

Measuring the Occurrence of Small Planets with K2

Erik Petigura (UC Berkeley), Geoffrey Marcy (UC Berkeley), Andrew Howard (Institute for Astronomy), Roberto Sanchis-Ojeda (MIT), Nathan De Lee (Vanderbilt), Lauren Weiss (UC Berkeley)

Summary: The scientific community, and the public as a whole, fully appreciates that *Kepler* is constraining the frequency of Earth-size planets around Sun-like stars. However, those measurements only pertain to the *Kepler* field, a narrow cone sampling one four-hundredth the sky. We face a serious question: Is the *Kepler* field representative of the rest of the Galaxy and, most importantly, the local solar neighborhood where upcoming NASA missions will search for Earth-size planets? Indeed, the occurrence of hot Jupiters in the *Kepler* field is only 40% that in the local stellar neighborhood (Howard et al. 2012). Therefore, it is imperative to measure the occurrence of small planets in additional fields. We propose to observe a magnitude-limited sample of the brightest FGK dwarfs in K2 Campaigns 2 and 3, with the primary objective of measuring the occurrence of nearly Earth-size planets.

Path to Science: Observing a well-defined, magnitude-limited sample of stars is vital for planet occurrence work. K2 is capable of detecting large numbers of $2\text{--}3 R_E$ planets. Assuming photometric precision of 80 ppm over 6.5 hours, a $2 R_E$ planet on a 20-day orbital period will be detectable at $\text{SNR} = 8$ during a single 75-day K2 campaign. Adopting occurrence rates from Petigura et al. (2013), **we expect to find 3.1 planets of size $2\text{--}3 R_E$ with $P < 20$ days per 1,000 stars observed.** Poisson errors associated with the finite number of detected planets set the precision to which we can measure planet occurrence. A sample of 5,000 stars is expected to yield ~ 15 planets of size $2\text{--}3 R_E$ and $P < 20$ days providing an occurrence measurement good to 25% fractional uncertainty. With 5,000 stars, **we can confirm or rule out a factor of two discrepancy in the occurrence rate of $2\text{--}3 R_E$ planets at 4 sigma significance.**

Target Selection: We started from the provisional TESS Dwarf Star Catalog, which combines 2MASS and Tycho-2 catalogs and has been cleaned of giants based on reduced proper motion cuts. We merged this list with the EPIC catalog and selected stars with *Kepler* magnitude (Kp) less than 13. Finally, we determined which stars will fall on (or near) the K2 detector with the K2fov tool. We request 5811 and 5375 targets for Campaigns 2 and 3, respectively. Our target lists include 7169 and 5314 additional targets falling near the detector for Campaigns 2 and 3, respectively. **Figure 1** shows Kp as a function of T_{eff} for both stellar samples. Over 99% of these stars are FGK spectral type ($T_{\text{eff}} = 3900\text{--}7600$ K).

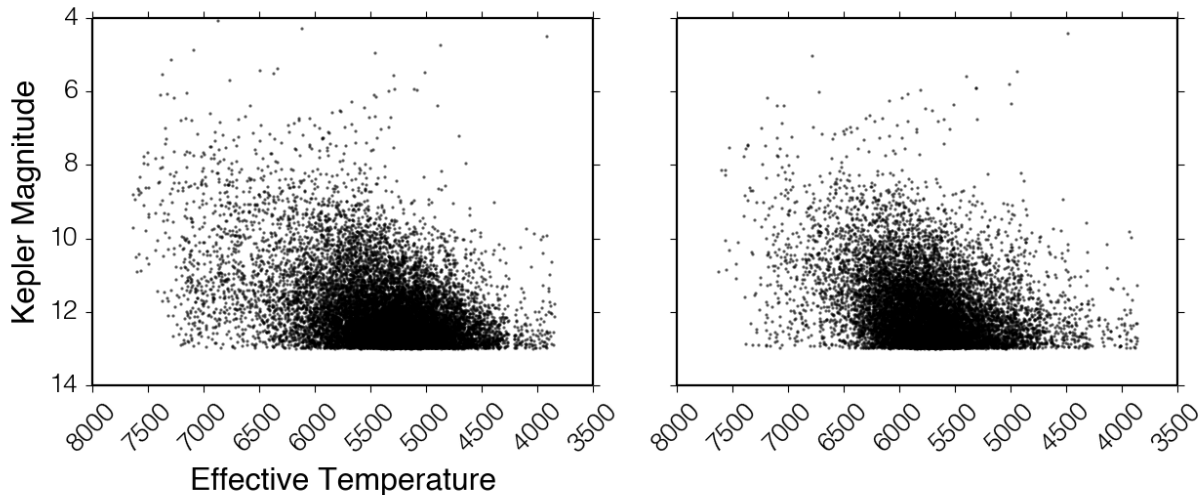


Figure 1. We propose observing 5811 and 5375 bright ($Kp < 13$) dwarf stars with K2 during Campaigns 2 and 3 respectively. We show *Kepler* magnitude and photometric temperatures from the TESS dwarf star catalog for proposed targets during Campaign 2 (left panel) and Campaign 3 (right). We have rejected giants based on reduced proper motion.