Herschel/PACS photometry of transiting planet host stars with candidate warm debris disks

Bruno Merín[1], David Ardila[2], Álvaro Ribas[3], Hervé Bouy[3], Geoffrey Bryden[4], Karl Stapelfeldt[5], and Deborah Padgett[6]

[1] Herschel Science Centre (ESAC, ESA), [2] NASA Herschel Science Center, [3] Centro de Astrobiología, [4] NASA JPL, [5] NASA Goddard, [6] Spitzer Science Center

Abstract

Dust in debris disks is produced by colliding or evaporating planetesimals, the remnant of the planet formation process. Warm debris disks, known by their emission at ≤ 24 microns, are rare (4% of FGK main−sequence stars), and specially interesting because they trace material in the region likely to host terrestrial planets, where the dust has very short dynamical lifetimes. Dust in this region comes from very recent asteroidal collisions, migrating Kuiper Belt planetesimals, or migrating dust. NASA's Kepler mission released a list of 2,321 candidate transiting planets, and in parallel, the Wide−Field Infrared Survey Explorer (WISE) published a sensitive all−sky catalogue in the 3.4, 4.6, 12, and 22 micron bands. By cross−identifying the WISE sources with all Kepler planet-host candidates as well as with other transiting planetary systems we identified 21 transiting planet hosts with previously unknown candidate warm debris disks, detected as 12 or 22 micron excesses. Here we report Herschel/PACS 100 and 160 micron follow-up observations of this sample, used to determine whether these systems represent stochastic outbursts of local dust production, or simply the result of chance alignment with background sources. No clear detections were found in any of the objects at both wavelengths. This cannot be used to rule out the presence of warm debris disks neither to support their presence. However, lack of far-infrared excesses suggests that at least some of these mid-infrared excesses could be in fact non-physically associated to the planet-hosting stars, which is expected due to their old ages, probably due to chance alignment with background sources.

Identifying stars with candidate warm excess

Following Ribas et al. (2012), we identify planet host stars with warm excesses by selecting those objects where $\chi_{12/24}$ (the significance of the excess flux compared with the error) is larger than a given threshold. We find 21 good warm excess candidates.

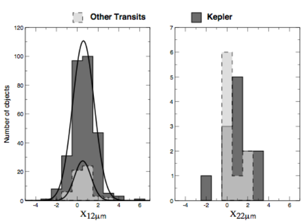
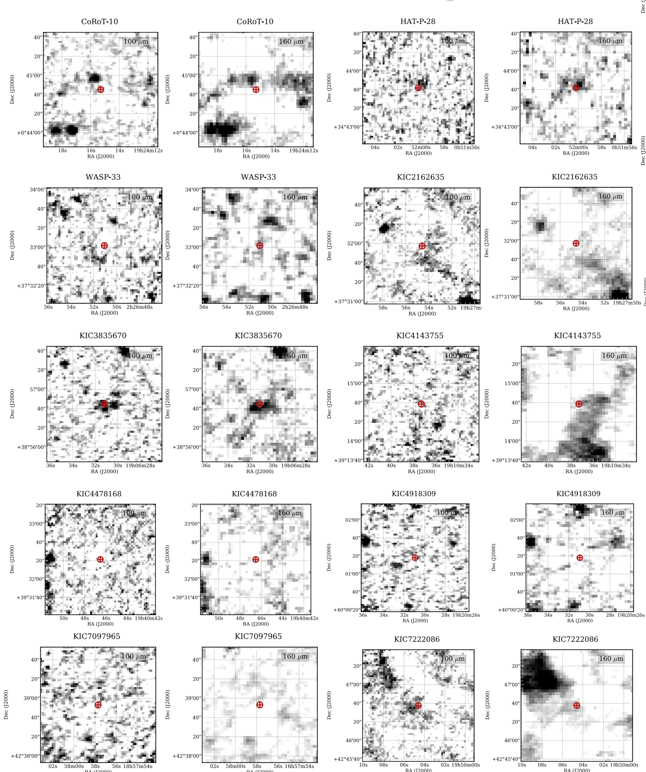


Figure 1: Histograms of $\chi_\lambda \equiv (F_{WISE} - F_{phot})/\sigma_{tot}$, for the 12 and 22 μm bands, for sources with *S/N* > 3 in the respective bands. The Kepler Input Catalogue (350 objects in the W3 band and 31 in the W4 band) and known planets samples (61 objects in the W3 band and 21 in the W4 band) are shown in dark and light grey respectively. A gaussian distribution is fitted for the 12 μm band, (x_0 = 0.5, σ = 1). From Ribas et al. (2012).

Herschel 100 and 160 micron images



Herschel 100 and 160 micron images

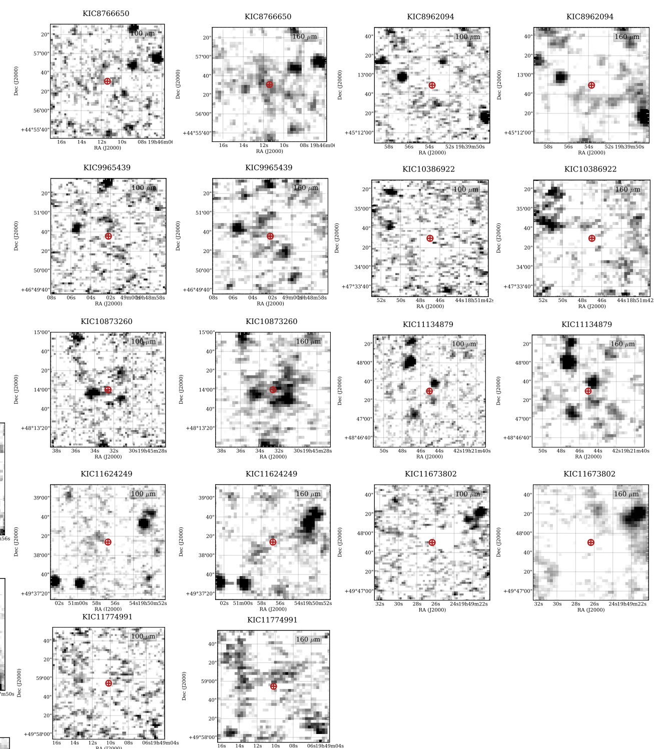


Figure 2: Herschel/PACS images of the planet host and host candidates in the sample. The red target symbol indicate the nominal. The linear color scale goes from zero to 3σ, where the σ is calculated as the standard deviation of the 50 x 50 central pixels in each image.

Conclusions

No clear detection at 100 or 160 μm in any target indicates that large excesses associated with catastrophic collisional events are likely not present in any of these systems. If the 12-22 micron excesses were to be proven as associated to the stars, the Herschel non-detections would imply narrow dusty rings at < 1 AU from the stars. However, the simplest explanation for the lack of Herschel detections is that the mid-IR excesses are caused by chance alignment of background sources which would imply no catastrophic events in any of these systems.

Acknowledgements

This work was partially made possible thanks to the ESA Trainee and Research Fellowship programs at ESAC (Spain).