STATUS OF THE TESS SCIENCE PROCESSING OPERATIONS CENTER

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Abstract

The Transiting Exoplanet Survey Satellite (TESS) science pipeline is being developed by the Science Processing Operations Center (SPOC) at NASA Ames Research Center based on the highly successful *Kepler Mission* science pipeline. Like the *Kepler* pipeline, the TESS science pipeline will provide calibrated pixels, simple and systematic error-corrected aperture photometry, and centroid locations for all 200,000+ target stars, observed over the 2-year mission, along with associated uncertainties. The pixel and light curve products are modeled on the *Kepler* archive products and will be archived to the Mikulski Archive for Space Telescopes (MAST). In addition to the nominal science data, the 30-minute Full Frame Images (FFIs) simultaneously collected by TESS will also be calibrated by the SPOC and archived at MAST.

The TESS pipeline will search through all light curves for evidence of periodic transit signals that occur when a planet crosses the disk of its host star. The Data Validation (DV) pipeline component will generate a suite of diagnostic metrics for each transit-like signature discovered, and extract planetary parameters by fitting a limb-darkened transit model to each potential planetary signature. The results of the transit search will be similar in content to the *Kepler* transit search products (tabulated numerical results, time series products, and pdf reports) all of which will be archived to MAST.

TESS was selected by NASA for launch in 2017 as an Astrophysics Explorer mission.

A one-page summary of transiting planet model fit and diagnostic test results is produced for each planet candidate identified in a TPS/DV pipeline run. The summaries are delivered to MAST along with the full reports where they are accessible by the community at large. The summary above was produced for Kepler-11b with the final version of the SOC codebase, SOC-9.3.

This SPOC pipeline can be run on a local workstation (below) a single workstation or on the NAS Pleiades supercomputer (left). The local cluster can support 1000s of simultaneous tasks while Pleiades can support 10s of 1000s.

Architecture diagram of the TESS Science Processing Operations Center, indicating the 14 major components comprising the TESS science pipeline and photometer management functions.

The SPOC is developing its 2nd software release SPOC2.0 in preparation for Ground Segment integration test 2 (GSIT-2) in Nov 2016. SPOC2.0 will demonstrate the capability to calibrate pixels, measure stellar brightnesses and centroids, identify and correct instrumental effects in the photometry.

The SPOC will process each 13.7-day orbit as the data arrive at the sector level, prior to a data review and delivery to the TESS Science Office (TSO) for all targets currently being observed and send the results to the POC for delivery to the MAST archive. The SPOC will then conduct a final search for transiting planets over the data to all targets currently being observed and send the results to the POC for delivery to the MAST archive and the TESS Science Office and the MAST archive.

The TESS ground segment is composed of the Science Processing Operations Center, NASA Ames Research Center, the Payload Operations Center at MIT, the Mikulski Archive for Space Telescopes at STScI, the TESS Science Office in Cambridge MA, the Navigation and Ancillary Information Facility at JPL, the Flight Dynamics Facility at GSFC, and the Deep Space Network. This system manages the TESS science instrument to collect the data and all the information necessary to carry out TESS's main objective: searching for Earth's nearest cousins. This diagram illustrates the flow of information and data across the system.

http://tess.gsfc.nasa.gov/