K2 Target Proposal:

Making F Dwarfs Cool Again – Demystifying the Radial Velocity (RV) Jitter of F Dwarfs

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Together, Doppler and photometric surveys of Sun-like stars have yielded a large number of planet discoveries (Wright et al. 2011), with a rich variety of planetary configurations very different from our own. Yet, even with the high precision afforded by spectrographs on 10-m class telescopes or by highly successful photometric surveys like *Kepler*, the hunt for planets is fundamentally limited by intrinsic stellar noise ("jitter" in the RV domain) that can hide or sometimes mimic planetary signals (Queloz et al. 2001). F dwarfs are notably problematic RV targets as they seem to exhibit higher baseline levels of RV jitter (Wright 2005; Isaacson & Fischer 2010), to the point that RV planet surveys now largely avoid them (Fig. 1). Such avoidances impede our ability to understand the occurrence of planets around more massive Sun-like stars. For example, the conclusion that stellar mass likely correlates with the presence of a Jupiter-mass planetary companion was largely derived from RV surveys of subgiant and giant stars partially in an effort to circumvent the high F dwarf jitter problem. However, the masses of these stars have recently been called into question (Schlaufman & Winn 2013, Lloyd 2013), and hence also our understanding of the occurrence of Jovian planets around massive Sun-like stars. A key solution to the problem, then, is to somehow identify massive but unevolved Sun-like stars – F dwarfs, whose masses are more well-constrained – that are sufficiently RV stable to carry out an RV planet search. Using a mixed sample of Sun-like stars (spectral types of F, G, K), we have shown that the RV jitter of magnetically quiet stars is driven by granulation (Bastien et al. 2014), which can be measured in *Kepler* light curves via "flicker" (Bastien et al. 2013). Most importantly, we have found that we can also use this to identify RV stable F dwarfs using the small sample of bright *Kepler* F stars with RV measurements (Fig. 2): high surface gravity, as indicated by flicker, correlates with low RV jitter. We seek to extend this work with K2 in order to (1) solidify this correlation with a larger sample of stars and (2) lay the groundwork for the first dedicated RV planet survey of RV stable F dwarfs, with the RV stable stars we identify with K2 forming the basis of this planet search.

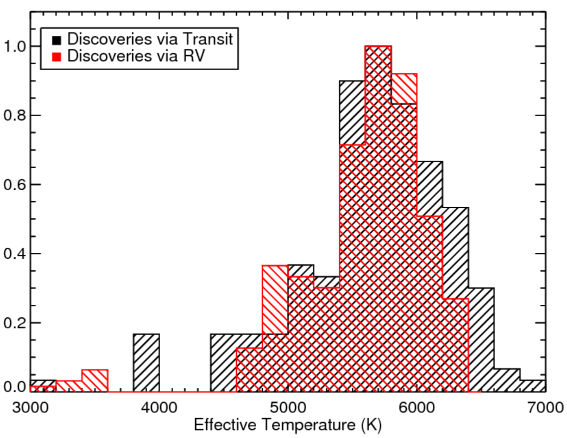

Fig. 1: Histograms of planet discoveries around dwarf stars as a function of effective temperature for both transit and RV surveys (targets from www.exoplanet.org). While transit surveys show planet detections for all Sun-like stars, RV planet discovery declines steeply with increasing effective temperature.

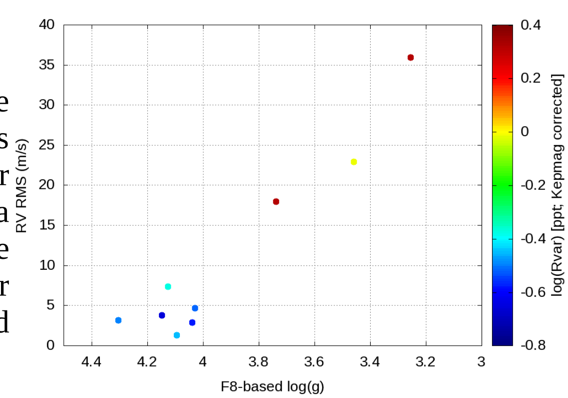

Fig. 2: A comparison between all F stars in the *Kepler* field with Keck RV jitter measurements (ordinate) and surface gravities derived from 8-hr flicker (abscissa). For this initial sample, we find a strong correlation between the two. All of these objects are dwarfs according to their spectroscopically or photometrically determined surface gravities.