

A Circumbinary Planet Transiting A Pair of Active, Rotating Stars

Sean Mills

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Now at Caltech!

Come talk to me about transits, dynamics,
statistics, etc.

KIC 107 Binary Properties

Period = 19.4 days

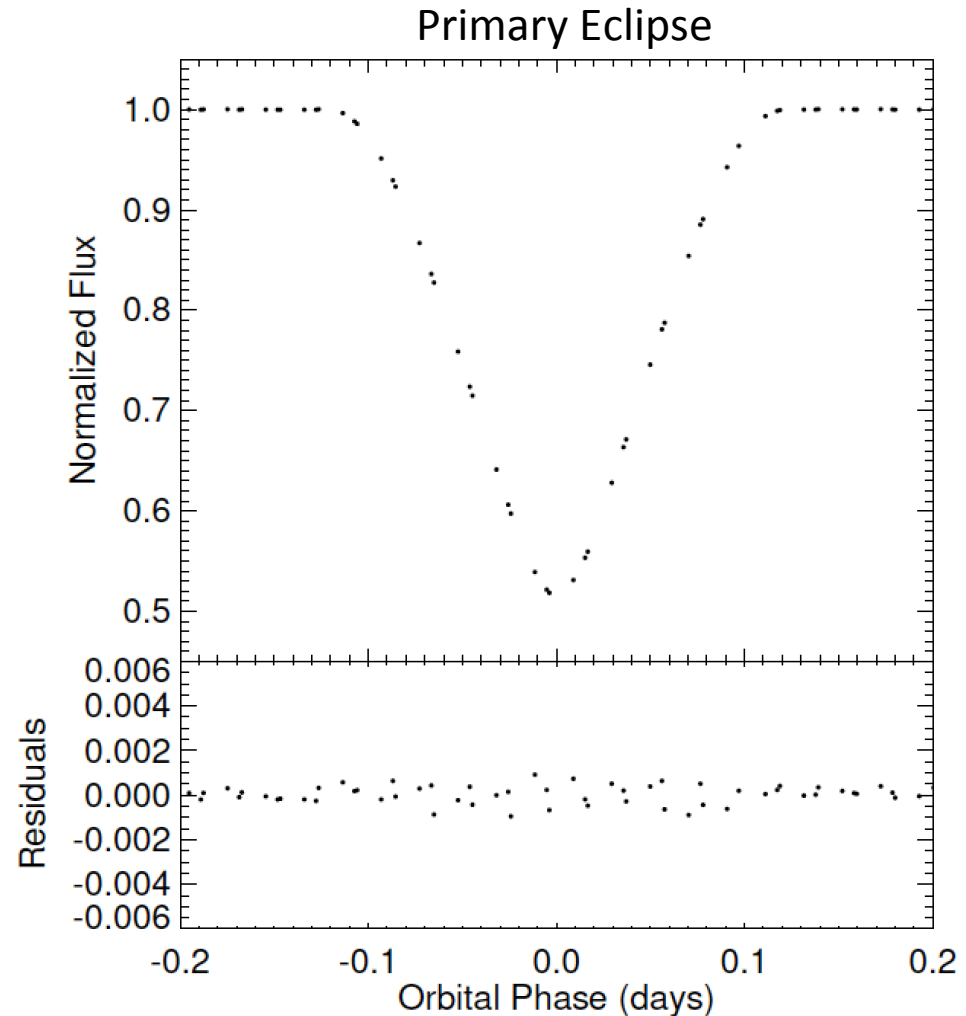
$e = 0.52$

$M_A = 1.05 \pm 0.02 M_{\text{sun}}$

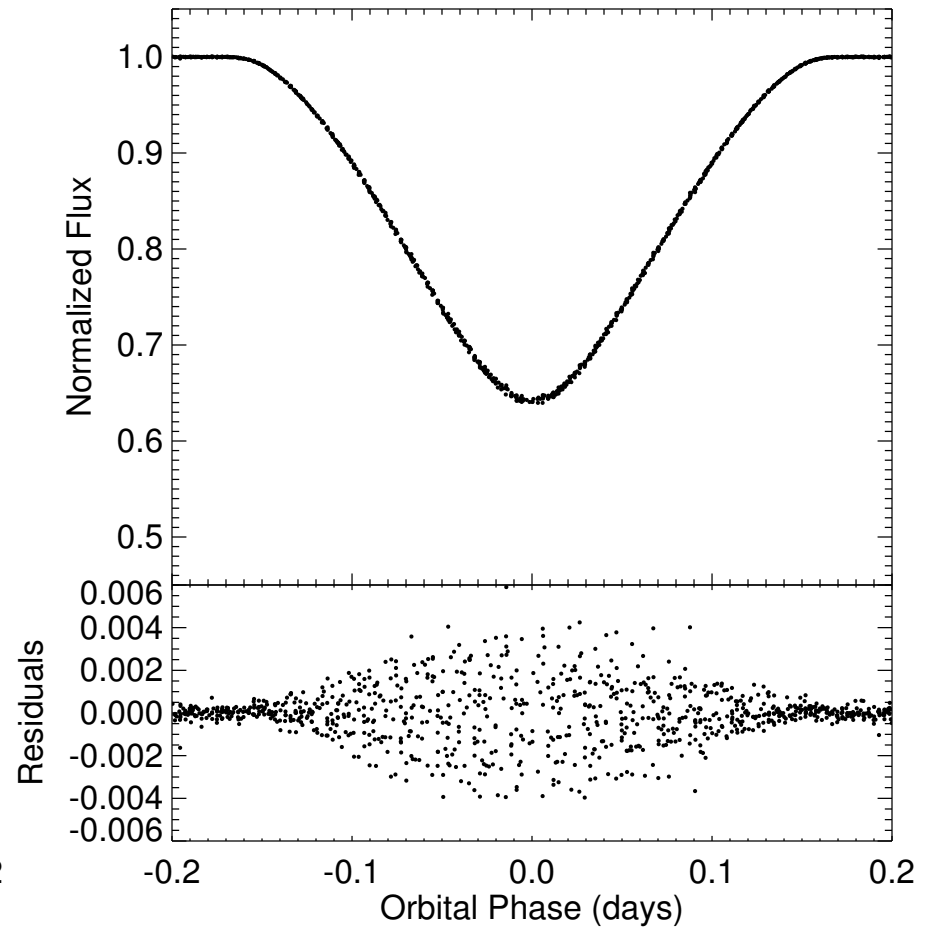
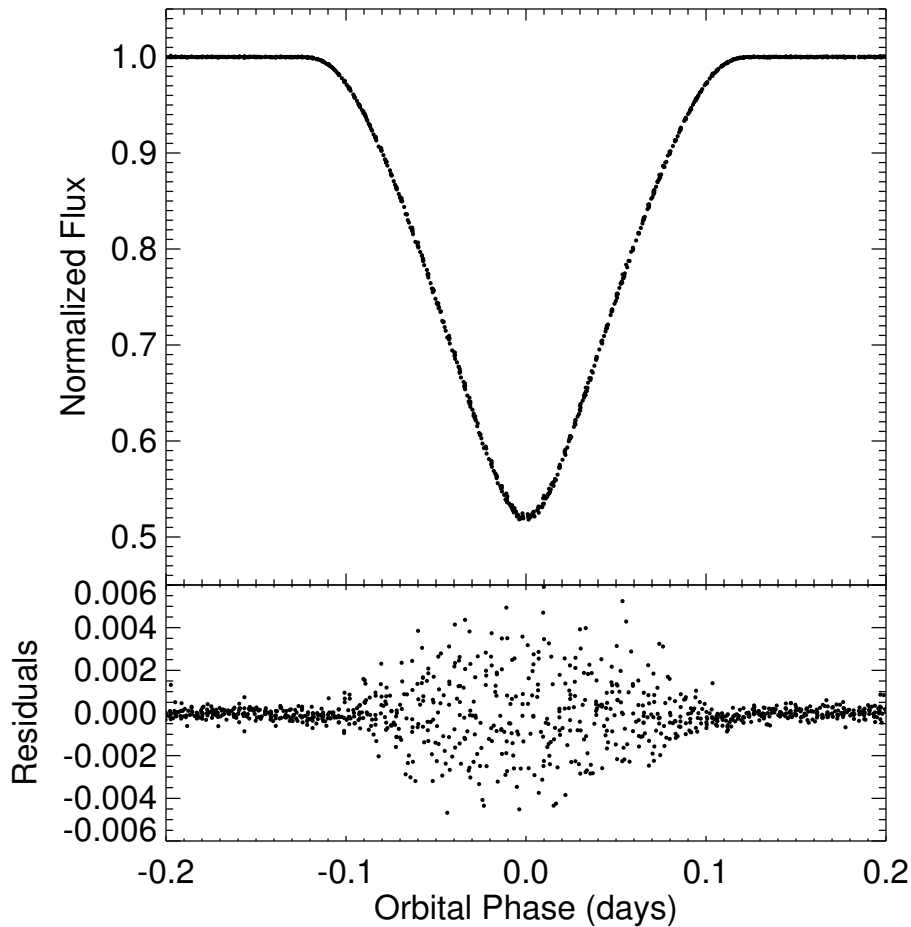
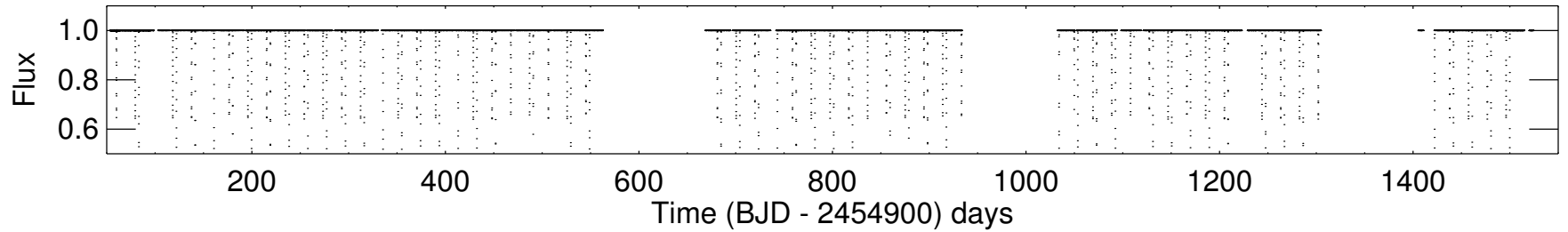
$R_A = 1.06 \pm 0.01 R_{\text{sun}}$

