

Spin-Orbit Precession of the Hot Jupiter *Kepler-13Ab*

Miranda Herman¹

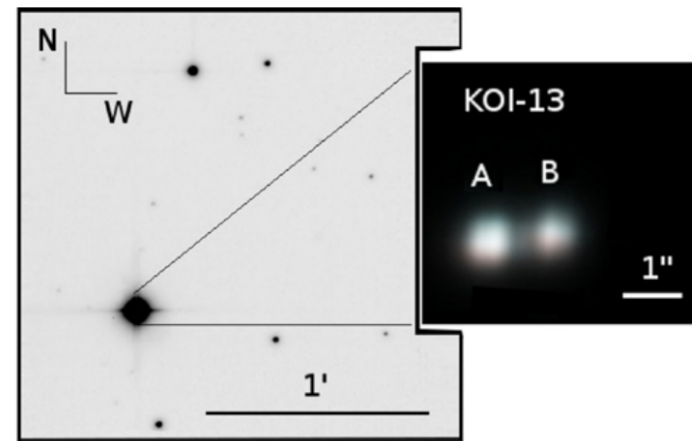
with Ray Jayawardhana^{1,2}, Ernst de Mooij³, & Chelsea Huang⁴

ERES III Conference

13 June 2017

Kepler-13Ab

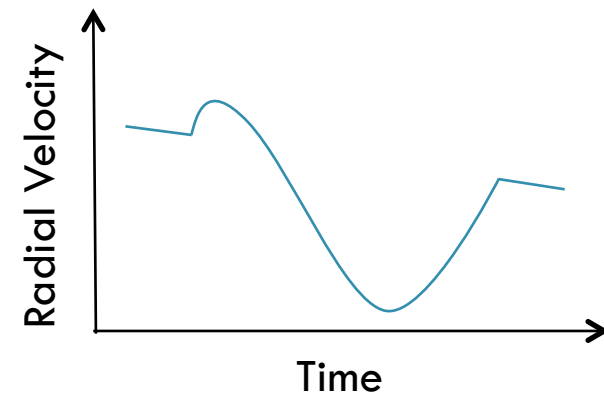
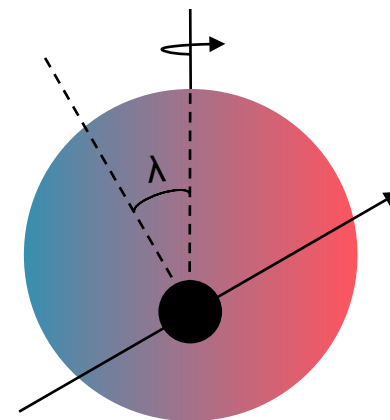
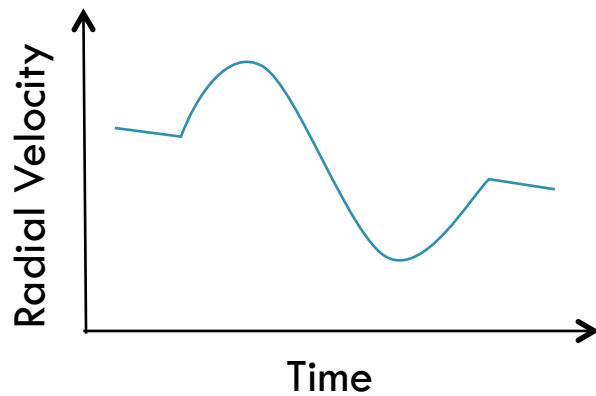
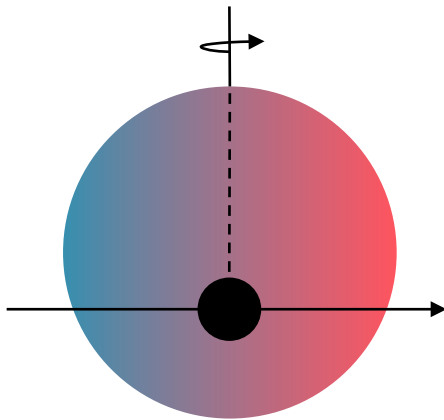
- Hot Jupiter
- Orbiting fast-rotating A-star within wide binary system
- ~ 1.8 day period
- Misaligned, precessing orbit



Szabó et al. (2011)

