WISE Infrared Excess Detections for SDSS M Dwarfs: Cool Field Stars with Evidence of Warm Circumstellar Material

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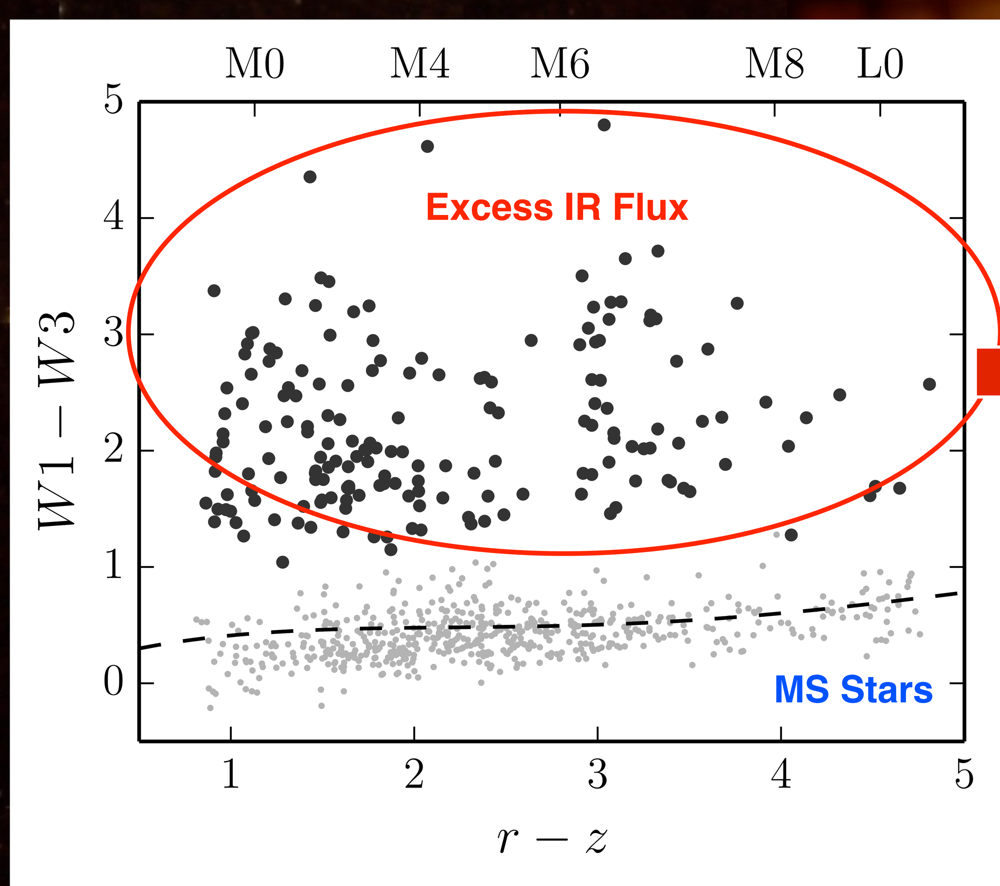
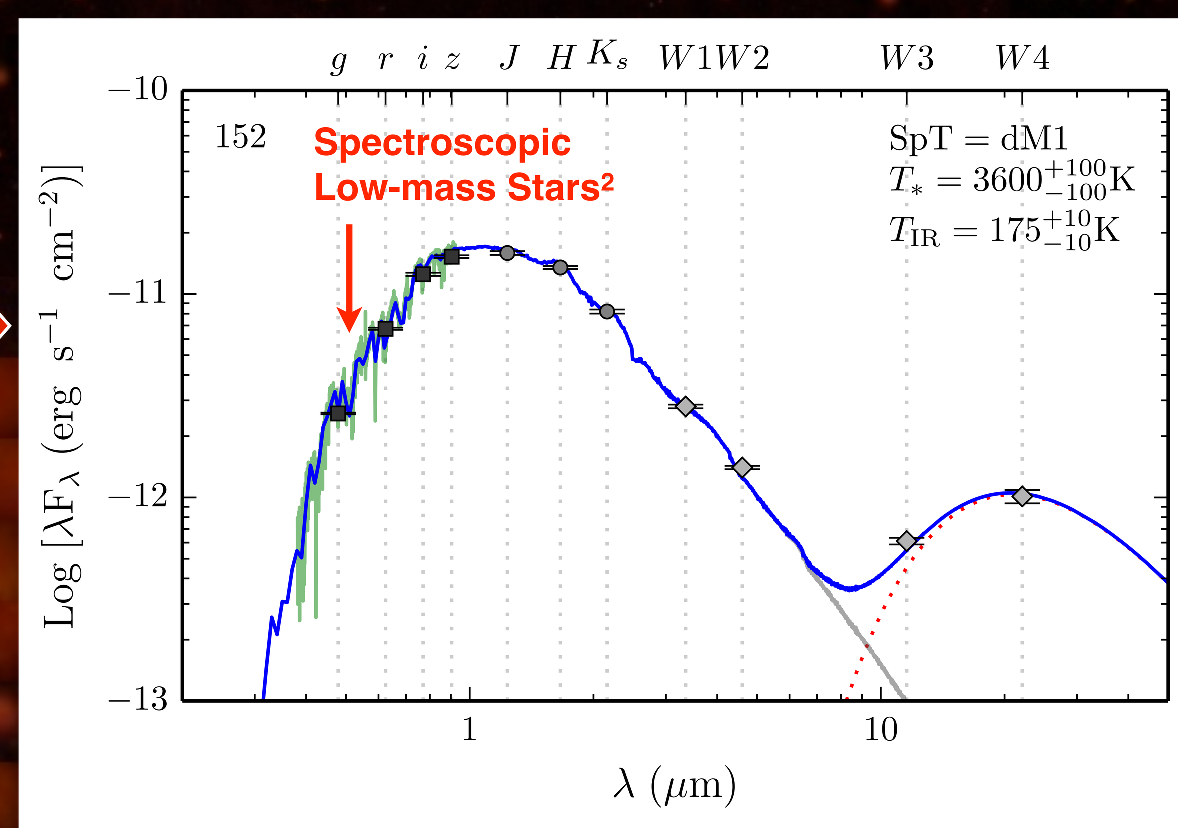
A small number of field stars, with ages likely > 1 Gyr, have been found with excess infrared emission. One possible explanation for this emission is dust generated through the collision of planet sized bodies. Low-mass stars are prone to form terrestrial planets, therefore, we may expect a similar mechanism to be found more commonly around low-mass stars. Such collisions may have important implications on the habitability of planetary systems around low-mass stars. Here we present a search for such candidates.

