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TESS in the Extended Mission: A Powerful Tool for Time-Domain Exoplanet Science

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Since its launch in 2018, the Transiting Exoplanet Survey Satellite (TESS) has embarked on an ambitious mission to image almost the entire sky in search of nearby transiting exoplanet systems. Upon completion of its Primary Mission in July 2020, TESS transitioned to its first Extended Mission, during which it has returned to both the southern and northern ecliptic hemispheres and revisited most of the targets it observed during the first two years of operation. With future Extended Missions likely, the end-to-end time baseline provided by TESS will significantly exceed that of Kepler, enabling a plethora of scientific investigations into time-domain exoplanet science. TESS has already established itself as an extremely productive tool for studying visible-wavelength exoplanet phase curves. During the Primary Mission, we carried out a systematic phase-curve analysis of more than 30 transiting exoplanet systems. These datasets constrained the dayside hemisphere brightness temperatures, day-night brightness contrasts, and optical geometric albedos of a wide range of gas giant planets, revealing some tantalizing trends that warrant further study. In particular, we uncovered a tentative positive correlation between geometric albedo and equilibrium temperature for gas giants with $1500 < T_{\text{eq}} < 3000$ K. The new light curves from the Extended Mission have refined the measured astrophysical parameters of the previously studied systems and yielded statistically significant secondary eclipse and phase-curve detections for dozens of more systems. By comparing the phase-curve properties obtained from TESS observations separated by months or years, we have also probed for possible atmospheric variability, as well as transit-timing variations due to orbital decay or additional companions. In this presentation, I will provide an overview of the main results from our ongoing multiyear study of TESS light curves and discuss potentially fruitful avenues for further research as TESS continues its all-sky survey into the future.