The K Dwarf Advantage: Exploring Habitability Around the Sun's Cooler Cousins

Hodari-Sadiki Hubbard-James[1,2], Todd J. Henry[2], Sebastian C. Gaxiola[2,3], Allison Youngblood[4], Kayla Gossett Roper[1], Makaila Jennings[1], Lia Faulks[1]

[1]*Agnes Scott College* [2]*RECONS Institute* [3]*Georgia State University* [4]*NASA Goddard Space Flight Center*

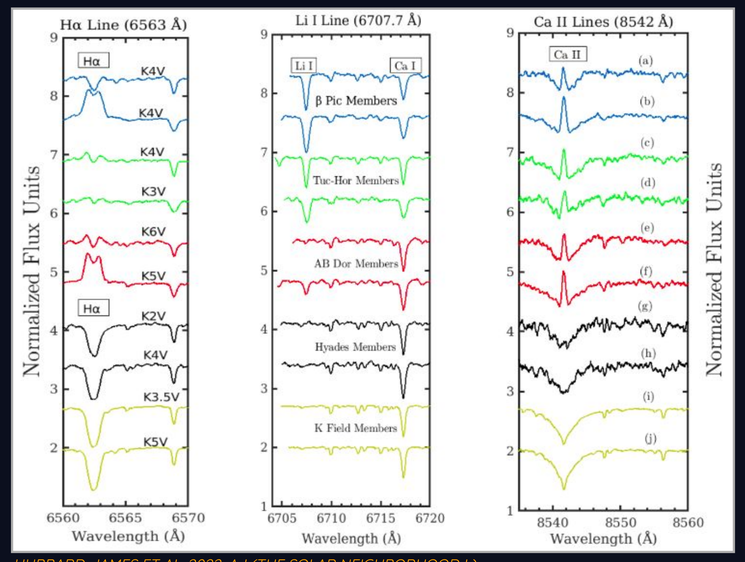
ISLANDS Interstellar Search for Life Around Nearby Dwarf Stars

Young, Active K Dwarf

ILLUSTRATION BY SULLIVAN GUTIERREZ TORRES (ASC '25)

Young K dwarfs are not gentle hosts. Rapid rotation drives a strong magnetic dynamo, producing elevated UV and X-ray emission that strips planetary atmospheres (Lammer et al. 2009). FUV radiation photodissociates key molecules like H_2O and CO_2, complicating the search for biosignatures (Segura et al. 2010).

CHIRON SPECTROSCOPY



HUBBARD-JAMES ET AL. 2022, AJ (THE SOLAR NEIGHBORHOOD L)

High-resolution (R=80,000) spectra from the CHIRON echelle spectrograph at CTIO 1.5m telescope in Chile. Three diagnostic regions distinguish young/active from mature/quiet K dwarfs: Hα shifts from emission to absorption, lithium depletes with age, and Ca II core emission fades (Hubbard-James et al. 2022, AJ, 164, 174).

RESEARCH PIPELINE

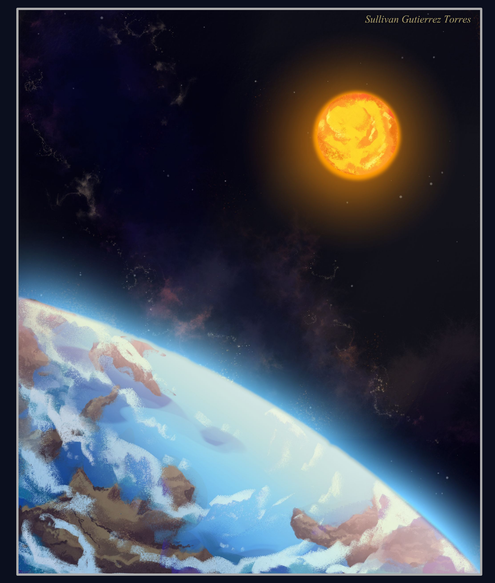
When can life survive around K dwarf stars?

580 K stars surveyed
Cooler, smaller, longer-lived

Plant growth under K Dwarf starlight
Simulated K dwarf spectra

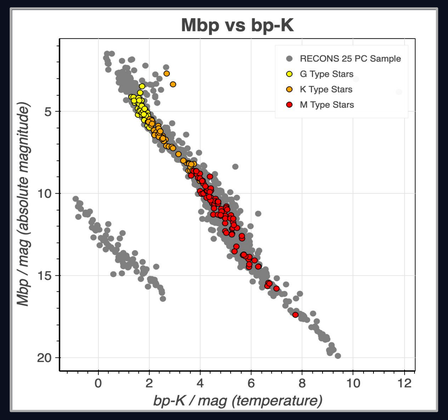
Characterize: CHIRON spectra for 580 K dwarfs within 33 pc
Classify: Identify young/active vs. mature/quiet using Hα, Li I, Ca II
Correlate: Link optical activity to archival UV and X-ray emission
Test: Grow photosynthetic organisms under simulated K dwarf starlight

Mature, Quiet K Dwarf



Mature K dwarfs offer main sequence lifetimes up to 40 billion years and habitable zones wide enough to reduce the risk of tidal locking (Cuntz & Guinan 2016). Their stable energy output and favorable contrast ratios make biosignatures like O_2 and CH_4 easier to detect than around G or M dwarfs (Arney 2019).