$M_B = 0.94 \pm 0.01 M_{\text{sun}}$

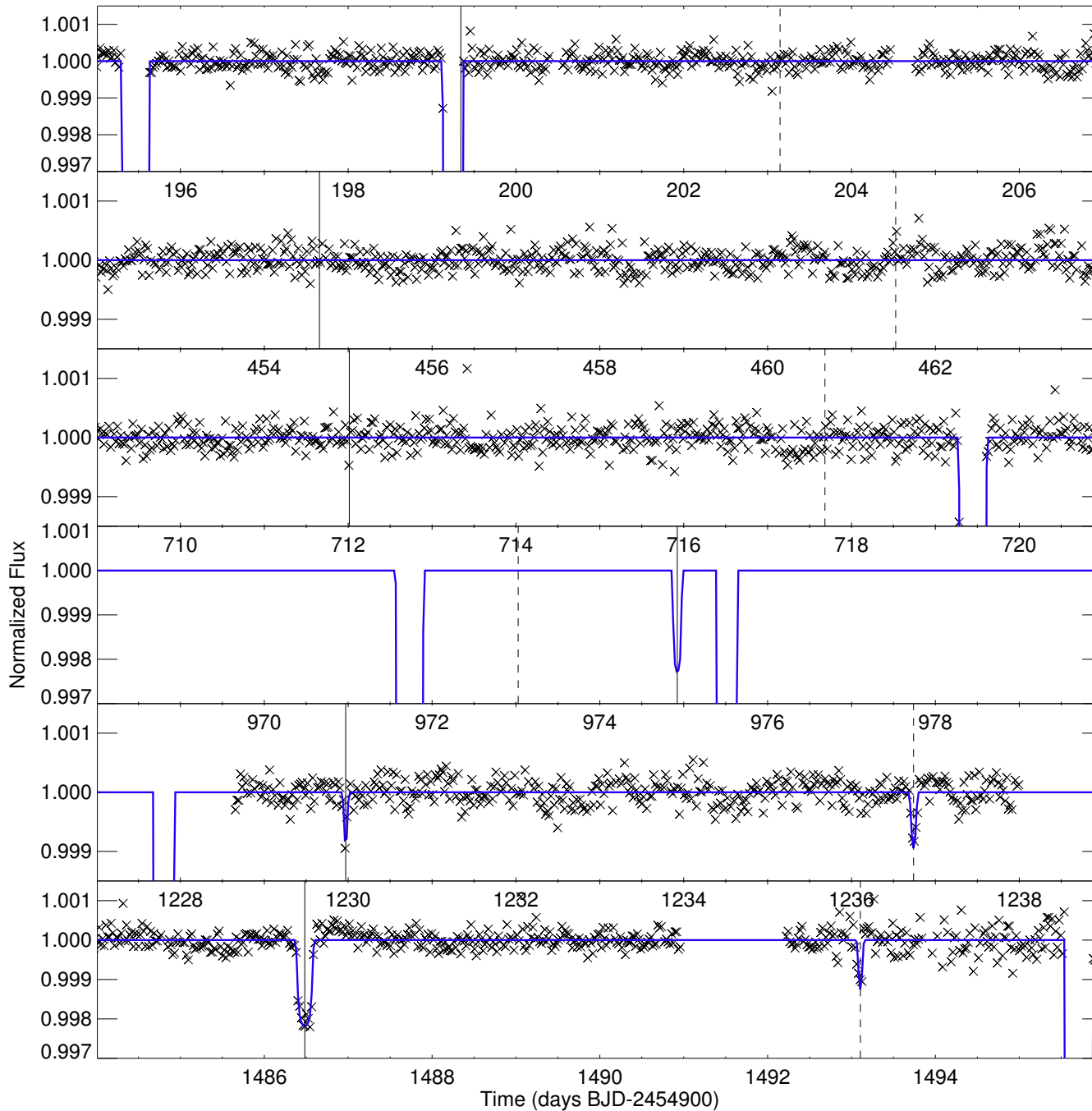
$R_B = 0.90 \pm 0.01 R_{\text{sun}}$



Binary Properties



Planet Transits



Period = 254 days

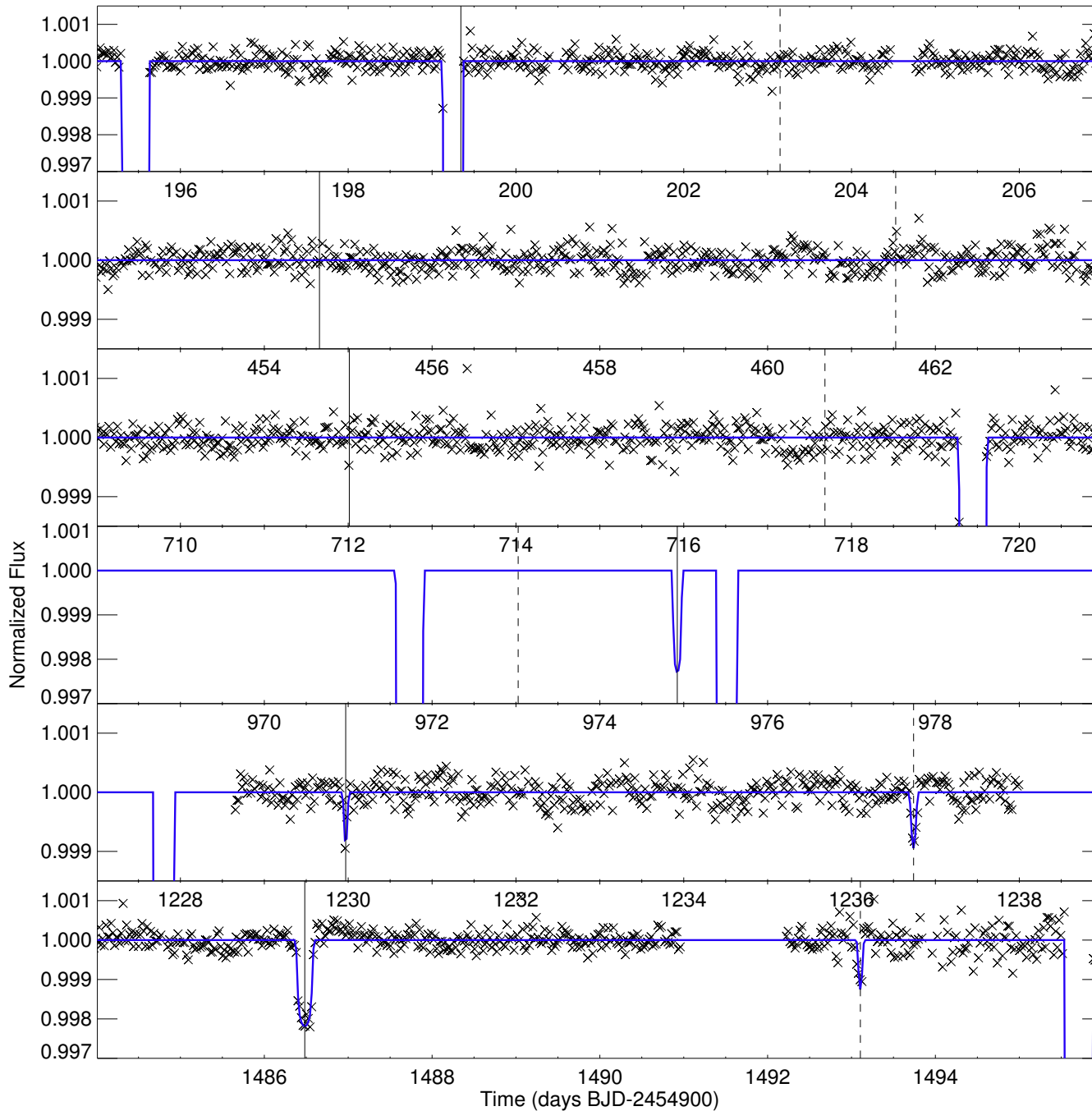
$P/P_{\text{crit}} = 1.8$

$e = 0.27$

$R_p = 0.61 \pm 0.01 R_{\text{Jup}}$

$\Delta I = 2.56 \pm 0.02^\circ$

