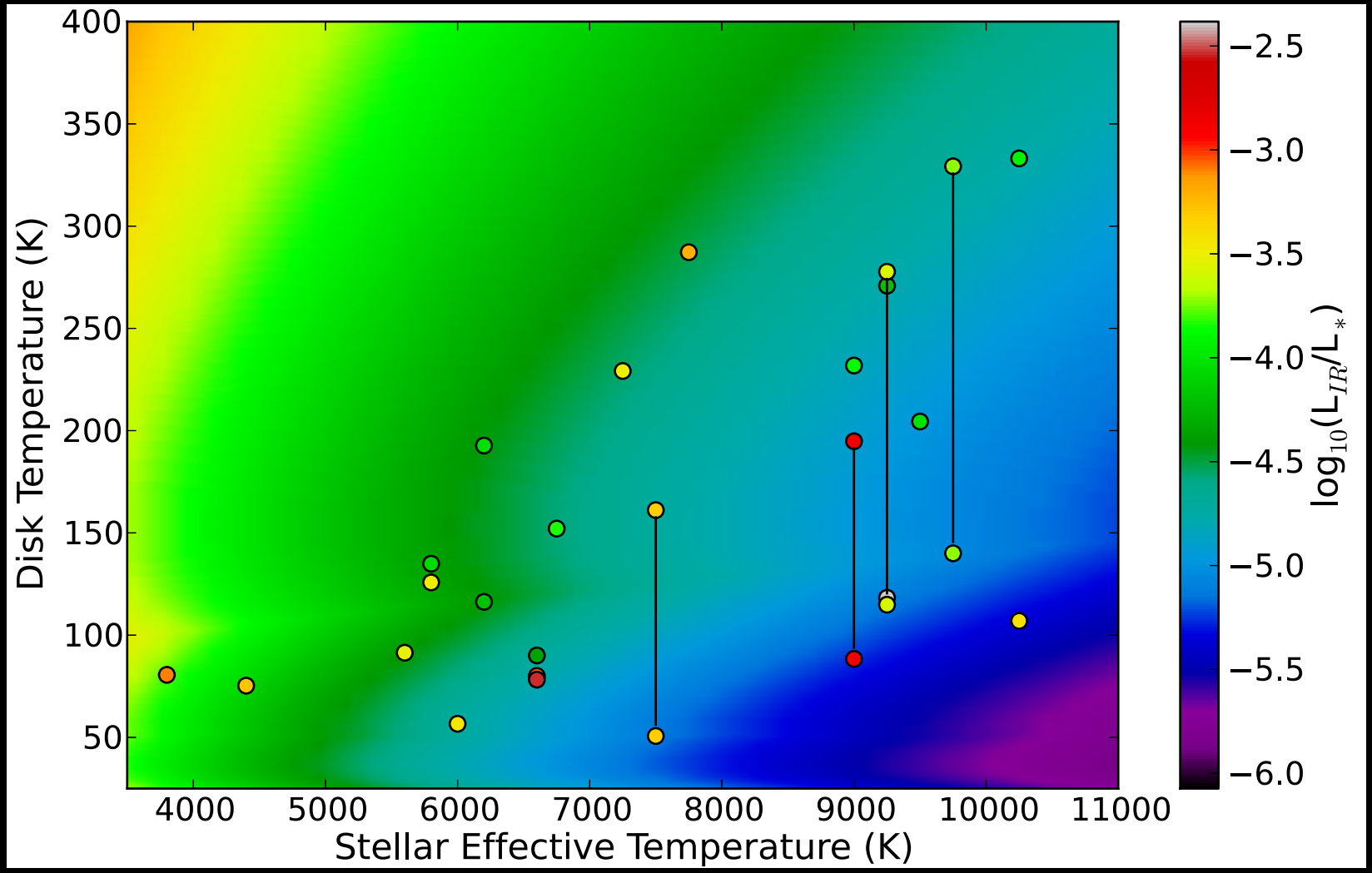
