Cool Stars with Extreme Mid-Infrared Excesses:
Potential Tracers of Planetary Collisions

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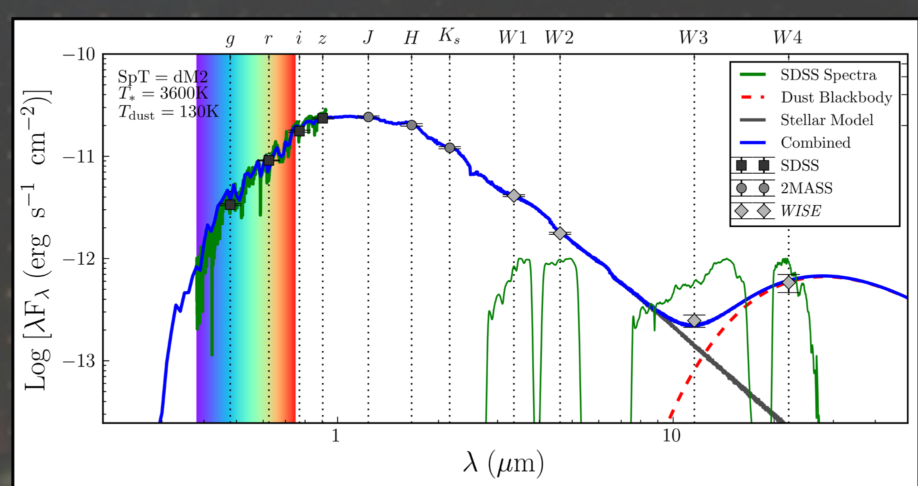
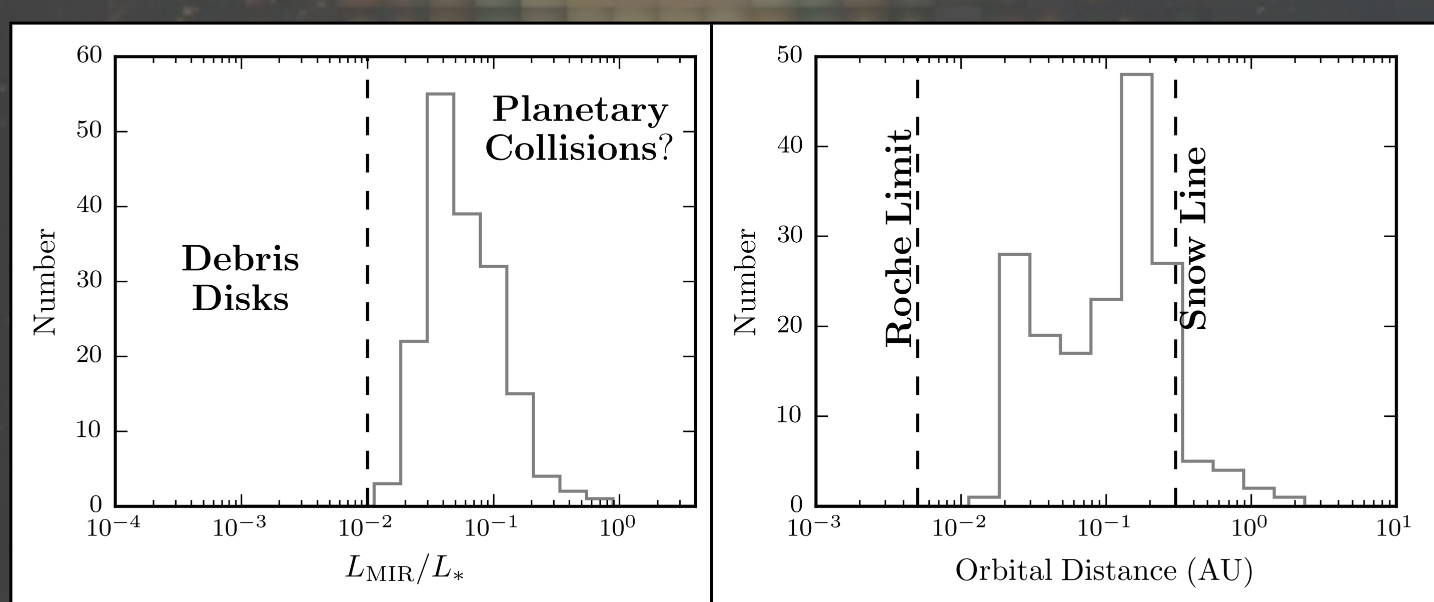
Stars with Extreme MIR Excesses: Tracers of Planetary Collisions

Theissen & West[1] found a small sample of older (>1 Gyr), low-mass field stars showing extreme mid-infrared (MIR) excesses.

