



The Motion Verified Red Stars (MoVeRS) Catalog and Low-Mass Field Stars with Warm Dust

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Low-mass stars represent ~70% of the entire stellar population² and have main sequence lifetimes much longer than the current age of the Universe³. This makes low-mass stars particularly important for studies of galactic structure, kinematics, and evolution. We present the MoVeRS catalog, which contains 8.7 million proper motion verified low-mass stars from SDSS, WISE, and 2MASS. Using this catalog, we show preliminary results from an investigation of low-mass field stars exhibiting large infrared (IR) excesses, a phenomenon thought to originate from collisions between giant planetismals or terrestrial planets. Such events have important implications for the habitability of worlds around low-mass stars.

Why measure proper motions?

Faint Dwarf Star?



Giant Star?



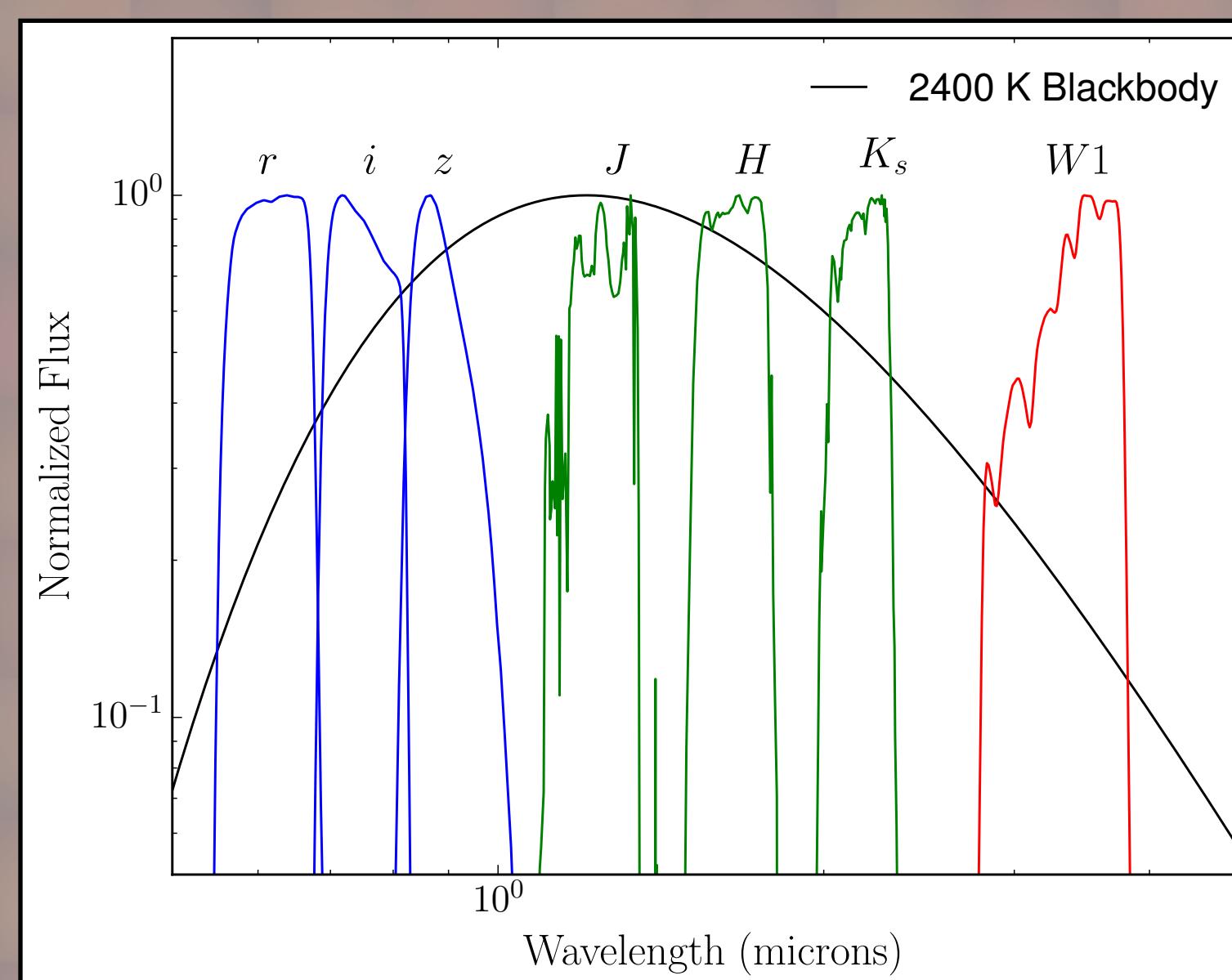
Galaxy?



