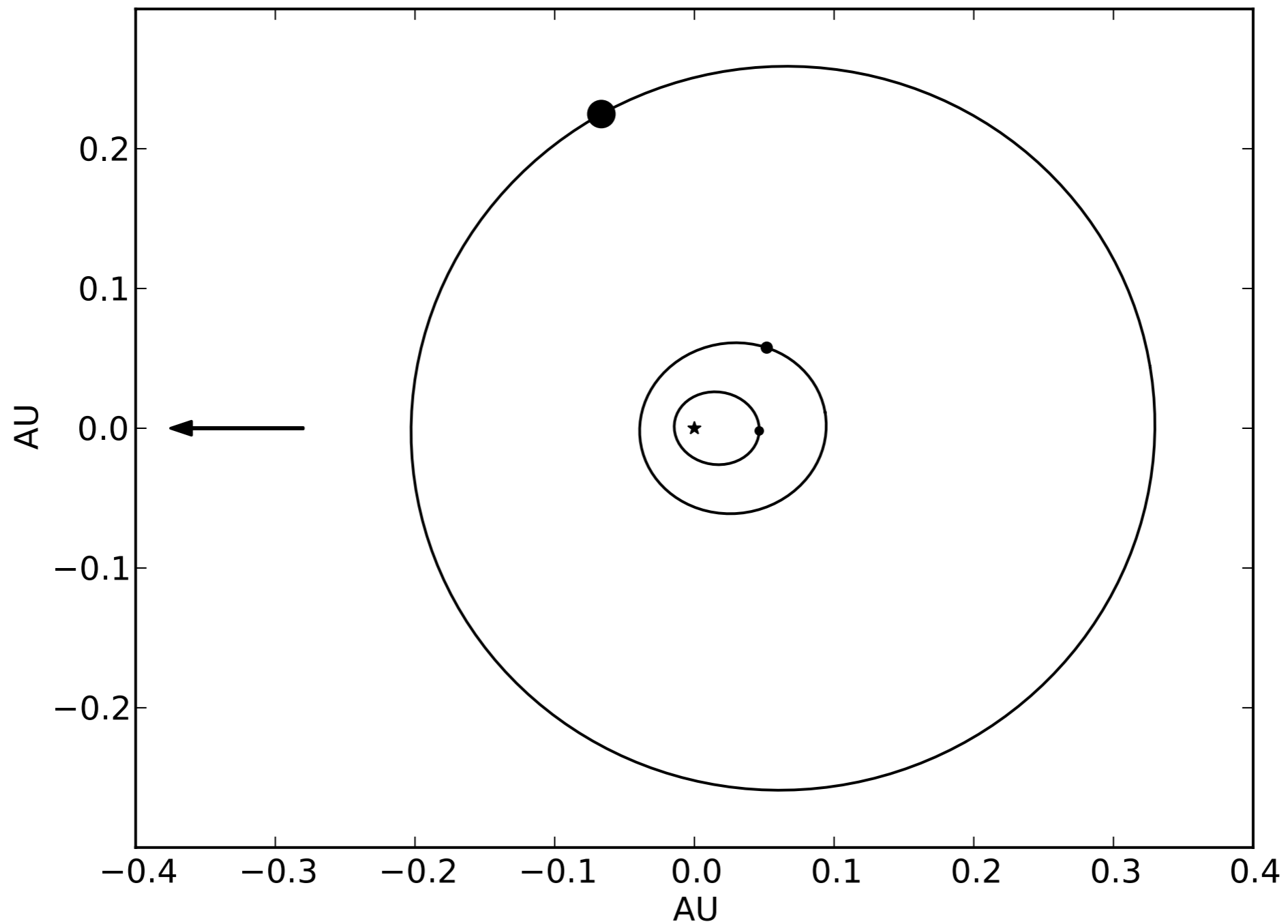


STELLAR SPOTS AND TRANSIT TIMING VARIATIONS

PANAGIOTIS IOANNIDIS
HAMBURG OBSERVATORY



Kepler 210: An active star with at least two planets

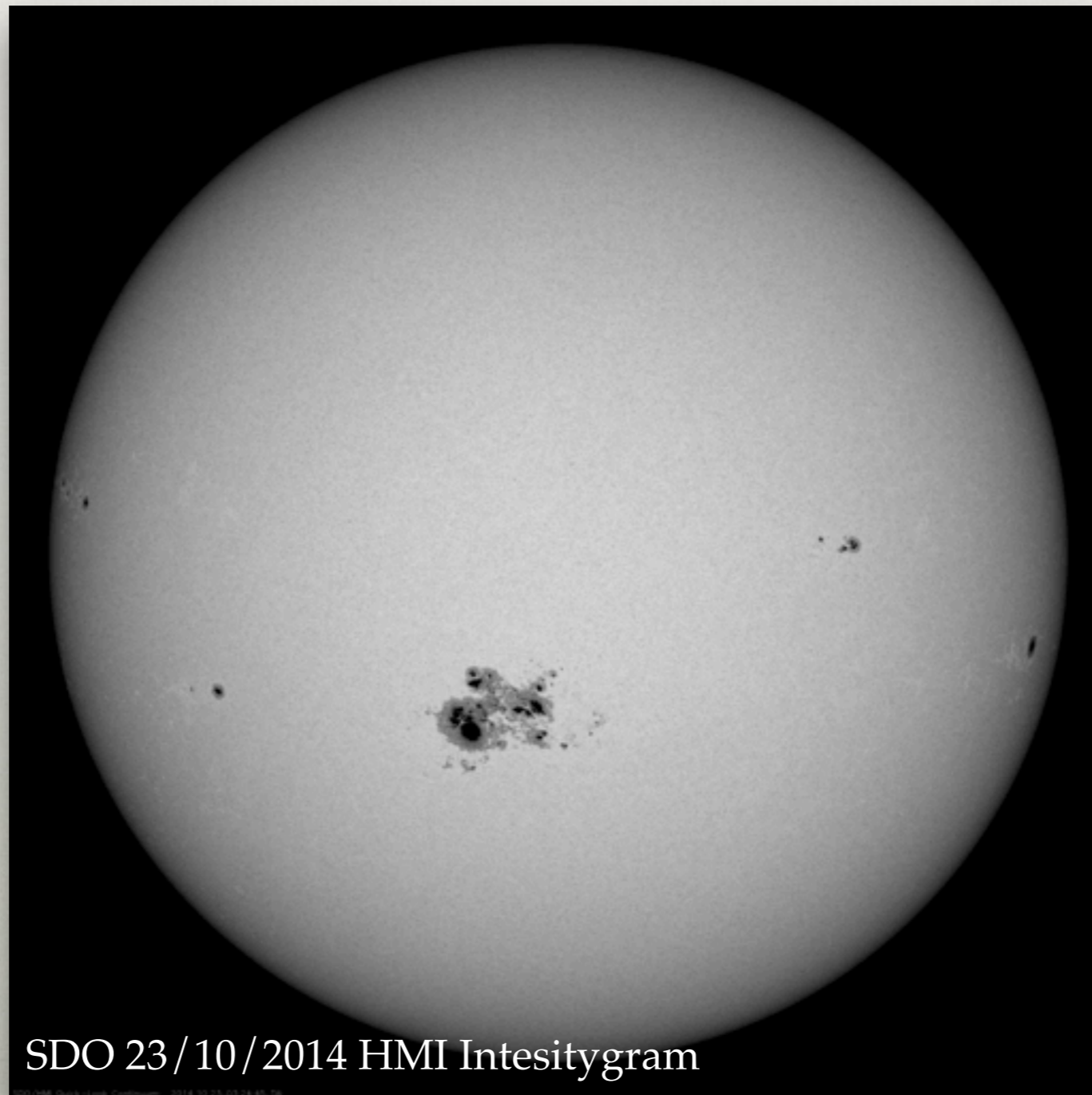


Ioannidis et al. 2014

OUTLINE

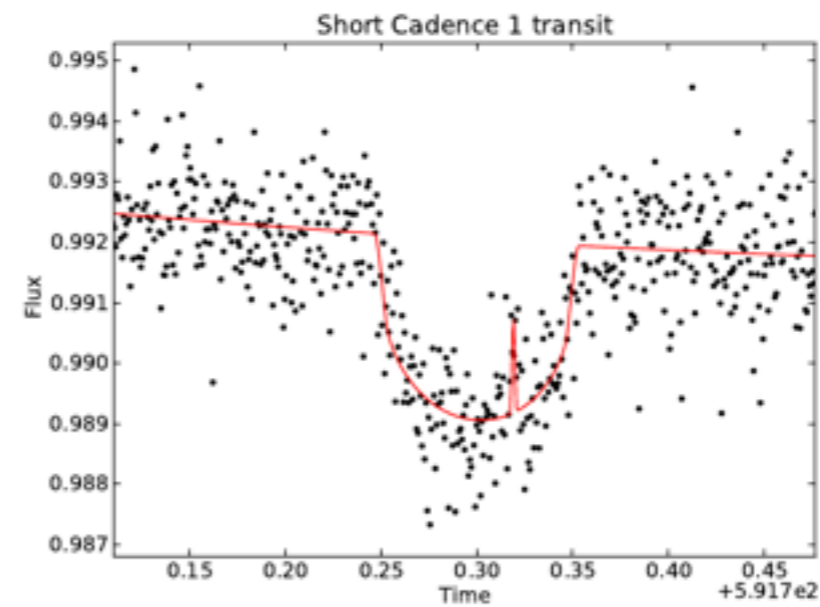
