DUNES observations of debris discs around nearby stars with exoplanets

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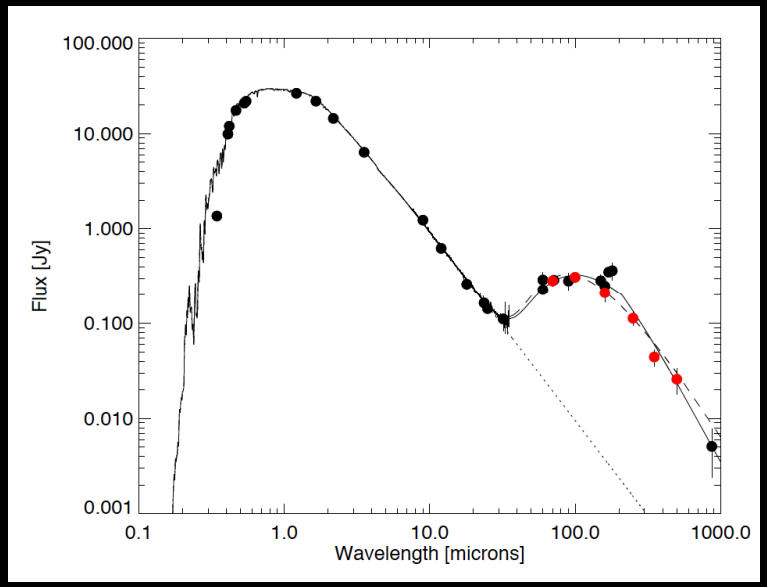
on behalf of the DUNES consortium

Overview

- Introduction
  - Debris discs
  - DUst around NEarby Stars (DUNES)
- Summary of DUNES results
- Stars with both exoplanets and a debris disc
  - HIP7978
- A star with a debris disc from which we infer an exoplanet
  - HIP15371
- Summary

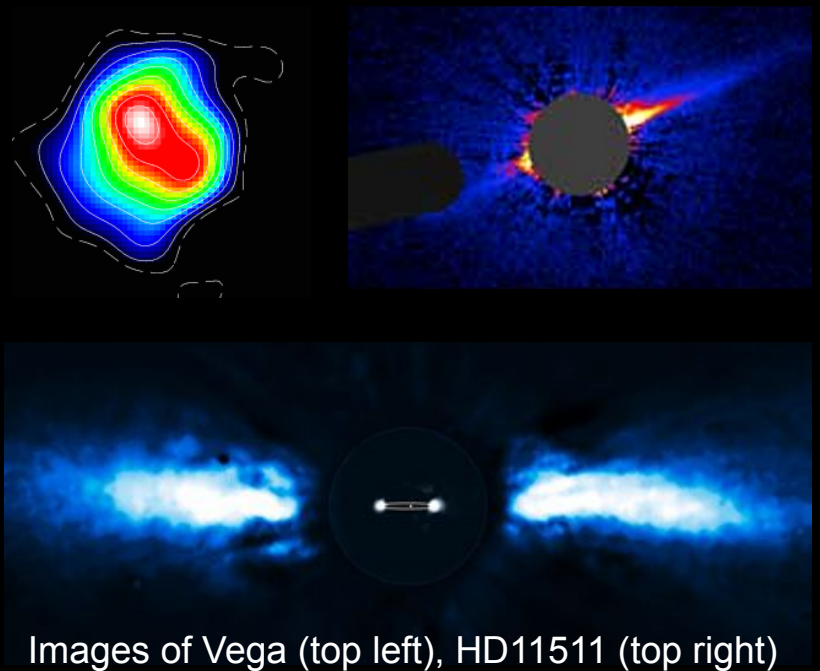
Debris discs

- Detected through infrared excess from dust emission.
- Lifetime of the grains is much shorter than the star, so must be continually replenished.
- Analogous to the Solar system's Edgeworth-Kuiper belt.
- Dust can tell us about (unseen) planetary companions in these systems.