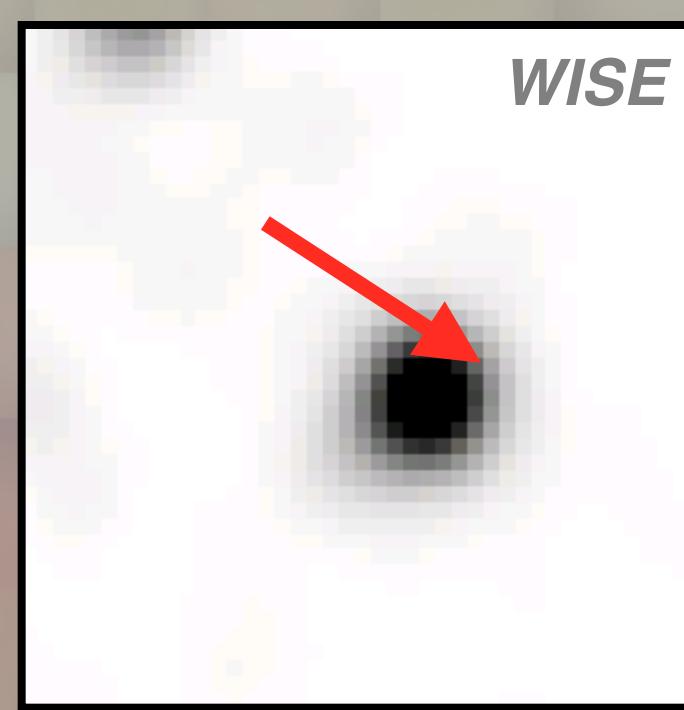
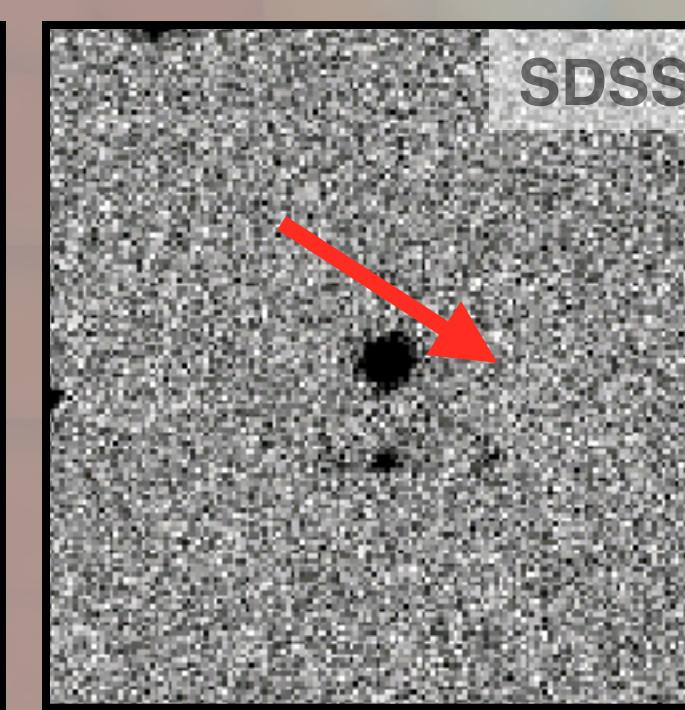
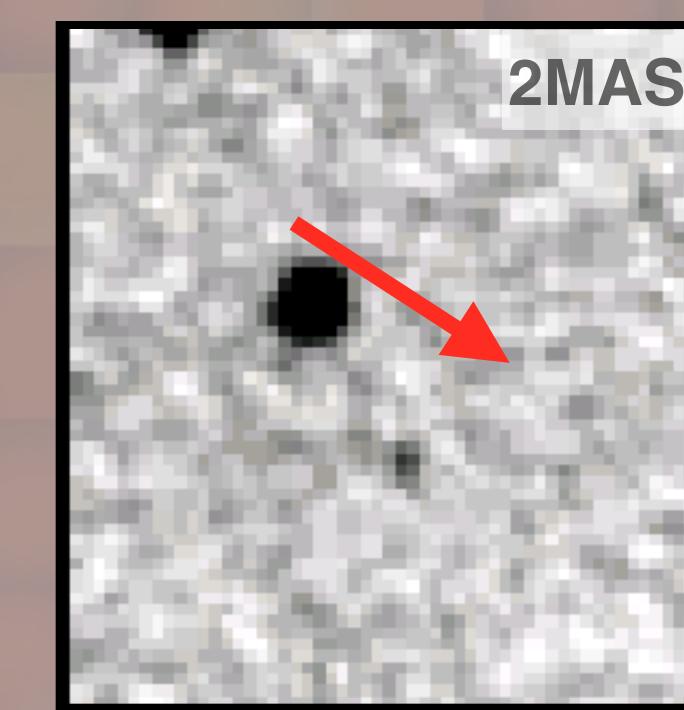
1. Morphological classification of sources can only distinguish between resolved galaxies and stars.
2. Giant stars and dwarf stars have similar morphologies.
3. Spectroscopy is expensive.

