Mapping M Dwarf Metallicities

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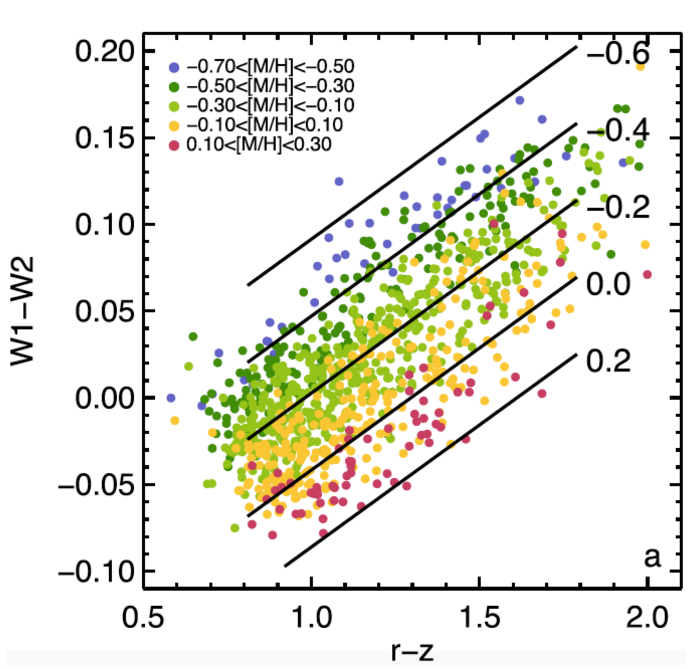
Mapping Stellar Metallicity Helps Constrain Galactic Evolution Models

- The chemical composition of a star is a fossil record of the Galaxy's composition at the location and time of that star's formation.
- **Stellar chemical variation reflects star formation history and stellar dynamics** throughout Galactic evolution.
- M dwarfs are the most common stars in the Galaxy, so we can use them to **probe the Galaxy on small spatial scales**.

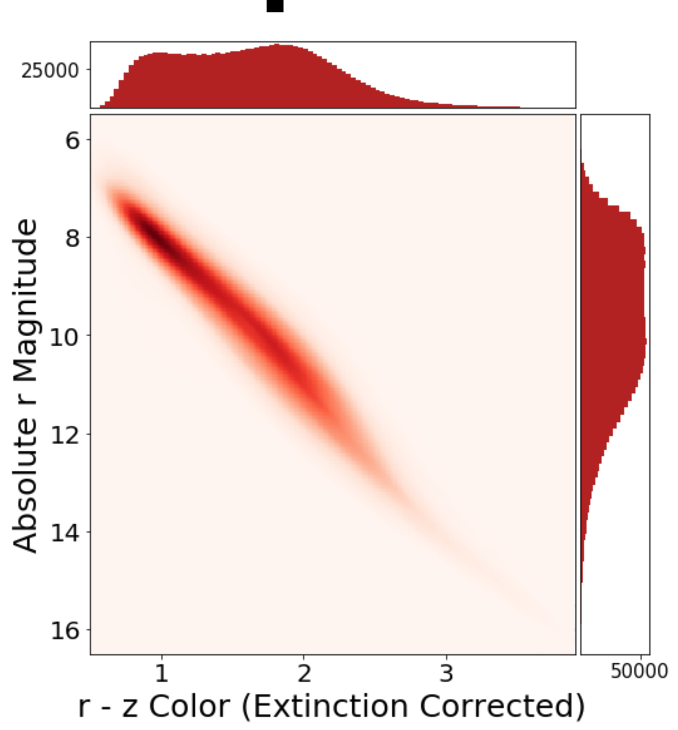
Color Relates to M Dwarf Metallicity



Schmidt et al 2016

- We can **determine the metallicity of low-mass stars using SDSS and WISE colours**.
- This relationship was calibrated using low-mass stars in APOGEE Stellar Parameters and Chemical Abundances Pipeline (ASPCAP, GP15), which fits synthetic spectra to SDSS APOGEE spectra.
- It yields [M/H] for stars 0.8 < r-z < 1.8 with an uncertainty of 0.102 dex.