Planet Transits



Period = 254 days

$P/P_{\text{crit}} = 1.8$

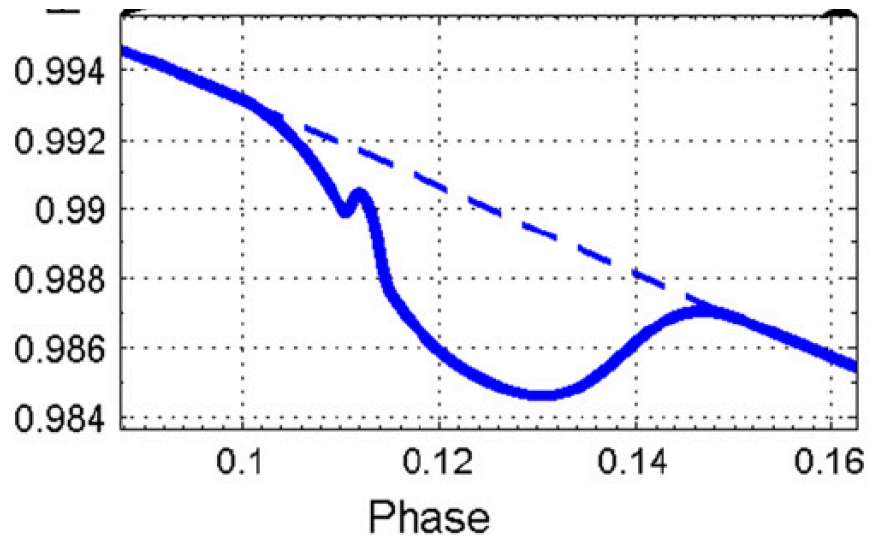
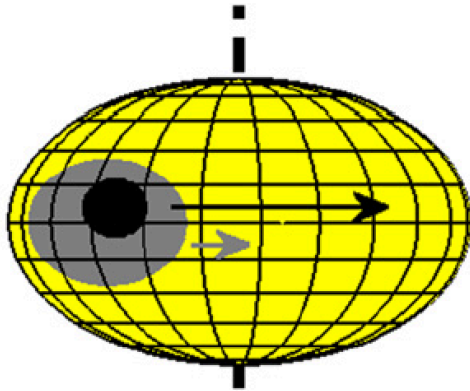
$e = 0.27$

$R_p = 0.61 \pm 0.01 R_{\text{Jup}}$

$\Delta I = 2.56 \pm 0.02^\circ$

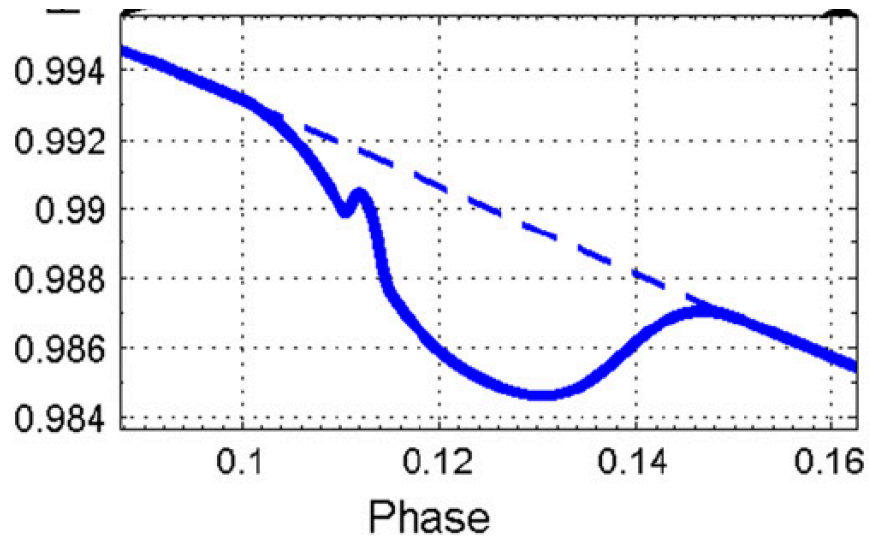
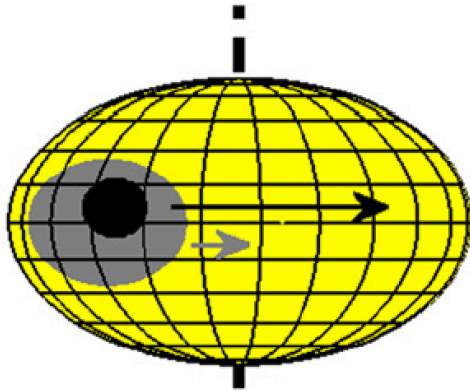
$M_p = ?? M_{\text{jup}}$