Proper motions help distinguish dwarf stars from other astrophysical point-sources.

Which surveys are best?



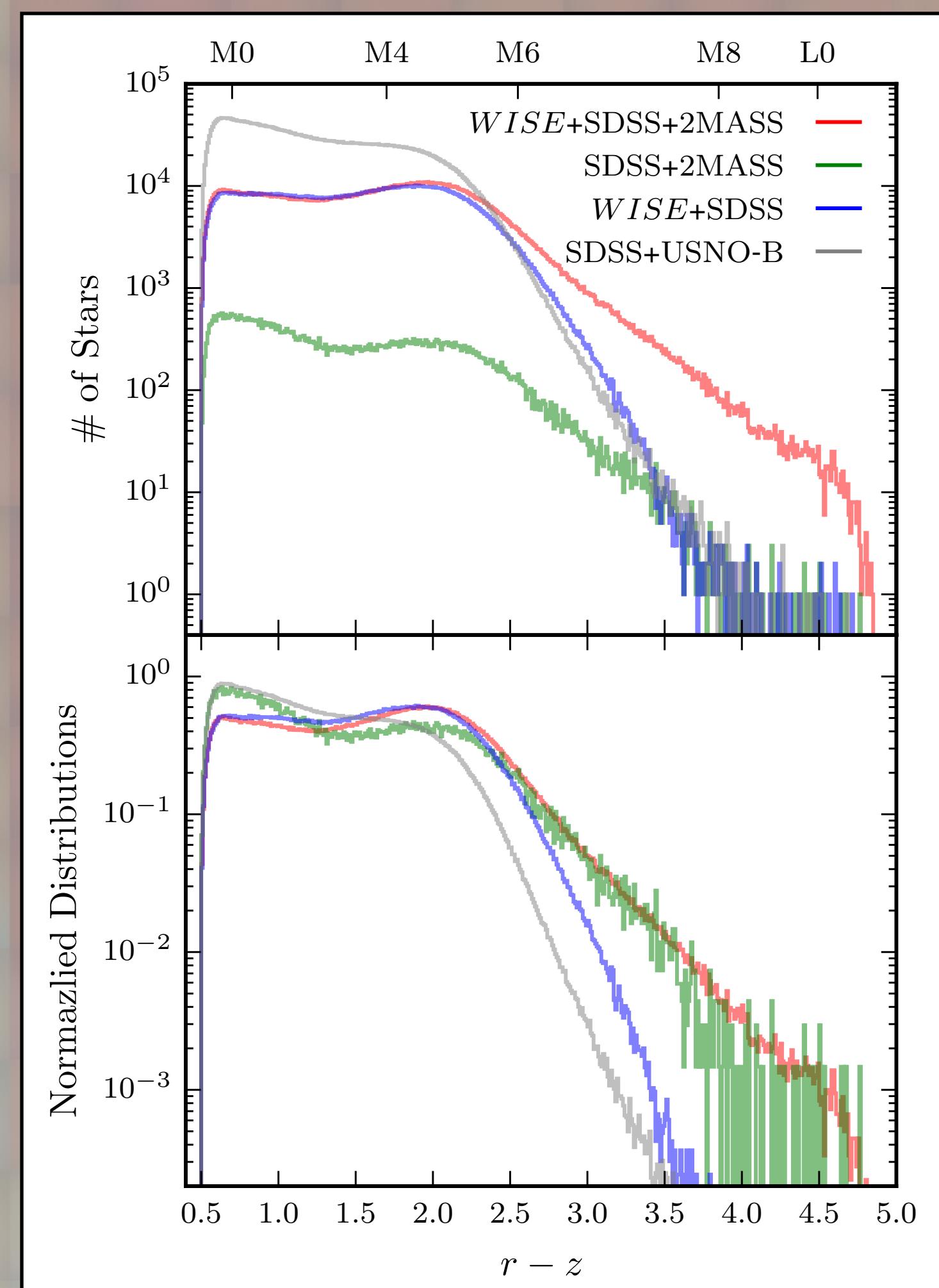
SDSS, 2MASS, and WISE, sample the peak of the spectral energy distribution for stars with M dwarf temperatures.