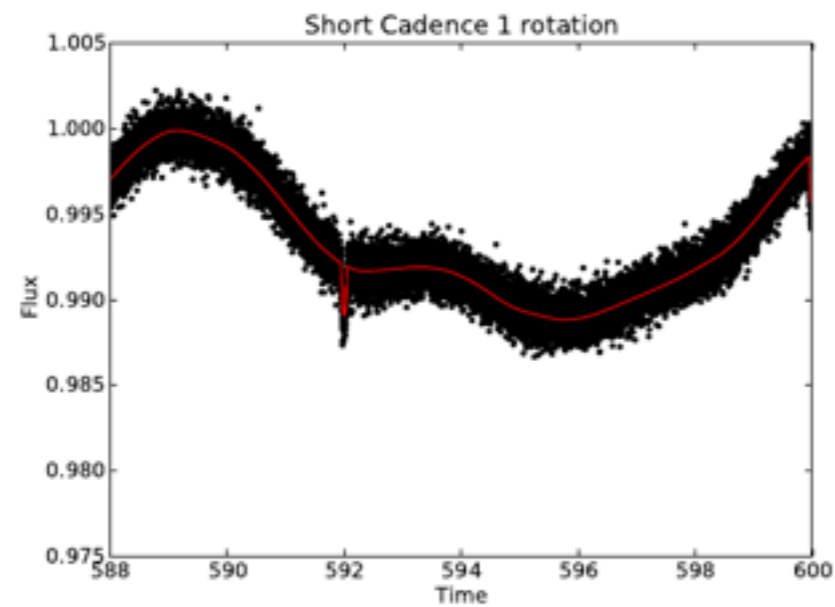
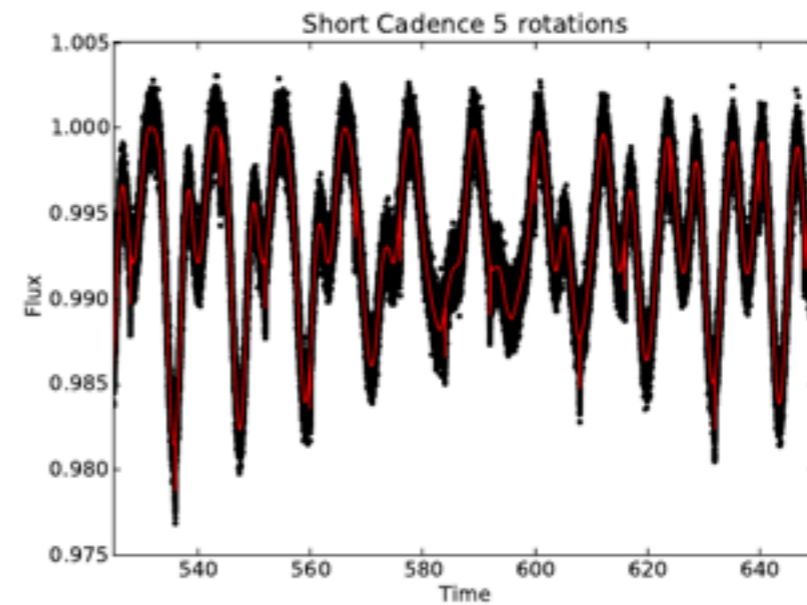
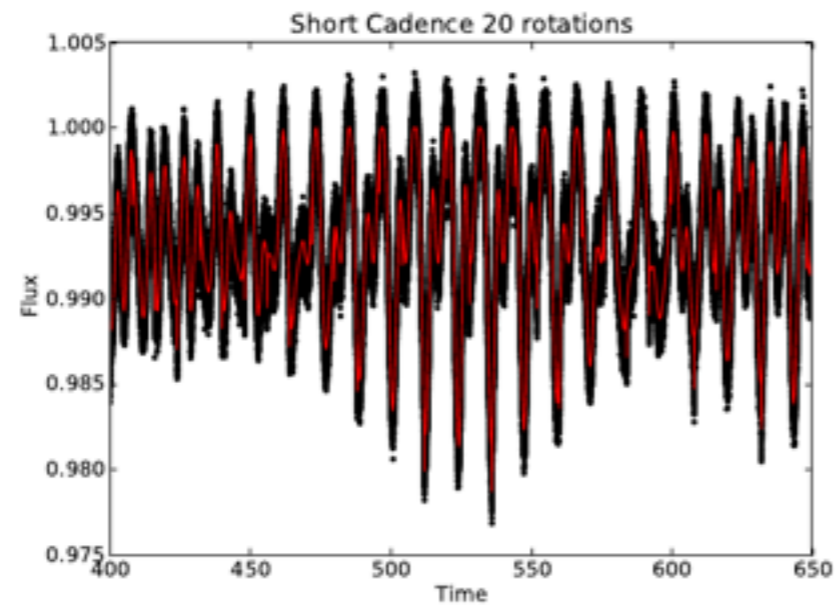
1. Starspots and light curves
2. Starspots and transiting planets
3. Starspots and TTVs
 - Single transit
 - Series of transits
4. Summary

