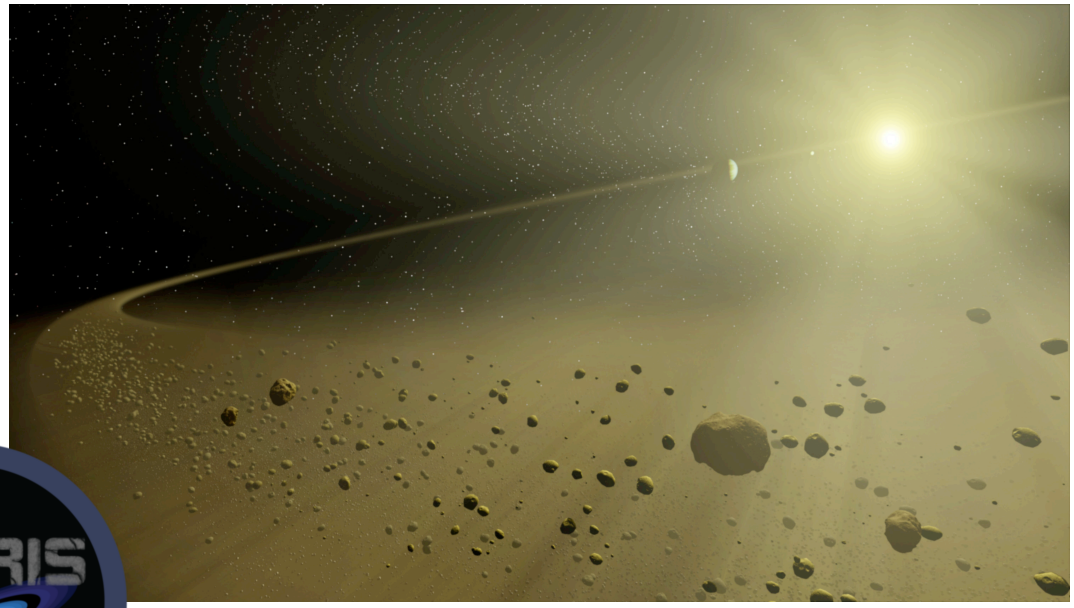


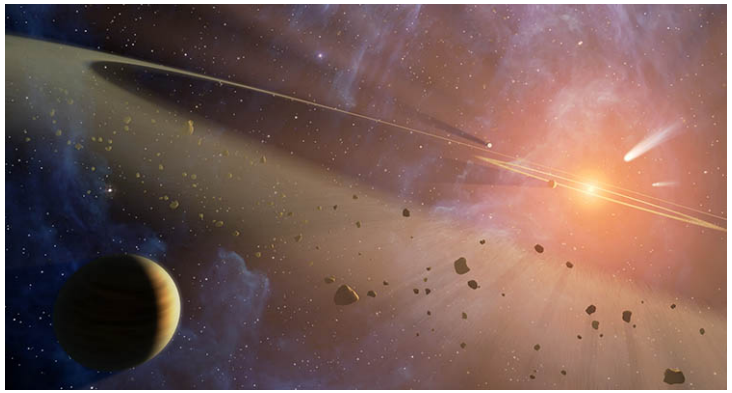
THE FIRST DAYS OF DEBRIS

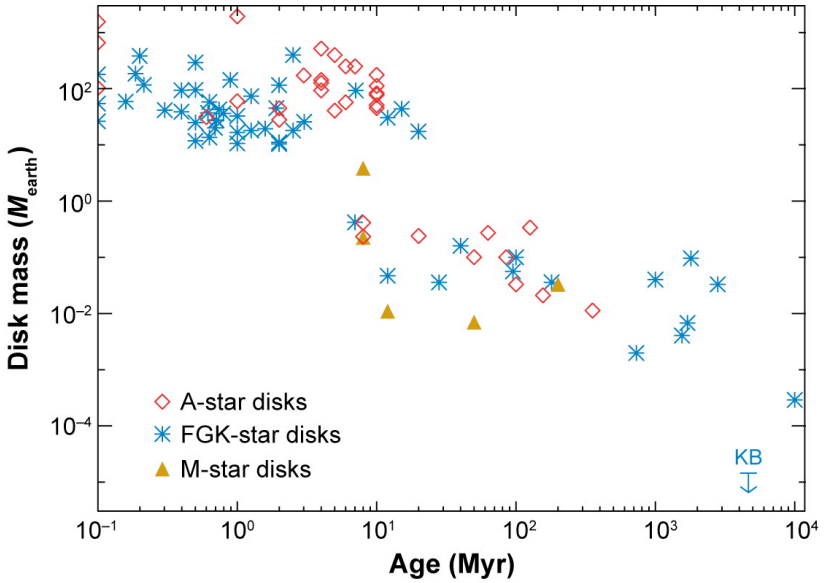
Exciting Results and Unexpected (Good) Surprises

