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Extreme debris discs around nearby stars with *Herschel*

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Abstract

The excellent sensitivity and high resolution of PACS on the *Herschel* Space Observatory has opened up the possibility of detecting direct analogues to the Solar System's Edgeworth-Kuiper belt around nearby stars. We present an overview of the results from the *Herschel*/DUNES Open Time Key Program, highlighting the extreme diversity of observed debris discs, covering both newly discovered and newly resolved systems that are amongst the largest, faintest and coldest discs yet known around Sun-like stars.

1. Introduction

The *Herschel* [1] DUNES survey has observed 133 nearby, Sun-like stars (< 20 pc, FGK spectral type) with the PACS instrument [2] at 100 and 160 μm in a volume limited survey to constrain the absolute incidence of cold dust around these stars through detection of far infrared excess emission from circumstellar dust at flux levels comparable to the Solar System's Edgeworth-Kuiper belt (EKB) [3].

1.1. Faint discs

We have detected excess emission from ~ 30% of the stars in the DUNES sample, almost double the incidence of excess recorded in *Spitzer* observations [4]. The newly observed excess stars are all faint, with fractional luminosities $L_{IR}/L_{\star} < 10^{-5}$ and are more commonly found around spectral type K stars. We see no change in the frequency of excess emission with spectral type, as had been previously postulated.

1.2. Cold discs

One of the most interesting discoveries of the DUNES survey has been the detection of unusual cold debris discs, exhibiting excess emission only beyond 70 μm. These discs are cold, exhibiting temperatures < 25 K, faint, with fractional luminosities ~ 10^{-6} and have unusually steep spectral energy distributions, as the peaks in around 200 μm, but falls off rapidly such that they are undetectable at SPIRE wavelengths (250–500 μm). This combination of observational properties makes them extremely challenging targets to observe and interpret clearly in the presence of background contamination.

1.3. Resolved discs

We have resolved several previously known debris discs at far infrared wavelengths for the first time, e.g. HIP7978 [5], HIP 15371 [6] and HIP 107649 (see Fig 1) [7], providing better constraints on the disc structure and dust emission properties than previously possible. In two cases, HIP 7978 and HIP 15371, we have also observed structure within their discs that implies the dynamical influence of previously unknown exoplanets shaping them [5,6].

2. Summary and Conclusions

We have detected thermal emission from circumstellar dust around 30 nearby mature Sun-like stars, with flux levels comparable to that expected of our own Edgeworth-Kuiper belt. These debris discs represent the first direct analogues of our own Solar system, in respect of stellar age, spectral type and dust mass. We find that the majority of the new discs in the sample are at the extreme end of our parameter space, being colder or fainter than 'typical' debris discs, exhibiting typical temperatures < 50 K and fractional luminosities less than 10^{-5}.

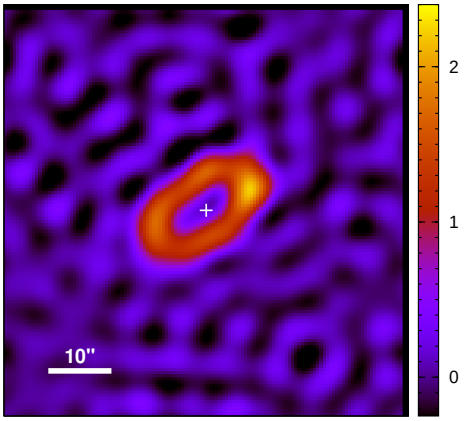

Figure 1: Star subtracted and Wiener filter deconvolved PACS 100 μm image of the debris disc around HIP107649 (HD 207129). The disc's ring-like structure is clearly visible and is measured to be comparable in size to that of the scattered light disc previously observed with *HST* [8]. Orientation is N up, E left. Flux scale bar is in MJy/sr.

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