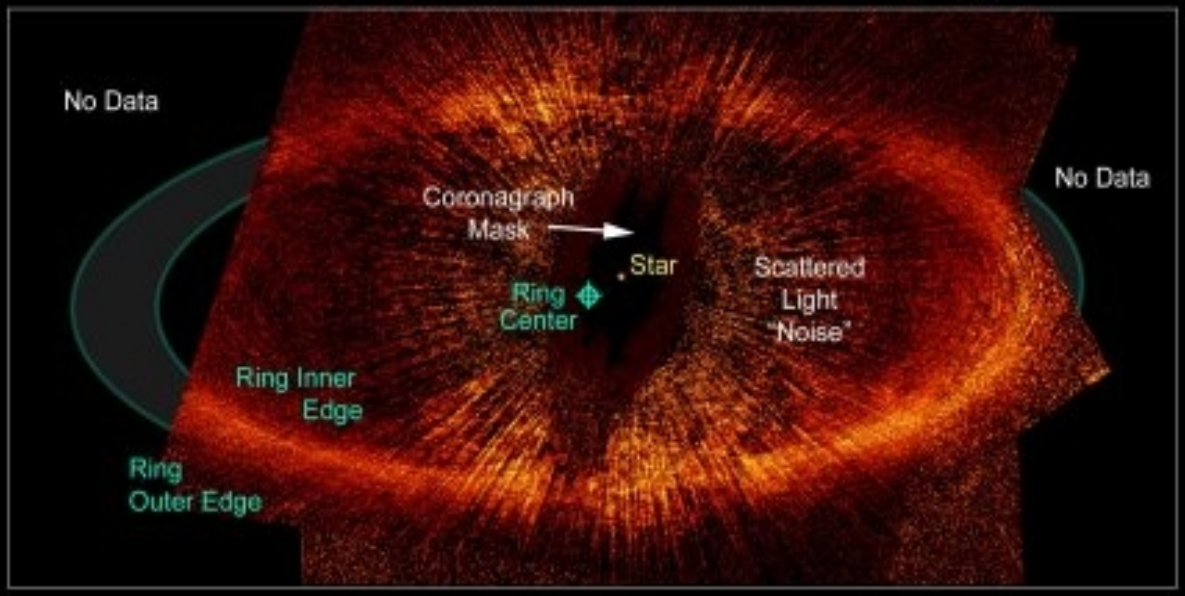
Debris discs

- Most discs are unresolved, leading to degeneracy between parameters of dust emission models.
- Resolved emission can also be used as a probe for the influence of an unseen planet on the disc.



Images of Vega (top left), HD11511 (top right) and Beta Pic (bottom) illustrating the types of features in a disc that could be induced by the influence of an exoplanet.

Debris discs



DUNES

- DUst around NEarby Stars:
  - Dependence of planet formation on stellar mass
  - Collisional and dynamical evolution of exo-EKBs
  - Presence of exo-EKB vs presence of planet(s)
  - Dust properties and sizes in exo-EKBs

- Searching for EKB analogue ($L_{ir}/L_{\star} \sim 10^{-6} – 10^{-7}$) debris discs around a volume limited sample of 133 nearby (< 20pc) sun-like (FGK) stars.
  - Spitzer debris discs < 25pc
  - Stars with known planets < 25pc
  - 106 common sources with DEBRIS

- Strategy: to detect the stellar photosphere at 100μm with SNR ≥ 5.

DUNES

- So far we have observed 123 of the 133 stars in the sample. (27/04/2011)

• Excess stars	35
• Non-excess stars	88
• New debris disc stars	15
• Stars with exoplanets	19
• Debris disc stars with planets	3
• Resolved discs	16

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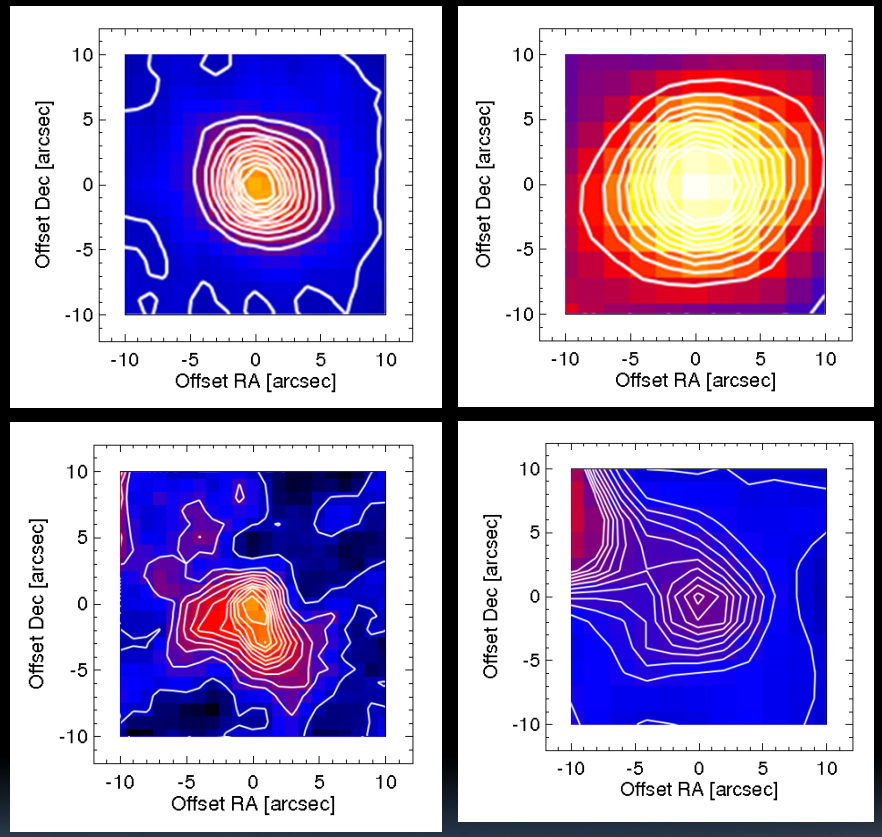
Stars with exoplanets

