Python Pipeline to Simultaneously Extract Exoplanet and Variable Star Data From TESS Ground-Based Follow-up Observations

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Summary

We have been developing software using Python to produce the data products needed for a TFOP submission. A recent addition to that pipeline generates photometry for stars in the field that are in VSX. To create a submission for TESS, we must be able to produce the following:

Photometry measurement table	In Progress
Field image with apertures	Figure 1
Light curve plot with configuration file	In Progress – Figure 2
Seeing profile	Figure 3
Zoomed in field of view	Figure 4
Photometry aperture file	Complete
Plate solved image	Complete
Dmag vs RMS plot & NEB Table and depth plot files	Plans for future
Magnitude of variable stars	Figure 5

Figure 1
This is the field of the Kelt 16; this is an exoplanet but not a TESS target. Green circles are Gaia sources near the TESS 'target', blue circles are comparison stars from APASS that match the TESS criteria for comparison stars, red stars are VSX [1]. These apertures were made by the software written as part of this project using queries to APASS, VSX and TESS.

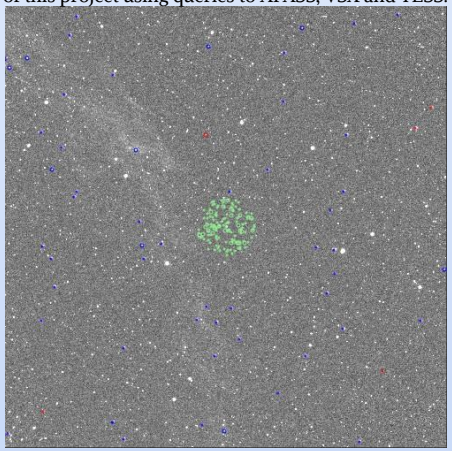
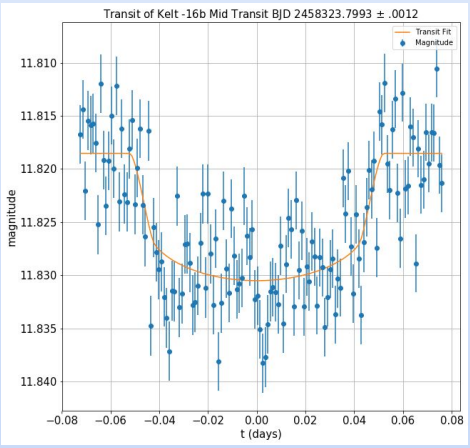


Figure 2
Light curve of Kelt 16b from June 23rd, 2018 with midpoint centered at 0, with atmospheric trends removed. This differential photometry is completed using magnitudes as opposed to the flux ratios required for a TESS submission.



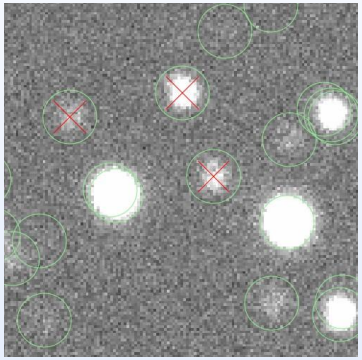


Figure 4
Zoomed in field of view of Kelt 16, showing interactive feature to cross out stars that are unwanted in photometry calculations. 'X's can be added or removed to include or exclude stars from the table of comparisons.

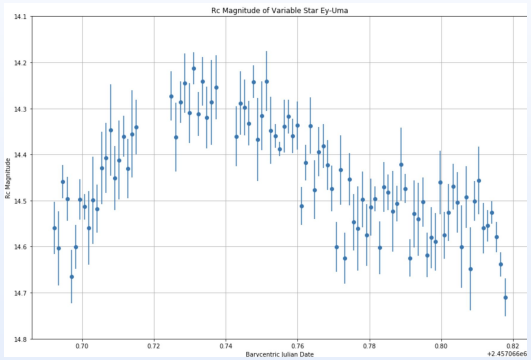


Figure 5
Light curve from variable star EY Uma from December 29th, 2014. The magnitudes calculated with methods from the AAVSO CCD Observing Guide [3]. Comparison stars' magnitudes are those from the AAVSO Variable Star Plotter.

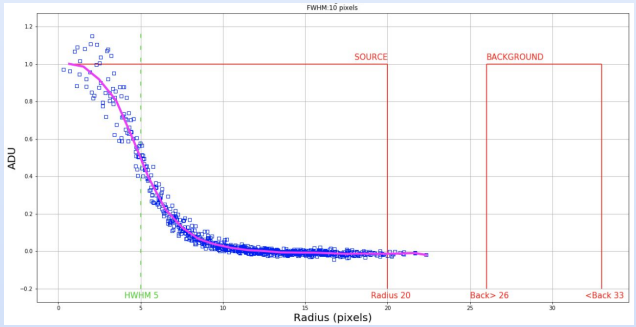


Figure 3
A Python-generated seeing profile for Kelt-16 from June 23rd, 2018 with a FWHM of 9 pixels. The appearance is purposefully similar to that of AstroImageJ [2].

SCAN ME

Link to Github repository with a copy of the poster and all the software used.

References

[1] AAVSO Variable Star Plotter
[2] Collins, K., et al. AstroImagej: Image Processing And Photometric Extraction For Ultra-Precise Astronomical Light Curves, AJ **153** (2017).
[3] AAVSO CCD Observing Guide v1.1 (2015).
[4] Robitaille, T., et al. Astropy: A Community Python Package for Astronomy (2013).
[5] Conti, D., TFOP SG1 Observation Guidelines (2019). Please see Github repository for more details.

Acknowledgements

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astropy-powered
astropy.org