Name: Martin Still
Email: martin.still@nasa.gov
Institution: BAERI/NASA Ames Research Center

Title: Increasing the sensitivity of the Kepler legacy archive to transiting planets

Type: Poster

Session: Future Exoplanet Telescopes and Instrumentation

Abstract: All legacy light curves archived by the Kepler project are available to the community. They are based upon simple aperture extractions from time-tagged pixel data. We demonstrate that this photometry method works well for the bright end of the Kepler target sample yet there is enormous scope for further gains in sensitivity to planet transits of faint stars in the sample. To this end, all pixel data have been made available in the archive. Methods for the user community to optimize aperture photometry and exploit point spread function modeling are being developed. Exploiting existing Kepler planet candidates, we showcase the signal-to-noise to be gained by these methods. We argue that at the faintest end of the
candidate distribution, optimization provides a factor two improvement in sensitivity to transits, reaching the signal-to-noise promised by the eight year mission, curtailed by reaction wheel failure after four years. These methods can provide potentially significant improvement to a number of facets of the Kepler
mission: 1. Sensitivity to new planet candidates residing currently below the signal-to-noise detection threshold; 2. Characterizing known transit profiles to higher precision; 3. Identifying contamination from nearby sources and removing contamination bias from transit depths; 4. Mitigating focus and pointing systematics within the Kepler data, and 5. Allowing the direct characterization of time-dependent physical and detector biases within the image background. With exisiting focal plane calibrations, the number of targets that currently benefit from optimized photometry is relatively small, limited to sources of magnitude $Kp > 16$. However, with additional refinement of the focal plane calibration, improvement in light curve quality for objects $14 < Kp < 16$ can be anticipated, impacting 50% of the Kepler target sample. These methods are equally applicable to data from the upcoming TESS mission and are potentially a critical
component to the exploitation of a two-wheel Kepler mission currently being developed and tendered.