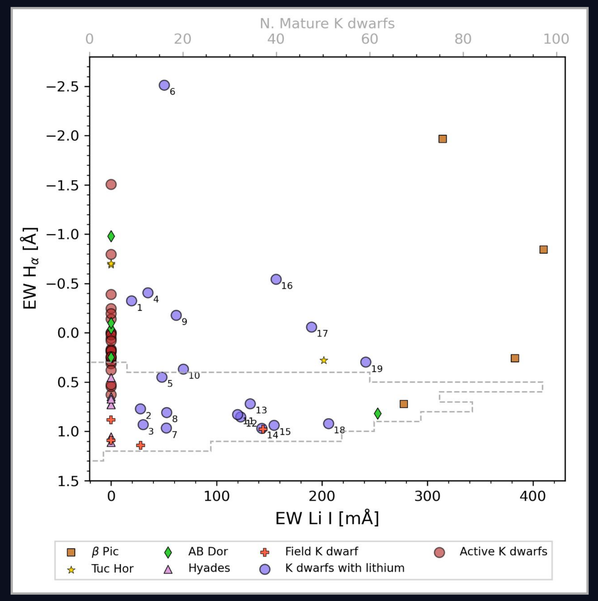
THE SAMPLE



BY DANIELA GARCIA LARA (ASC '27)

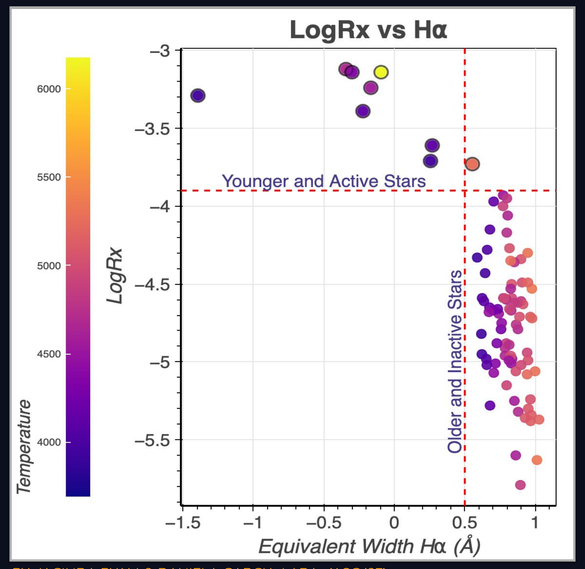
HR diagram of the RECONS 25 pc sample (gray) with G (yellow), K (orange), and M (red) type stars with confirmed exoplanets highlighted. K dwarfs make up ~12% of nearby stars, outnumbering G dwarfs, yet seem host far fewer confirmed planets (Henry et al. 2006). Our survey targets 580 K dwarfs within 33 pc to characterize their activity and ages (Hubbard-James et al. 2026, AJ, 171, 175).

YOUNG & ACTIVE STARS



Key Result: 7.4% (43 stars) exhibit youth or chromospheric activity: 19 show lithium absorption indicating ages <1 Gyr, 36 display Hα emission. Hubbard-James et al. 2026, AJ, 171, 175.

OPTICAL → UV/X-RAY CORRELATIONS

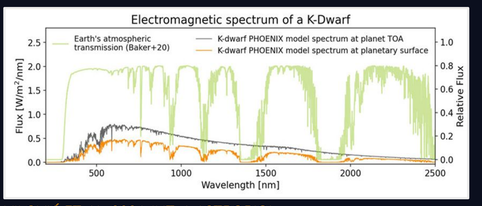


BY JACINDA BYAM & DANIELA GARCIA-LARA (ASC '27)

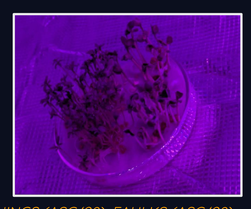
Can optical activity indicators predict UV and X-ray emission?

Hα equivalent width correlates with ROSAT X-ray flux, cleanly separating young/active stars from older/inactive stars. This enables high-energy activity estimates for K dwarfs without space-based observations.

ISLANDS Lab



VILOVIĆ ET. AL. 2024, INT. J. ASTROBIOL.



GOSSETT ROPER (ASC '27), JENNINGS (ASC '28), FAULKS (ASC '28).

K dwarf spectra peak in the infrared (top, Vilović et al. 2024). Using LED grow chambers and optical filters, we test photosynthesis under four conditions: Solar control, Quiet K5V, Active K5V, and Active K2V. No previous experiment has incorporated realistic stellar activity into K dwarf habitability testing.

References: [1] Arney 2019, ApJL, 873, L7 [2] Cuntz & Guinan 2016, ApJ, 827, 79 [3] Hubbard-James+ 2022, AJ, 164, 174 [4] Hubbard-James+ 2026, AJ, 171, 175 [5] Lammer+ 2009, A&ARv, 17, 181 [6] Segura+ 2010, AsBio, 10, 751 [7] Vilović+ 2024, Int. J. Astrobiol.

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