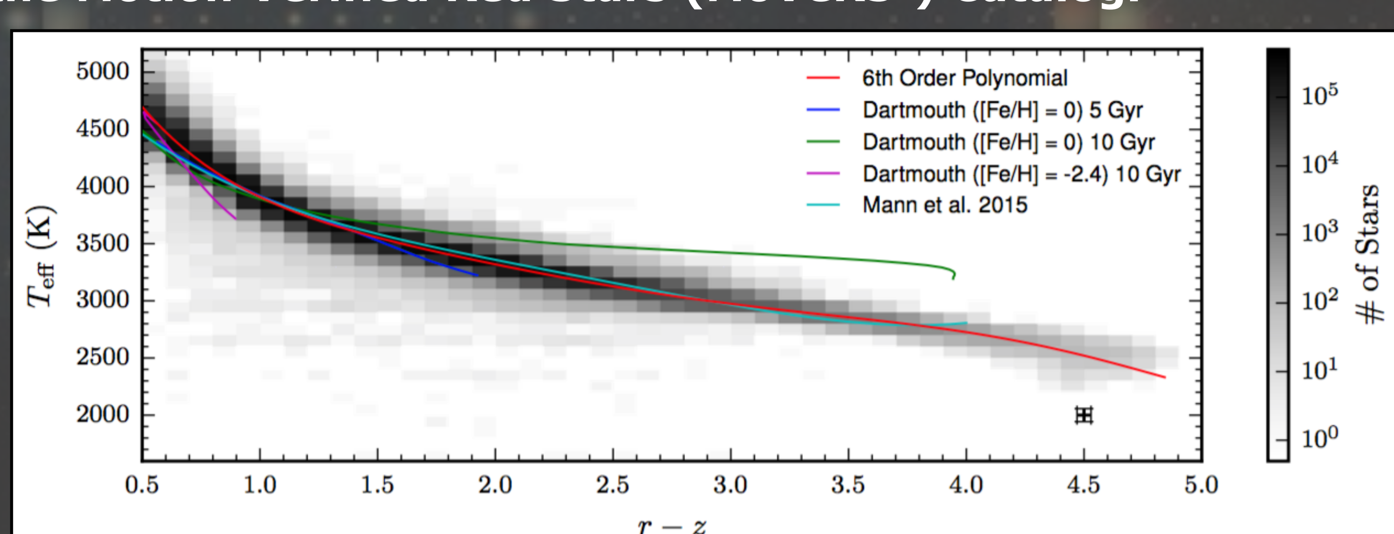


The amount of MIR flux observed is too large to be attributed to primordial debris disks[2]. Modeling indicates that dust causing the observed MIR excesses is *orbiting within the zones where terrestrial planets are formed.*

