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Title: Understanding Kepler's Super-Earths and Sub-Neptunes: Insights from Thermal Evolution and Photo-Evaporation

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Abstract: NASA's Kepler mission has discovered a large new population of super-Earth and sub-Neptune sized planets. Although we have no analogous planet in our own solar system, such planets are incredibly common. Understanding the nature and formation of systems of these planets is one of the key challenges for theories of planet formation. We use models of thermal evolution and photo-evaporation to constrain the structure, composition, and evolution of low-mass planets. Over time Neptune-like planets with large H/He envelopes can be transformed into rocky super-Earths. We show that differences in mass loss history provide a natural explanation for many features of the Kepler multi-planet systems, such as large density contrast between Kepler-36b and Kepler-36c. For the broader population of Kepler planets, we find that there is a threshold in bulk planet density, mass, and incident flux above which no low-mass transiting planets have been observed. We suggest that this threshold is due to XUV-driven photo-evaporation and show that it is well-reproduced by our evolution models.