SYSTEM ENGINEERING FOR THE *KEPLER MISSION*: A SEARCH FOR TERRESTRIAL PLANETS

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ABSTRACT:

The *Kepler mission* will launch in 2007 and determine the distribution of earth-size planets (0.5 to 10 earth masses) in the habitable zones (HZs) of solar-like stars. The mission will monitor > 100,000 dwarf stars simultaneously for at least 4 years. Precision (10 parts per million) differential photometry will be used to detect the periodic signals of transiting planets. The mission will be capable of not only detecting Earth analogs, but a wide range of planetary types and characteristics ranging from Mercury-size objects with orbital periods of days to gas-giants in decade long orbits that have undeniable signatures even with only one transit detected. *Kepler* will also support asteroseismology by measuring the pressure-mode oscillations of selected stars. Key mission elements include a spacecraft bus and 0.95meter, wide-field, CCD-based photometer injected into an earth-trailing heliocentric orbit by a 3-stage Delta II launch vehicle as well as a distributed Ground Segment and Follow-up Observing Program.

In order to meet the unprecedented photometric precision requirement and to ensure a statistically significant result, the *Kepler mission* involves technical challenges such as noise and systematic error reduction, stability, mission-life, and false-positive rejection. Programmatic and logistical challenges include the collaborative design, integration, test, and operation of a geographically and functionally distributed project (7 primary mission partners). The project is currently preparing for Preliminary Design Review (October 2004) and is proceeding with detailed design and procurement of long-lead items such as the large optics, CCDs, and telecom hardware. The rigor and comprehensive nature of the *Kepler* system engineering program was recently lauded by external review boards. This paper provides an overview of this system engineering program, highlighting such processes as: requirements synthesis, end-to-end performance modeling, validation & verification, trade-study management, mission fault tree analysis, and end-to-end information system design and test. Each of these processes are applicable and readily adaptable to other complex astronomy missions.

KEYWORDS: SYSTEM ENGINEERING, TRANSIT PHOTOMETRY, EXTRASOLAR PLANETS, SPACE ASTRONOMY