Jane Greaves (St Andrews), for Brenda Matthews (HIA) & The DEBRIS team

INTRODUCTION

- Debris discs are rarefied discs
  - parent population of (invisible) rocky/icy planetestimals
  - second-generation dust produced by their collisions
- For older, fainter discs, need sensitivity and resolution to detect them, due to confusion with background galaxies

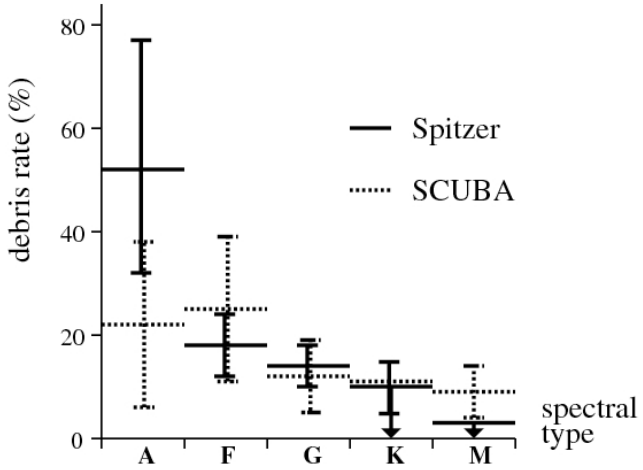


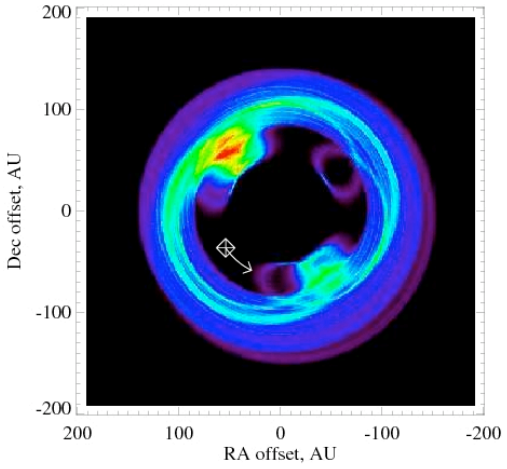


Wyatt MC. 2008.
Annu. Rev. Astron. Astrophys. 46:339–83

THE DEBRIS SURVEY: SCIENCE

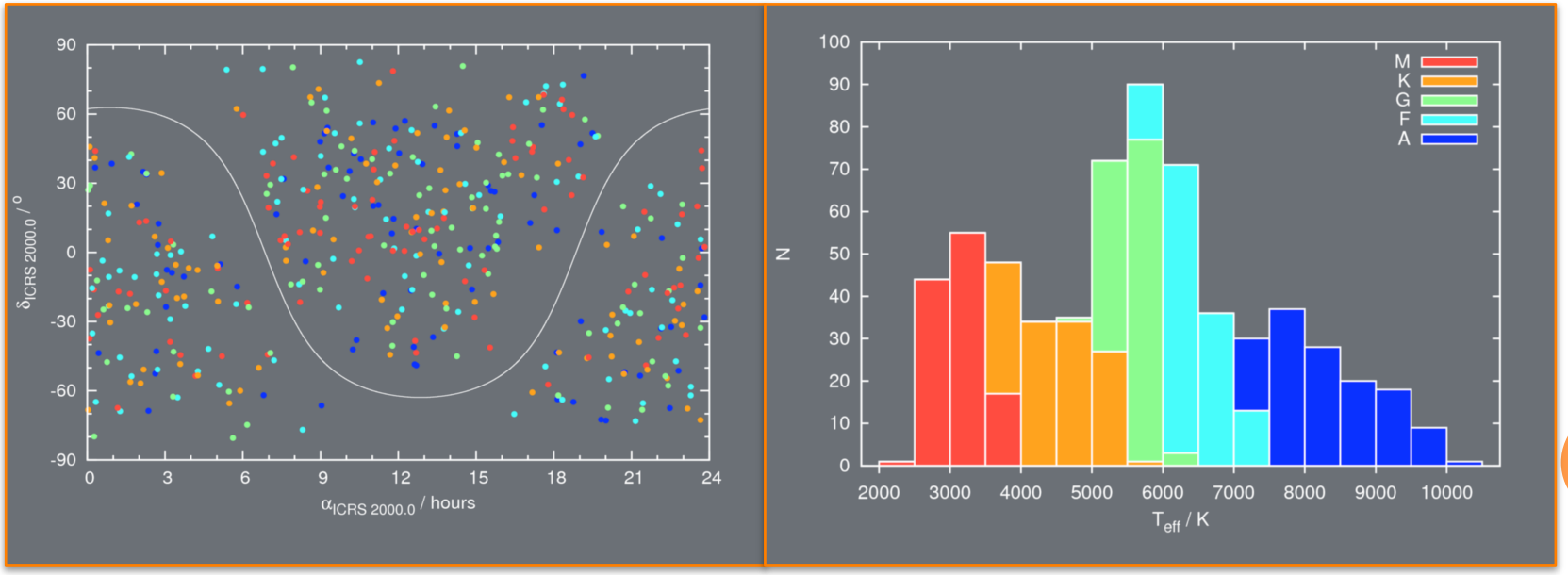