Accounting For Starspots

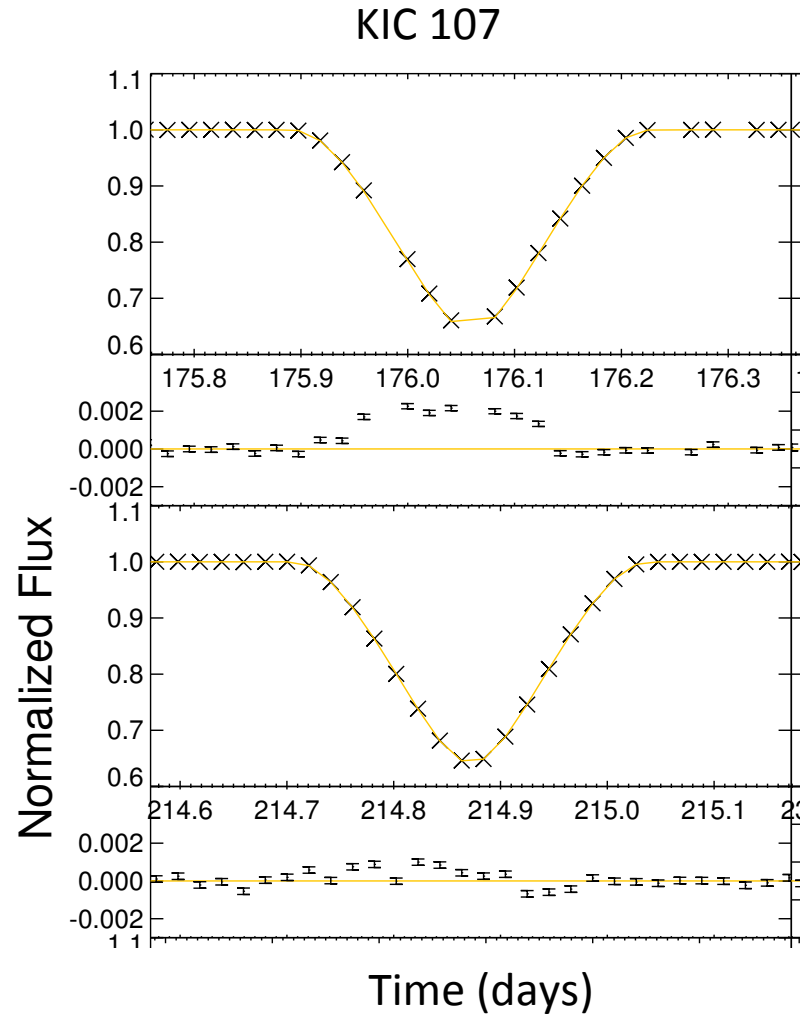


Mazeh, Holczer & Shporer 2015

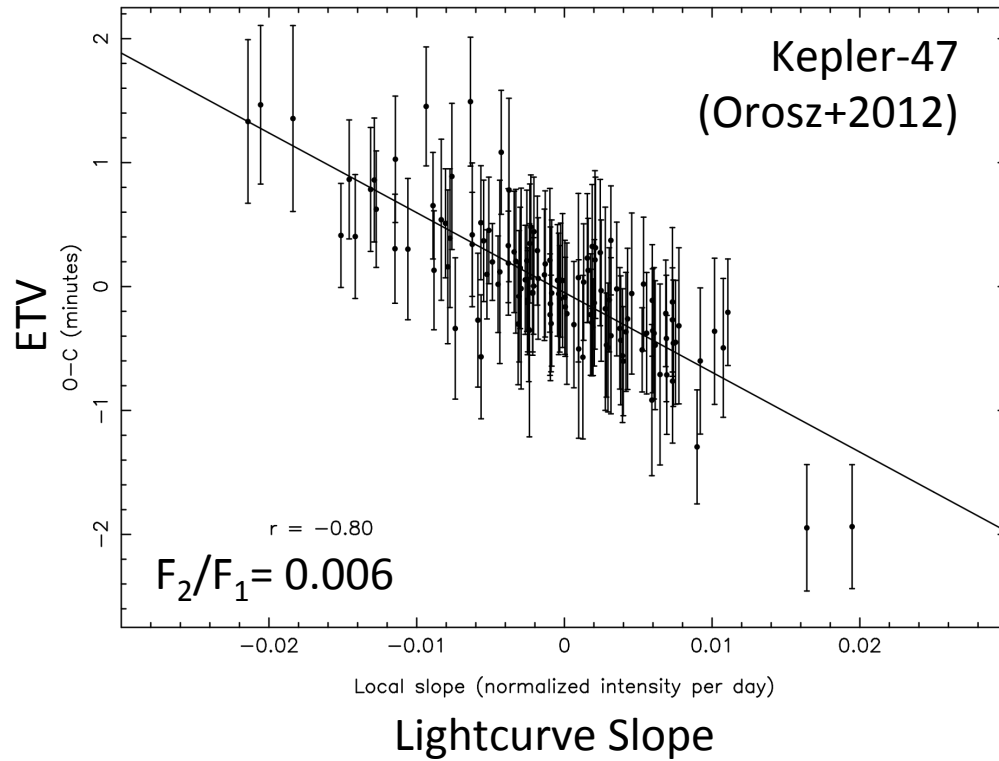
