TESS Follow-up Observation with IRSF/SIRIUS

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We observed planetary candidates from Transiting Exoplanet Survey Satellite (**TESS**) with **1.4m telescope IRSF** in South Africa, as part of TESS Follow-Up Observing Program (**TFOP**).
Though it is predicted that TESS will find several thousands of exoplanet candidates, a large part of them will be **false positives produced by eclipsing binaries**[1]. In order to distinguish them, follow-up observations from ground-based telescopes are important. IRSF and its simultaneous-3 color infrared imager SIRIUS is suitable for follow-up observation.
Compared to TESS, IRSF/SIRIUS has **higher angular resolution**(0.453arcsec/pix), and it enables us to derive each stars' light curve inside TESS aperture and identify the culprit of brightness variability. Also its **simultaneous photometry in J, H, Ks band** is useful to clarify wavelength dependence of transit depth and then distinguish blended binaries from transiting planets. However, because IRSF/SIRIUS is not originally designed for transit observations, it required a new pipeline to convert raw images into the data and figures for transit analysis.
Our new pipeline can take photometry of all detectable stars inside the field of view, and create each light curve in simple process. It also calculates the separation and the magnitude difference between each stars, and they are useful to eliminate diluted eclipsing binaries. Besides, it can calculate the correlation between brightness variability and the effects from instrument, and fit light curves with a simple linear model of such systematics. The pipeline made us able to submit the observational results to TFOP team within a few days.
The observations were conducted from October to November in 2018. 45 transits of 35 candidates were observed. We reported our results to TFOP team on 8 exoplanets, TOI 125, TOI 142, TOI 157, TOI 174, TOI 178, TOI 179, TOI 193 and TOI212. Our contribution was useful to detect exoplanets and to eliminate eclipsing binaries.
Above all, for **TOI 125**, our observation contributed a lot to eliminate diluted eclipsing binaries. TFOP team detected that TOI 125 is a K dwarf with 2 confirmed sub-Neptune sized planets(2.76R_E, 2.79R_E) and 3 planetary candidates. The ratio of orbital periods between planet c and b is slightly smaller than an 2:1 commensurability, and it makes this system dynamically interesting.
In our poster, we will introduce the details of our pipeline and several observational results.
[1] Sullivan et al.(2015), ApJ, 809, 77

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