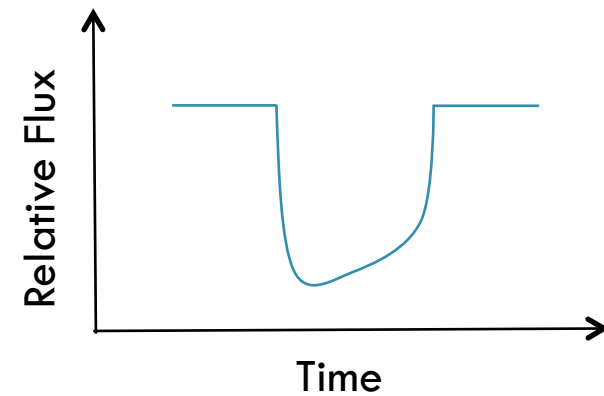
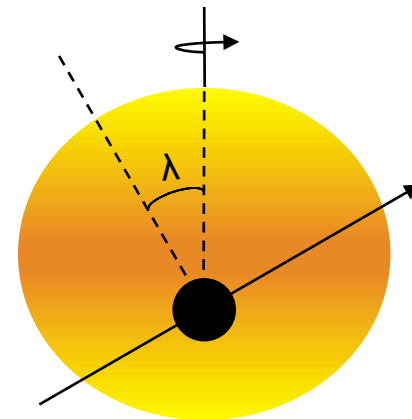
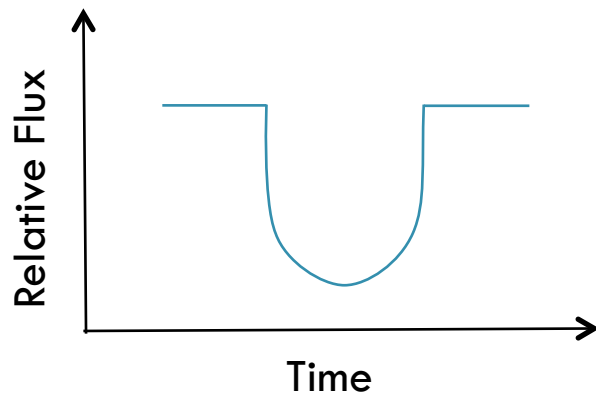
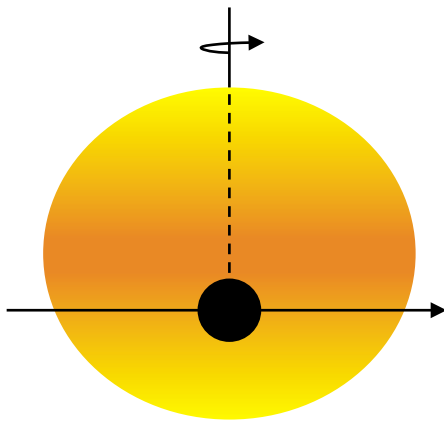
Spin-Orbit Misalignment

- Rossiter-McLaughlin Effect



Spin-Orbit Misalignment

- Gravity Darkening



SimuTrans

- Gravity-darkened transit modeling code
 - [*github.com/chelseah/simuTrans*](https://github.com/chelseah/simuTrans)

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- Applied to 12 phase-folded and binned transits, corresponding to each of the short-cadence *Kepler* quarters

