Survey of the Spitzer Enhanced Imaging Products (SEIP) Catalog for Potential Debris Disks Around Main Sequence M Class Stars

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Abstract

M class dwarf stars are the most common type of star but, due to their low luminosities and similar spectral characteristics to M class red giants, relatively few exoplanets have currently been identified orbiting them. An approach to establishing the possible existence of terrestrial exoplanets in M dwarf systems is the detection, using infrared excess, of a debris disk orbiting a mature star. A survey of the Spitzer Enhanced Imaging Products (SEIP) catalog, a collection of nearly 42 million point sources obtained by the Spitzer Space Telescope during its 5+ year cryogenic mission, was a starting point to search for infrared evidence of debris disks. In this study, we examined isolated sources in the SEIP with a signal-to-noise ratio (SNR) greater than 5 in four IR wavelength channels (3.6, 4.5, 8, and 24 microns) to search for sources with infrared excess in order to obtain a large and reliable set of candidates. Using Gaia distances, we refined the search to 553 main sequence M stars in the SEIP by excluding M class red giants. Visual inspection of these sources to ensure a valid point source reduced these eligible candidates by a third by eliminating images with contamination due to nearby companions, cosmetic defects, or other infrared dilution. Final selection of dwarf M stars was made by excluding known young stellar objects and sources near star-forming regions, which may show an infrared excess due to a remnant star forming disk. This final selection creates a catalog of approximately 70 mature red dwarf stars with debris disks for potential follow up searches for the presence of rocky exoplanets. This research was made possible through the NASA/IPAC Teacher Archive Research Program (NITARP) and was funded by NASA Astrophysics Data Program.

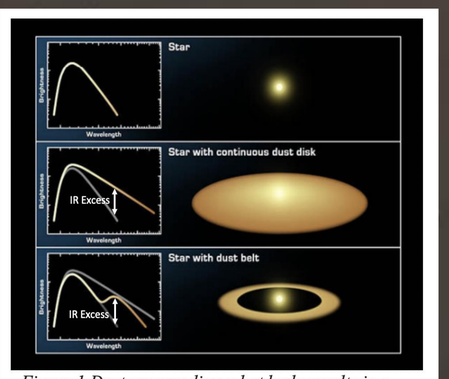
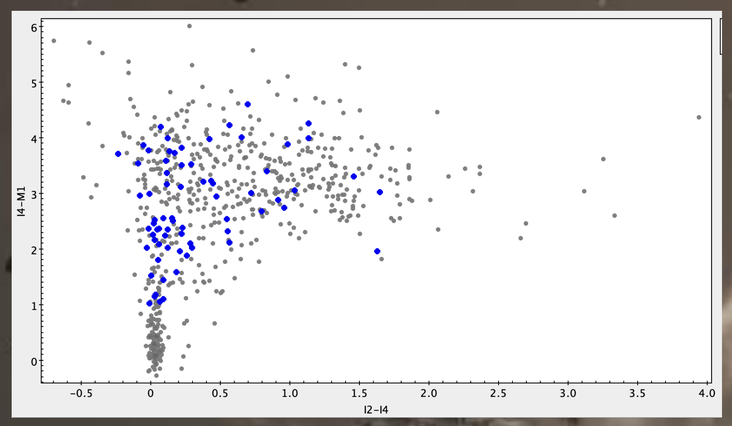


