HR 8799: Giant Planets, Giant Debris Disc

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First multi-planet system discovered through direct imaging. (Marois et al. 2008, 2010).
Discovered by IRAS. (Sadakane & Nishida 1986)

Resolved at 24 µm with Spitzer. (Su et al. 2009)

Warm component also detected.
Clumps?

CSO (350 μm)
Patience et al. (2011)

SMA (880 μm)
Hughes et al. (2011)
Herschel
The images are best fit by a disc with an inclination of 26°.

The disc is formed of an inner warm component, a planetesimal belt between 100 and 310 AU and a blowout halo extending out to 2000 AU.
The SED is well fit by a two temperature disc.
Collaborators: Rafael Brahm, Andrés Jordán, Antonio Hales, Pablo Román, Simon Casassus, Neil Philips, Bill Dent, Jorge Cuadra and Denis Barkats
ALMA Debris Disc Observations

Fomalhaut
Boley et al. 2010

AU Mic
Macgregor et al. 2013

Beta Pic
Dent et al. 2014
ALMA Cycle 0

- Observed with Band 7 (870 µm)
- Total time 4.7 hours
- Between 13 and 27 antennas
- NO DETECTION
Visibilities
The Fourier transform of an ellipse is also an ellipse but at right angles to the original. We can use this to deproject and azimuthally average the visibilities.

Lay, Carlstrom and Hills 1997
Solid line: wide disc with inner hole.
Dotted line: thin ring

Hughes et al. 2007
From this we can constrain the width of the disc and the inner edge.
SONS is one of 7 Legacy Surveys currently underway on the James Clerk Maxwell telescope (JCMT), searching for debris signatures in the form of excess emission at 850 μm around 115 nearby stars.

Collaborators: Wayne Holland, Brenda Matthews and the SONS JLS Team
Peak flux is $9.5 \pm 1.2$ mJy/beam
Compares well with that from SCUBA: $10.3 \pm 1.8$ mJy/beam
SCUBA-2 clearly shows resolved emission, unlike SCUBA
Total flux is $28.7 \pm 3.0$ mJy in a 60” aperture.
Preliminary Gaussian fitting gives a disc radius of 600 AU.
The spectral energy distribution is well fit by two narrow rings but the resolved emission shows dust out to ~2000 AU.

The Herschel data can be explained by the Su et al. (2009) model with a planetesimal belt between 100 and 310 AU and a halo of blowout grains beyond this.

The ALMA cycle 0 data shows that the planetesimal belt must be wider than this and confirms the smooth nature of the disc.

The SONS data also shows the disc to be wider with an outer edge of ~600 AU.