A Resolved Debris Disk around F085 using *Herschel*

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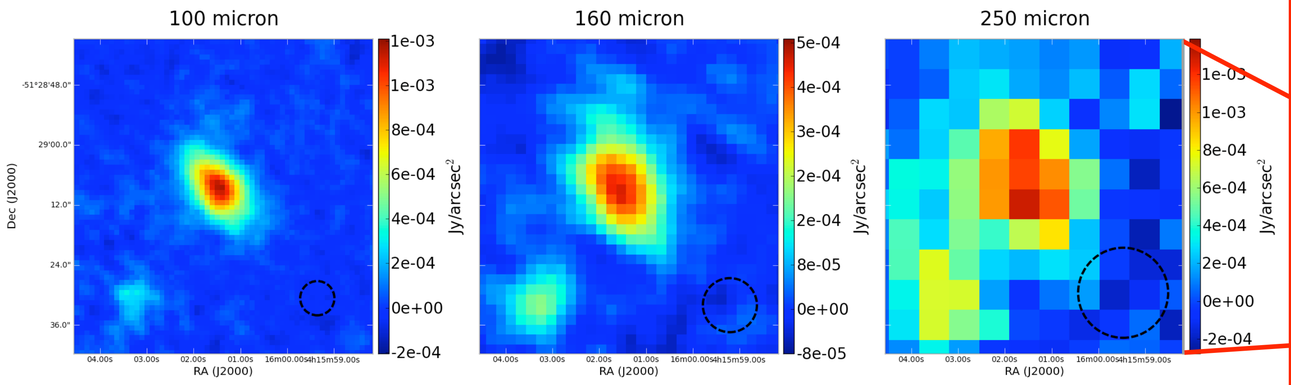
ABSTRACT

Debris disks are composed of dust grains and planetesimals around main-sequence stars. The dust population is replenished by colliding planetesimals which were formed in the protoplanetary disk. The *Herschel* DEBRIS (Disk Emission via Bias-free Reconnaissance in the Infrared/Submillimetre) survey is a flux-limited survey of 446 nearby main-sequence stars designed to detect and characterize debris disks. It is unbiased to spectral type, age, metallicity, binarity and presence of known planets. *Herschel's* observing wavelengths and sensitivity promise to increase the number of known debris disk hosts. Its resolving power offers the ability to learn more on the structure of disks, as they have sizes on the scales of 10-1000 AU.

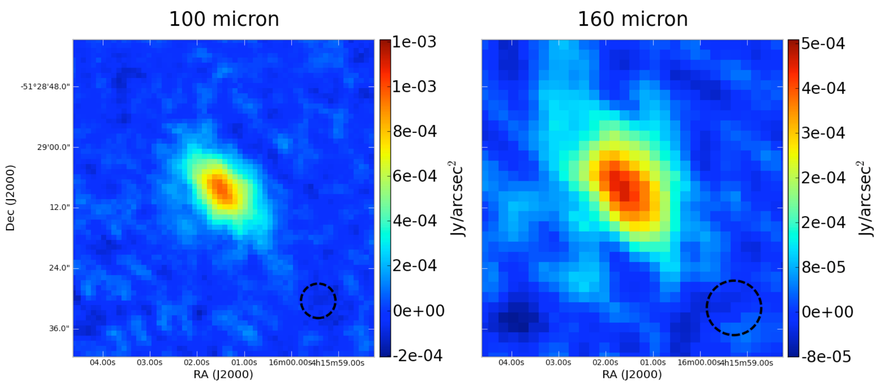
The spatial information is of key interest because the observed spectral energy distribution (SED) of the dust has degeneracies between the grain properties and the disk size. Disk radii estimated from SEDs have been found to generally underestimate the radii determined from imaging. The multi-wavelength imaging also samples different grain populations at each wavelength. (Cooler grains dominate more at longer wavelengths.) Finally, determining the spatial distribution of dust grains can point towards the location of the parent planetesimal population.

We present resolved maps and surface brightness distributions at 100 and 160 μm (using PACS) showing the extended emission due to the disk. Observations at 250, 350 and 500 μm (using SPIRE) detect the submillimetre emission from this disk for the first time. We show the 250 μm map which is heavily populated by extragalactic background sources.