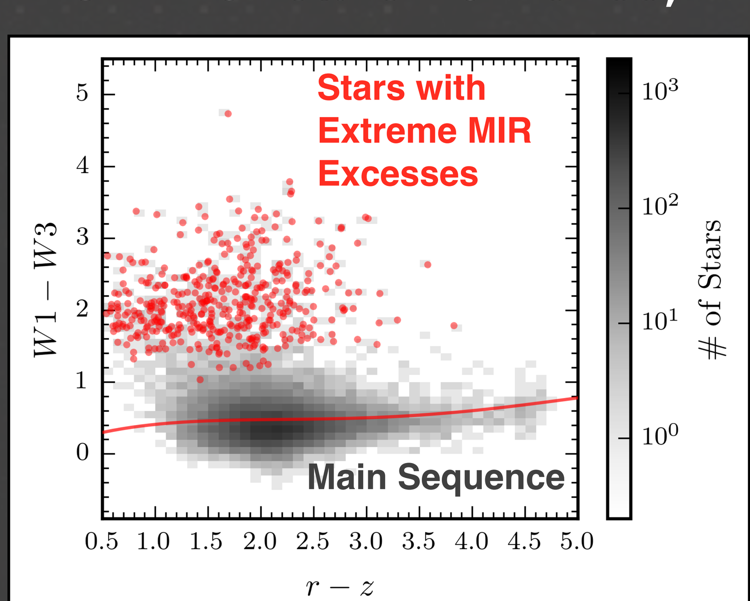


A Larger Sample of Stars with MIR Excesses

We found that low-mass stars exhibiting extreme MIR excesses are *less than 0.1% of the entire population*[1]. A larger input catalog of bona fide low-mass stars is required to identify a significant number of stars with MIR excesses. Photometric surveys contain millions of objects with colors of low-mass stars. However, only proper motions (μ) can distinguish dwarf stars from other red objects. Thus, we built the Motion Verified Red Stars (MoVeRS[3]) Catalog.



~8 million stars from SDSS, 2MASS, and *WISE* with proper motions (μ > 4 mas/yr).