Accounting For Starspots



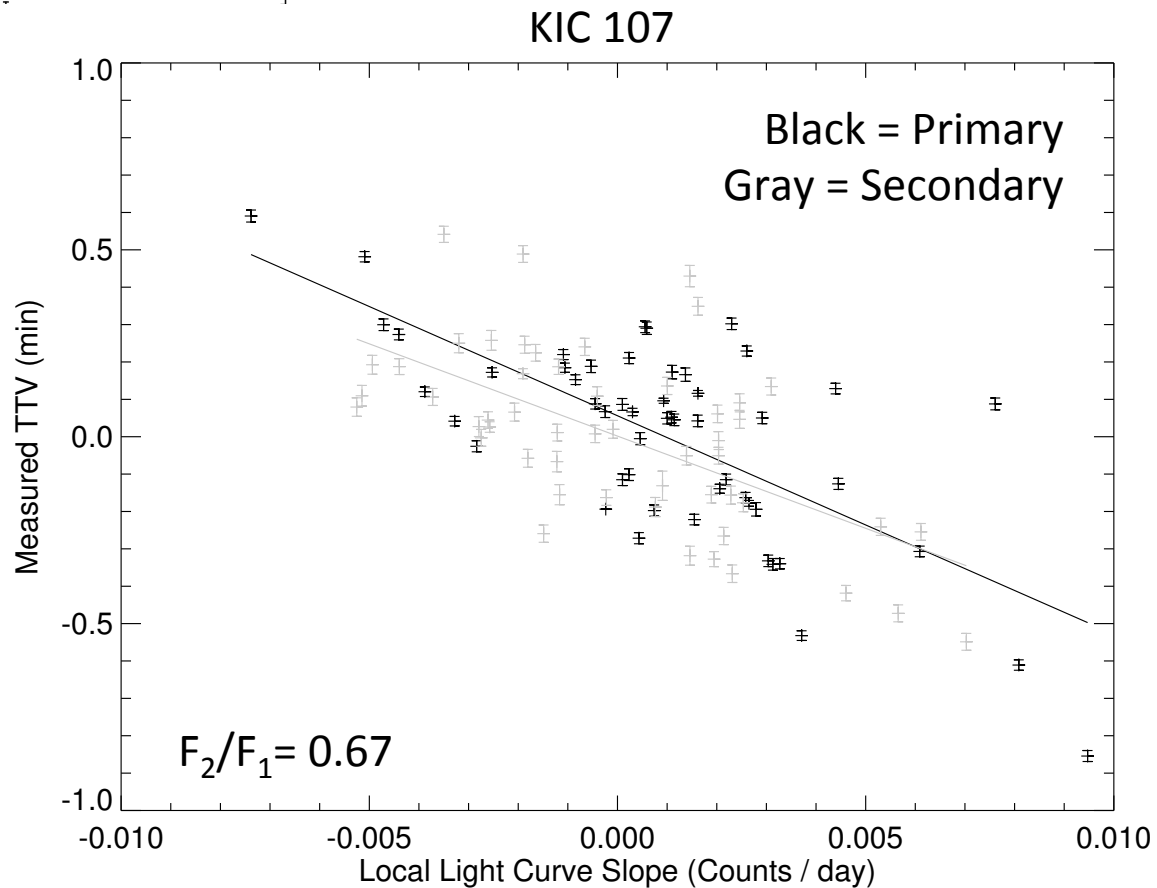
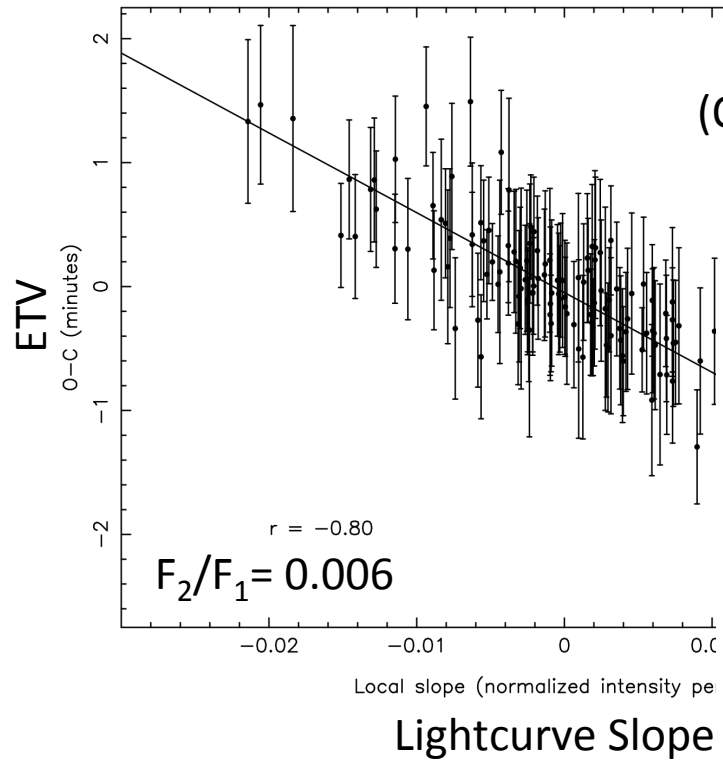
Mazeh, Holczer & Shporer 2015