- Disc Emission via a Bias-free Reconnaissance in the Infrared/Submillimetre
- Four primary science goals:
  - To establish the incidence of discs statistically
  - To place the solar system in context (common or unusual)
  - To characterize the debris disc population
  - To resolve discs and model their structure





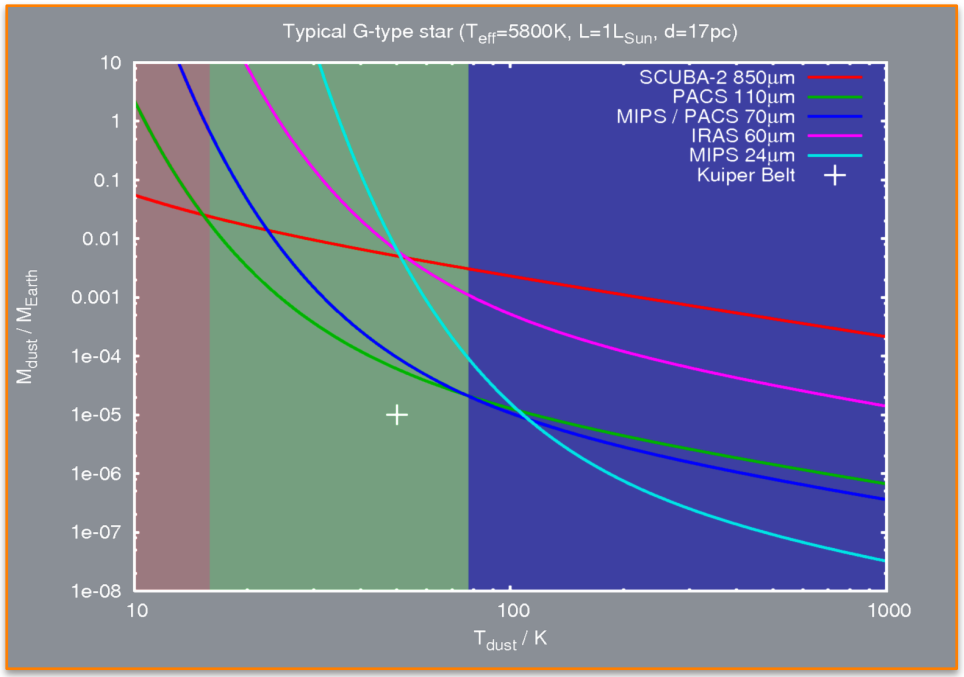
THE DEBRIS SURVEY: SAMPLE

- Targets drawn from Unbiased Nearby Stars sample (Phillips et al. 2010)
- ~90 each of A, F, G, K and M type primaries (446)
- Sp. Type samples volume-limited, with confusion cut
  - Volume limits: 46, 24, 21, 16, 8.6 (A-M)