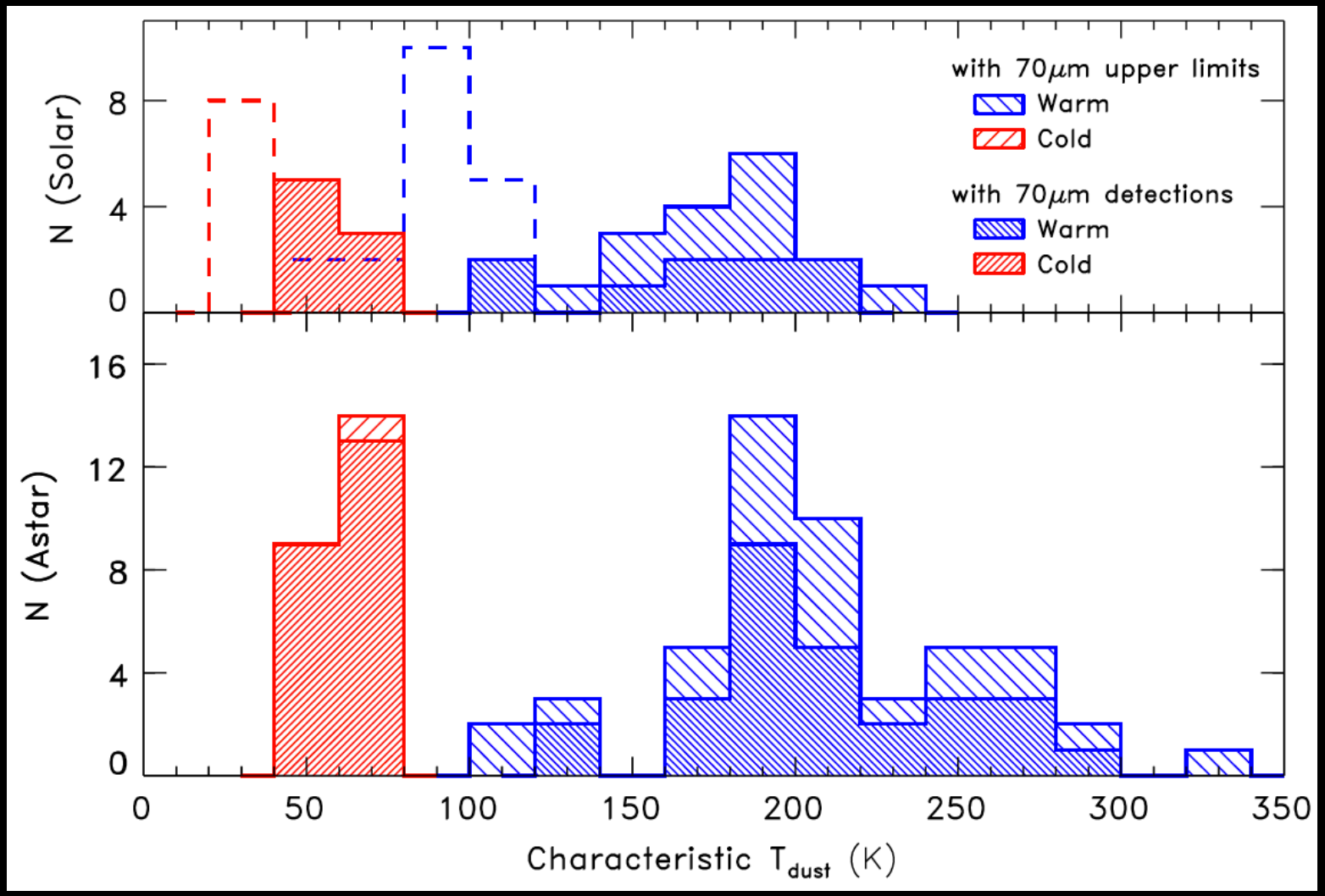
