Spitzer 160 μm Observations of Nearby Stars

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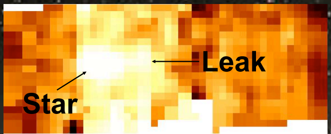
The Leak

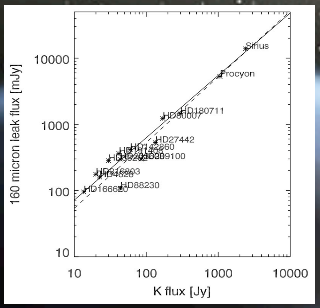


The light leak seen in 160 μm MIPS images. It lies a few pixels to the right of the target position and is a problem for bright stars with potential excess emission

Abstract

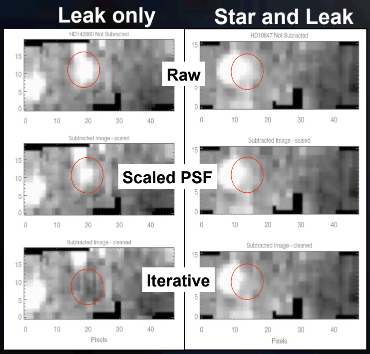
Over the past four years *Spitzer* has discovered an entirely new sample of debris disks around nearby AFGK & M stars both old and new. Out of ~350 stars observed to date, the majority of the excesses due to thermal emission from debris disks have been found at 70 μm with only a few also at 24 μm. Here, we report the results from a sub-sample of stars observed at 160 μm. Special care must be taken when estimating stellar excesses from this data set due to a near-infrared light leak a few pixels to the right of the star. Here we describe how to deal with the leak and find that four stars with 70 μm excesses also have excesses at 160 μm. No stars have 160 μm excesses alone. We fit simple dust models to the Spitzer/MIPS 24, 70 and 160 μm photometry and IRS spectroscopy. The addition of the 160 μm photometry helps to better constrain the properties of the dust.

Leak flux vs. Star flux



The 2.2 micron flux from the star vs. the flux of the leak in the 160 micron image. This clear correlation can be used to help remove the leak from the data.

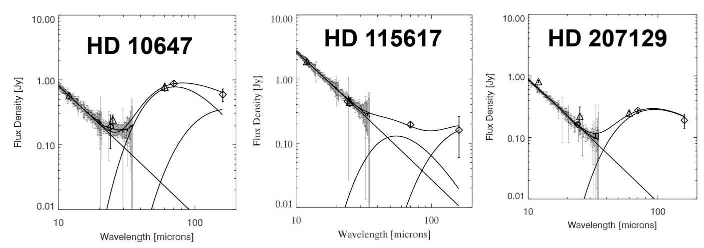
Removing the Leak

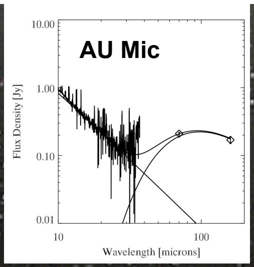


To remove the leak from the 160 μm data, we used two methods:

1) Scale a leak PSF based on the above relation between near-IR flux and leak flux and subtract it from the image (middle pane)
2) Iteratively remove the leak by subtracting a scaled leak PSF within a circle centered at the leak position until the noise within an annulus around the leak matches the noise on the other side of the star where there is no leak (bottom pane).

Debris Disk SEDs





SEDs of stars with excesses at 160 μm. Some disks are modeled with a single blackbody while others require two distinct dust components.

Dust Properties and Fitting Procedure

1) Three sources (HD 10647, 115617, 207129) are spatially resolved at 70 μm (Bryden et al. 2008). All three SEDs can be modeled by placing dust at the resolved radii
2) Dust is composed of either a blackbody or a~0.25/10 μm grains as the features in IRS spectra suggests the presence of small grains. Dust temperatures are determined from radiative equilibrium.
3) First try to fit all data with a single dust component and add another if necessary

What to take away …

- The MIPS 160 μm leak can be dealt with
- The 160 μm data constrain the properties of the cold (T < 50 K) dust
- All stars with 160 μm excesses have 70 μm excess (no stars in sample have very cold (T<30K) dust)
- Inner dust components occur at ~30 AU (T~50-100 K) while outer components are at 100 AU (T~20 K)
- More complete wavelength coverage and higher angular resolution with Herschel will break degeneracies between grain size, temperature and spatial location and, perhaps, reveal, rings, gaps or other structures due to presence of planets