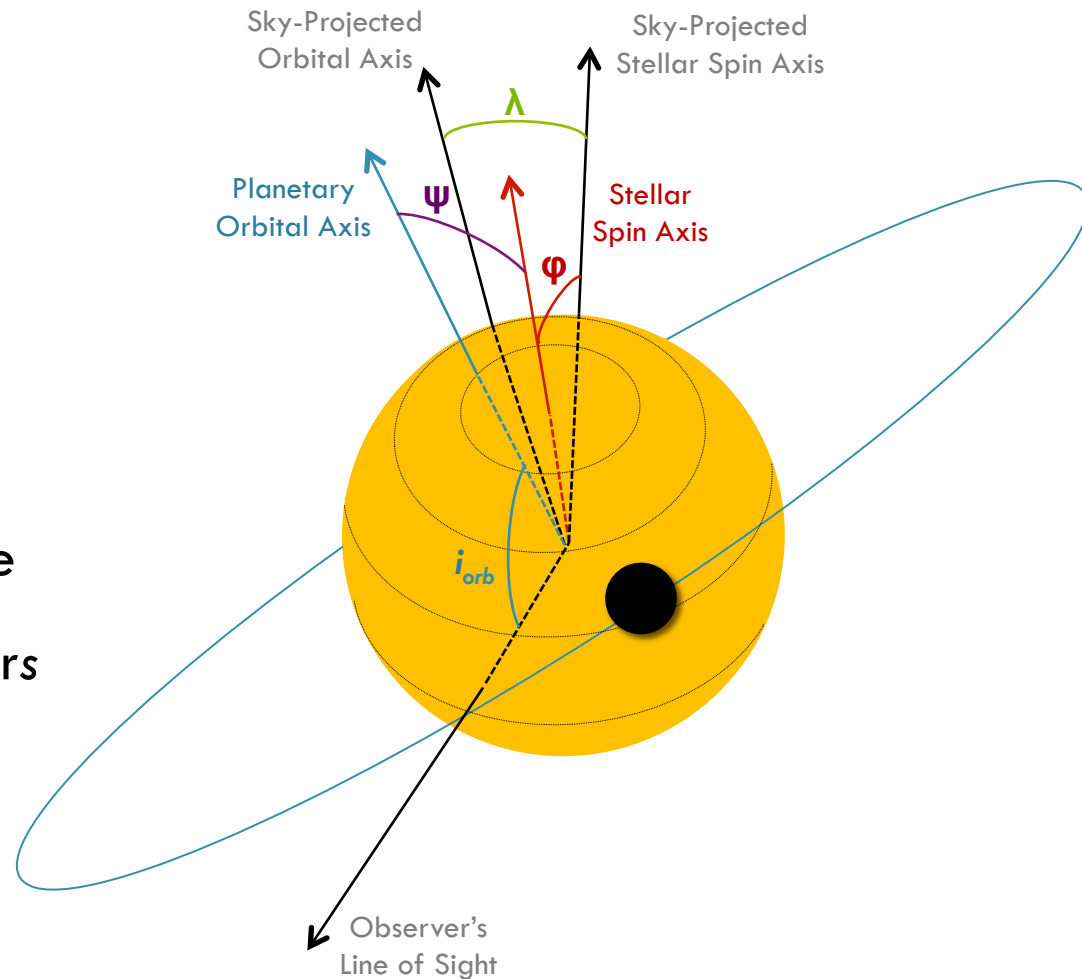
SimuTrans

- Gravity-darkened transit

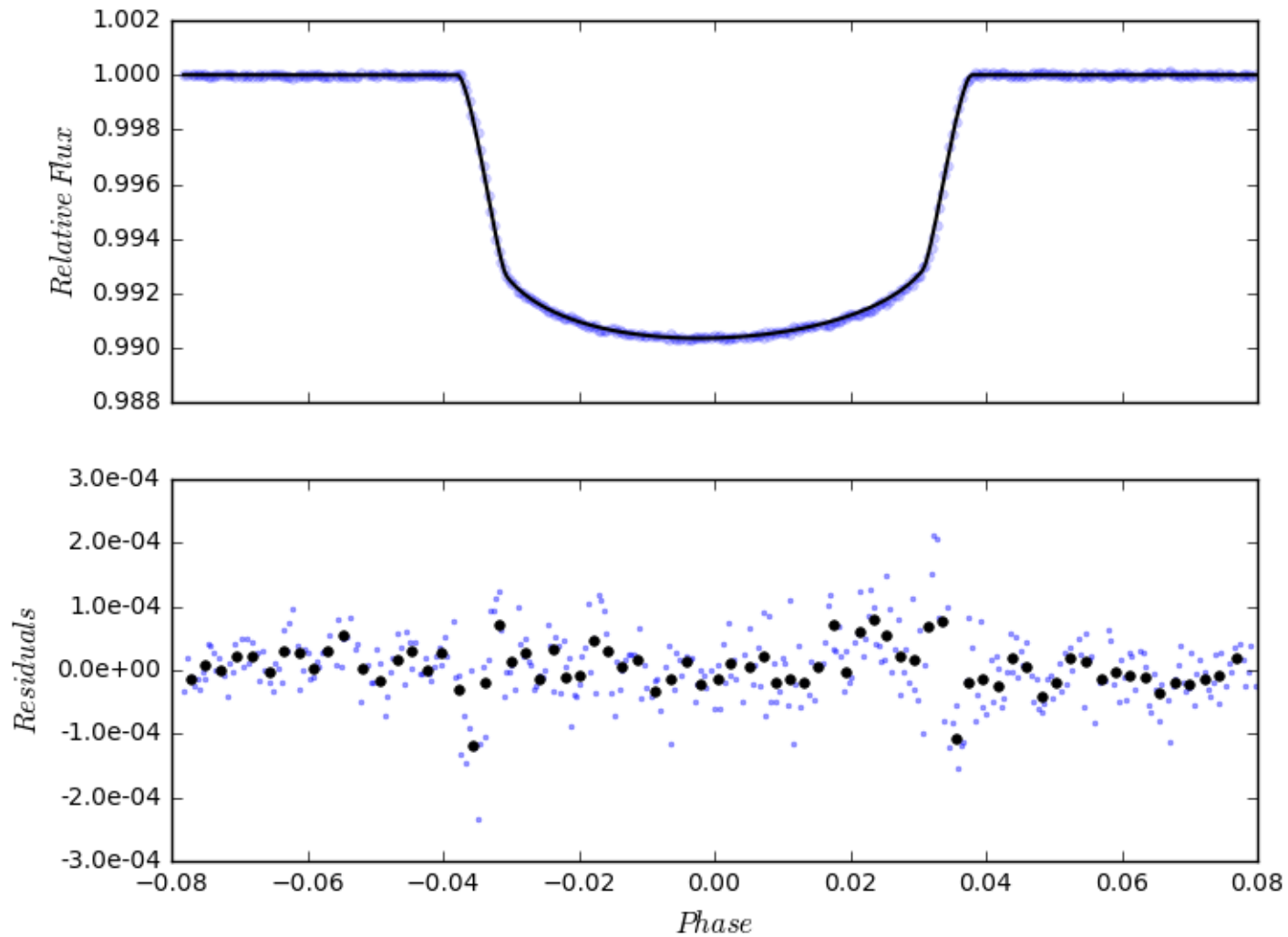
modeling code

- github.com/chelseah/simuTrans

