VALIDATING KEPLER'S HABITABLE-ZONE SUPER-EARTHS WITH THE SPITZER SPACE TELESCOPE

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The NASA Kepler Mission will soon have completed two years of science observations, the minumum baseline sufficient to identify candidate transiting planets orbiting with the habitable zones of Sun-like stars. The Kepler Team has already identified planets orbiting within the habitable zones of stars less massive that the Sun, and it will continue to uncover habitable zone planets as the mission baseline increases. The principal task that lies ahead is to reject from this sample the astrophysical false positives (blends of eclipsing binaries that precisely mimic the signal of a transiting exoplanet), and to confirm the planetary nature of the remaining candidates. For planets more massive than Neptune, the direct confirmation of their planetary status can be accomplished by radial- velocity measurements. However, such planets possess primordial envelopes of hydrogen and helium that make them unsuitable to life as we know it. The most exciting candidates-- and the ones that Kepler is specifically tasked with finding -- are super-Earth and Earth-sized candidates orbiting within their stellar habitable zones. While the Kepler Team has developed powerful tools to weed out impostors, the Spitzer Space Telescope possesses the unique capability to provide the final validation of these candidates as planets, namely by measuring the depth of the transit at infrared wavelengths. By combining the infrared and optical measurements of the transit depth with models of hypothetical stellar blends, we can definitively test the stellar-blend hypothesis. We have submitted an Exploration Science proposal to Spitzer requesting 600 hours of observations with the IRAC camera. We propose to use this time to observe the transits of 20 candidate habitable-zone super-Earths identified, or to be identified, by the Kepler Mission. For these investigations to succeed, they must be developed in direct partnership with the Kepler Science Team and planned with the use of the Kepler photometry, and the results from Spitzer must be shared directly with the Kepler Follow- On Program, all of which motivates the current Kepler Mission Participating Scientist proposal. The results from this proposal will be twofold: First, we will definitively validate the first potentially habitable planets ever identified. Second, we will determine the rate of occurrence of impostors. This rate of false positives can then be applied to the much larger sample of candidates identified by Kepler, to deduce the true rate of planetary companions. The proposed investigation will directly address the Kepler Mission goals to "provide a statistically significant value for the frequency of Earth-size and larger planets in and near the habitable zone of their host stars" and "charaterize the size and orbital distributions of planets around other stars", and the NASA Research Objective to "generate a census of extra-solar planets and measure their properties".