**STOKED* with TESS: WASP-77A b**

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*STudy Of Known Exoplanet re-Discoveries

**Introduction**

Atmospheric characterization is a major goal of exoplanet research. Promising targets for future observations with the James Webb Space Telescope (JWST) can be selected using the Emission Spectroscopy Metric (ESM):

$$ESM = \frac{B_\lambda(T_{eq})}{B_\lambda(T_\star)} \times \left(\frac{R_p}{R_\star}\right)^2 \times 10^{-m_{g}/5}$$

Here, we focus on updating the period and epoch of WASP-77A b in order to predict ideal JWST observation times for atmospheric characterization.

![Figure 1: Known exoplanets observed by TESS in year 1 graphed for planet equilibrium temperature vs. stellar effective temperature, with the top 10 ESM targets labeled in blue.](image)

**Methodology**

We utilize the software package *allesfitter* (Günther & Daylan 2019) in order to fit an appropriate planetary model to all the gathered data for WASP-77Ab. This includes photometric data from WASP-South, EulerCAM, TRAPPIST, Kuiper, and TESS, along with RV data from CORALIE and HARPS⁵,⁸,⁹. We run fits for each instrument individually first to determine the red (systematic) noise, then fit for all astrophysical parameters at once.

![Figure 3: Model fit to the photometric data from TESS.](image)

**Results and Discussion**

We show that TESS data is essential when establishing specific windows for JWST observations in the years following its launch (Figure 5). The decreased error for period (Table 1) is particularly crucial, as this error compounds over time when attempting to predict transits. We are still investigating the increased error in epoch for causes such as transit timing variations (TTVs) or orbital decay. We have also begun fitting models for WASP-18 b and WASP-43 b, and will continue with the other top ESM targets.

![Figure 4: Model fit to the RV data from HARPS.](image)

![Figure 5: Transit timing uncertainty in 2023 without TESS (left) and with TESS (right), showing how TESS significantly decreases uncertainty.](image)

**Key Ideas**

By using TESS data in addition to previous observations, we greatly decrease uncertainty for the period of WASP-77A b. This will be helpful when selecting observation times for atmospheric characterization with JWST. We aim to apply the same methods for other planets that are likely to have characterizable atmospheres.

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Table 1: Preliminary findings for astrophysical parameters of WASP-77A b with (left) and without (right) TESS data. Dilution from WASP-77B needs to be readjusted before final conclusions are drawn.

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⁷Kempton et al., 2018, ascl:1903.003, ⁸Maxted et al., 2013, ⁹Turner et al., 2016