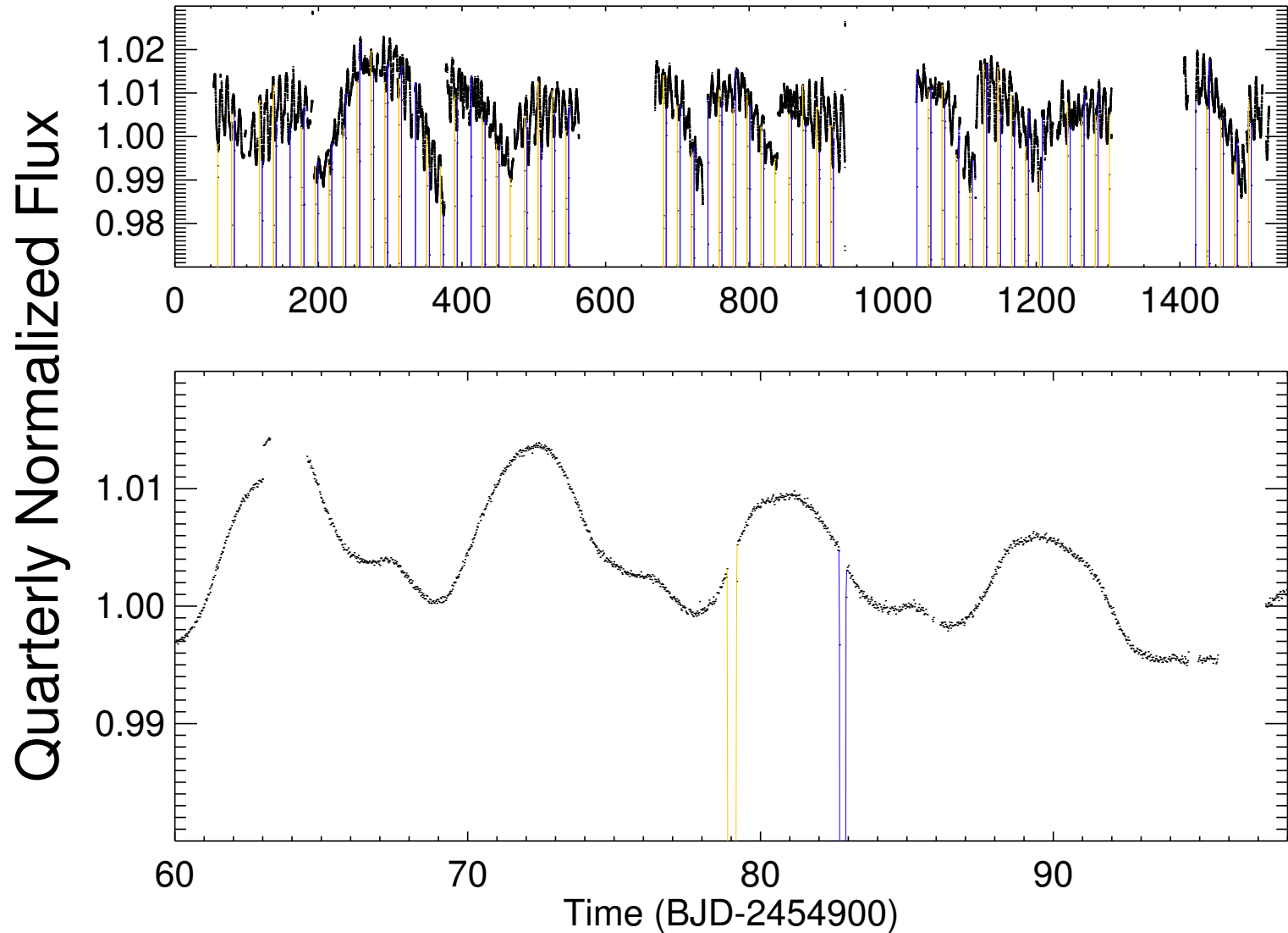
Modeling Eclipse Times w/ Starspots



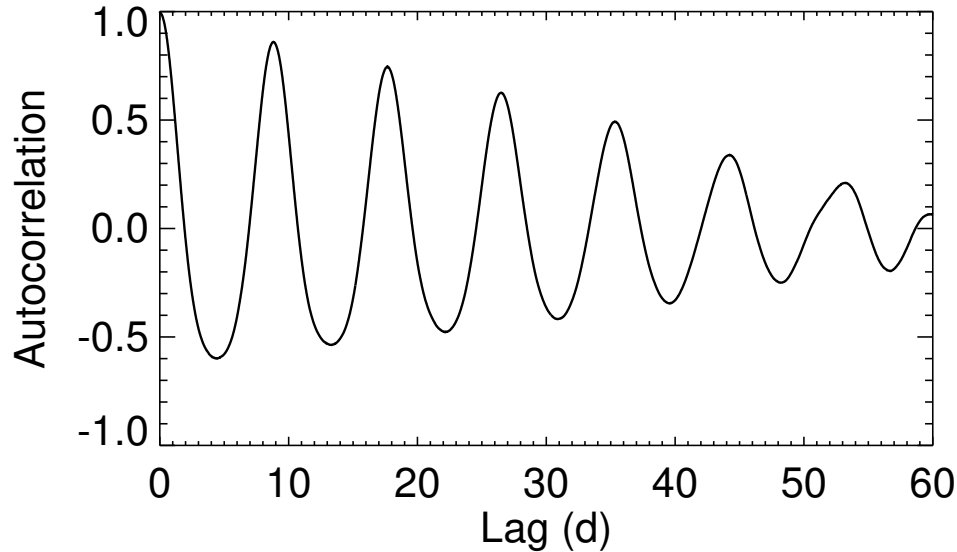
Modeling Eclipse Times w/ Starspots



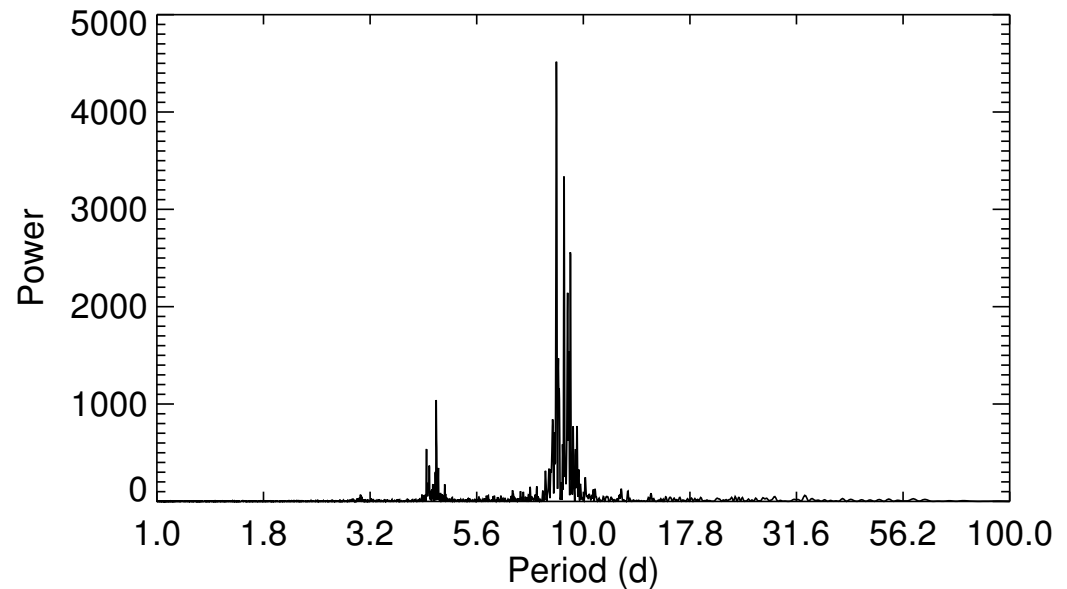
Both Stars Show Rotation and Activity



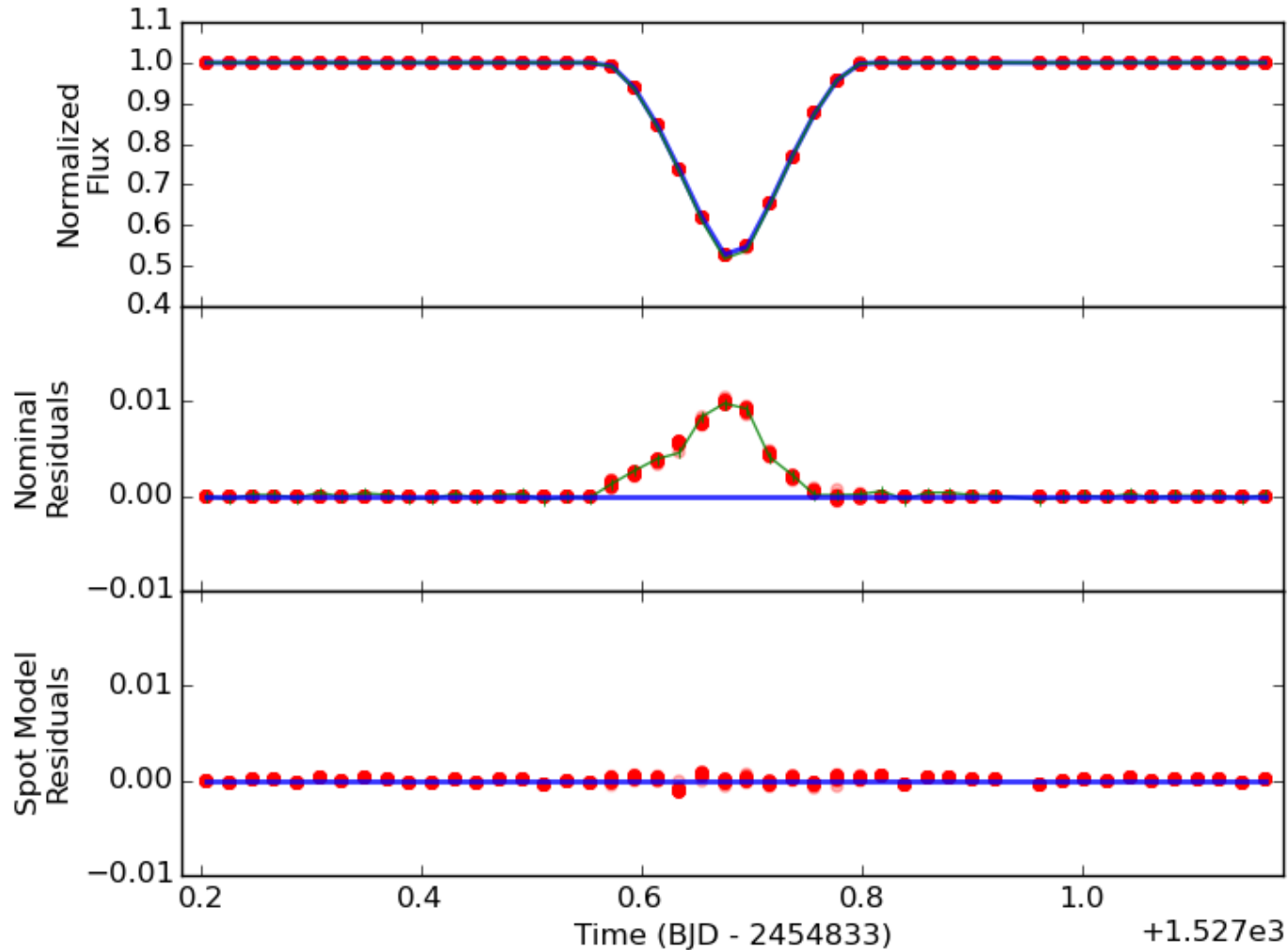
Both Stars Show Rotation and Activity



$P_{\text{rot}} = 8.7$ days
 $\neq P_{\text{ps}} = 6.1$ days
 $\neq P_{\text{bin}} = 19.4$ days

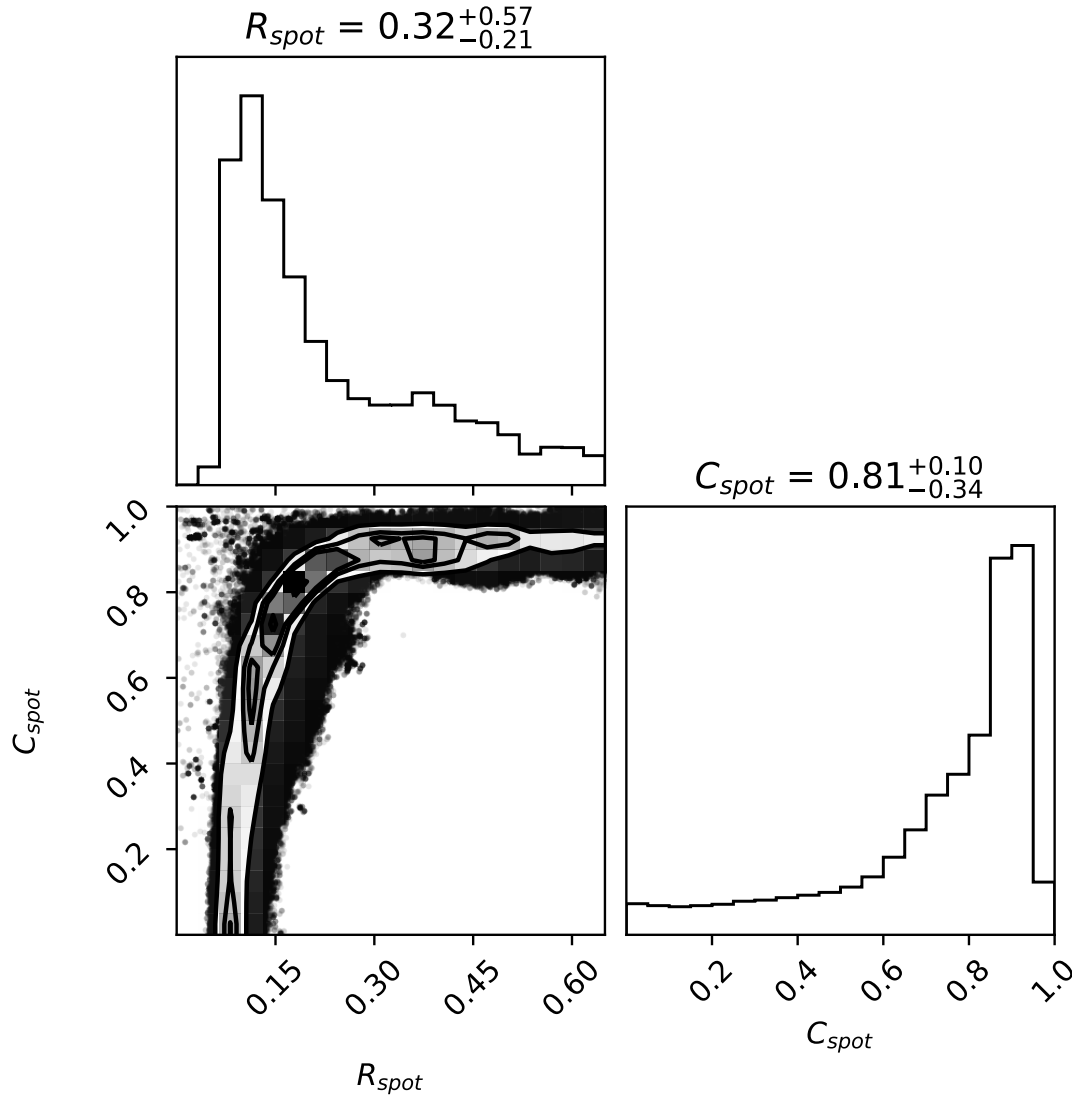


Modeling Eclipse Times w/ Starspots



Based on "spotrod" (Beky, Kipping & Holman 2014)

Modeling Eclipse Times w/ Starspots



Planet

Period = 254 days

$P/P_{crit} = 1.8$

$e = 0.27$

$R_p = 0.61 \pm 0.01 R_{Jup}$

$\Delta I = 2.56 \pm 0.02^\circ$

$M_p = 0.2 \pm 0.7 M_{jup}$

Summary

- CBP dynamics yields percent-level uncertainties of stellar M , R , orbital parameters
- Learn about stellar rotation and spots
- Spot marginalization results in accurate characterization of planetary properties
- Can apply technique to future datasets (e.g. PLATO)

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