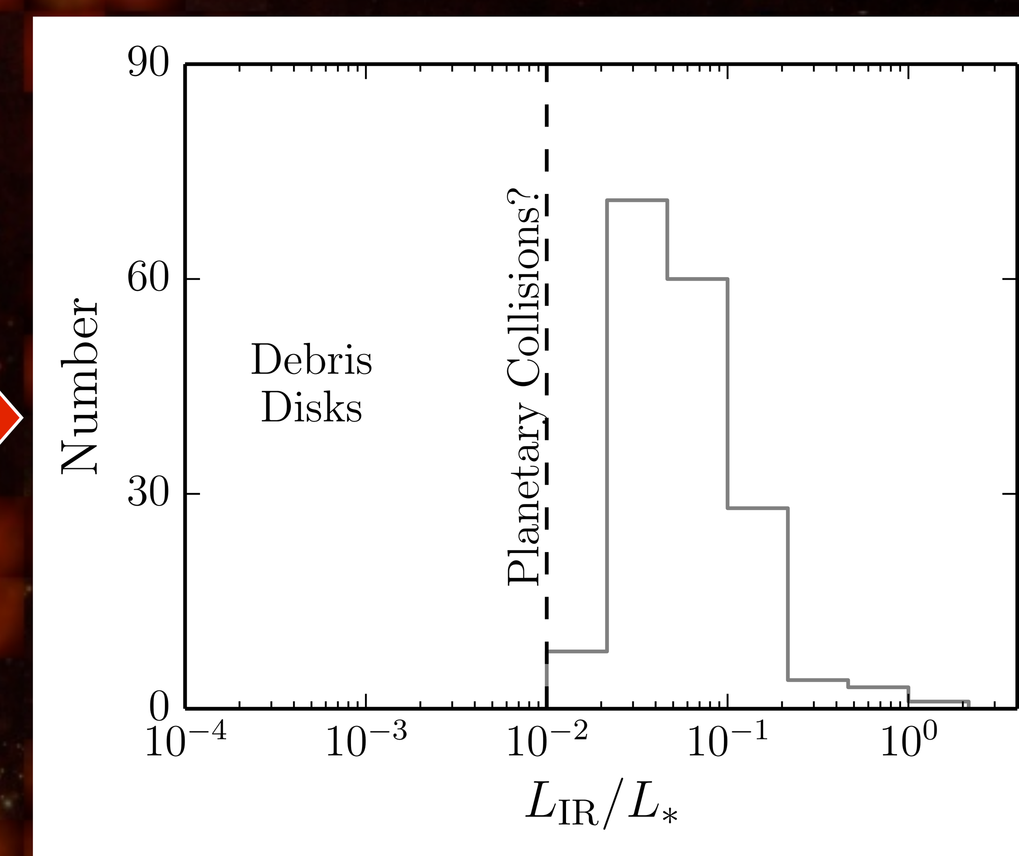
How do we determine an IR excess?