STARSPOTS AND LIGHT CURVES



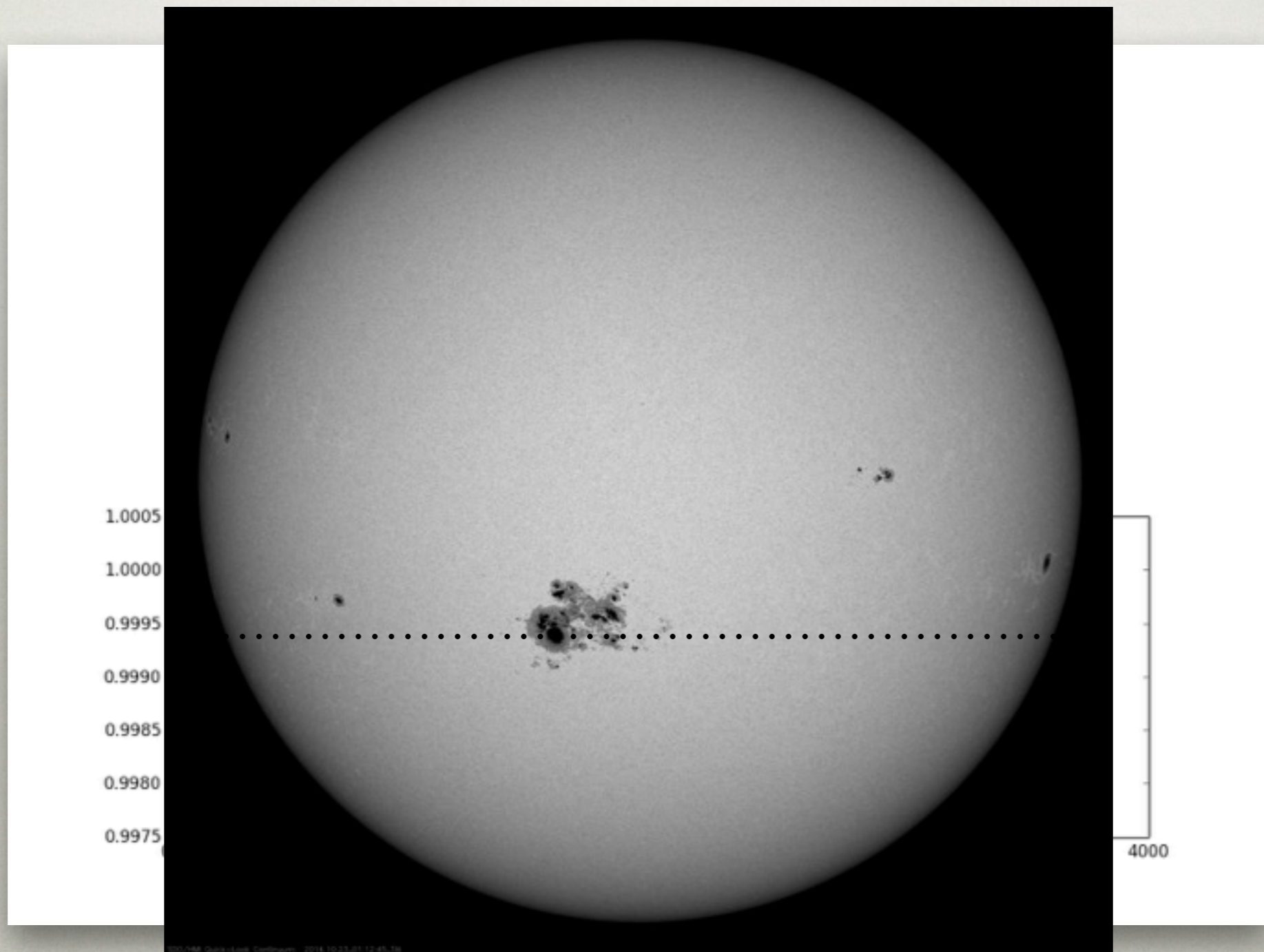
STARSPOTS AND LIGHT CURVES

KEPLER LIKE LIGHT CURVE OF AN ACTIVE STAR



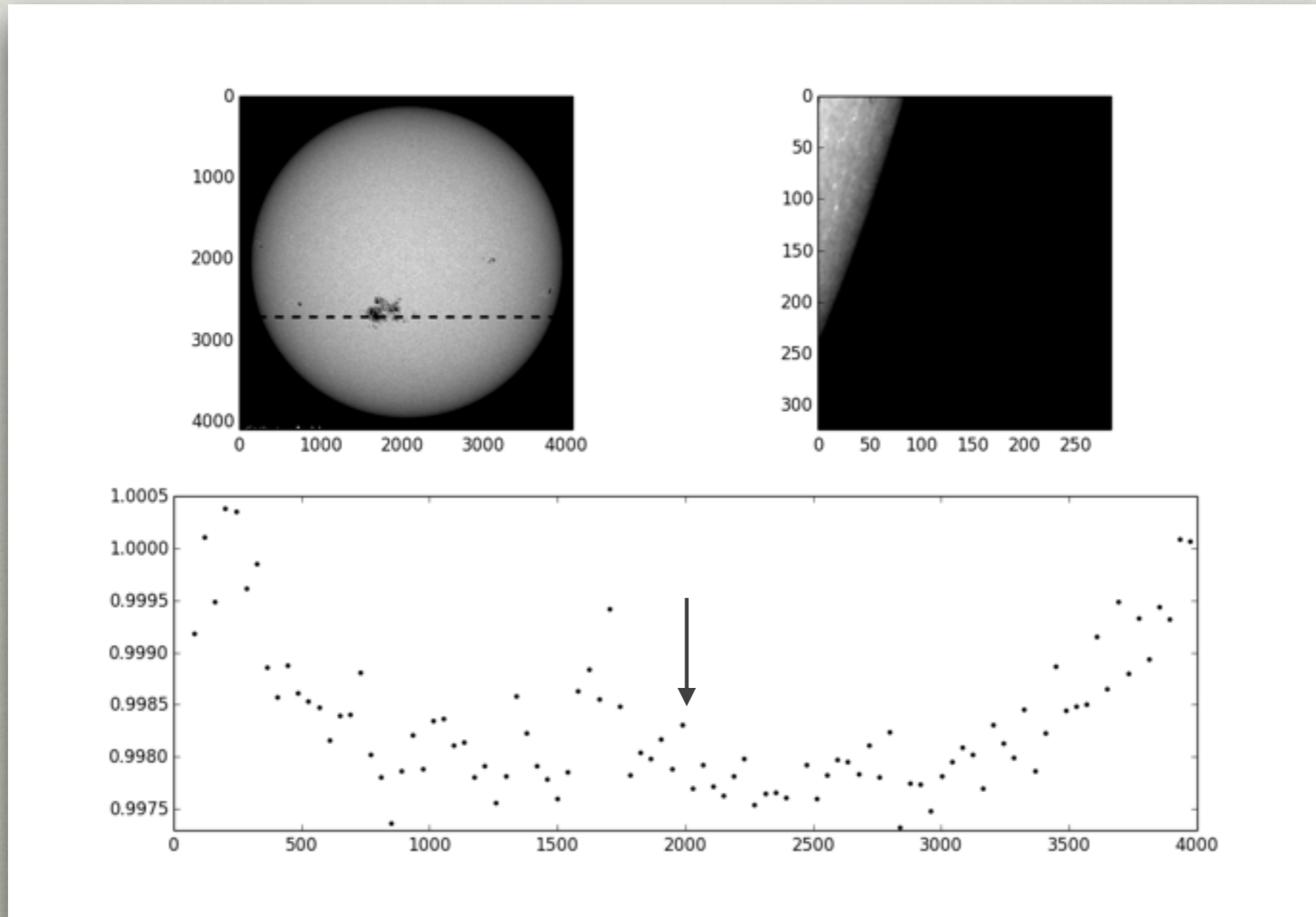
STARSPOTS AND LIGHT CURVES

