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DETECTABILITY OF HABITABLE PLANETS AROUND VERY LOW-MASS STARS

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We present observations of 18 very low-mass stars with Kepler light curves available in the public archive, where we performed a search for transits and characterized the photometric variability to estimate the effects of stellar activity in the detectability of habitable planets around stars at the cool end of the stellar mass distribution.

We obtained low-resolution red optical spectra of 18 very low-mass star (VLM) candidates in the Kepler field. The spectral types of these objects were found to lie in the range dM 4.5 to dM 8.5, confirming the VLM nature and implying spectrophotometric distances from 17 pc to 80 pc. We find that the size of the planets detectable by Kepler around these small stars typically lie in the range 1 to 5 Earth radii within the habitable regions ($P < 10$ days). Figure 1 shows a transit-like periodic signal detected in one of our targets, KIC 3330684.

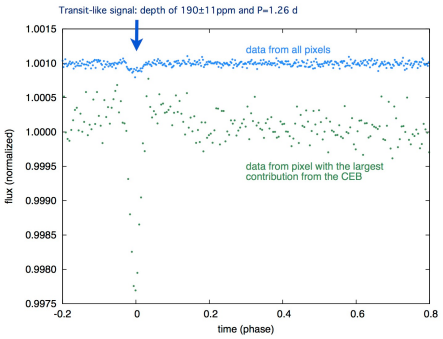

Fig. 1. Lightcurve of KIC 3330684 ($P = 1.26$ days).

The signal has a period of 1.2613198 ± 0.0000016 days with a depth of 190 ± 11 ppm, compatible with the detection limit expected from the candidate distribution of Batalha et al. (2012), which would correspond, for a central transit and considering the radius of the dM5 host, to an object of 0.24 Earth radii or 0.9 times the radius of the Moon. However, our pixel by pixel analysis of Kepler data indicates that the signal is likely a contamination from an unidentified eclipsing binary located to the SW of the target, as explained in Martín et al. (2013).

For 11 objects in our sample, reliable photometric periods shorter than 7 days are derived and are interpreted as rotational modulation of magnetic cool spots. For 3 objects we find possible photometric periods longer than 50 days that require confirmation. H-alpha emission and flare rates were used as proxies for chromospheric activity. We found that the detectability of planets is affected by different levels of chromospheric activity in VLMs. Figure 2 shows a mosaic of light curves for the 18 VLMs, where detected flares are shown in blue open circles. The overlapping filled blue circles show the size of detectable exoplanets. Notice that planet sizes scale with levels of chromospheric activity. Super-Earth planets with sizes lower than 2 Earth radii are detectable with Kepler around about half of the stars in our sample, independently from their level of chromospheric activity. A thorough discussion of these results can be found in Martín et al. (2013).

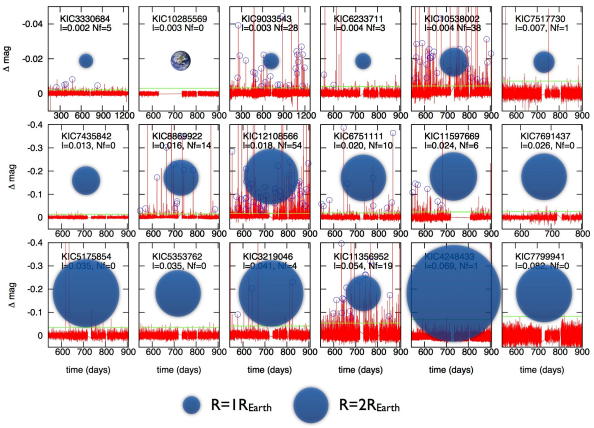

Fig. 2. Mosaic of lightcurves of all 18 VLMs. Overlapping blue circles represent the size of detectable planets.

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