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Starspots, spin-orbit misalignment, and active latitudes in the HAT-P-11 exoplanetary system

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We present the analysis of 4 months of Kepler photometry of the K4V star HAT-P-11, including 26 transits of its "super-Neptune" planet. The transit data exhibit numerous anomalies that we interpret as passages of the planet over dark starspots. These spot-crossing anomalies preferentially occur at two specific phases of the transit. These phases can be understood as the intersection points between the transit chord and the active latitudes of the host star, where starspots are most abundant. Based on the measured characteristics of spot-crossing anomalies, and previous observations of the Rossiter-McLaughlin effect, we find two solutions for the stellar obliquity (ψ) and active latitude (l): either $\psi = 106$ and $l = 19.7$, or $\psi = 97$ and $l = 67$ (all in degrees). If the active latitude changes with time in analogy with the "butterfly diagram" of the Sun's activity cycle, future observations should reveal changes in the preferred phases of spot-crossing anomalies.

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