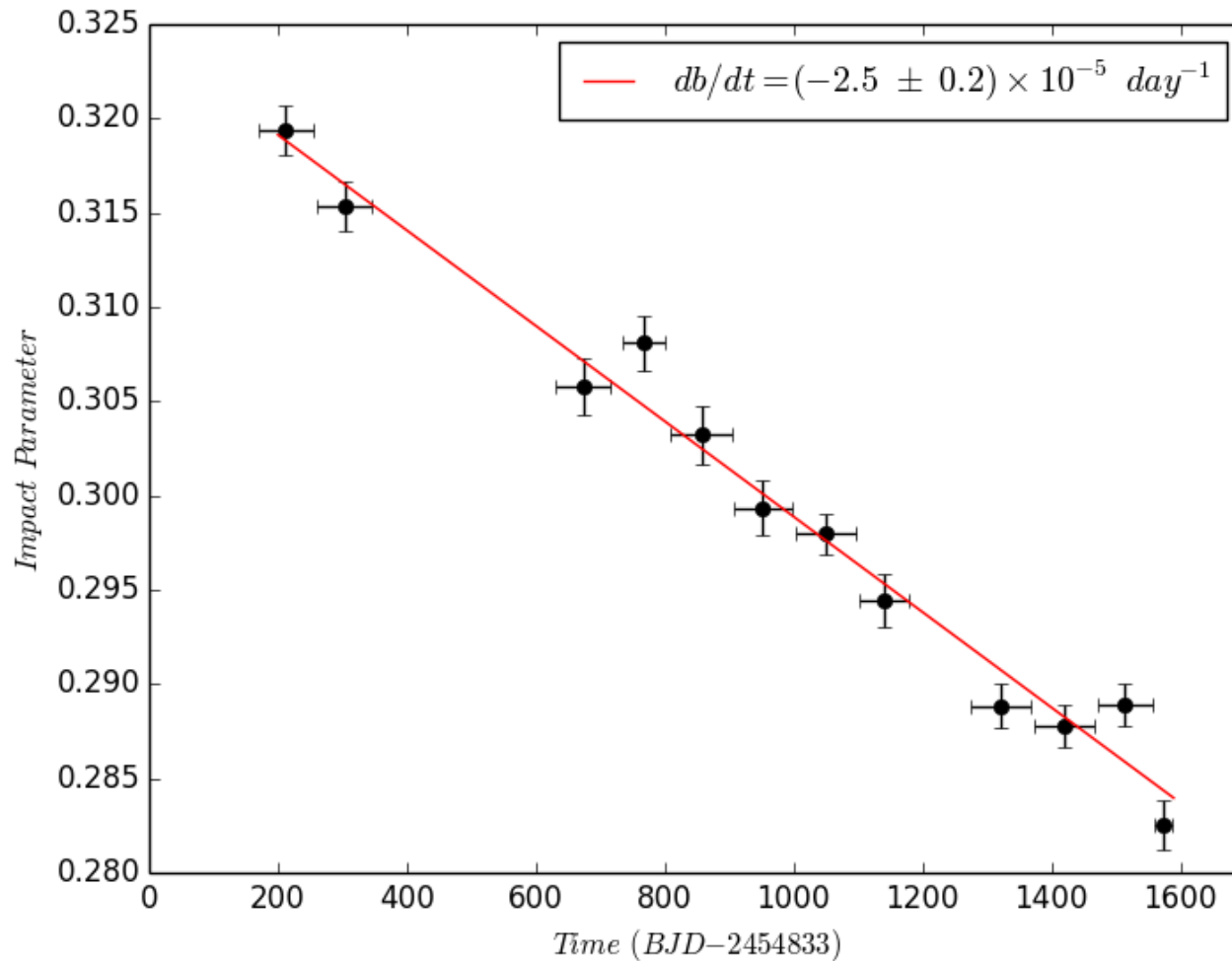
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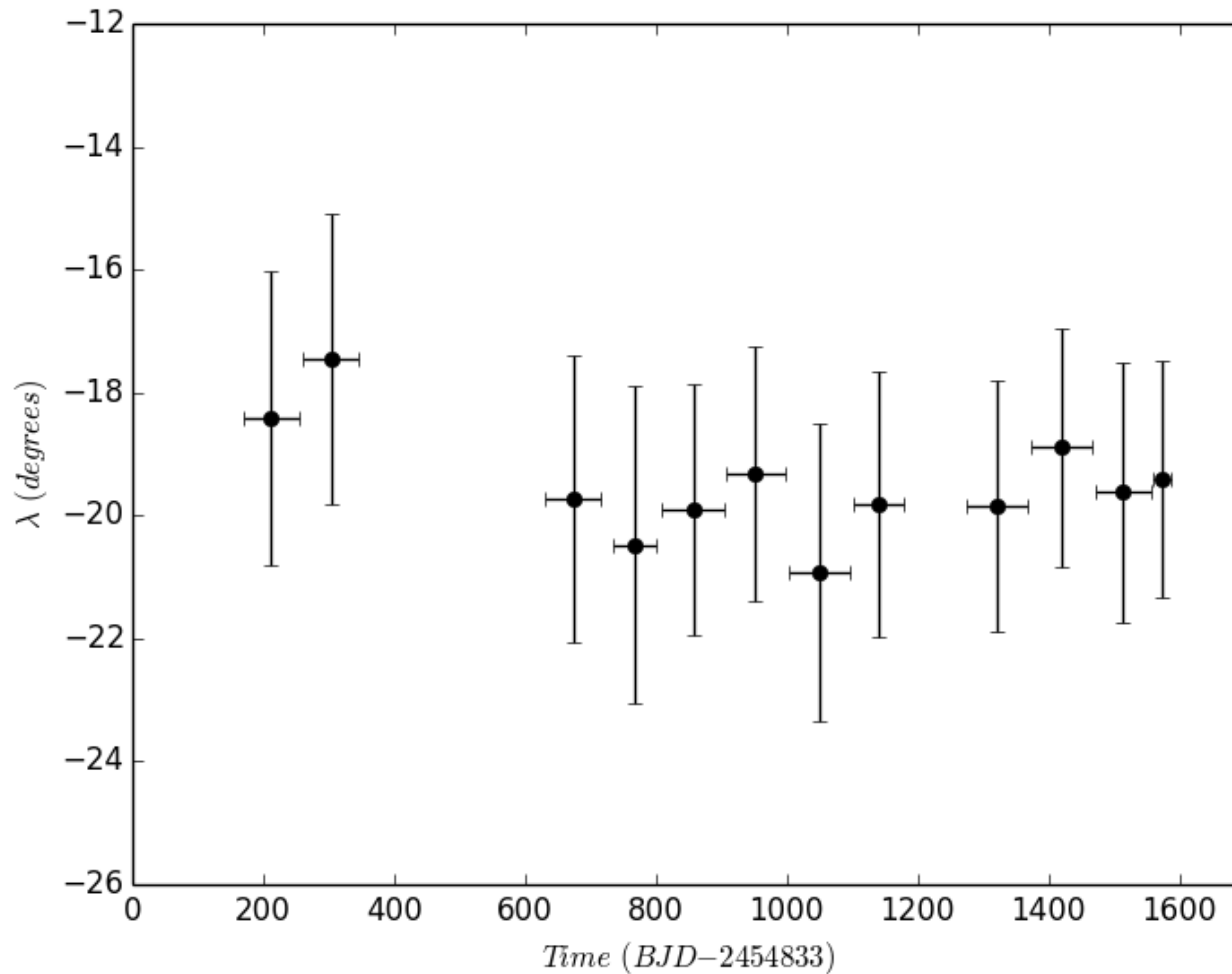
Fitted Model