Using SDSS and *WISE* colors we were able to separate main sequence (MS) stars from stars with excess infrared (IR) flux (168 SDSS spectroscopic low-mass stars[1,2]).



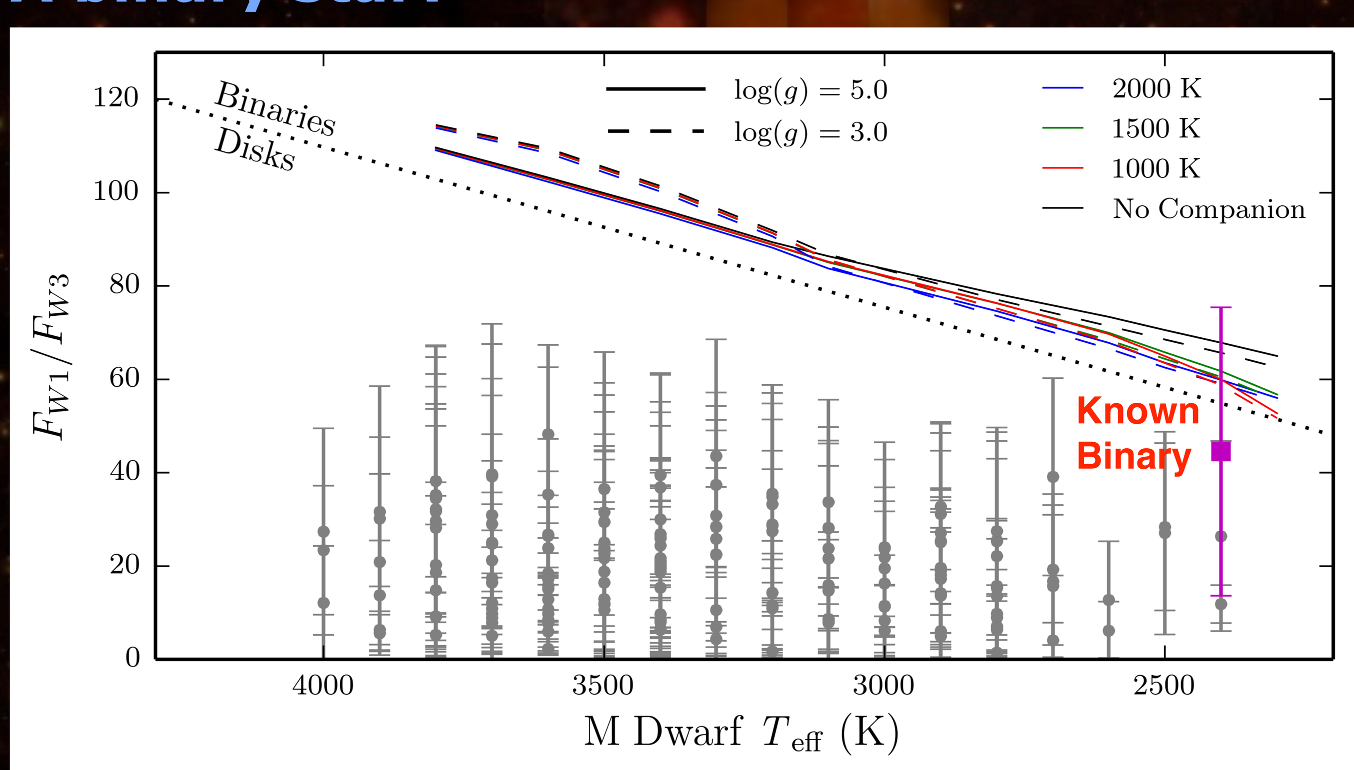
We fit the excess IR flux assuming it came from a single temperature blackbody.