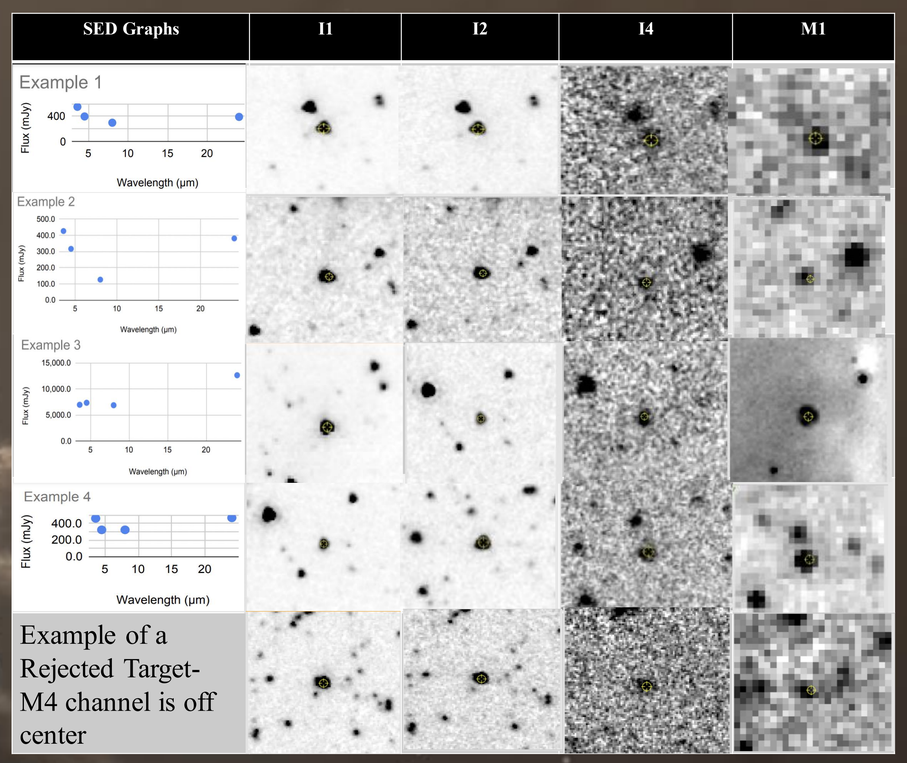
Figure 1 Dust surrounding a hot body results in a Rayleigh_Jeans tail with slope different from that of a single temperature black body. (Artist rendition by T. Pyle (SSC)). IR excess noted with white arrow.

Color-Color Diagram

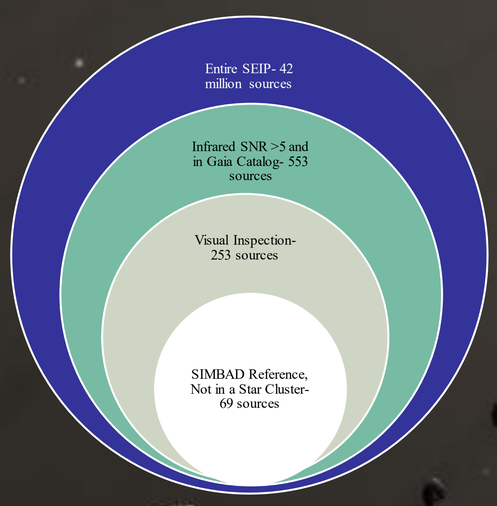


A diagram showing all the targets (grey) and the targets for further research (blue)

Examples of Targets for Further Research

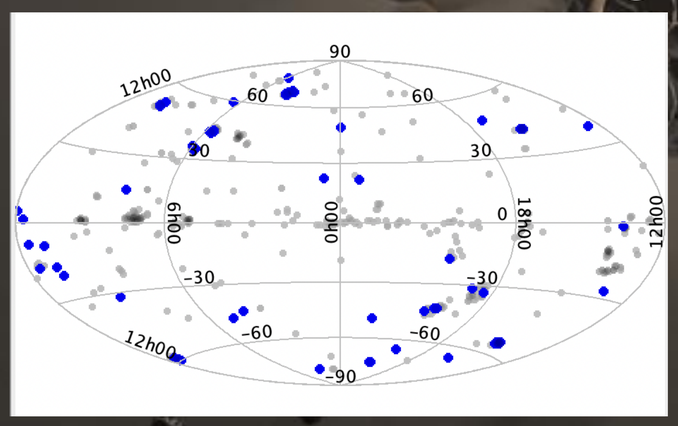


Methods



Above is the graphical representation of our selection criteria from the SEIP

Distribution of Final Targets



Distribution of the all the targets (grey) and the targets for further research (blue)

Conclusions

- Eliminated all targets with infrared dilution, objects that were not labeled as stars in SIMBAD, and stars not obviously located in a star cluster.
- Found 69 viable stars with a potential debris disk.

The Next Steps

- Fit blackbody spectra to assess the temperature of the infrared excess.
- Obtain spectroscopic follow up for verification of the excess.

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Background Courtesy NASA/JPL-Caltech