A TRANSITING PLANET AND THE SPOT-CROSSING (S-C) EVENT



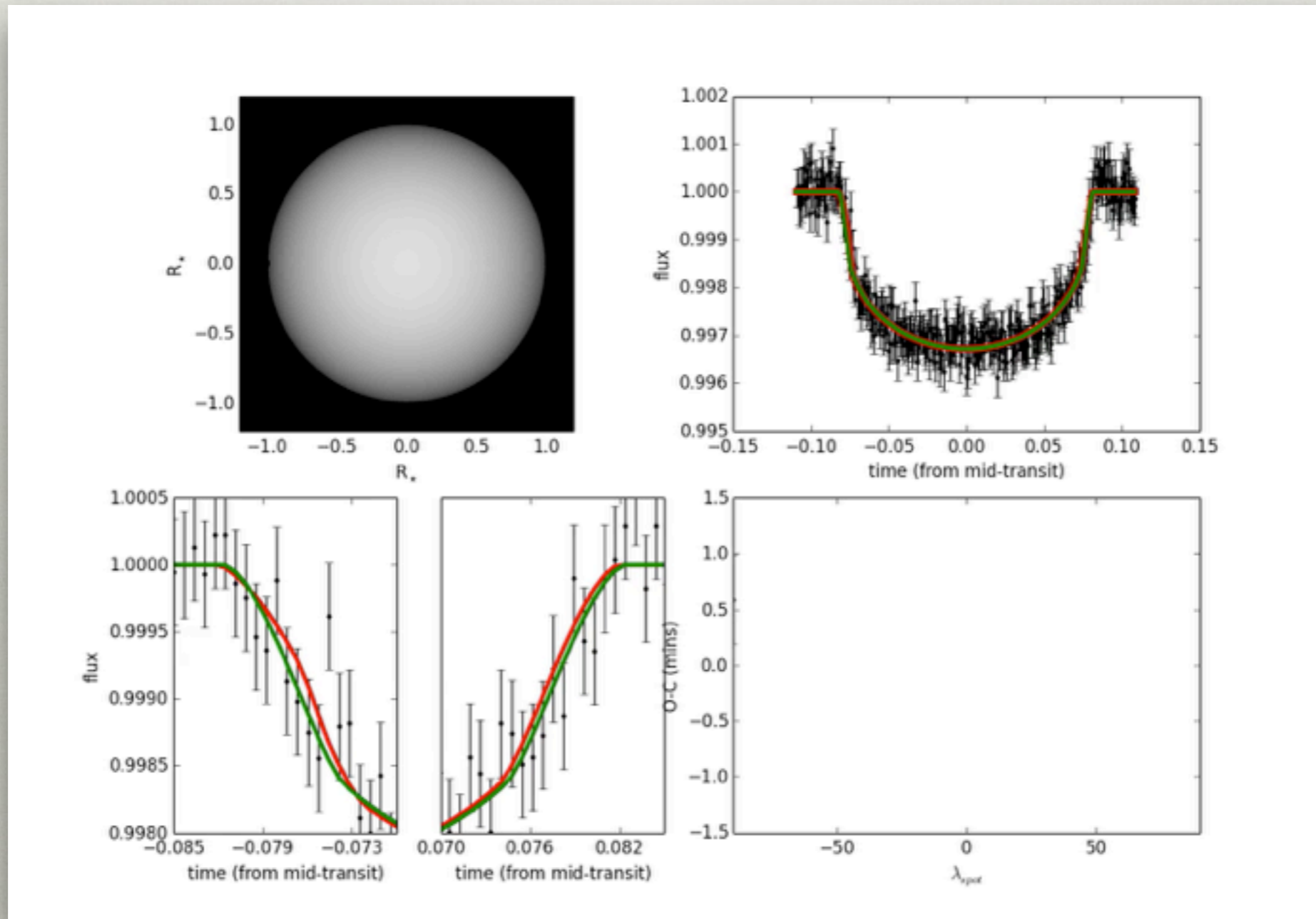
STARSPOTS AND LIGHT CURVES

A TRANSITING PLANET AND THE SPOT-CROSSING (S-C) EVENT



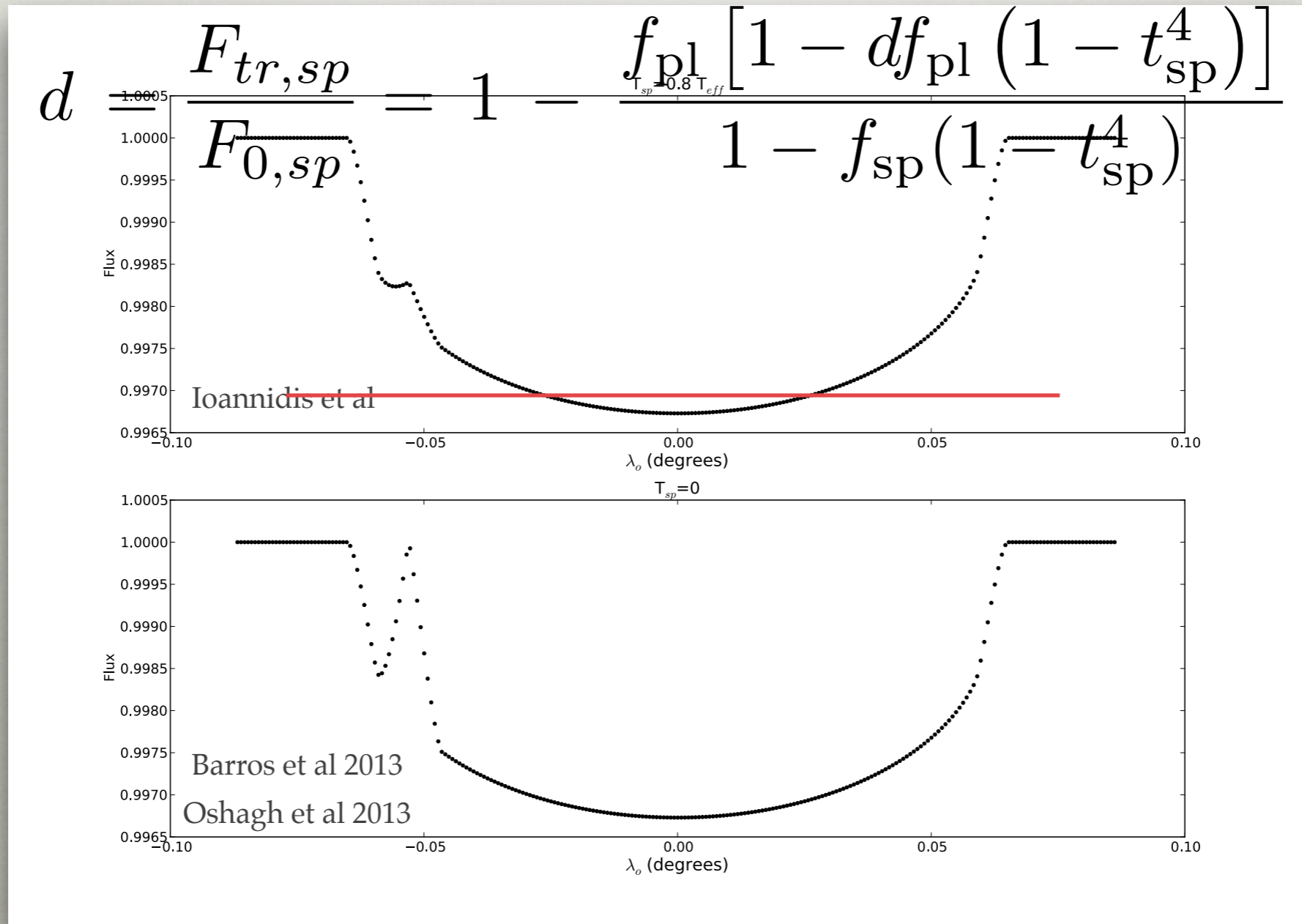
STARSPOTS AND TTVs