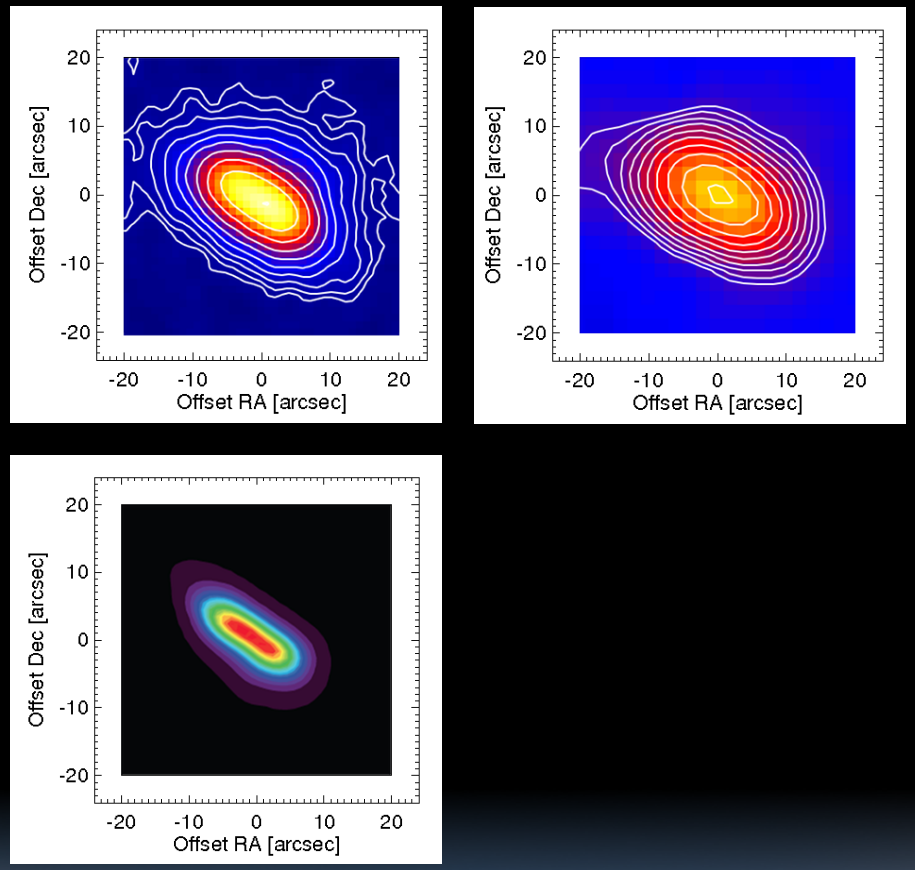
- From the 19 exoplanet host stars in the survey, we have observed debris discs around 3.
- Previously, there has been little observational evidence that exoplanet systems are more likely to also host a debris disc.
- Due to the small sample size, the statistical significance of this result is dubious, however!



Herschel PACS 100 and 160μm observations of two debris disc stars.

HIP 7978

- HIP7978 (q^1 Eridani) is known to host a single giant exoplanet, well separated from the debris disc.
- Deconvolved images of the debris disc by Herschel/PACS have resolved a sharp inner edge to the debris disc.
- We infer the presence of another exoplanet preventing the inward motion of dust in the system.



Herschel PACS observations of HIP7978, Liseau et al., 2010.