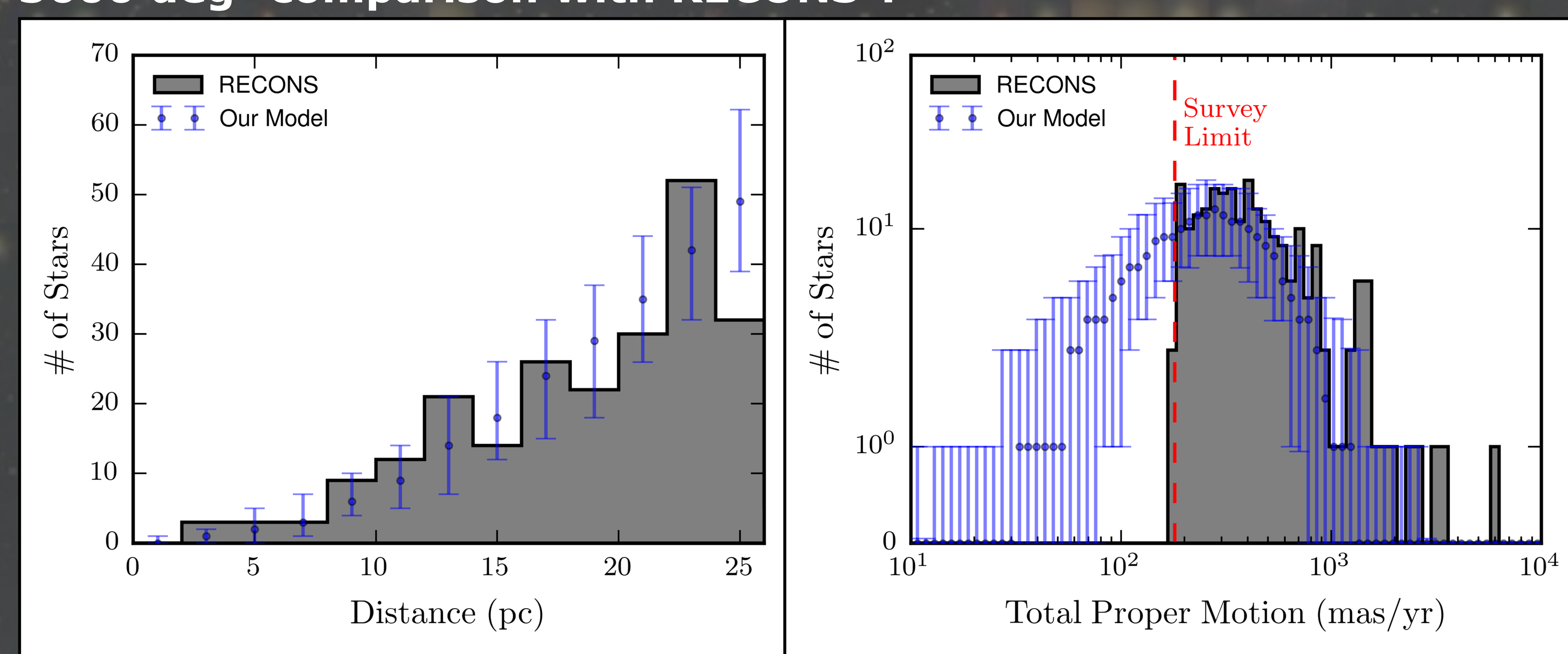


185,121 MoVeRS have *WISE* 12 μm measurements with S/N > 3. *We have identified 374 stars showing significant amounts of MIR excess flux.* This larger sample allows us to explore trends related to the frequency of MIR excesses.

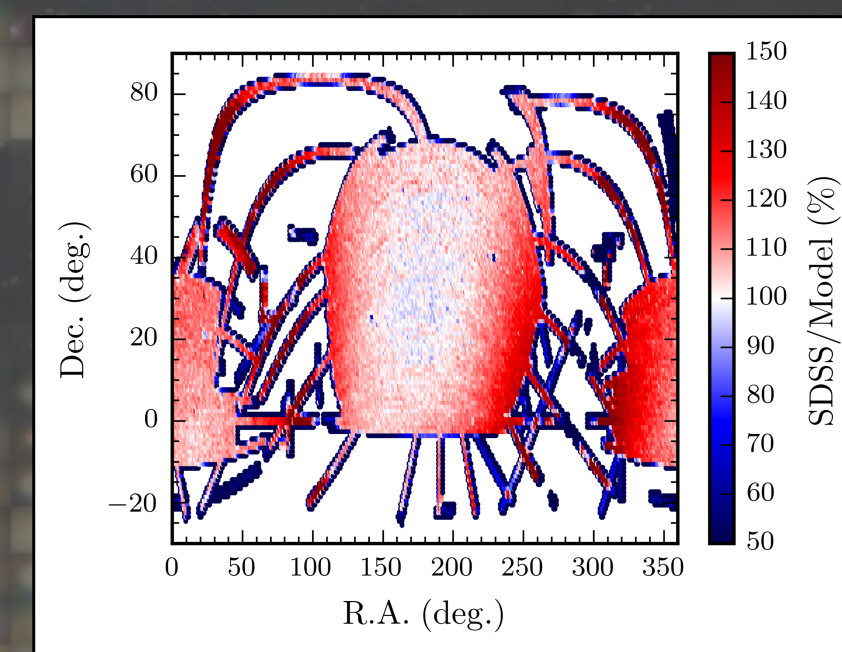
Building a Galactic Model to Estimate Completeness

Using a Galactic model[4], we can simulate low-mass stellar counts and kinematics in selected volumes within the Galaxy. We model the thin and thick disks, along with the halo, and their respective kinematics.

