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Direct evidence for an evolving dust cloud in the exoplanet KIC 12557548 b

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Abstract

We present simultaneous multi-color optical photometry of the transiting exoplanet KIC 12557548 b which reveals, for the first time, the colour dependence of the transit depth. These depths are consistent with dust extinction as observed in the ISM, but require grain sizes comparable to the largest found in the ISM: 0.25μm - 1μm. This provides direct evidence in favour of the disrupting low-mass rocky planet model for this object. Our light curves also give the the highest-quality coverage of *individual* transits to date. The smooth low amplitude pre-ingress and post-egress features, and the sharp V-shaped transits noted and modelled in the phase-folded *Kepler* data are probably artefacts of averaging many transits of variable shape. Our light curves reveal instead a step-like shoulder in the egress. The transit shape overall is not too different from that caused by a circular disc of occulting material, suggesting that the bulk of the extincting dust is not significantly elongated along the orbital path. The changing wavelength-dependent transit depth offers an unprecedented opportunity to determine the composition of the disintegrating rocky body KIC 12557548 b. We detected 3 out-of-transit u' band events consistent with stellar flares. These could be signatures of star-planet interactions.