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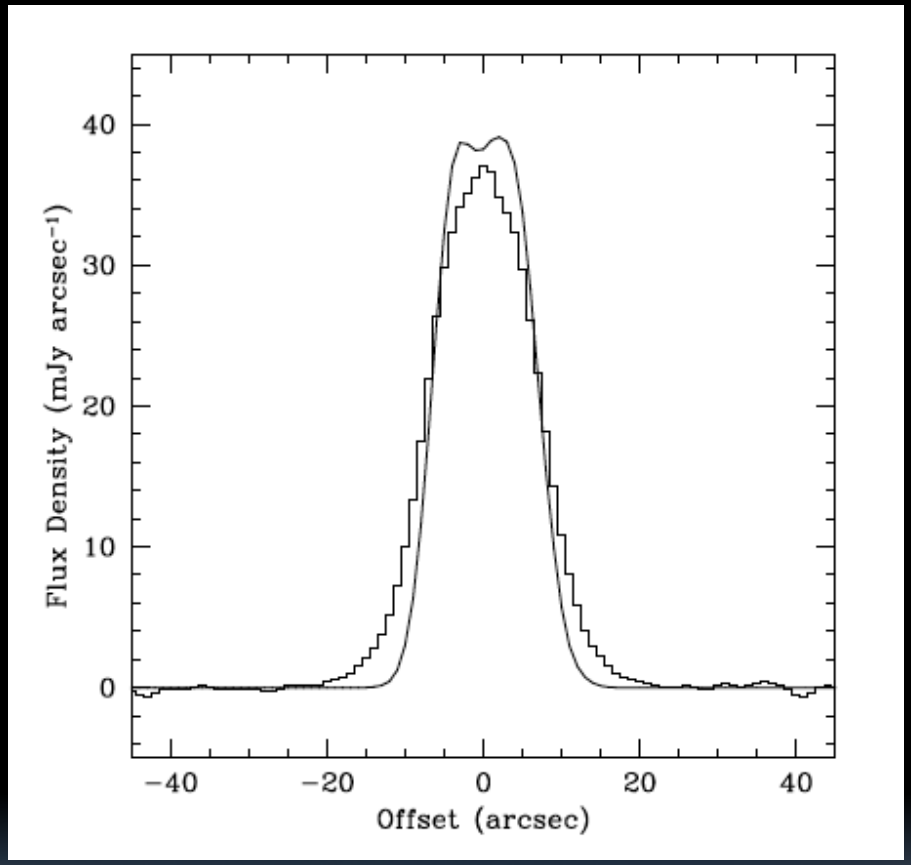
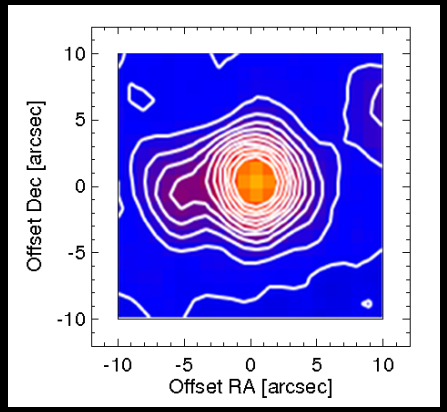
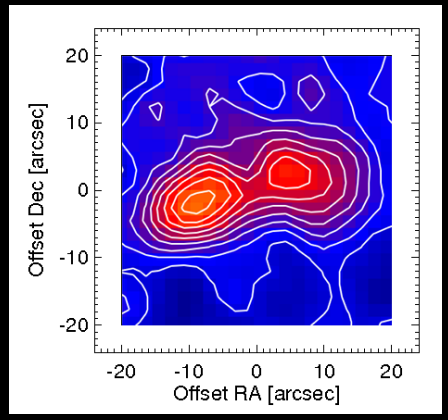


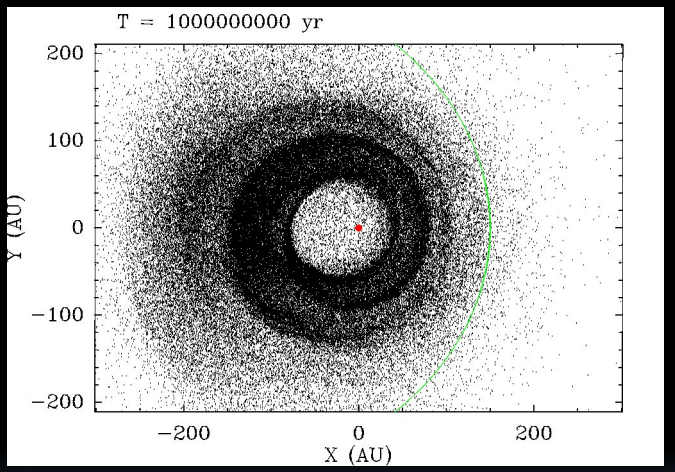
Herschel PACS observations of HIP7978, Liseau et al. ,2010

HIP15371

- HIP15371 (ξ^2 Reticuli) hosts a cold, faint and asymmetric debris disc.
- The shape of the disc could be the result of the influence of a Jupiter mass exoplanet on an eccentric orbit outside the disc.







Dynamical simulation of an exoplanet around HIP15371, courtesy of V. Faramaz.

Summary

- We have detected resolved emission from 16 nearby debris disc systems, at flux levels equivalent to the Solar system's Edgeworth-Kuiper belt.
- Three of these stars already have been identified as exoplanet hosts through radial velocity searches.
- The structure of two of these discs imply the presence of an exoplanet shaping the disc.
- Resolving the emission from debris disc systems is a powerful tool to constrain the dust properties of these systems, and a probe for planetary mass companions in regions usually excluded from traditional search methods.