We integrated both fluxes (stellar and IR), and compared their luminosities. We found that all of our candidates had IR luminosities too large to be explained by debris disks generated by asteroid sized objects[3]. However, collisions between terrestrial planets could generate enough dust[3].

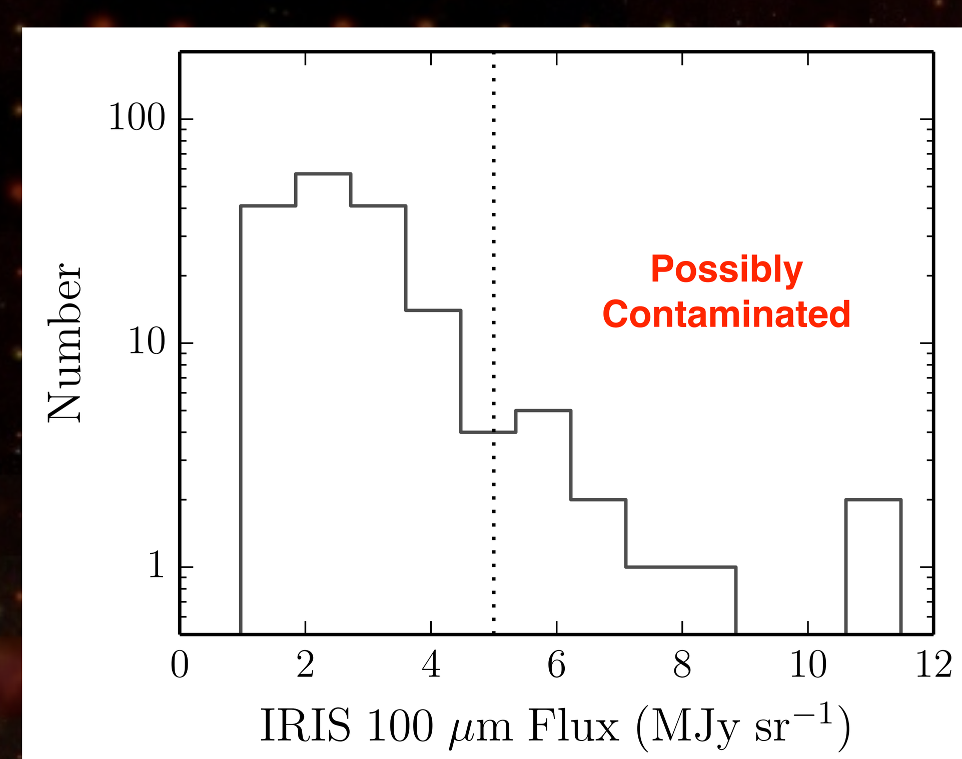
Exploring Alternative Explanations For IR Excesses

A binary star?