MEASURING TTVs FOR VARIOUS POSITIONS OF THE S-C EVENT



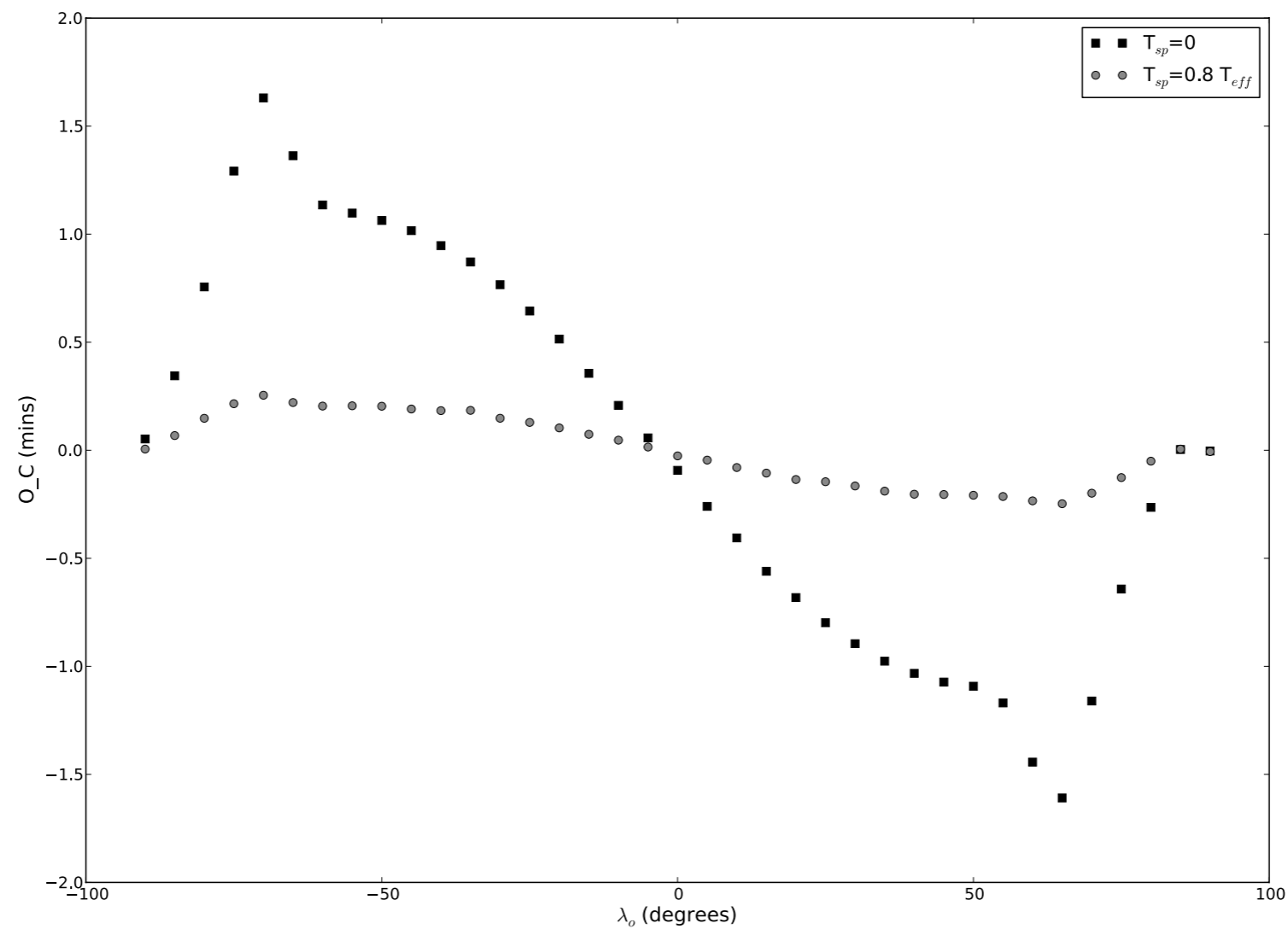
STARSPOTS AND TTVs

TTV SIGNATURE DIFFERENCE WITH T_{EFF}



STARSPOTS AND TTVs

TTV SIGNATURE DIFFERENCE WITH T_{EFF}

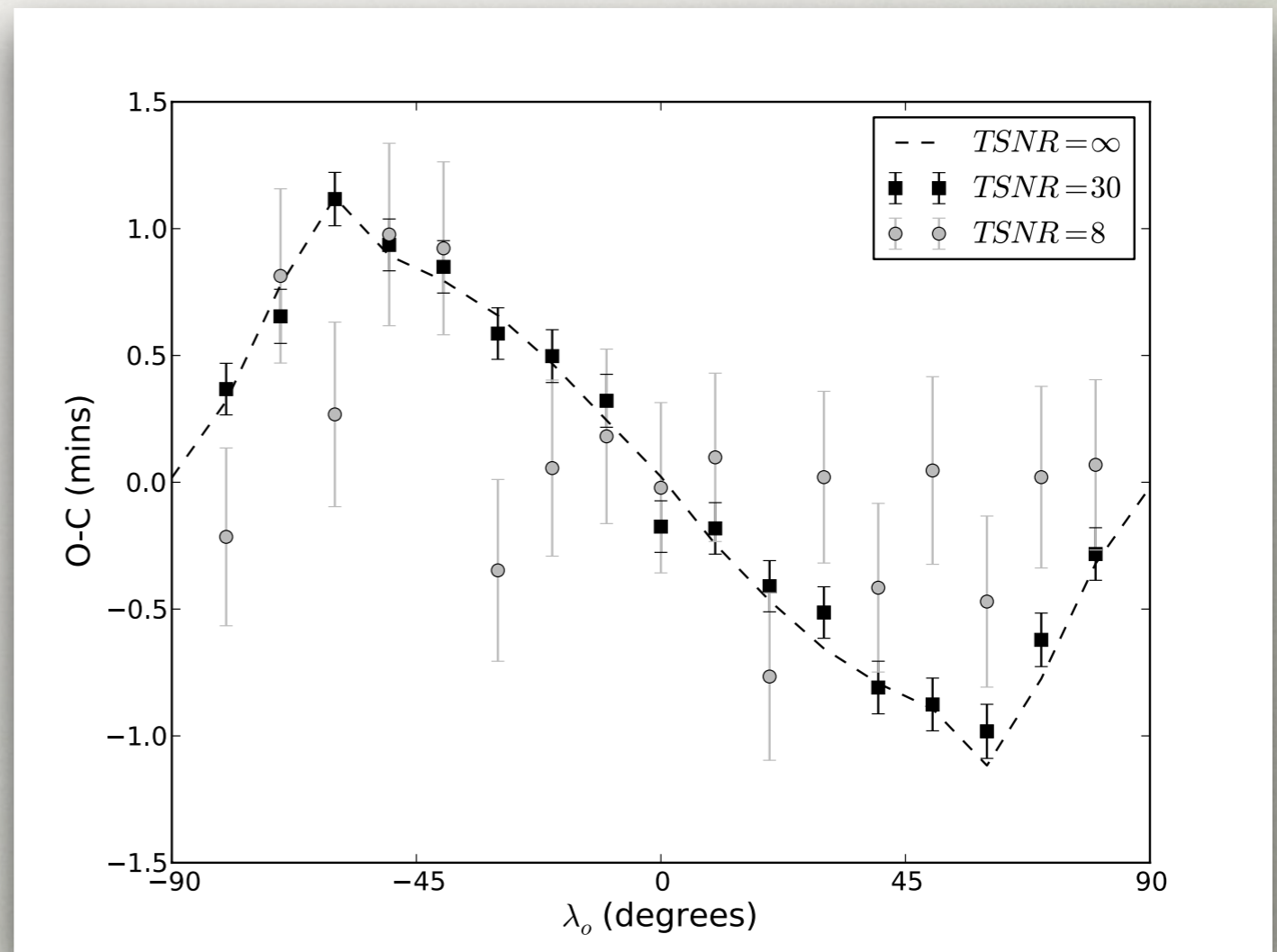