Multiwavelength data



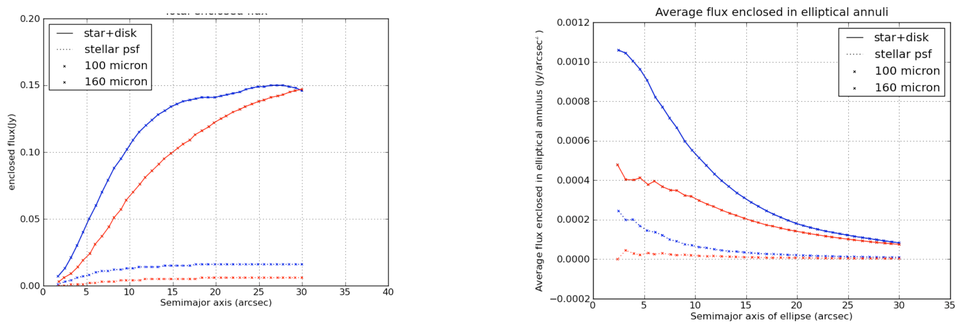
Herschel observations of F085 using PACS (100 & 160 μm) and SPIRE (250 μm) instruments. Our target is shown at the center. Dashed circles show the beam size at each wavelength. The background sources become brighter relative to the F085 at longer wavelengths. As resolution decreases, it is harder to isolate flux arising from F085, as opposed to the nearby background sources.



Star and background source removal

The stellar contribution can be removed from the map by subtracting the point spread function (PSF) scaled to the expected photospheric flux. Star subtracted images are shown on the left. Two nearby background sources (one above the star within the disk, the other at the bottom left of the map) have also been removed in order to isolate the disk.

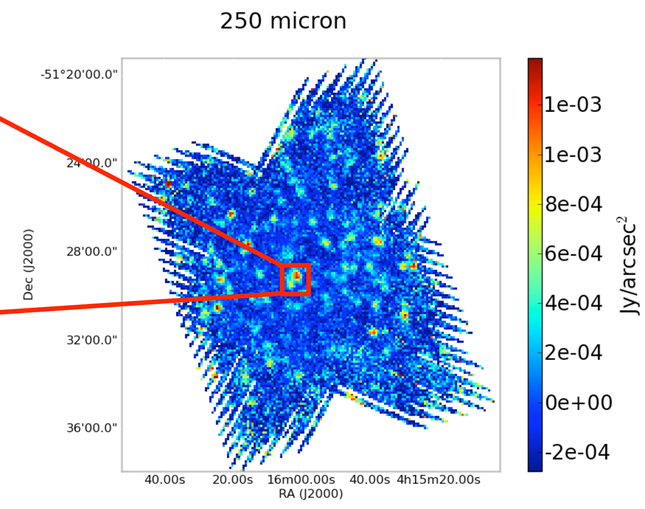
Surface brightness profiles



Preliminary profiles of the star + disk system (solid line) and the stellar PSF (dotted line) at 100 and 160 μm (blue and red lines, respectively). The stellar PSF is determined by scaling the PSF by the photospheric flux predicted by the stellar fit.

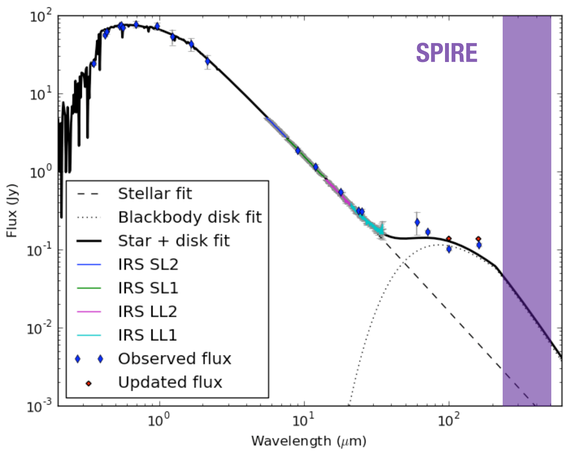
The target is fit to a 2D gaussian at each wavelength. The fitted gaussian parameters are used to define the elliptical annuli used in the aperture photometry.

SPIRE data



At SPIRE wavelengths (250, 350 & 500 μm), the map is heavily populated by background sources and it becomes more difficult to isolate flux originating from F085 as we observe down to the extragalactic background confusion limit.

Spectral Energy Distribution



Blue points show archival data from other instruments including 2MASS, AKARI (9 & 18 μm), IRAS (12, 25, 60 & 100 μm) and MIPS (24 & 70 μm) along with a first pass of *Herschel* PACS (100 & 160 μm) fluxes used to fit the star + disk system. The *Herschel* PACS data has been updated to include more of the extended emission using aperture photometry (red points). The blackbody fit estimates the disk to have a temperature of ~60 K.

Preliminary SPIRE fluxes are not shown as the field is more populated by background sources in the submillimetre. (See SPIRE data panel above.) At PACS wavelengths we can identify nearby sources which are contained within the SPIRE beam along with the target. (See Multiwavelength data panel.)

Future work

- analysis of background in SPIRE maps with the aim of source extraction and estimation of fluxes.
- SED modeling to characterize the disk properties.
  - to compare the disk radius inferred from the SED and the observed radii in the resolved maps.
  - determine implication on dust properties.
- collisional modeling of the system using parameters determined from analysis of F085.