# Orbital Decay Potentials of Selected Hot-Jupiters

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## ABSTRACT

We investigate signs of orbital decay in the orbits of selected hot Jupiters by studying their TTVs and the effects of dynamical tides on their orbital evolution through inertial and internal gravity waves inside their host stars. We present TTV analyses of a few systems selected according to their potential to display TTVs of a tidal origin based on their orbital and physical characteristics within this contribution. We also discuss the implications of our results for constraining the tidal theory.

## TARGET SELECTION

We selected the systems that are good candidates to display orbital decay based on the masses of both the planet and its host star, and the planetary orbital parameters based on two unitless metrics (Siverd et al. 2012, Baştürk et al. 2022). These two metrics are correlated with the exponential folding timescale ($\tau_a$) and spin-orbit synchronization timescale ($\tau_\omega$) are defined below in Eq-1. They are plotted with respect to the orbital period for planets with masses larger than 1 $M_{jup}$ and orbital periods below $P_{orb}$ < 4 days on the panels of Fig. 1.

$$\tau_a \equiv \left(\frac{M_*}{M_p}\right)\left(\frac{a}{R_*}\right)^5 \qquad \tau_\omega \equiv \left(\frac{M_*}{M_p}\right)^2\left(\frac{a}{R_*}\right)^3$$

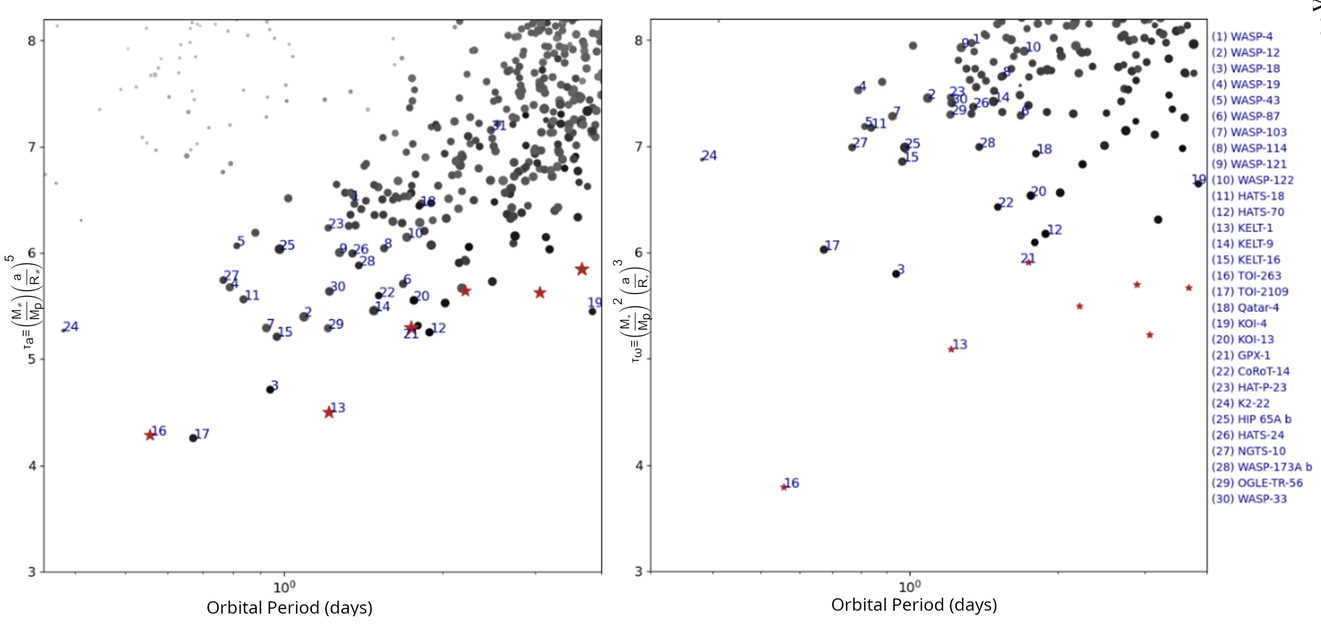
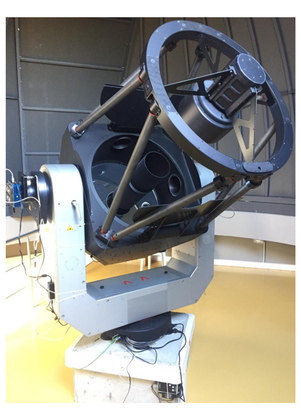



Figure 1. Targeted hot-Jupiters on orbital period-unitless metric planes

## OBSERVATIONAL DATA

We collected all transit light curves from the literature that we accessed either through personal communication or through CDS VizieR. We made use of the transit observations of amateur or professional astronomers submitted to the Exoplanet Transit Database (ETD). We downloaded Kepler and TESS light curves from the STScI MAST portal. We observed transits of our targets with the 80 cm telescope T80 in Ankara University Kreiken Observatory (AUKR) and 100 cm T100 telescope in Bakırlıtepe Campus of the National Observatories of Turkey.



AUKR T80



TUG T100




## TRANSIT MODELLING

We model the transit light curves with the web-version of the EXOFAST modelling suite (Eastmann et al. 2013) based on the system parameters compiled from the NASA Exoplanet Archive for homogeneity in our analyses. The mid-transit times and their associated uncertainties are derived from EXOFAST models (Fig. 2).