STARSPOTS AND TTVs

SINGLE TRANSIT

➔ Size / TSNR

- Shape
- Transit duration
- Impact factor b
- Stellar temperature



STARSPOTS AND TTVs

SINGLE TRANSIT

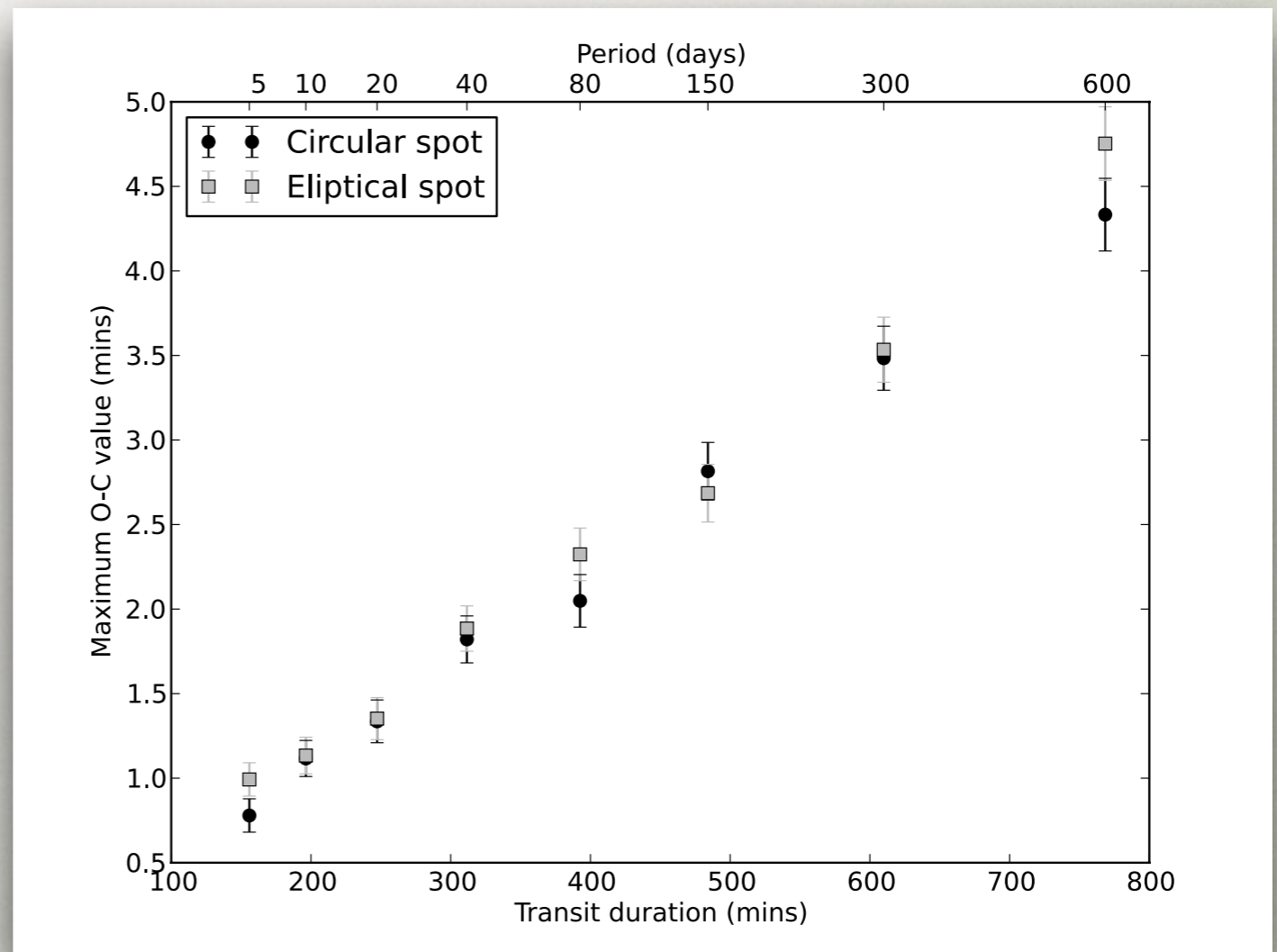
- Size / TSNR

➔ Shape

