Eta-Earth Estimates Informed by Exoplanet Evolution and Population Models

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Eta-Earth, the average number of rocky planets in the habitable zone of its star, requires integrating a population rate model across that habitable zone. The Kepler mission was designed to measure eta-Earth, but there are very few detected planets in the habitable zone, and these only partially cover the habitable zones of hotter stars. This implies the need to extrapolate the population rate models from larger, hotter exoplanets, for which there are more detections. Traditionally, estimates of eta-Earth use power-law-based population rate models, but the choice of power laws is not well supported by the observational evidence. Therefore extrapolation of power laws can lead to highly inaccurate estimates of eta-Earth. In this talk we present our initial explorations of using theory-based population rate models to cover the habitable zone. We address the problem of planet formation and evolution theories not being well constrained by considering several models, computing eta-Earth using those models, and using formal model selection techniques to quantitatively evaluate how well those models are supported by the observed data. Combining different models' eta-Earth values with their probability relative to other models (via Bayesian model stacking) provides a new approach to measuring eta-Earth that promises higher accuracy and precision.