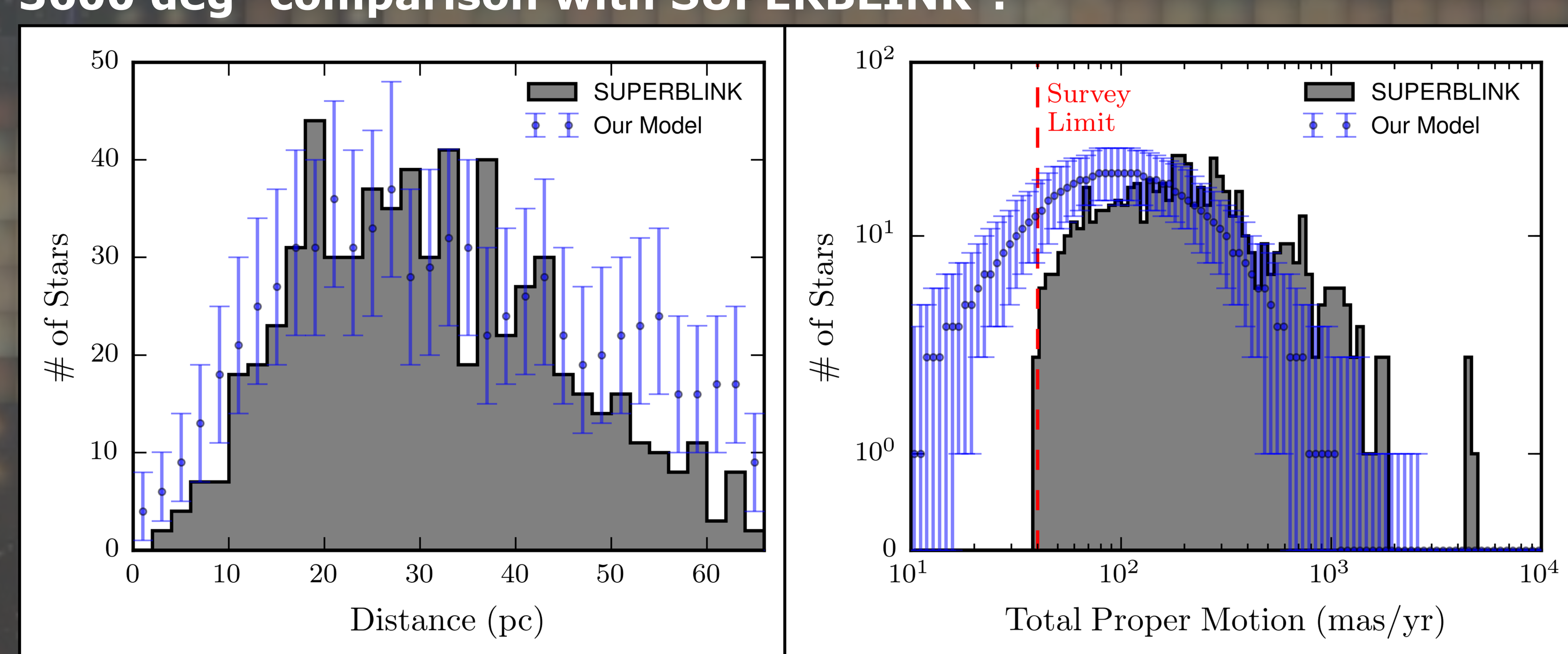
3600 deg² comparison with RECONS[5]:



Comparison to SDSS:



3600 deg² comparison with SUPERBLINK[6]:



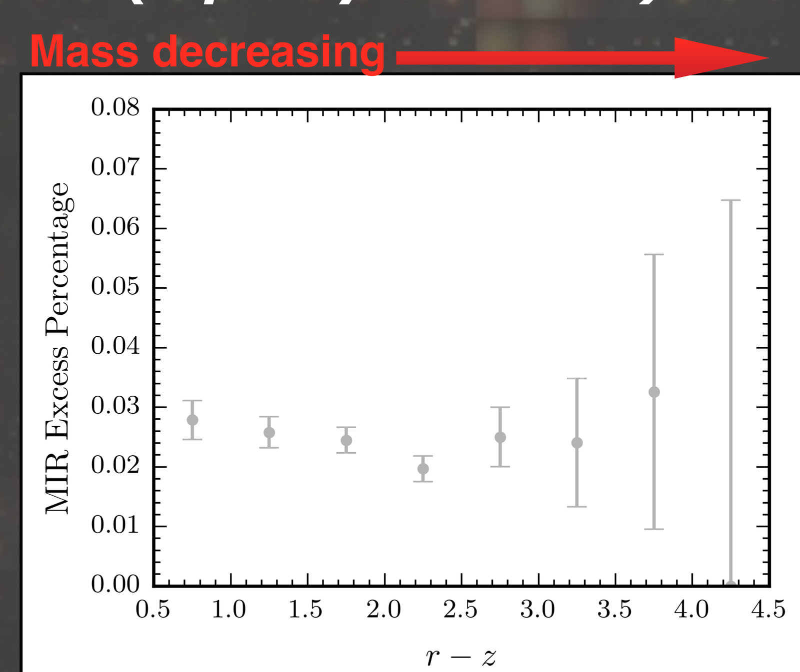
Our model can reproduce counts for objects with colors of low-mass stars from SDSS. Close to the Galactic plane, SDSS source counts are underpredicted due to reddened higher mass stars that fall within our color selection.