- Transit duration

- Impact factor b

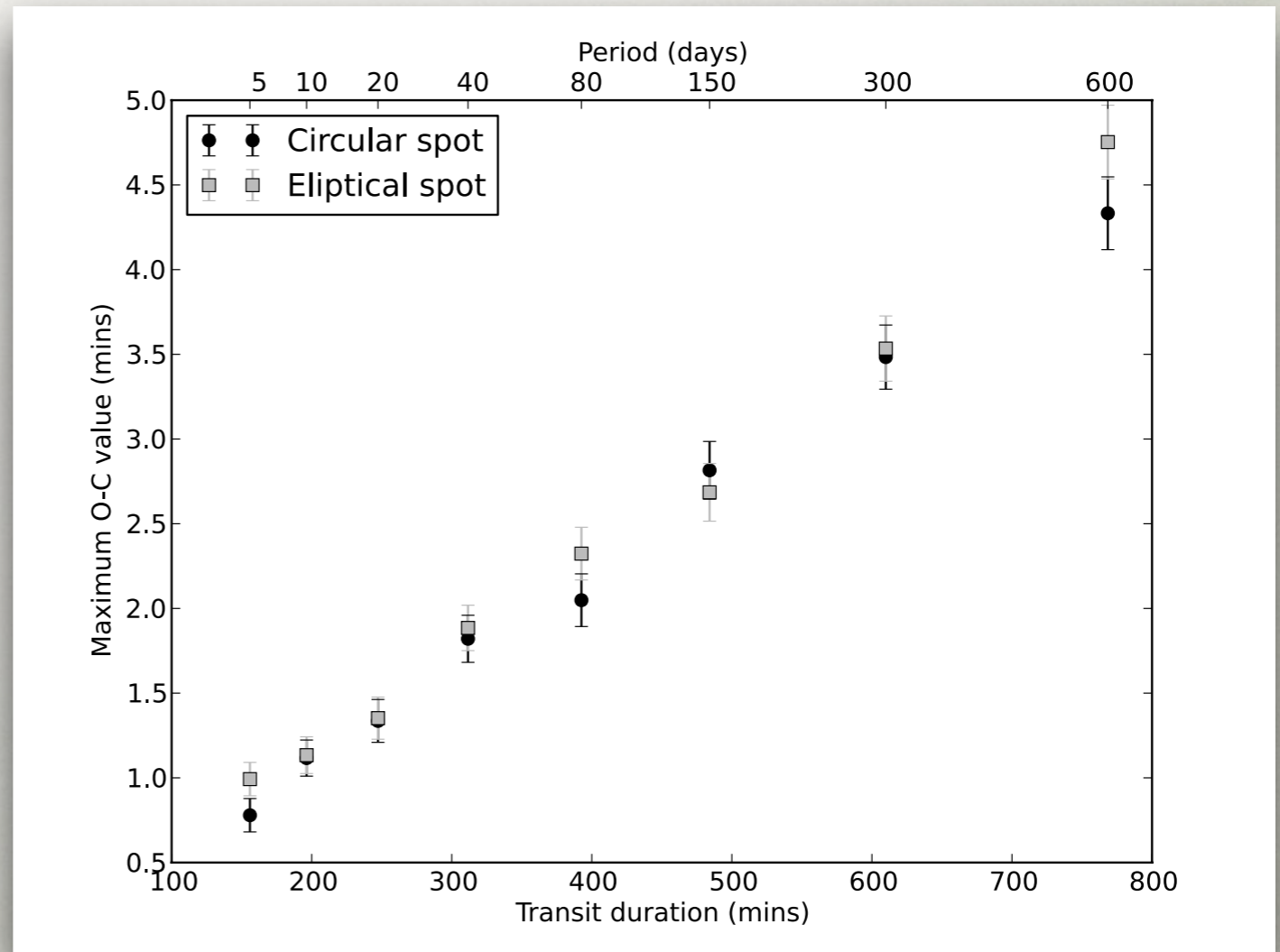
- Stellar temperature



STARSPOTS AND TTVs

SINGLE TRANSIT

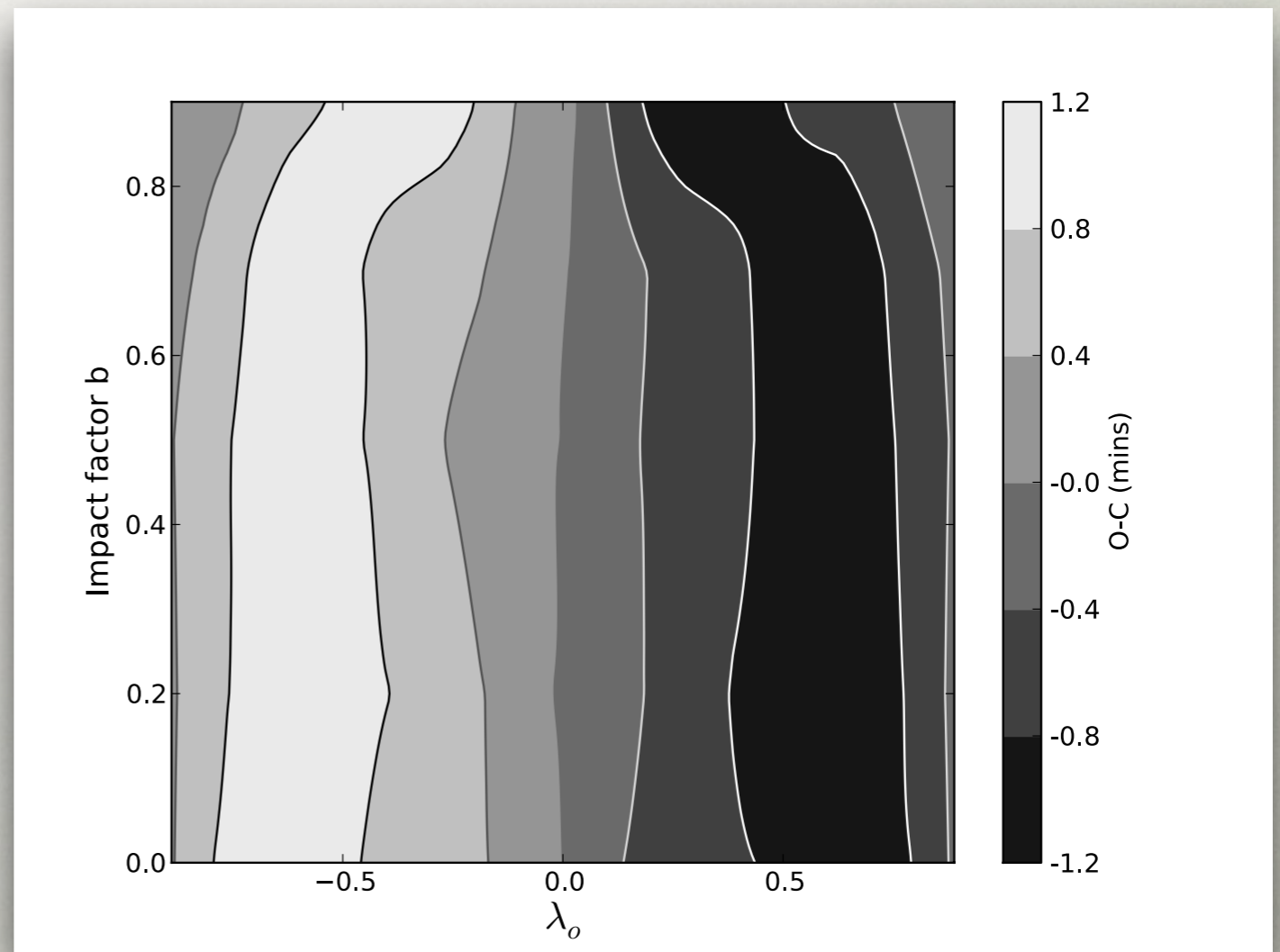
- Size / TSNR
- Shape
- ➔ Transit duration