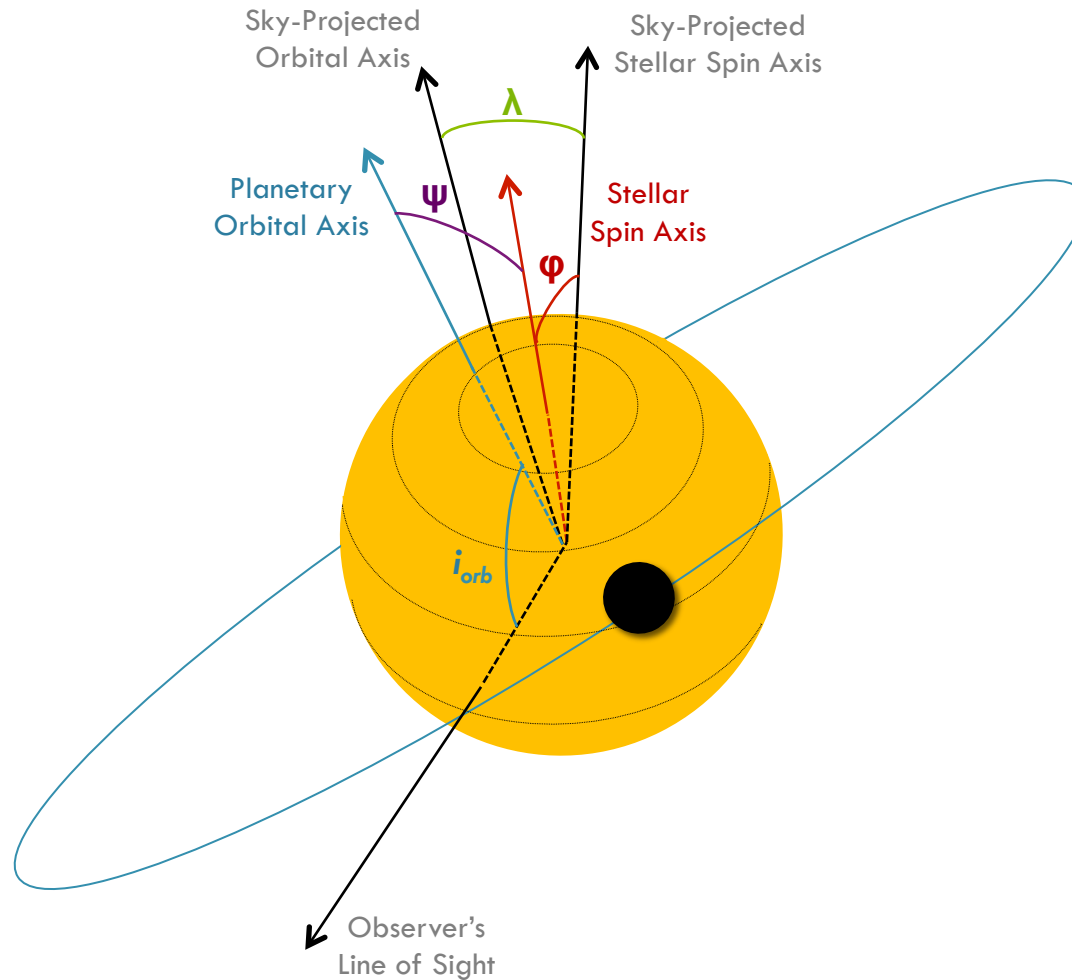
Impact Parameter Evolution



Sky-Projected Spin-Orbit Misalignment



True Spin-Orbit Misalignment



Remaining Questions

- What causes spin-orbit misalignment?
- How do these results fit into current theories of planet formation and migration?

