# AKARI Observations of Young Debris Discs

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## Introduction

One of the most important results of the IRAS all-sky survey was the detection of circumstellar dust around main sequence stars as a sign of planet formation. Although over 200 debris disc stars have now been identified since that initial detection 25 years ago, the majority of discs remain unresolved, limiting the constraints that can be placed on their physical properties through modelling due to the degeneracy between model parameters derived from the unresolved spectral energy distribution (SED).

Young debris discs, i.e. those analogous to β Pictoris, with large dust masses (1 – 10$M_{\oplus}$), high fractional luminosities (~ $10^{-3}$), evidence of remnant gas from their proto-planetary stage and a large extent ($R_{disc}$ > 100AU) are particularly suited to attempts to map their extension through PSF analysis and are also of great scientific interest, occupying a period in disc evolution at the tail end of gas giant formation but still in the middle of terrestrial planet formation.

The AKARI Far Infra-red Surveyor instrument, covering wavelengths from 65 – 160μm, is well suited to observing such targets, having a superior sensitivity and spatial resolution to both IRAS and ISO, with which previous attempts to resolve these discs have been made.

## Observations

We have obtained AKARI FIS pointed observations of four young debris discs previously identified through IRAS or ISO observations. These observations constrain both the disc SED at far infra-red wavelengths with photometric measurements, but also the disc spatial extent through comparison of the observed disc point spread function (PSF) to that of the model instrument PSF.

## Analysis - Photometry

The SEDs of the four discs have been fitted with modified blackbody emission models and from this disc masses and radii have been determined. The stellar SED and warm dust emission were constrained by optical, 2MASS and IRAS measurements respectively.

## Analysis – PSF

A series of cross-cuts were made through the PSFs of each of the four debris discs, Alpha Taurus (as a comparison) and the model instrument PSF in both SW band images (65 and 90μm). The one dimensional profiles along each angle were then fitted with a gaussian function from which the FWHM of the profile was calculated and the relative extension of the source along that angle was determined.

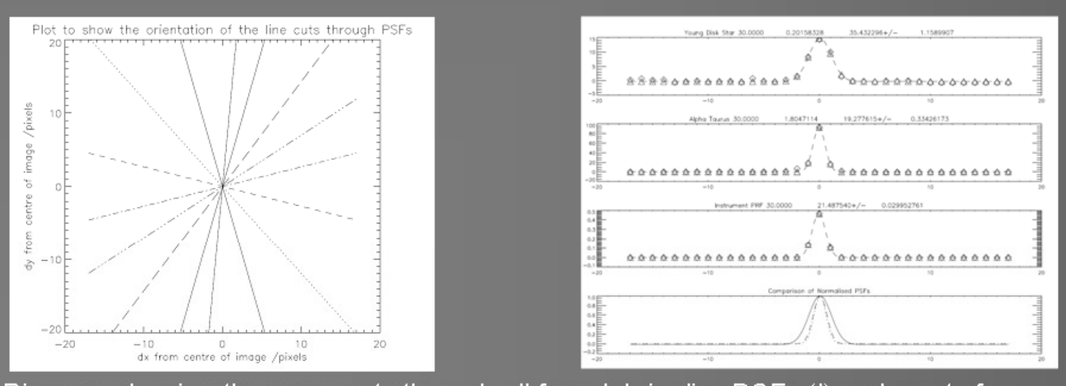


Fig 1. Diagram showing the cross-cuts through all four debris disc PSFs (l) and a set of gaussian fits showing the extension of the source (solid) compared to the PSF (dashed) and α Tau (dotted) in the bottom panel.

