Free-Floating and Bound Planet Mass Measurements with K2: Ground- and Space-Based Photometry, Event Detection and Modeling

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The K2 Campaign 9 microlensing survey is our first and potentially only opportunity to measure the masses of free-floating planets. This includes the first opportunity to confirm that they have planetary masses and (with additional follow-up observations) severely constrain the scenarios in which they could be bound to stars (i.e., not free floating).

Accomplishing this goal is extremely challenging. First, the techniques necessary to perform crowded field photometry on K2 data must be developed in order to monitor enough stars to find a significant number of candidate free-floating planet microlensing events. Second, the ground-based observations necessary to measure free-floating planet masses (namely high-cadence, multicolor monitoring of the K2 field to sufficient depth) are beyond the capabilities of the ground-based microlensing surveys, and will require time on competitively allocated 2-4-meter telescopes.

We propose to continue the work we have already begun to ensure that the software and hardware resources necessary to measure free-floating planet masses are in place ready for the commencement of Campaign 9. We will develop two photometric pipelines to extract photometry from the K2 data: one safe and one risky. The safe pipeline will use established difference imaging techniques. The risky pipeline potentially has a much lower noise floor, but relies on a novel technique of forward modeling the K2 images from much higher-resolution ground-based images.

The K2 Campaign 2 will also enable the measurement of the masses and distances of bound planets, and potentially the Galactic distribution of such planets. We will also continue our work on simulations, proposals and advocacy to secure publicly-available data from wide-field ground-based telescopes and optimize their observing in order to maximize the (bound and free-floating) planet detection efficiency and mass measurements. Finally, in collaboration with others we will search for and model both bound and free-floating planet candidate lightcurves in both the ground-based and K2 data, and model them to measure their microlensing parameters, planet detection efficiency, microlensing parallax, angular Einstein radii, masses and distances. If our efforts are successful, we will be able to, for the first time, infer the frequency, distance distribution, and mass function of both "cold" bound and free-floating planets. These measurements cannot be obtained in any other way within the next decade.