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Title: Spectro-Thermometry of M dwarfs and their candidate planets: too hot, too cool, or just right?
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A key goal of the Kepler mission is to detect and measure the frequency of planets in the circumstellar habitable zone (HZ). Whether a planet resides in the HZ depends on the irradiance the planet receives from its host star, which in turn depends on the star's luminosity and mass. For late-type dwarf stars (late K and M dwarfs), however, constraining their physical characteristics is notoriously difficult compared to Sun-like stars.
We utilize moderate-resolution spectra of nearby late K and M dwarf stars with parallaxes and interferometrically determined radii to refine their effective temperatures, luminosities, and metallicities. We use these revised values to calibrate spectroscopic techniques to infer the fundamental parameters of more distant late-type dwarf stars. We demonstrate that, with minor modifications, the CIFIST version of the PHOENIX model atmospheres accurately reproduce temperatures derived bolometrically. By applying our methods to late-type hosts of transiting planet candidates in the Kepler field we are able to calculate effective temperature, radius, mass, and luminosity with typical errors of 56 K, 7%, 11%, and 13%, respectively. Our derived stellar parameters are systematically offset form those in previous analyses of the same stars, which we attribute to differences in the atmospheric models utilized for each study. We investigate which of the planets in this sample are likely to orbit in the HZ. We determine that four candidate planets; KOI 854.01, 1298.02, 1686.01, and 2992.01, are inside of or within 1-sigma of the habitable zone, but that several planets identified by previous analyses are not (e.g. KOI 1422.02, KOI 2418.01, and KOI 2626.01). Only one of the four habitable zone planets is Earth-size, suggesting a downward revision in the occurrence of such planets around M dwarfs. Our findings highlight the importance of measuring accurate stellar parameters when deriving parameters of their orbiting planets.