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Abstract: J. Li, C. J. Burke, J. M. Jenkins, E. V. Quintana, J. F. Rowe, S. E. Seader, P. Tenenbaum, J. D. Twicken

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We describe transit model fitting performance of the latest release (9.1, July 2013) of the Kepler Science Operations Center (SOC) Pipeline in processing 16 quarters of flight data (Q1-Q16).

The targets for which a Threshold Crossing Event (TCE) is generated in the Transiting Planet Search (TPS) component of the pipeline are subsequently processed in the Data Validation (DV) component. Transit model parameters are fitted in DV to transit-like signatures in the light curves of the targets with TCEs. The transit model fitting results are used in diagnostic tests in DV, which help to validate planet candidates and identify false positive detections. The standard transit model includes five fit parameters: transit epoch time (i.e. central time of first transit), orbital period, impact parameter, ratio of planet radius to star radius and ratio of semi-major axis to star radius.

The performance of the fitter will suffer when there is insufficient information in the light curve to uniquely determine the impact parameter. In such instances the filter showed poor convergence performance. In the latest release of the Kepler SOC pipeline, a reduced parameter fit is included in DV: the impact parameter is set to a fixed value and the four remaining parameters are fitted. The standard transit model fit is implemented after a series of reduced parameter fits in which the impact parameter is varied between 0 and 1. Initial values for the standard transit model fit parameters are determined by the reduced parameter fit with the minimum chi-square metric. With reduced parameter fits, the robustness of the transit model fit is improved significantly. Diagnostic plots of the chi-square metrics and reduced parameter fit results illustrate how the fitted parameters vary as a function of impact parameter. Essentially, a family of transiting planet characteristics is determined in DV for each Pipeline TCE. New model fit diagnostic figures that appear in DV export products are also presented.

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