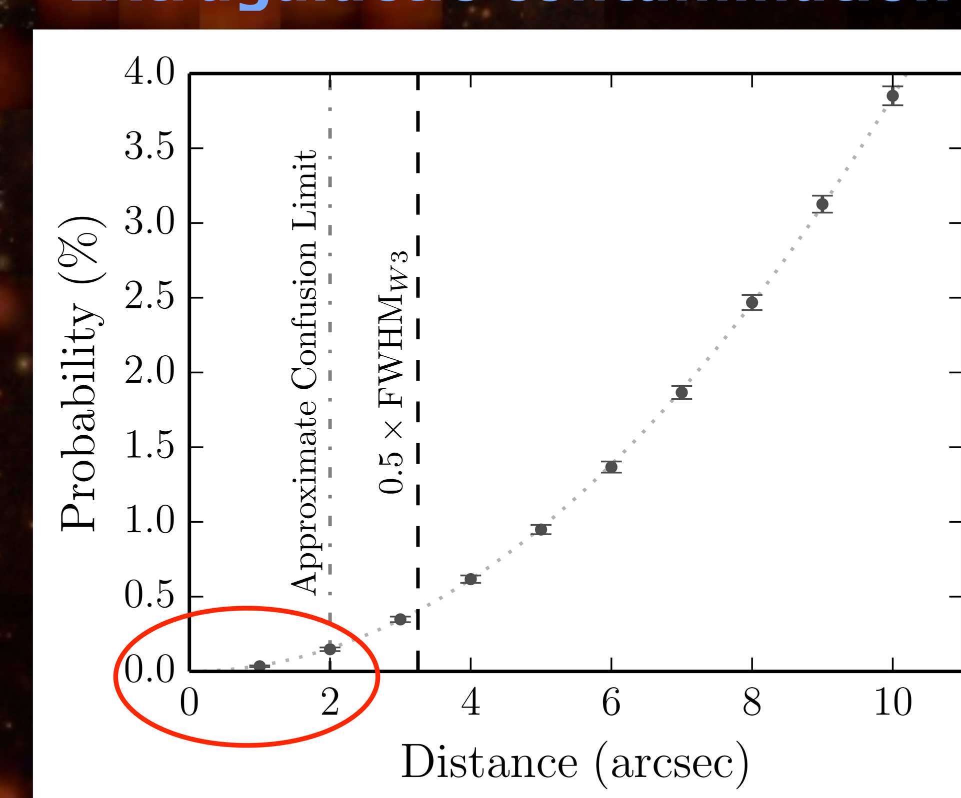
The amount of IR flux observed is too large to be explained by a low-mass star with an ultracool companion. Higher order multiplicity is also ruled out.

Galactic contamination?



Previous studies found that *IRAS* background flux was a good estimator of Galactic contamination[4]. The majority of our stars were not found along contaminated sightlines.

