Long-Term Transit Monitoring of WASP-19b: Evidence for Apsidal Precession

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In this study, we analyzed transit timing variations (TTVs) of the ultrashort-period hot Jupiter WASP-19b, a gas giant orbiting a G-type main-sequence star. Our dataset comprises 204 transit light curves from TESS, ETD, and ExoClock, 18 additional public light curves, and 98 mid-transit times from previous studies, covering nearly 14 years. After excluding transits affected by stellar activity (e.g., starspot anomalies), we retained 252 high-quality mid-transit times.

We modeled the timing residuals under an apsidal precession framework, initially suggesting a perturbing companion. However, frequency-domain and sinusoidal analyses favored apsidal precession of WASP-19b's orbit as the dominant mechanism. We also considered alternative explanations, including the Applegate mechanism, linked to stellar magnetic activity, and the Shklovskii effect. Our results support apsidal precession as the primary cause of the observed TTVs, with stellar magnetic activity contributing secondarily.

We conclude that apsidal precession best explains the orbital dynamics of WASP-19b and recommend continued high-precision transit monitoring to refine these constraints.