THE DEBRIS SURVEY: SENSITIVITY

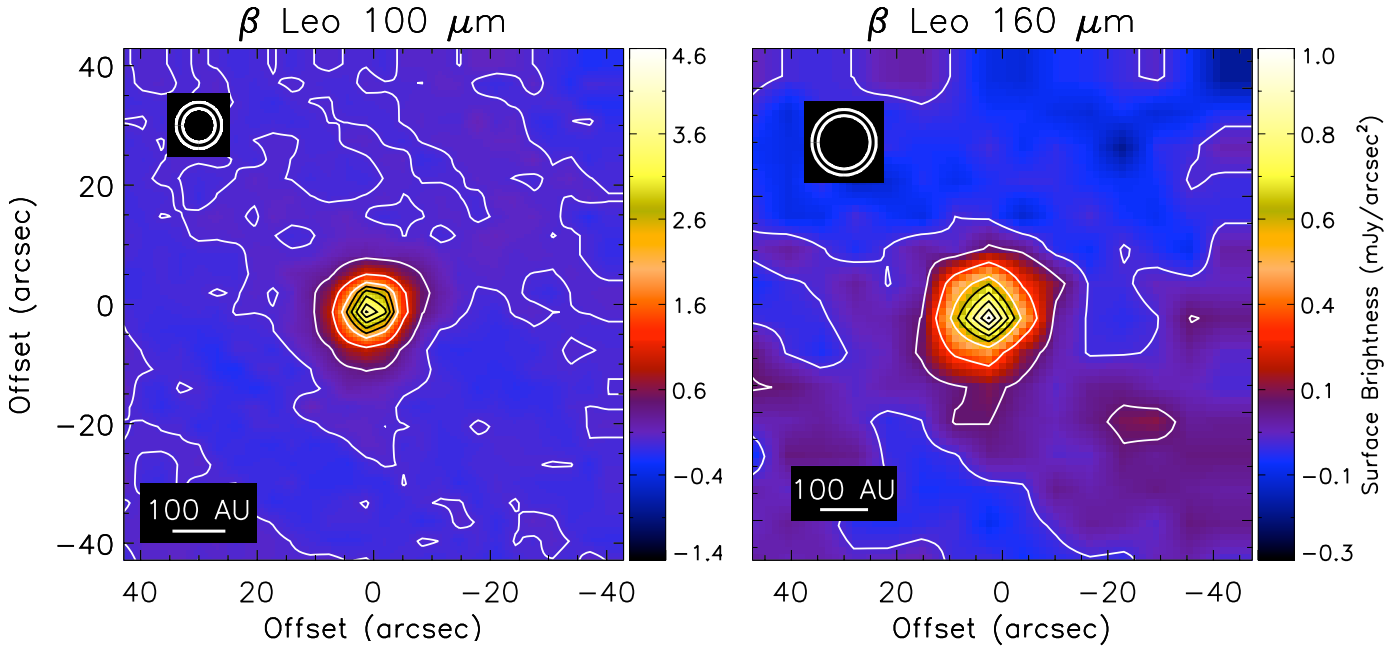
- Flux-limited, uniform depth
- Driven by 100 micron sensitivity
  - 1 sigma rms = 1.2 mJy at 100 micron
  - PACS 100/160
  - SPIRE followup for 98 targets (confusion limited)

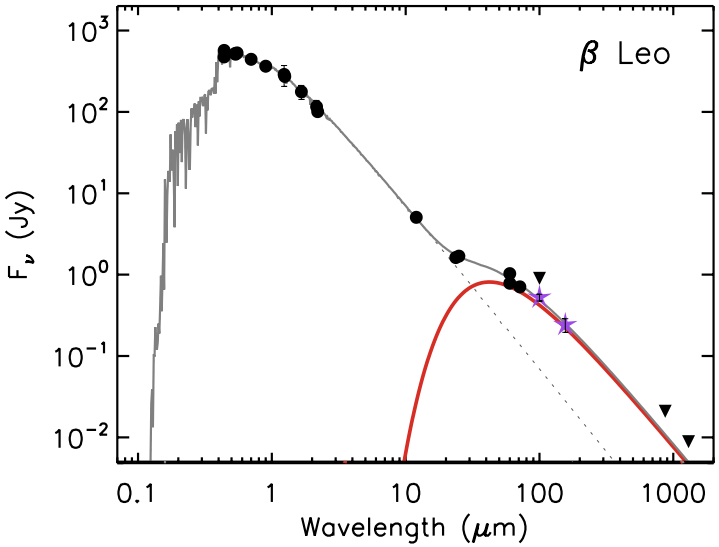


DEBRIS: STATUS

- SDP observations
  - Seven targets observed with PACS
    - All but one known disc hosts
  - Six discs detected
  - Single M star observed: no disc OR STAR detected
- 62 targets observed as of day 353 with PACS 100/160
- 5 targets observed with SPIRE (SDP)

