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# EXOPLANETSAT: HIGH PRECISION PHOTOMETRY FOR EXOPLANET TRANSIT DETECTION IN A 3U CUBESAT

**Abstract**

ExoplanetSat is a 3U CubeSat which will detect transiting "super-Earth" exoplanets around bright, nearby stars. The ExoplanetSat prototype, described in this paper, will focus on small planets discovered by radial velocity surveys but which are not yet known to transit. No other current ground or space-based mission is capable of observing these systems over long time periods with the required photometric precision to detect small planet transits. Eventually, many copies of the ExoplanetSat prototype will be launched to survey the brightest Sun-like stars in the sky for small, long-period planets like Earth.

ExoplanetSat will observe 55 Cancri e, a 2 Earth-radius transiting planet with an 18 hour period, as its validation case. Photometry with 40 part-per-million (ppm) precision is required to detect the 55 Cancri e transit with 7-sigma certainty. ExoplanetSat will achieve this goal through a novel two-stage pointing system capable of 20 arcsecond pointing. The system consists of a traditional reaction wheel and torque coil unit from MAI which provides coarse pointing to 120 arcseconds and a fine pointing piezoelectric stage which adjusts position of the focal plane to compensate for pointing drift. Such fine pointing is required to control the location of the star spot centroid on the detector to the same fraction of a pixel over many minutes to reduce noise from interpixel and intrapixel sensitivity variations. ExoplanetSat employs a hybrid focal plane composed of two CMOS detectors to perform three critical tasks: precision photometry for scientific measurements, "lost in space" attitude determination based on star patterns, and fine attitude control through rapid star centroid tracking. ExoplanetSat has been awarded a launch through NASA's ELaNa program in late 2013 – early 2014.

This paper will describe ExoplanetSat's scientific mission, target selection, and the engineering innovations required to meet the science goals of the mission, particularly in the optical payload and the ADCS system.