

Spectral Characterization of a Complete Equatorial Sample of 687 K Dwarfs within 33 Parsecs — Active Stars, Calm Stars, and the Best Places for Habitable Worlds

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ABSTRACT

We present the results of an ongoing spectroscopic study to determine the stellar properties, activity levels, space motions, and ages of the nearest K dwarfs. The targeted stars are members of RKSTAR (RECONS K Stars) Survey that includes ~ 5000 K dwarf primaries within 50 pc. An initial study established a benchmark calibration set of 35 K dwarfs with known ages and high resolution ($R=80000$) spectra acquired on the CHIRON echelle spectrometer on the SMARTS 1.5m telescope at CTIO. Two known spectral indicators of activity and youth — the $H\alpha$ absorption line (6562.8 Å) and the Li I resonance line (6707.8 Å) — showed strong trends in the training set. A sample of 687 K dwarfs within 33 parsecs and found in an equatorial sample between declinations $+30^\circ$ and -30° has now been observed with CHIRON and analyzed relative to the stars in the benchmark calibration set. Surprisingly, it appears that as many as $\sim 7\%$ of these K dwarfs have spectroscopic features indicating that they are young and/or active. As expected, Galactic UVW space motions indicate that most of the stars fall into the thick and thin disk populations, with a few outliers that may be halo stars.

Empirical SpecMatch has been used to measure stellar properties for this sample of K dwarfs: temperatures range from 3700–5300 K, metallicities range from $-0.6 < [\text{Fe}/\text{H}] < +0.4$, and rotational velocities ($v \sin i$) range from less than 10 km/s to more than 50 km/s. Surface gravity values ($\log g$ values) have also been determined, although they are less reliable than the other quantities. A cross-match with NASA’s Exoplanet Archive for confirmed planets illustrates the neglect of mid- and late-type K dwarfs ($T_{\text{eff}} < 4800$ K) by large exoplanet surveys, and emphasizes the importance of our complimentary searches for stellar, brown dwarf, and jovian planetary companions around RKSTAR members via speckle and radial velocity surveys. Upon completion, this study will serve as an excellent resource to evaluate host stars for exoplanet habitability.

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Keywords: stars: late-type — Galaxy: solar neighborhood — stars: activity — stars: stellar age — open clusters and associations: general — techniques: spectroscopic

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