Potential Biases in the Detection of Planetary Systems with Large Transit Timing Variations

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The Transit Timing Variations (TTVs) technique provides a powerful tool to detect additional planets in transiting exoplanetary systems. In this paper we show how transiting planets with significant TTVs can be systematically missed, or cataloged as false positives, by current transit search algorithms, unless they are in multi-transit systems. If the period of the TTVs, P_TTV, is longer than the time baseline of the observations and its amplitude, A_TTV, is larger than the timing precision limit of the data, transiting planet candidates are still detected, but with incorrect ephemerides. Therefore, they will be discarded during follow-up. When P_TTV is shorter than the time baseline of the observations and A_TTV is sufficiently large, constant period search algorithms find an average period for the system, which results in altered transit durations and depths in the folded light curves. Those candidates can get subsequently discarded as eclipsing binaries, grazing eclipses, or blends. Also, for large enough A_TTVs, the transits can get fully occulted by the photometric dispersion of the light curves. These detection biases could explain the observed statistical differences between the frequency of multiple systems among planets detected via other techniques and those detected via transits. We suggest that new transit search algorithms allowing for non-constant period planets should be implemented.

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