First results: beta Leo





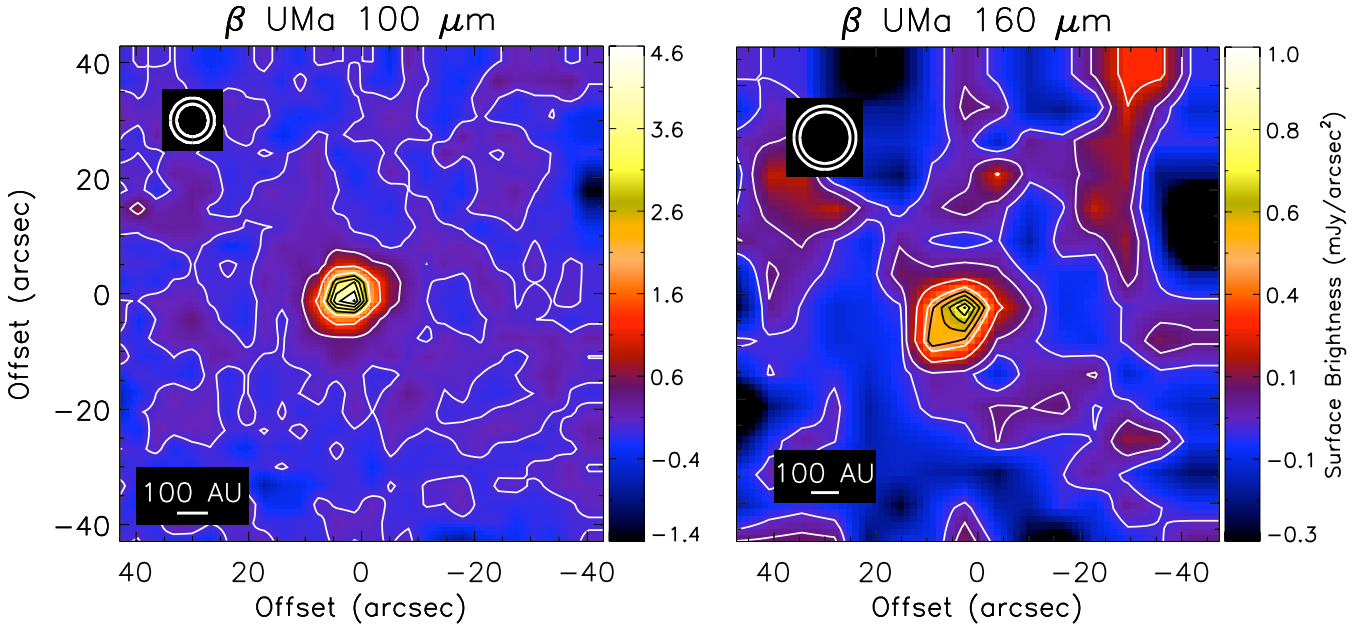
- 5th closest A star to Sun (11 pc)
- disc resolved for the first time!
- 100 micron size 10.4 arcsec x 9.2 arcsec*

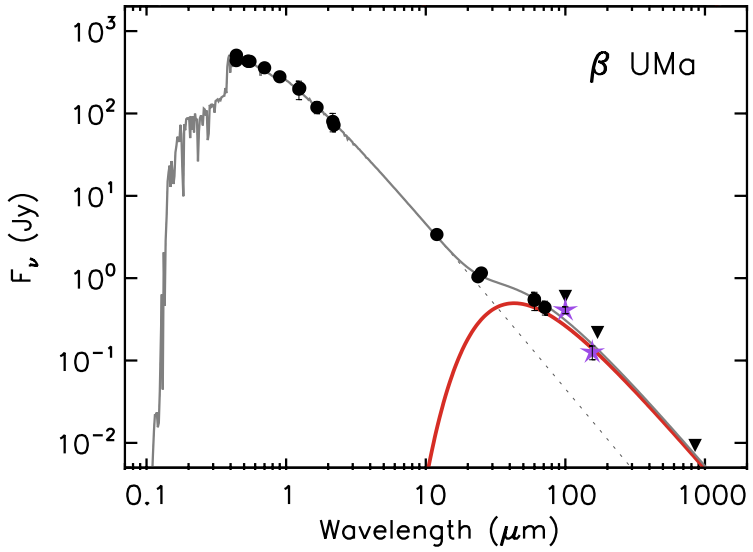
- SED is well fit by blackbody grains of temperature 112 K