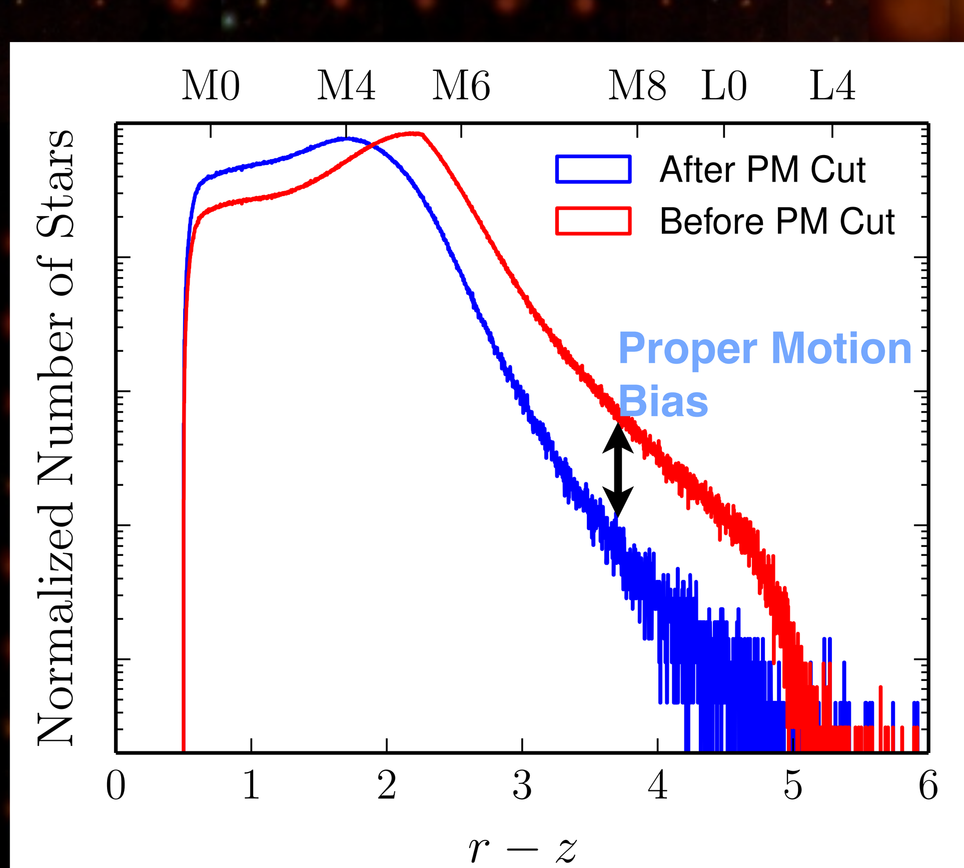
Extragalactic contamination?



Using the density of extragalactic IR sources, we estimated the probability of chance alignment with one of our stars to be unlikely (less than 0.15%).

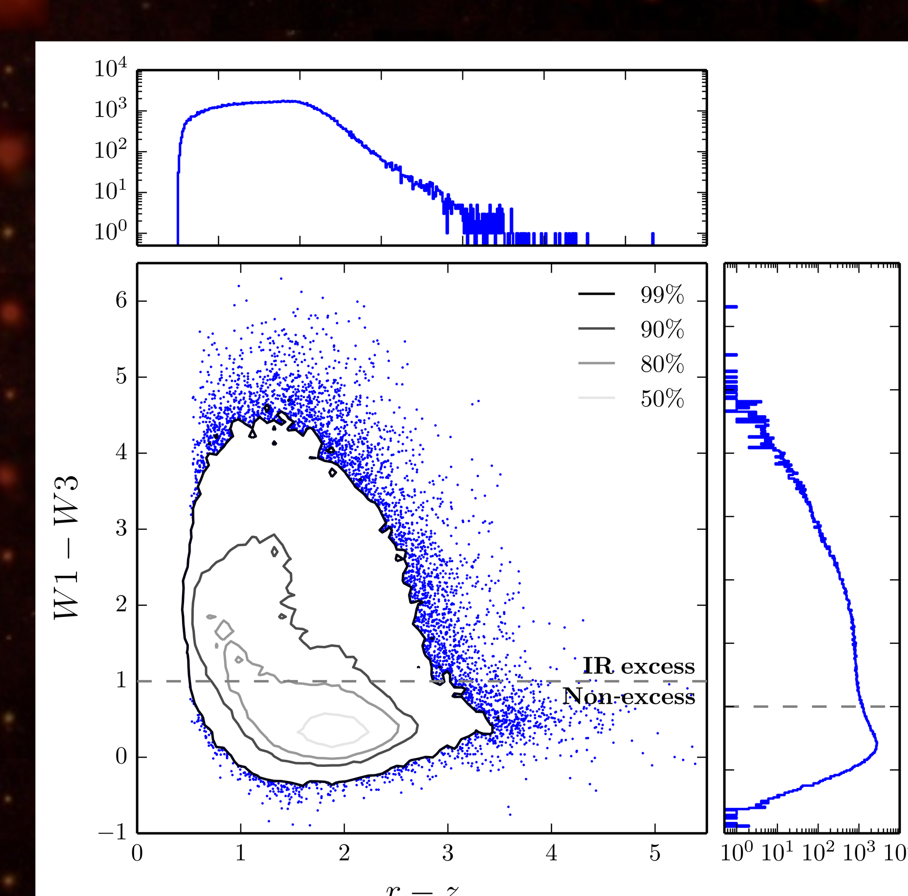
Increasing the Sample: Photometric Stars