Together, 2MASS, SDSS, and WISE span a time baseline of ~12 years. Using all three surveys, we can achieve a precision of ~11 mas/year¹.

These surveys also have a large combined footprint (14,555 deg², limited by SDSS) and extensive depth (r ~ 22), allowing us to probe a large volume.

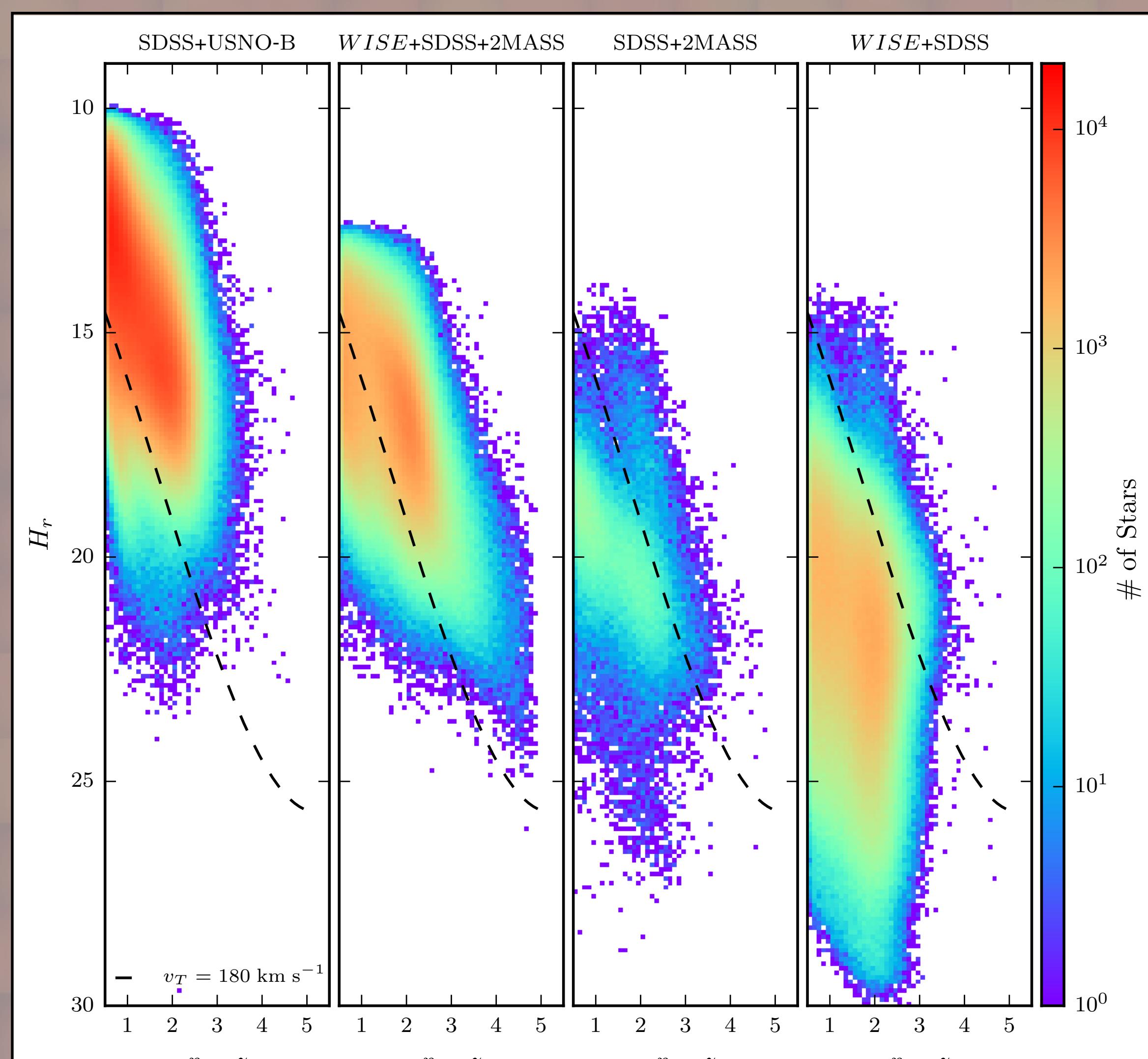
The MoVeRS Catalog



Stars by Color (Spectral Types)

MoVeRS is comprised of 4 subsamples, each with different sensitivities (in color, magnitude, and proper motion). The MoVeRS sample is the most complete proper motion catalog for the reddest sources. Current proper motion catalogs (such as USNO-B) tend to be deficient for spectral types later than ~M6.

MoVeRS is also estimated to be more complete than Gaia will be for its reddest sources.



Stars by Proper Motion (Reduced Proper Motions)

