

## **TOWARDS ETA-EARTH: CHARACTERIZING THE DETECTION RATE OF SMALL PLANETS IN THE KEPLER PIPELINE**

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This proposal lays out a plan for directly measuring the completeness and reliability of the planet sample produced by the Kepler pipeline. This knowledge is essential for determining an accurate picture of the distribution and occurrence rate of small planets. Measuring this distribution is the main goal of the Kepler Extended Mission, in particular the frequency of Earth-size planets in and near the habitable zone of their host stars. As the number of planet candidates detected by Kepler increases, and as their properties become more interesting (smaller planets, further from their host stars), people are turning their attention to characterising the underlying distribution of planets indicated by the planet candidate catalogues. However, unless we have a rigorous understanding of the completeness of the planet sample being generated by the Kepler pipeline, i.e. what fraction of real, detectable planets are being discovered, and the reliability of that planet sample, i.e. what fraction of candidates in the sample are due to real planets as compared to false positives, we cannot derive an accurate picture of the true underlying planet population. The work proposed here aims to characterise the detection efficiency of the Kepler pipeline. We will inject simulated planet signals into the real Kepler data, which will allow us to empirically measure the types of planets to which the pipeline is sensitive, and more importantly, the types to which it is not sensitive. From this we can derive the completeness of the Kepler planet sample. We will also separately inject simulated astrophysical false positives in the real Kepler data, which gives us the opportunity to examine the types of false positives that the pipeline is capable of identifying and rejecting. This will directly inform our understanding of the reliability of the Kepler planet sample. Finally, the set of significant periodic signals identified by the Kepler pipeline is dominated by spurious detections, and therefore needs to be carefully vetted in order to produce the final planet sample. Currently, a team of volunteers is assembled who follow a set of rules in order to identify the truly transit-like signatures. In the future, the Mission will move towards an automated vetting procedure using machine learning. The impact of both vetting procedures on the completeness and reliability of the generated planet sample must be quantified. We will produce a challenge set of light curves, containing both simulated planet signals and simulated astrophysical false positive signals, as well as genuine periodic events found by the pipeline, with which to assess the performance of the vetting procedure.