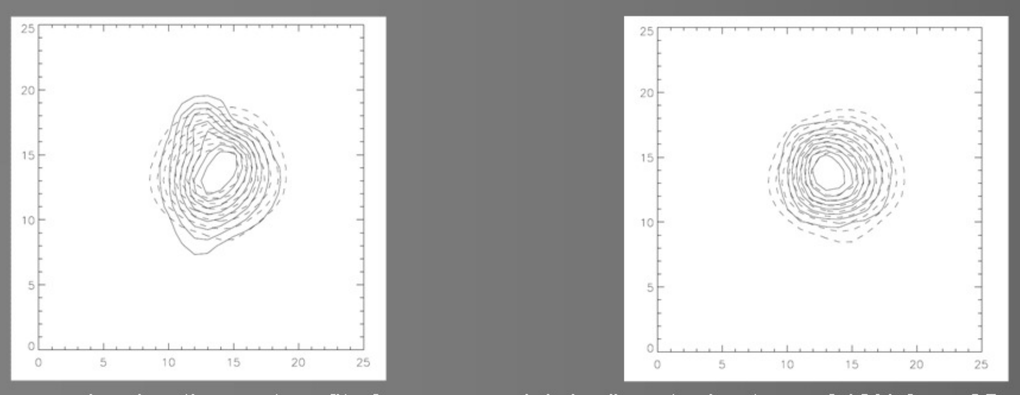

Fig 2. Diagram showing the contour fits for a young debris disc star in steps of 10% from 25 – 95% (solid line) and the FIS PSF at both 65 (l) and 90μm (r). Note that the target is just resolved at 65μm but not 90μm. Axes are image size in pixels.

## Beta Pictoris

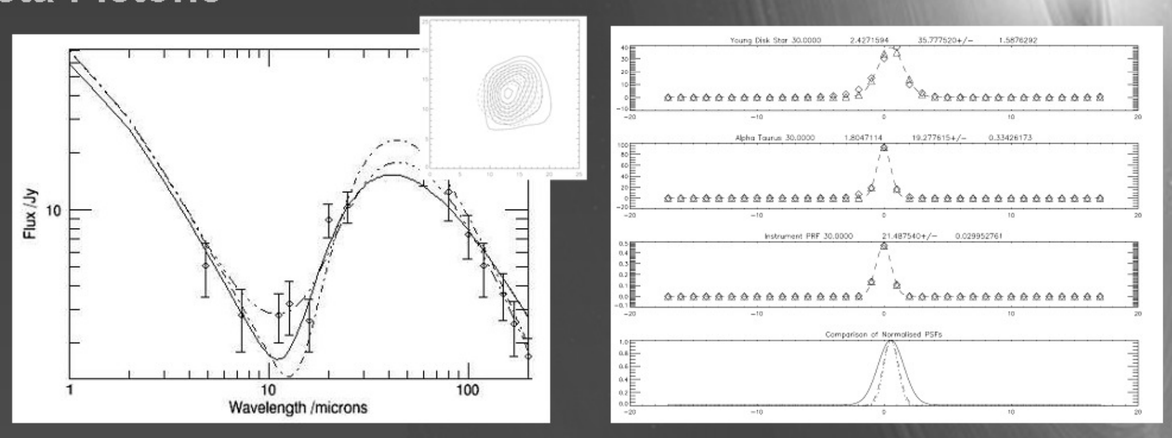


Fig 3. [left] The disc SED has been fitted with three contrasting models to illustrate degeneracy. A single temperature blackbody, modified blackbody and thermal emission model have been plotted over the observed AKARI and IRAS fluxes.

[right] Beta Pictoris is resolved at both 65 and 90μm along a PA of 30°, consistent with scattered light and mid infra-red measurements.

## 49 Ceti

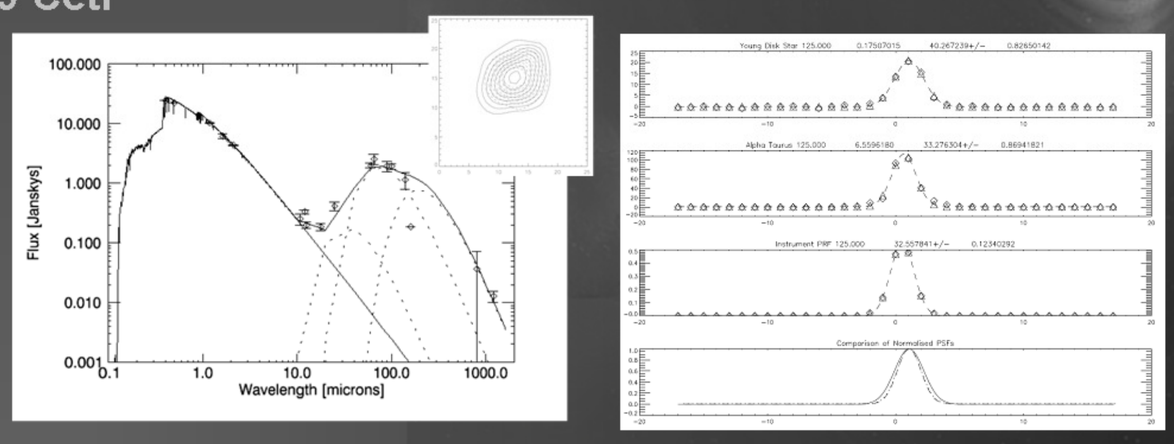


Fig 4. [left] The disc SED has been fitted with three blackbodies at 80, 40 and 15K. AKARI FIS fluxes provide a strict constraint on the peak of the cold dust emission, limiting the dust effective temperature and disc radius.