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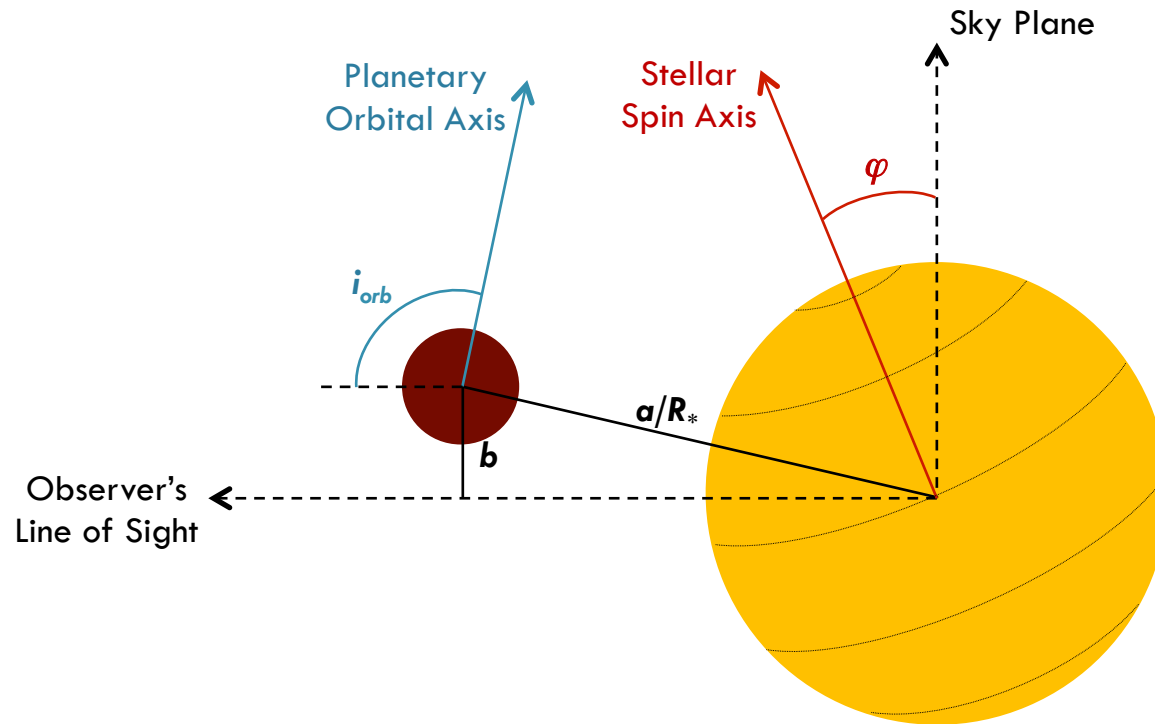
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Thank you!

References

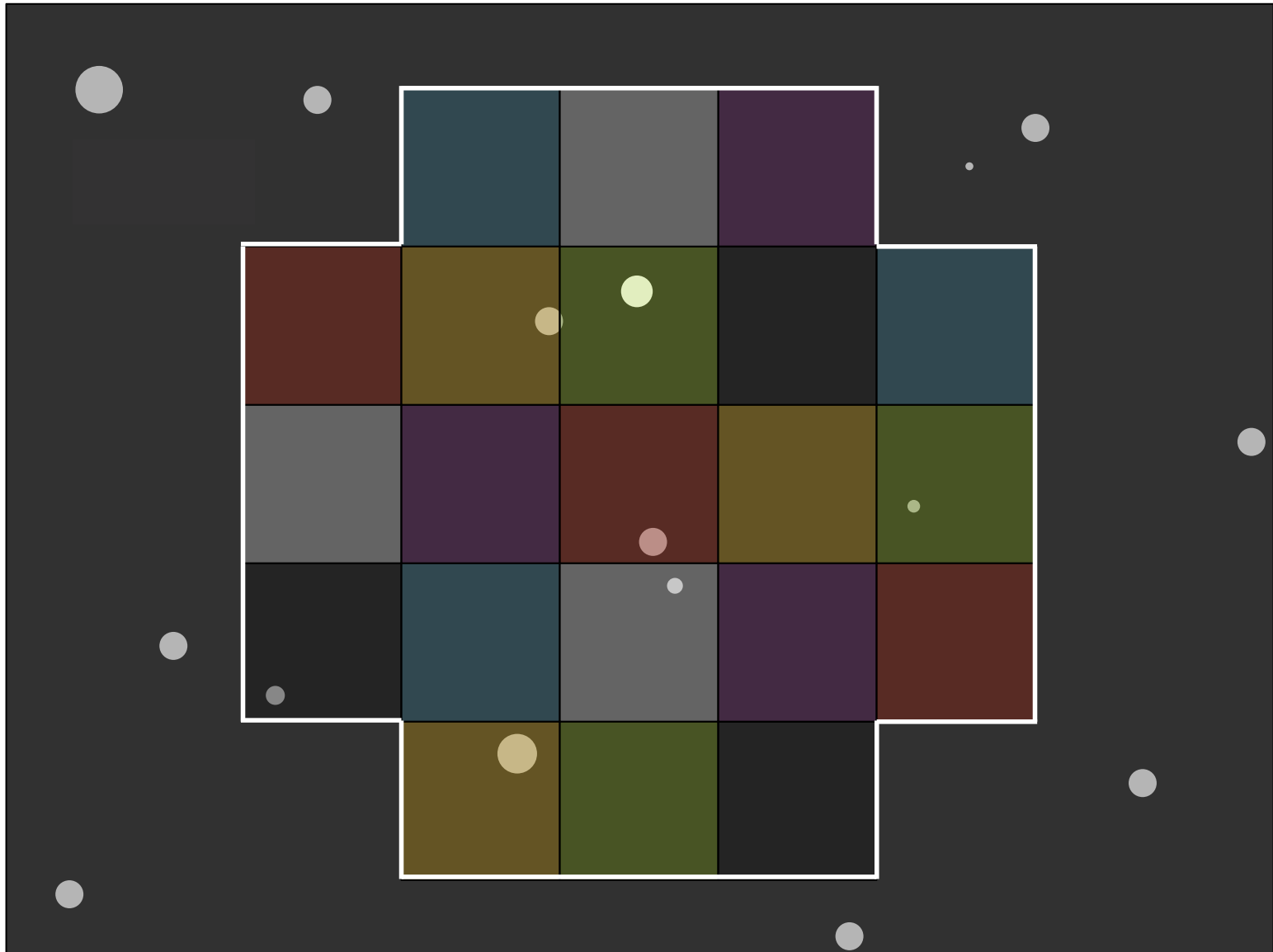
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Model Parameters