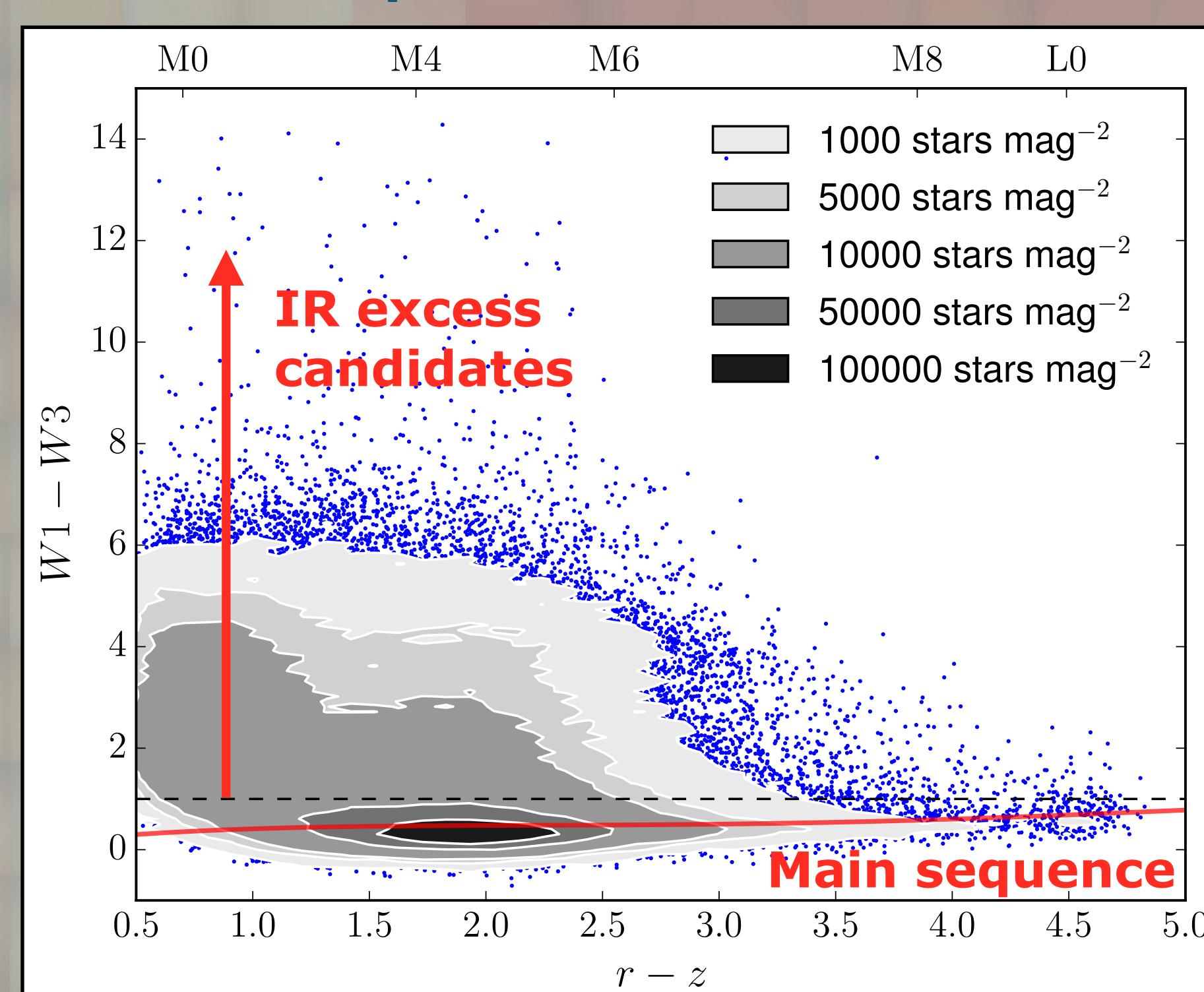
Each combination of surveys in MoVeRS typically probes a different kinematic population.

Disk stars (above the dashed line) and halo stars (below the dashed line) are both represented within the MoVeRS catalog.

MoVeRS contains one of the largest samples of potential halo dwarfs.