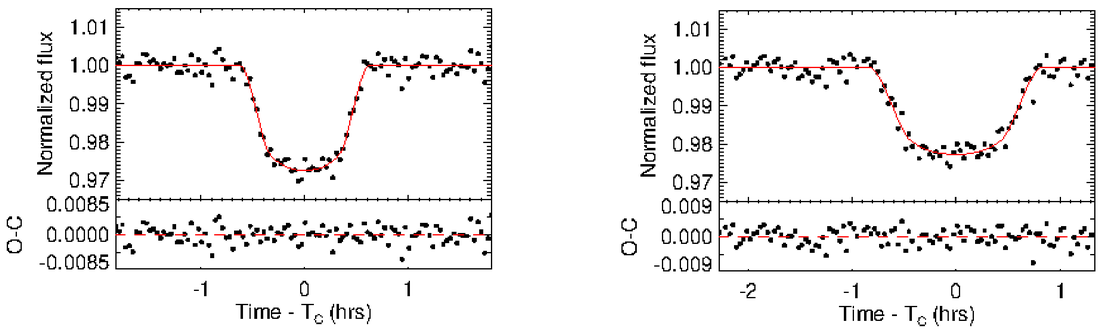
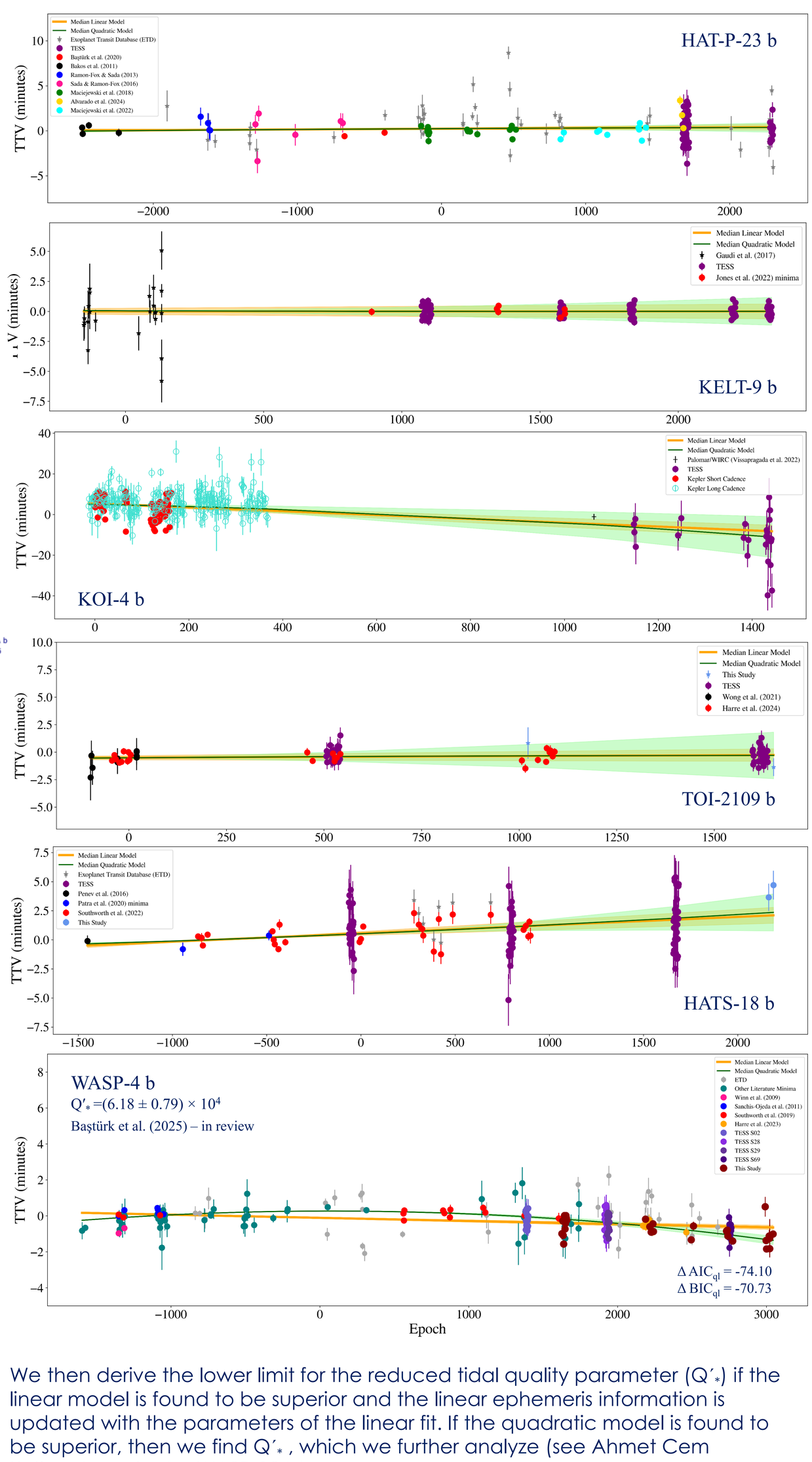



Figure 2. EXOFAST models of the transit light curves of WASP-43b (TESS, left) and Qatar-1b (T100, right)

## TRANSIT TIMING VARIATION (TTV) DIAGRAMS

With measurements of the mid-transit times from our light curve models, we construct the so-called TTV diagrams based on the linear ephemeris information from the literature. We model the TTV diagrams with two basic models (linear: orange in the figures below and quadratic: pale green for selected systems given below) in a probabilistic fitting scheme. We then compare these two models based on goodness-fit-statistics such as $\chi^2_v$ , AIC, and BIC.




We then derive the lower limit for the reduced tidal quality parameter ($Q'_*$) if the linear model is found to be superior and the linear ephemeris information is updated with the parameters of the linear fit. If the quadratic model is found to be superior, then we find $Q'_*$ , which we further analyze (see Ahmet Cem Kutluay's poster for WASP-12 b).

## AFFILIATIONS

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