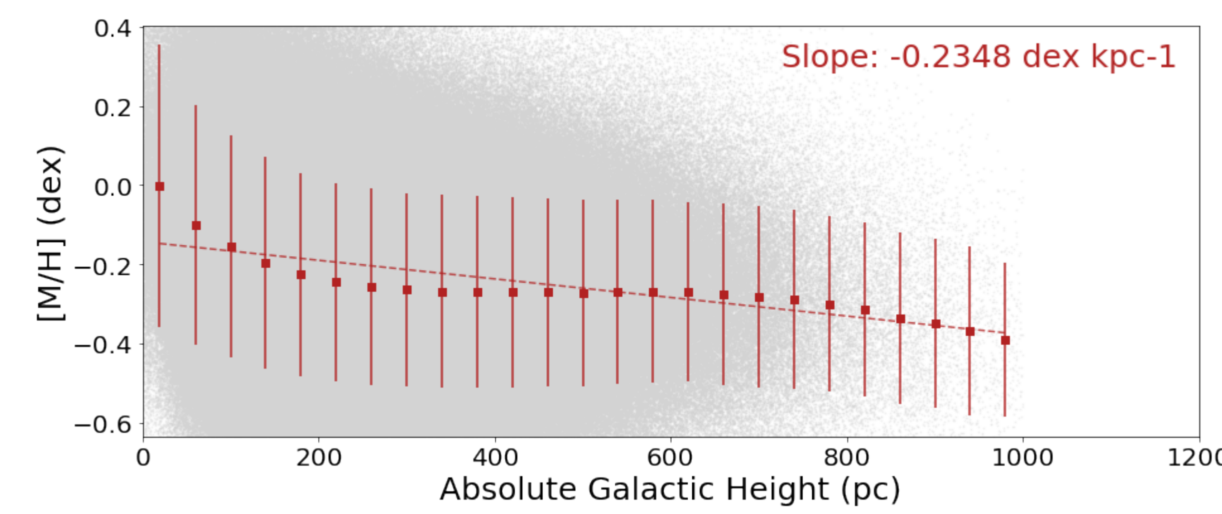
Sample: ~2 Million M dwarfs in Gaia

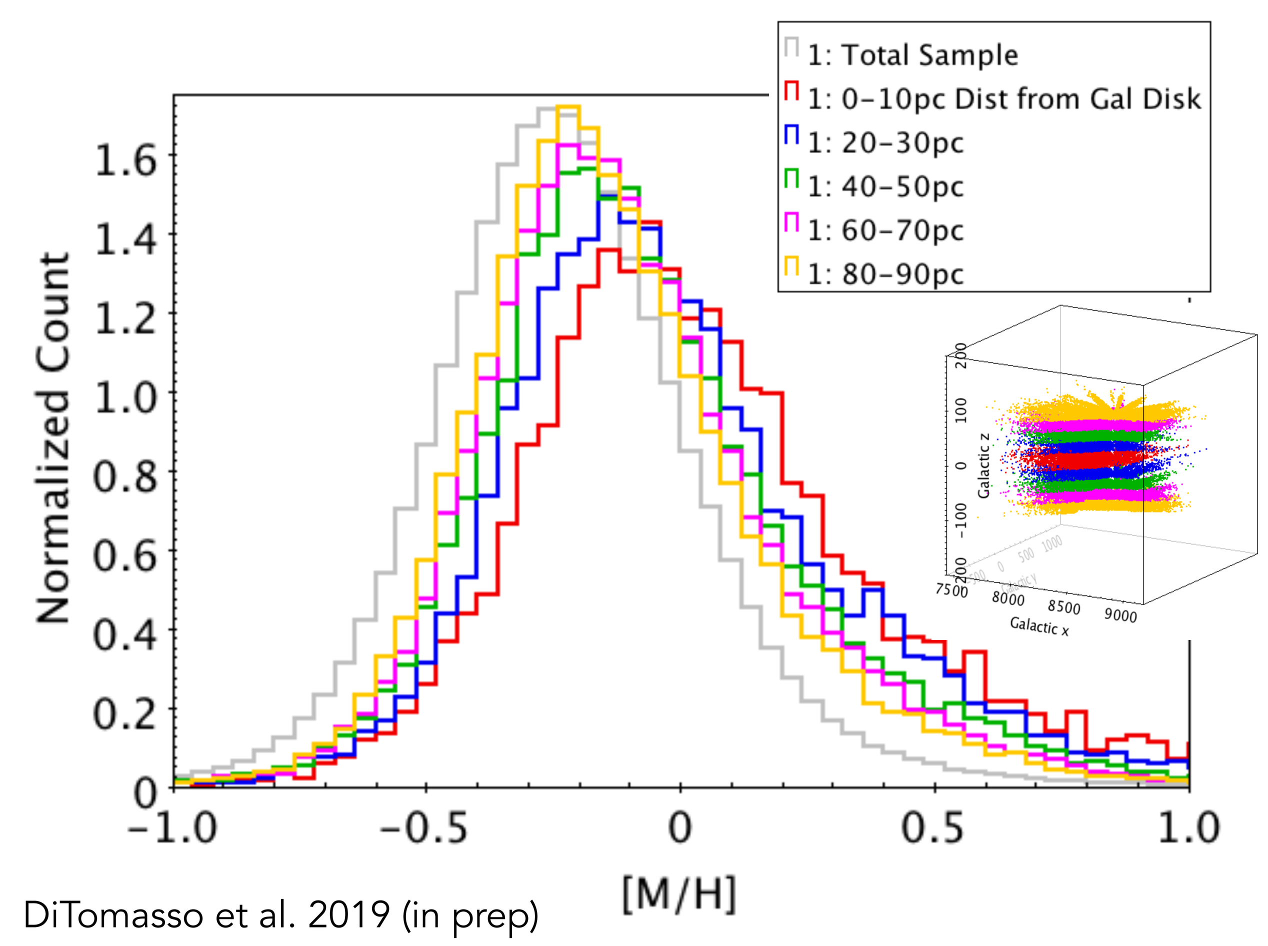


DiTomasso et al 2019 (in prep)

- We selected a sample of stars with WISE and SDSS photometry, red colors typical of M dwarfs, Teff ~3500-4200K, Gaia parallaxes and calculated distances.
- We extinction corrected the photometry using Bayestar17 3D dust maps (G18).

Metallicity Distribution Gradient As a Function of Galactic Height





DiTomasso et al. 2019 (in prep)

- Previous work has found a negative trend in metallicity as a function of distance from the galactic plane in various stellar populations, e.g.:
  - HY82 found a gradient of -0.2 dex kpc^{-1} for G and K stars out to $z > 5$ kpc.
  - S14 found -0.243 dex kpc^{-1} for G dwarfs ~$0.3 < z < 1.6$ kpc.
- We find a **negative vertical gradient throughout our sample** (z <1 kpc) of -0.23 dex kpc^{-1}.
- We see a **strong negative vertical metallicity distribution gradient within 100 pc** above and below the galactic plane.

Future Work

- Compare our results to other metallicity and metallicity distribution studies (eg WW12, DD19).
- Investigate why we have not found evidence of a strong radial metallicity gradient, as has been observed in previous work (e.g. C12).
- Explore how our findings help inform understanding of Galactic evolution.

Citations

(C12) Cheng, J. Y., et al. Metallicity Gradients in the Milky Way Disk as Observed by the SEGUE Survey
(DD19) Davenport, J. R. A. & Dorn-Wallenstein, T. Z., Photometric Metallicities for Low-mass Stars with Gaia and WISE
(GP15) Garcia Perez, A. E., et al. (2015) ASPCAP: The APOGEE Stellar Parameter and Chemical Abundances Pipeline
(G18) Green, G. M., et al. (2018) Galactic reddening in 3D from stellar photometry - an improved map
(HY82) Hartkopf, W.I. & Yoss, K.M. (1982) A Kinematic and Abundance Survey at the Galactic Poles
(S14) Schlesinger, K.J., et al. (2014) The Vertical Metallicity Gradient of the Milky Way Disk: Transitions in [α/Fe] Populations
(S16) Schmidt, S. J., et al. (2016) Examining the relationships between colour, Teff, and [M/H] for APOGEE K and M dwarfs
(WW12) Woolf, V. M. & West, A. A. (2012) The M dwarf problem in the Galaxy