To study the occurrence rate of the mechanism creating this dust, we require a large number of stars with IR excesses. SDSS DR10 has ~70 million point sources that are likely low-mass stars. We can use proper motions to differentiate dwarf stars from other contaminating sources (e.g., QSOs, giants, etc.).

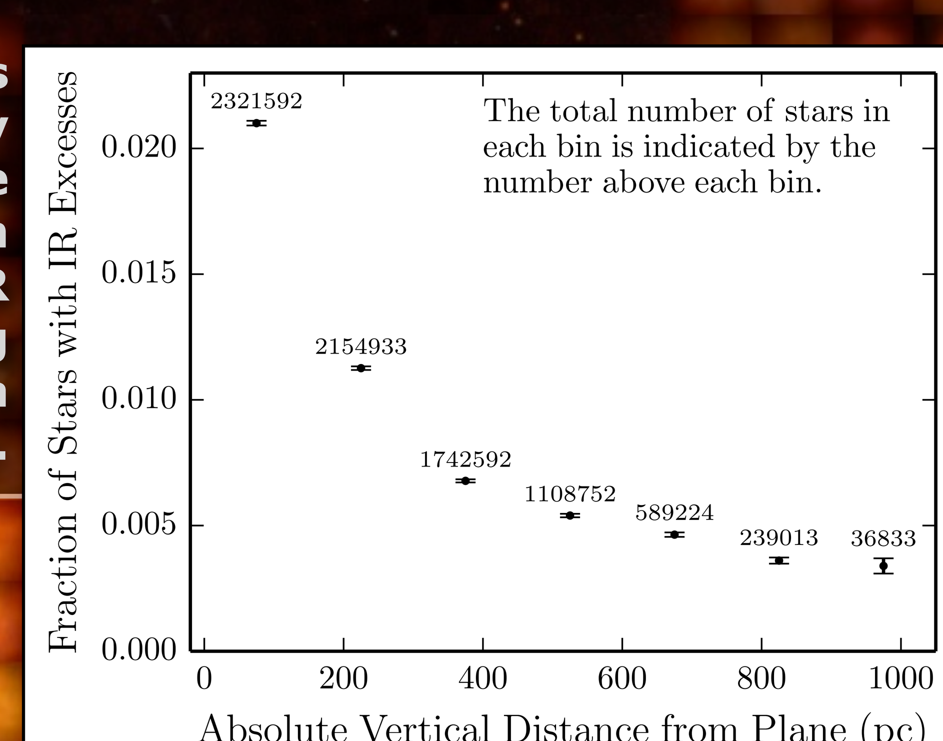


Current proper motions are biased towards bluer stars. To include more late-type stars, we must develop a new IR proper motion catalog using SDSS, 2MASS, and *WISE*.

Estimates made using current proper motion catalogs[5] indicate that our photometric sample will include over 100,000 disk candidates.



Preliminary results suggest that there may be an age dependence for the mechanism creating the IR excesses (using Galactic height as a proxy for stellar age).



References

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2. West, A. A., et al. 2011, AJ, 141, 97
3. Weinberger, A. J., et al. 2011, ApJ,
4. Kennedy, G. M., & Wyatt, M. C. 2012, MNRAS, 426,
5. Munn, J. A., et al. 2004, AJ, 127, 3034

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