

COMPLETING THE KEPLER CENSUS OF EARTH-LIKE PLANETS

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The central goal of the Kepler Mission is to characterize the statistical distribution of small planets in the Galaxy. Of particular interest are Earth-like planets---rocky planets in the habitable zones of their stars. The main product of the Kepler detection pipeline, however, is a large population of transit candidates, not secure planets, and any of a number of astrophysical eclipse scenarios can mimic the signal of a transiting planet. While there have been several a priori studies--the pioneering one by the PI--suggesting that the rate of such false positives among well-vetted candidates should be low, a large, detailed, and observationally informed study of this rate has yet to be undertaken. Such a study is critical to properly understanding the demographics of small planets. The PI proposes to apply two existing unrivaled Kepler follow-up datasets - a Keck/HIRES spectroscopic survey of nearly 1000 Kepler Objects of Interest (KOIs) and a Robo-AO adaptive optics survey of over 1100 KOIs - to this effort, in order to calculate observationally informed false positive probabilities for every KOI. This will likely lead to the validation of nearly 1000 Kepler planet candidates. Equally critical to a proper understanding of the true demographics of small planets is the development of a statistical framework to distill the true radius and period distributions of exoplanets from the results of the Kepler survey, properly incorporating all the subtleties of reliability and completeness. The PI has done a pilot study along these lines with a small sample of cool-star KOIs, for which he has demonstrated the use of some novel statistical techniques. This study has identified some hitherto-unknown features of the radius distribution of planets around cool stars, including that planets around the size of Earth appear to be the most common type of planet around those stars. As a Participating Scientist, in addition to characterizing the false positive probabilities of all the planet candidates, the PI will bring his substantial statistical expertise to the Kepler Project to continue to develop these statistical techniques and apply them to the whole survey, in order to characterize in detail the demographics of small planets in the Galaxy and to calculate the frequency of Earth-like planets.