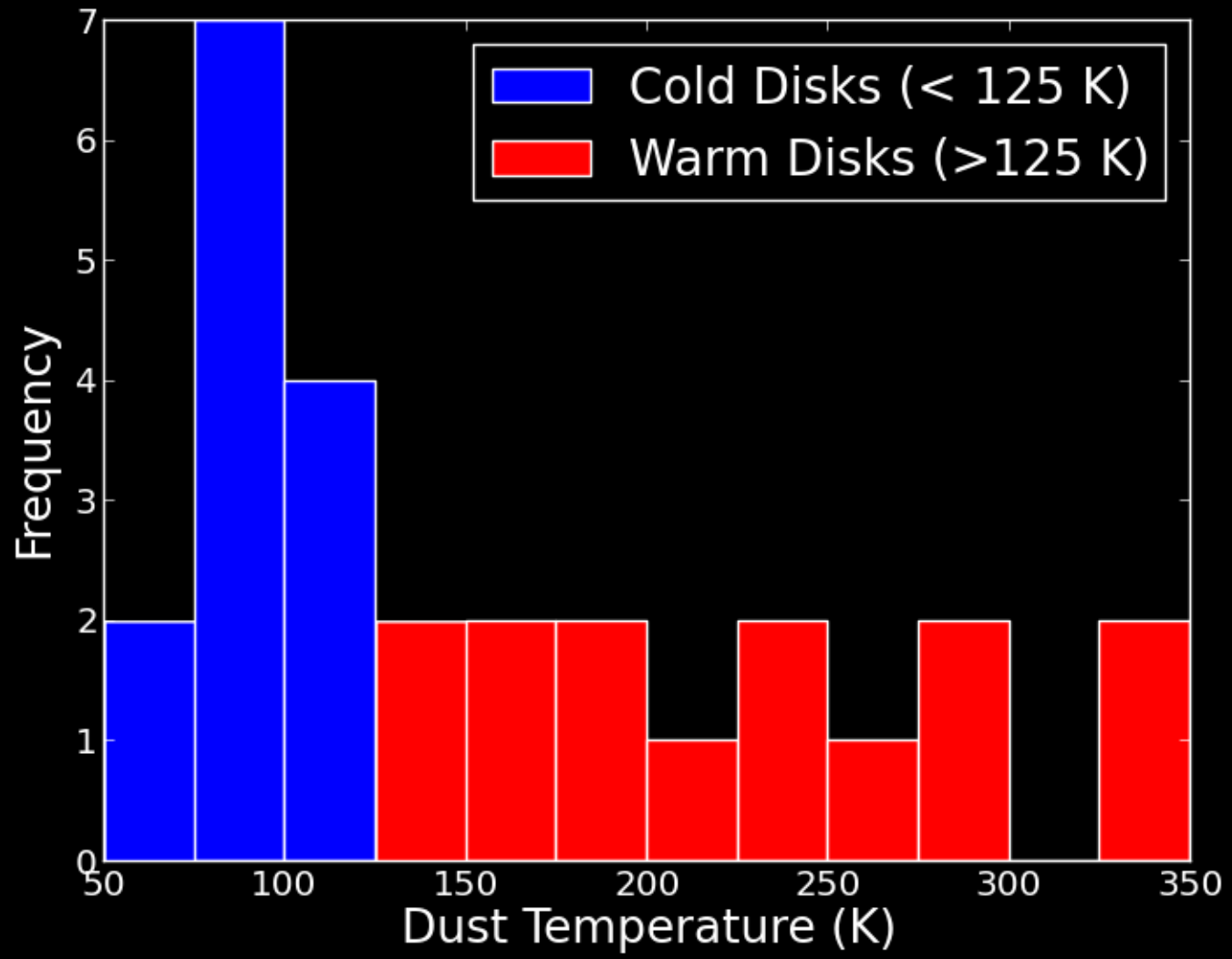