* Beam is 6.7 arcsec x 6.9 arcsec

Matthews et al. 2010, submitted

First results: beta UMa



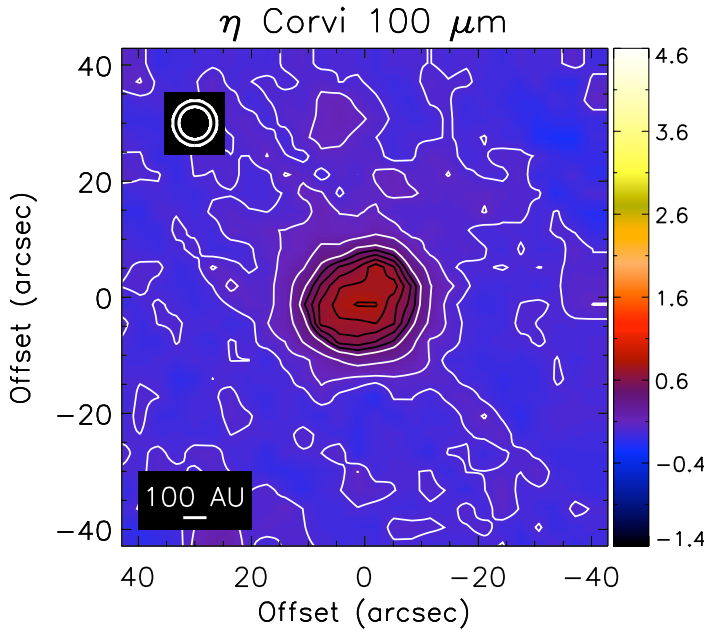


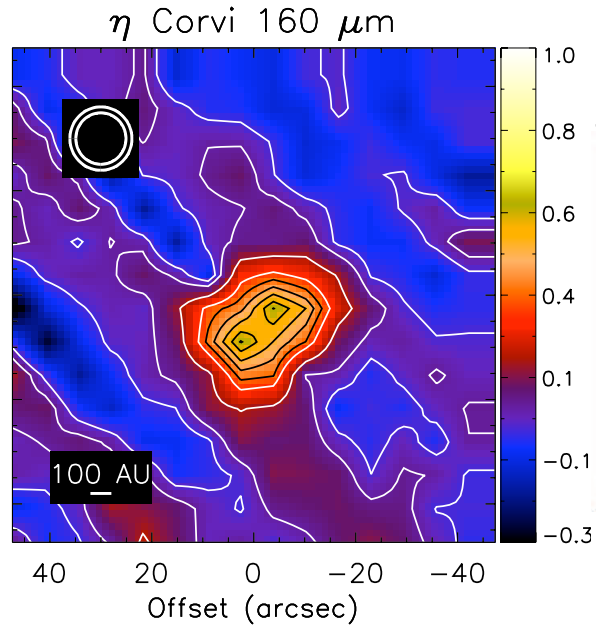
- 24th closest A star to Sun (24.3 pc)
- disc marginally resolved (one axis)
- 100 micron size 8.4 arcsec x 7.3 arcsec

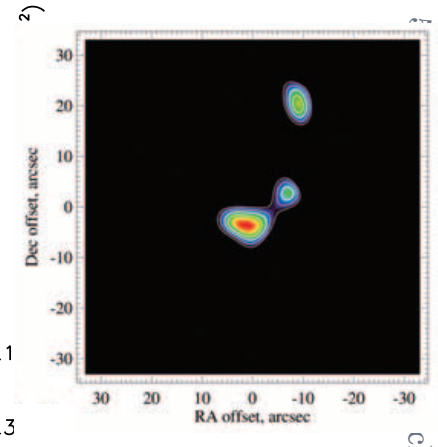
- SED is well fit by blackbody grains of temperature 109 K

