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Oblateness-Induced Transit Variations

Determination of an exoplanet’s oblateness would shed light on the planet’s internal structure and formation history. Specifically, it may be possible to empirically constrain the rotation rate, obliquity and J2 moment of an exoplanet from its oblateness. Previous work (e.g. Carter & Winn 2010) has shown, however, that the difference between the light curves of an oblate transiting planet and a spherical one is extremely difficult to detect. Carter and Winn (2010) demonstrate that a more feasible observable is the long-term variation in transit depth introduced by the spin-precession of an oblate planet. This is expected to be of order ~1% of the transit depth. For planets with spin precession periods of ~10 years oblateness induced transit depth variations may be detectable in Kepler photometry. The best candidates are those with (1) short precession periods, (2) tidal spin-down times greater than 1 Gyr, (3) relatively bright host stars, (4) deep transits, and (5) short cadence photometry. We examine a handful of near-Jupiter-sized Kepler planets and planet candidates for evidence of oblateness-induced transit depth variation.