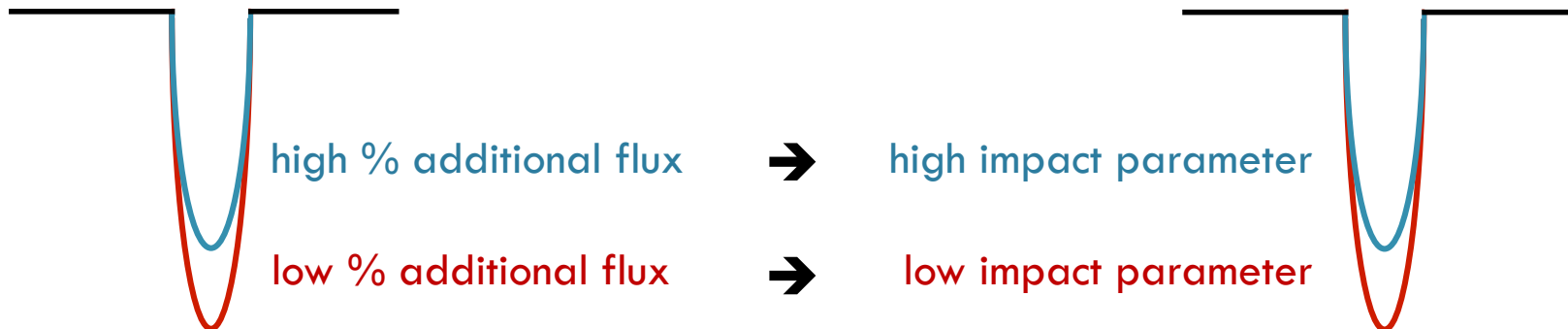
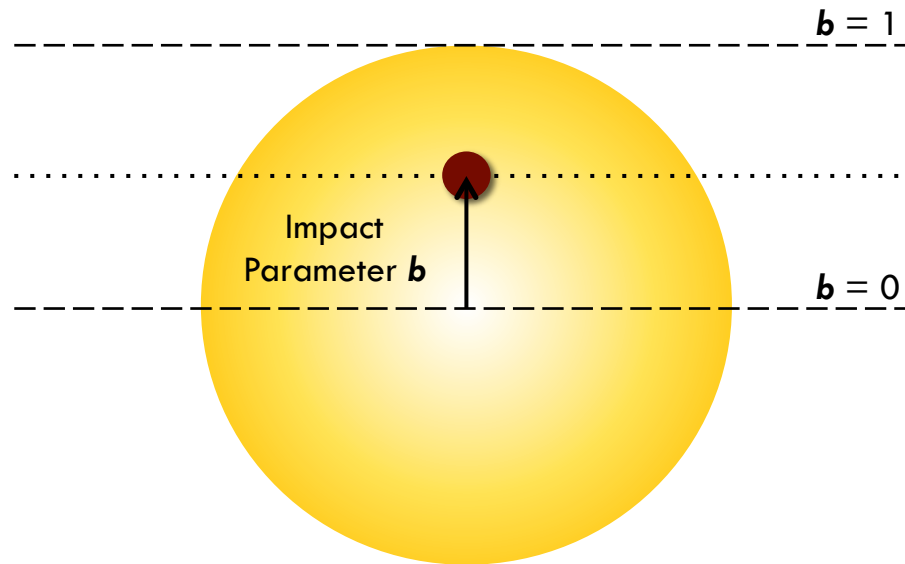