Extreme IR excess in 35,000 MoVeRS indicates circumstellar material⁴

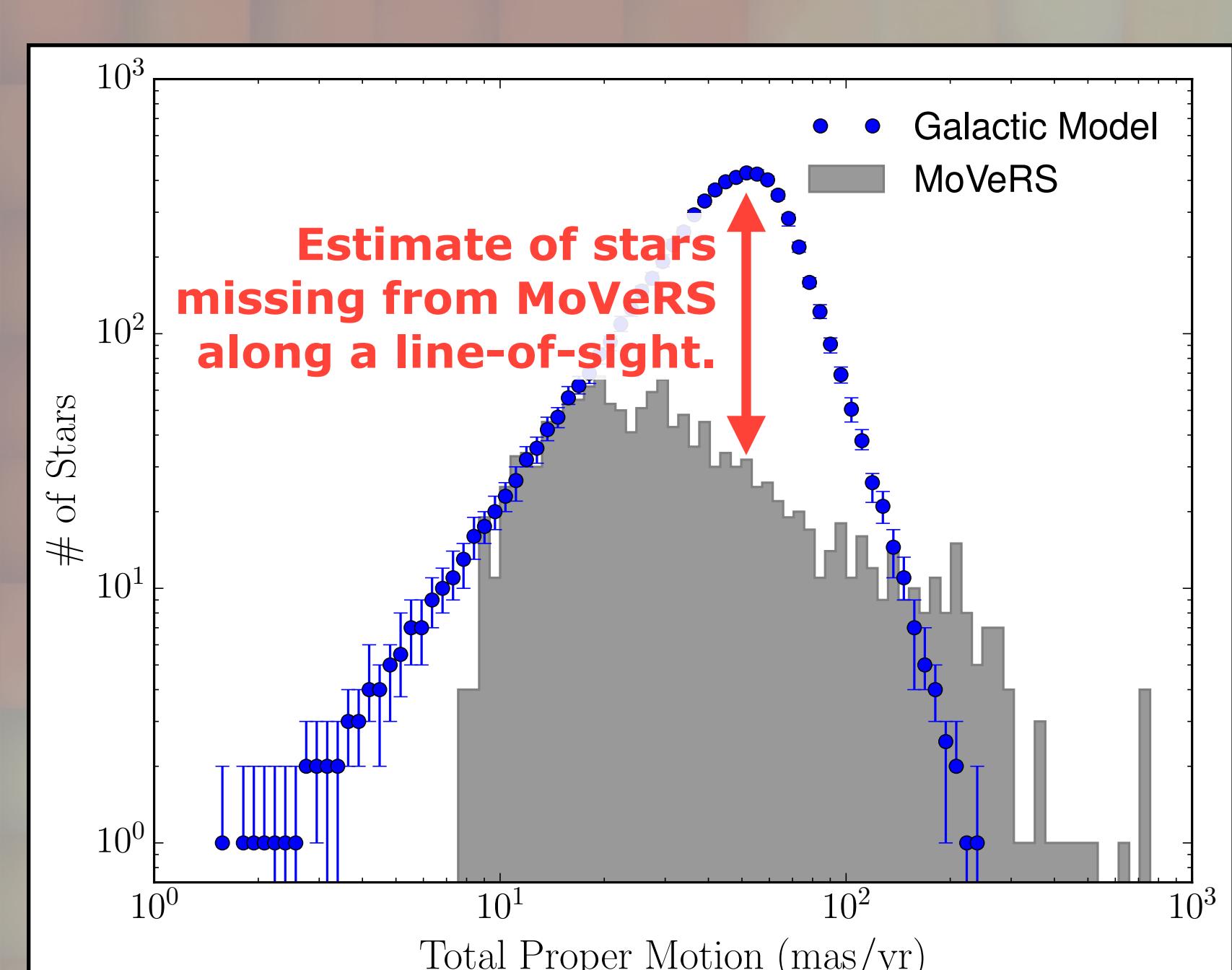
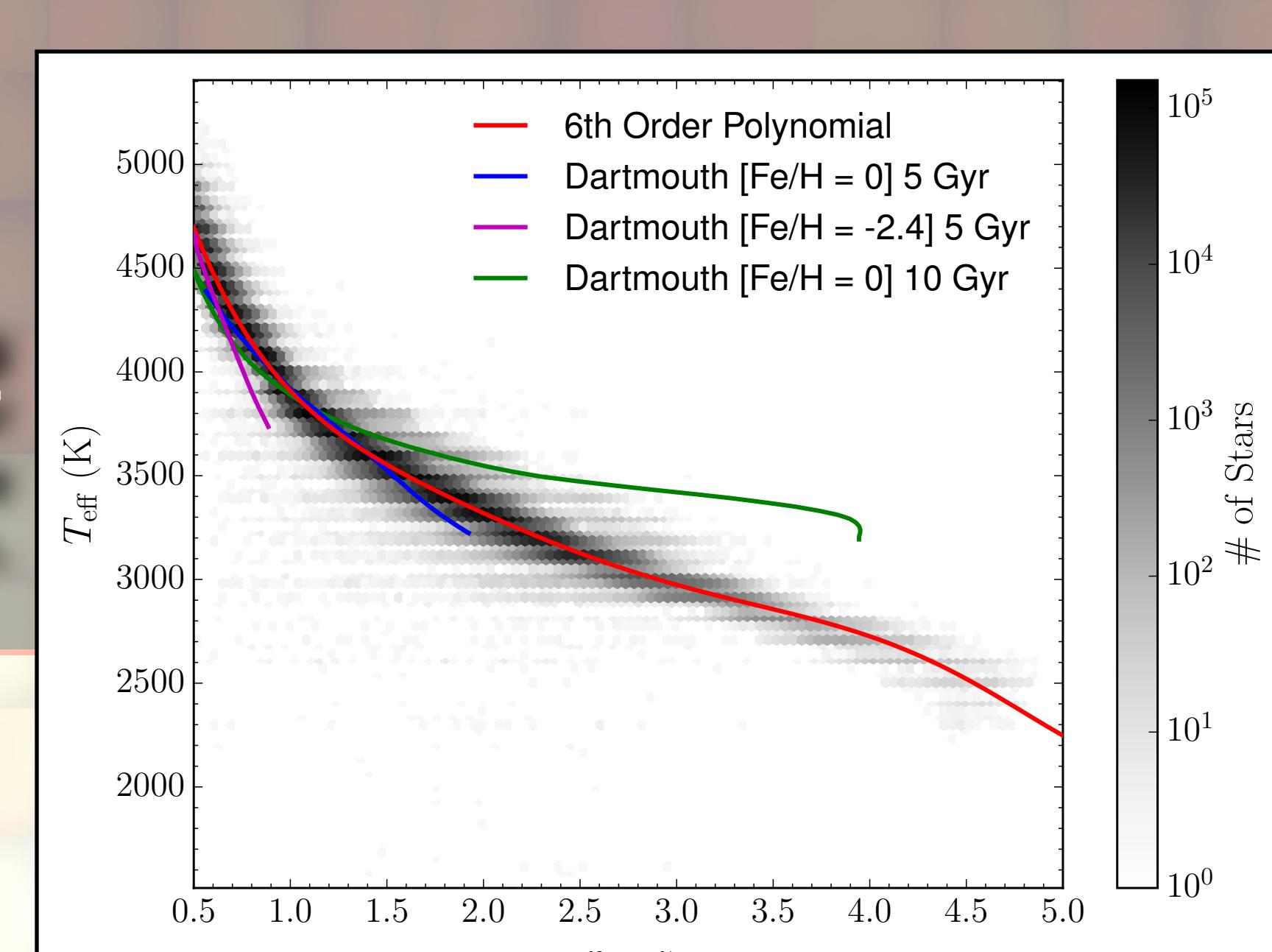
Only a small sample of low-mass stars exhibit large IR excesses is currently known⁴. A large sample of candidates will allow us to probe important parameters of this infrared phenomenon, such as timescale, mass dependence, and frequency throughout the Galaxy. A preliminary selection of possible candidates within our MoVeRS sample indicates there may be as many as 35,000 stars that exhibit an IR excess.



Candidate stars showing excess IR flux can be separated from the main sequence using SDSS bands to separate stars by spectral type, and WISE bands to separate stars with excess IR flux.

Currently estimating fundamental stellar parameters for the entire MoVeRS sample.

Using a Galactic Model⁵ to simulate expected proper motions for a line-of-sight through the Galaxy, we can make a comparison to the MoVeRS sample for the same line-of-sight to estimate our completeness.



REFERENCES

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3. Laughlin, G., et al. 1997, ApJ, 482, 420
4. Theissen, C. A., & West, A. A. 2014, 794, 146
5. Dhital, S., et al. 2010, AJ, 139, 2566

ACKNOWLEDGEMENTS