[right] 49 Ceti is just resolved at 65μm, along a PA of 125° and is extended at 90μm, though not along the same PA as the disc, implying instrumental effects for the extension at longer wavelengths.

## HD34700

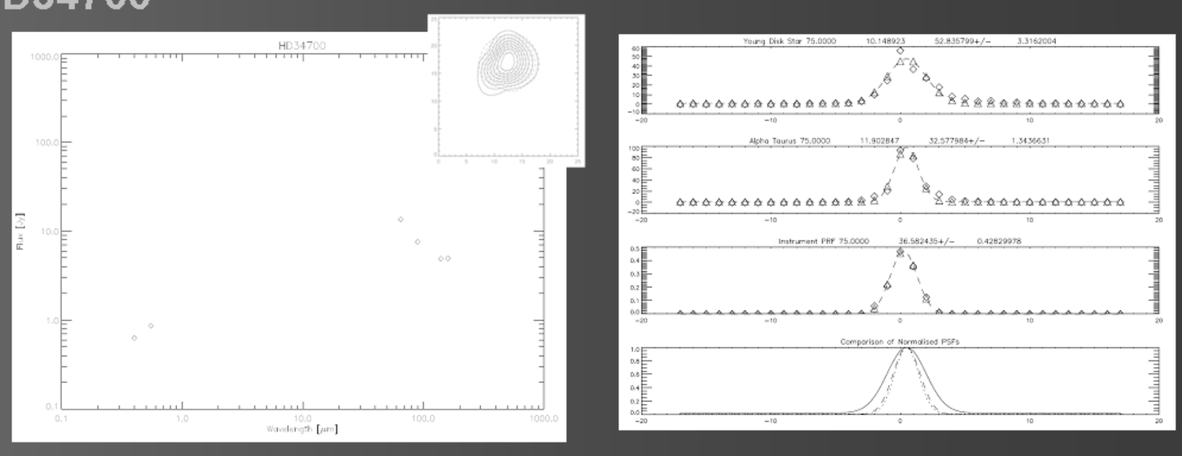


Fig 5. HD34700 is resolved at 65μm, along a PA of 105°, but not at 90μm.

## HD233517

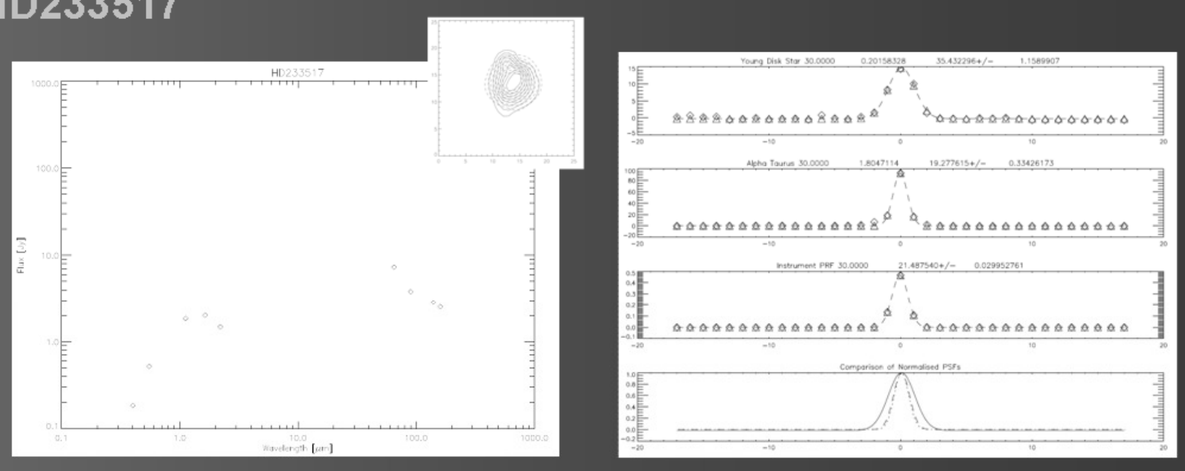


Fig 6. HD233517 is resolved at 65μm, along a PA of 30°, but not at 90μm.

## References

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