SimuTrans Model Parameters

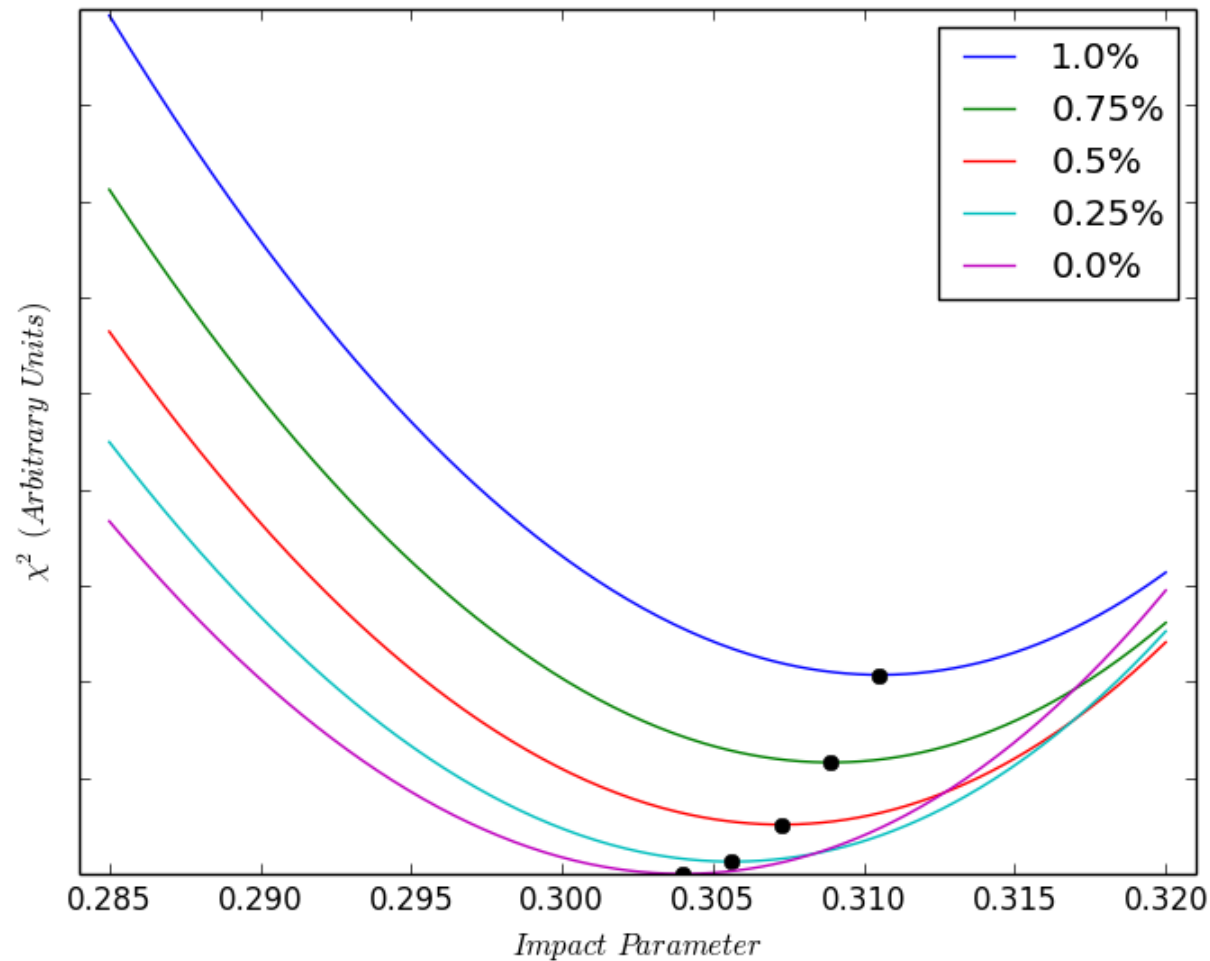
- Projected Stellar Spin Angle φ
- Projected Spin-Orbit Angle λ
- Impact Parameter b
- Semi-major Axis a/R_*
- Planet-Star Radius Ratio R_p/R_*
- Gravity Darkening Parameter β
- Limb Darkening Coefficients q_1, q_2
- Orbital Period P
- Time of First Transit T_0
- Stellar Mass M_*
- Stellar Radius R_*
- Stellar Rotation Period P_{rot}
- Stellar Oblateness f_*



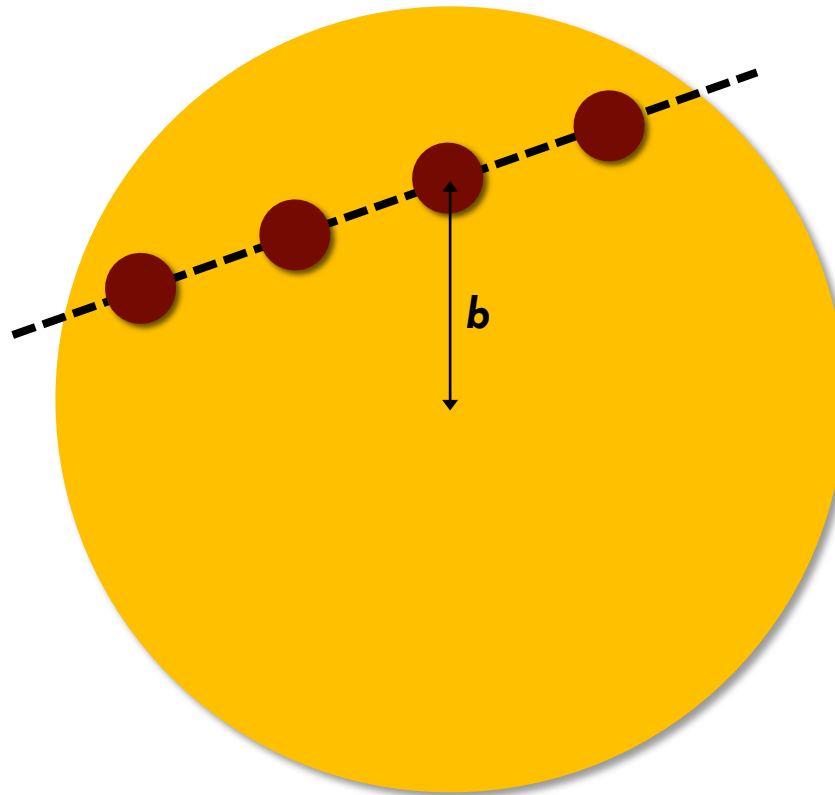
Contaminating Light



Seasonal Variations due to Contaminating Light



Transit Evolution



Transit Evolution