Matthews et al. 2010, submitted

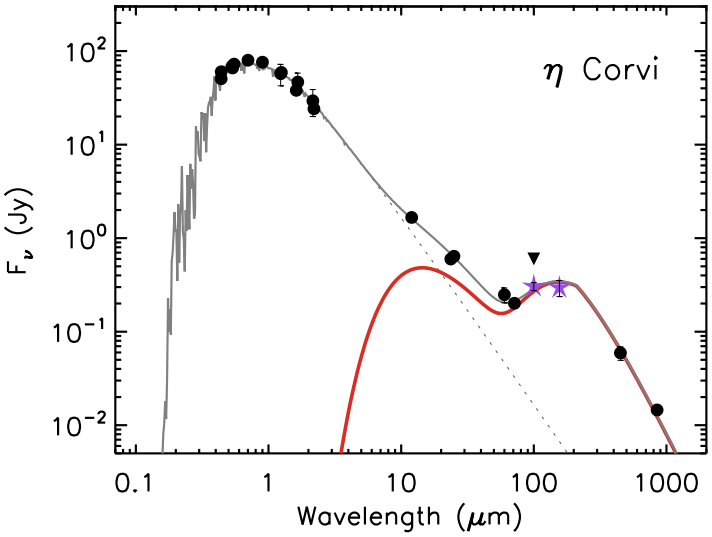
First results: eta Corvi







450 micron
Wyatt et al. 2005



- 63rd F star from the Sun (18.2 pc)
- disc resolved at 100 and 160 micron
- 100 micron size 18.3 arcsec x 16.4 arcsec
- emission double peaked at 160 micron

- SED requires two components
  (T = 31 K and 354 K)
- greybody grains longward of 210 micron

Matthews et al. 2010, submitted

First results: disc parameters

Parameter	β Leo	β UMa	η Corvi
$f_D = L_{IR}/L^*$	2.2×10^{-5}	1.4×10^{-5}	3.6×10^{-4}
T_{disc} [K]	112	109	31, 354
R_{dust} [AU]	23	51	174, 1.4
R_{obs} [a] [AU]	~ 39	~ 47	~ 145

[a] *derived from FWHM*

- Beta Leo and Beta UMa measured disc sizes ~ R_{KB}
- Beta Leo
  - $R_{dust} < R_{obs}$ (BB fit radius is too small)
  - grains are small, inefficient radiators
  - characteristic particle size, $a < \lambda/2\pi = 16$ micron
- Beta UMa
  - $R_{dust} = R_{obs}$
  - blackbody grains present in this disc
  - blackbody fit unconstrained in submm
- SPIRE data forthcoming for both sources

First results: disc parameters

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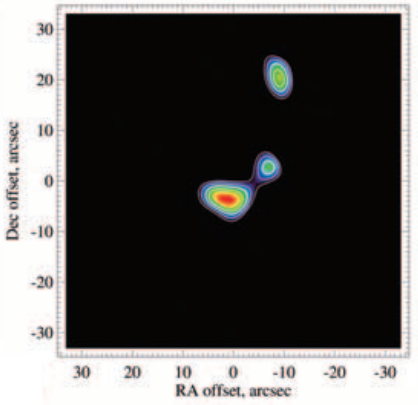

- Eta Corvi is well resolved, as expected
  - 150 AU radius measured at 450 micron
  - Similar morphologies at 160 and 450 micron
  - 100 micron morphology suggests warmer component within cool (31 K) outer ring (proposed by Chen et al. 2006)
  - Generally suggests radial distribution of material is broader than the two ring system of Wyatt et al. (2005)
  - As for Beta UMa, $R_{obs} = R_{dust}$
    - absence of small, inefficiently radiating grains
- SPIRE data forthcoming

SUMMARY

- Resolution impact is immediate
  - Beta Leo and Beta UMa discs resolved for the first time (Beta UMa along one axis only)
  - Disc sizes are comparable to Kuiper Belt (40-50 AU)
  - Among smallest discs yet resolved
- Target sensitivity limits are reachable in scan-mapping mode
  - 1.2 mJy/beam at 100 micron
  - vs. 5 mJy/beam at 70 micron from Spitzer (Trilling et al. 2008)
- More results are coming fast!