Our model can reproduce nearby stellar samples, uncovering biases and estimating completeness levels for a given volume, magnitude, and/or proper motion.

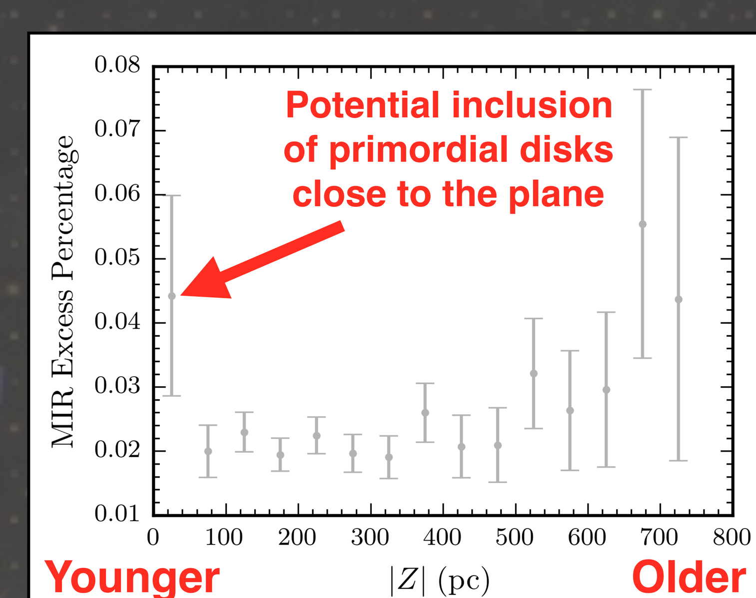
Investigating Trends for Stars with Extreme MIR Excesses

With this larger, more uniform sample, and methods to determine completeness, we can investigate trends with stellar mass and age for stars exhibiting extreme MIR excesses.

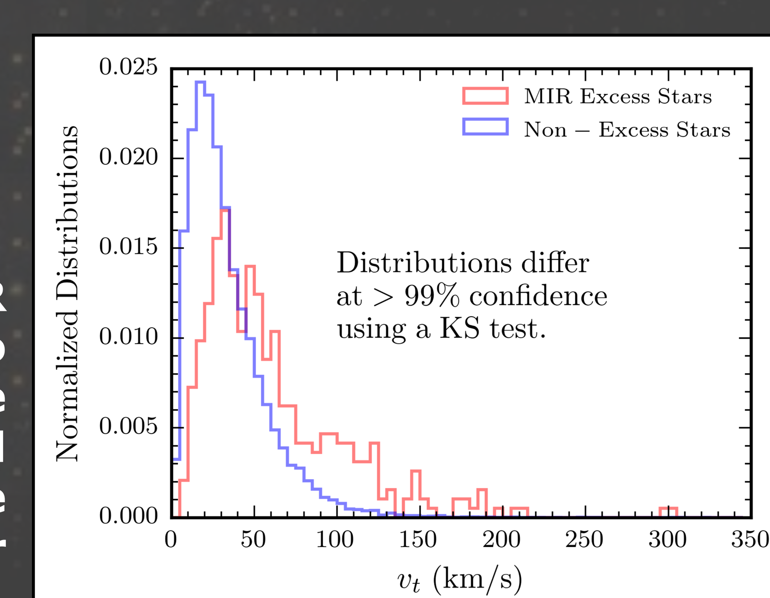
Color (a proxy for mass)



Proxies for age



There is no strong correlation with distance from the Galactic plane, indicating no strong dependence on age.



Stars with MIR excesses appear to be more dynamically heated (older) than the rest of the stellar population.

We find no clear trend with stellar mass, indicating that planetary collisions occur at similar rates in all low-mass stellar systems. Our percentages are also lower than our previous study due to our more selective MIR excess criteria and larger parent population from which they are drawn.

These systems are important for understanding the long-term evolution of planetary systems and habitability of planets around low-mass stars. These systems will make important targets for the next generation of telescopes.

ACKNOWLEDGEMENTS

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