Morales et al. (2011) –all warm disks have similar temperatures



We split the disks into warm and cold populations



We tried 3 different models to fit the temperature trend

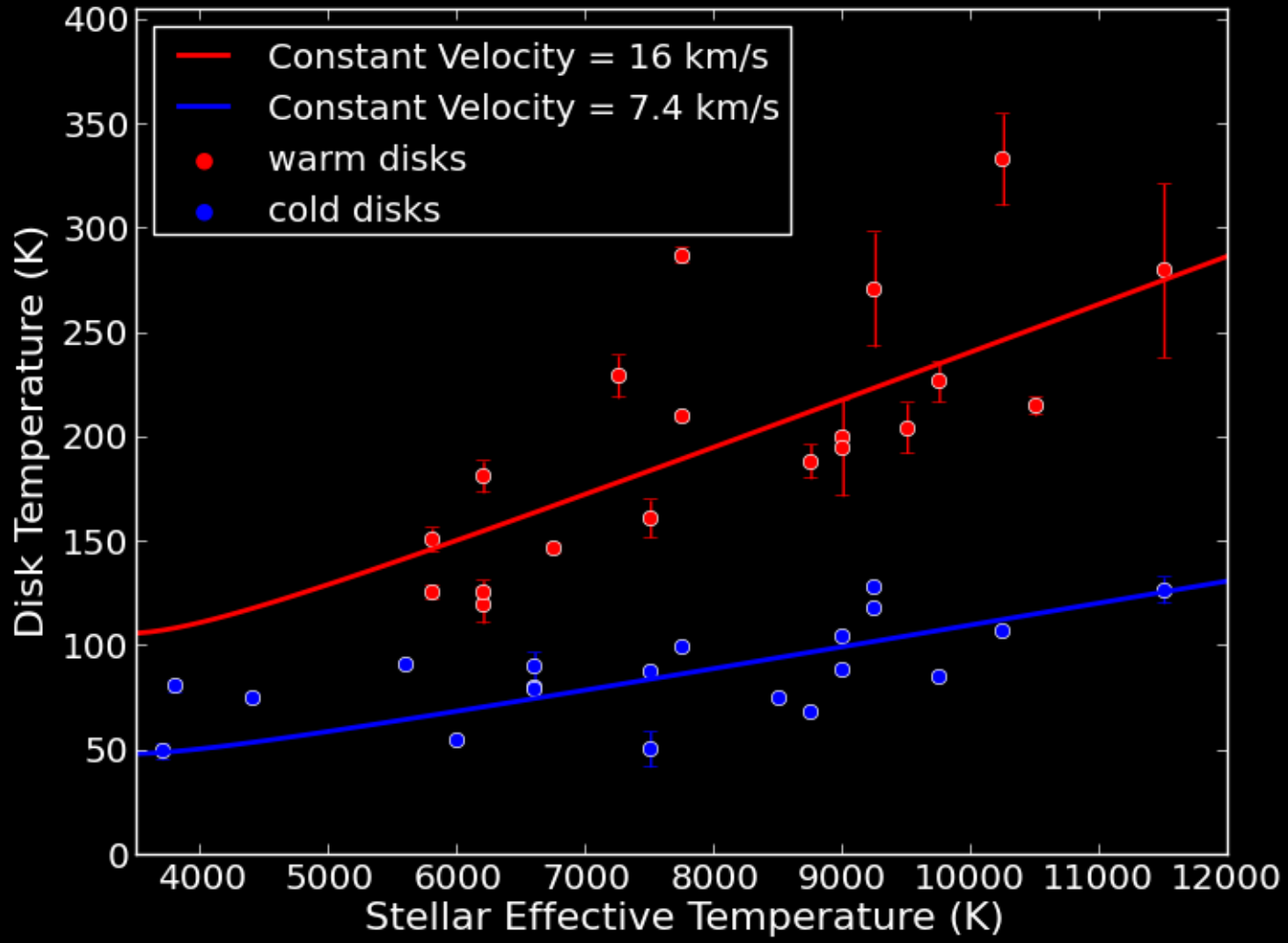
- Constant Temperature $T_d = const$
- Constant Radius $T_d \propto L_*^{1/4}$
- Disk Radius vs Stellar Mass relations

$$R \propto M^{\gamma}$$

γ is a free parameter

$$T_d \propto M_*^{-\gamma/2} L_*^{1/4}$$

Best Fit $R \propto M, \gamma = 1$
Constant Orbital Velocity



Conclusions

- Surveyed 68 stars in 4 stellar associations
  - Found 24 debris disks
- Fit the disks with modified blackbody models
- Found a trend between dust location and stellar mass
  - Well fit by a constant orbital velocity model