- Impact factor b
- Stellar temperature



STARSPOTS AND TTVs

SINGLE TRANSIT

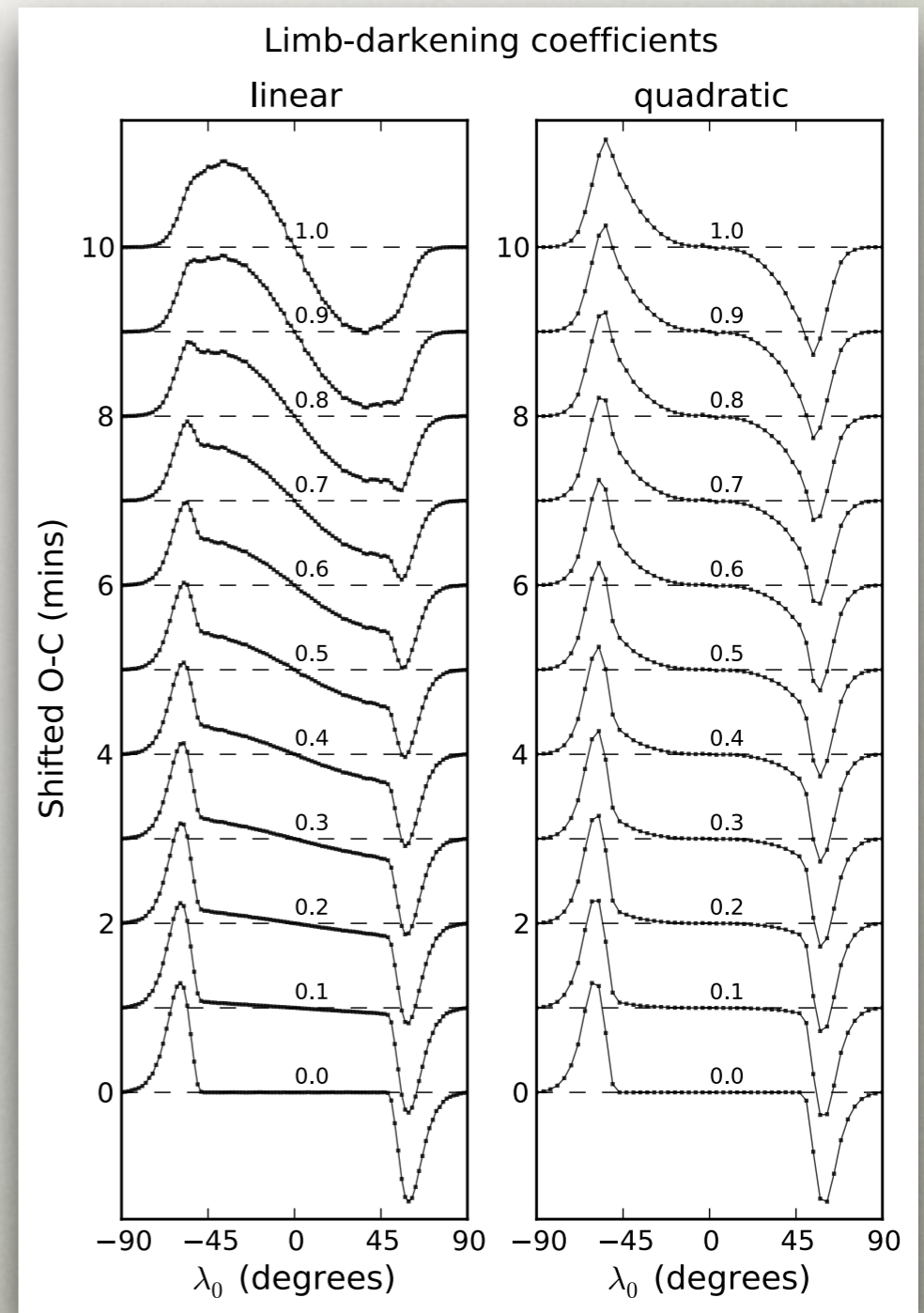
- Size / TSNR
- Shape
- Transit duration
- ➔ Impact factor b
- Stellar temperature



STARSPOTS AND TTVs

SINGLE TRANSIT

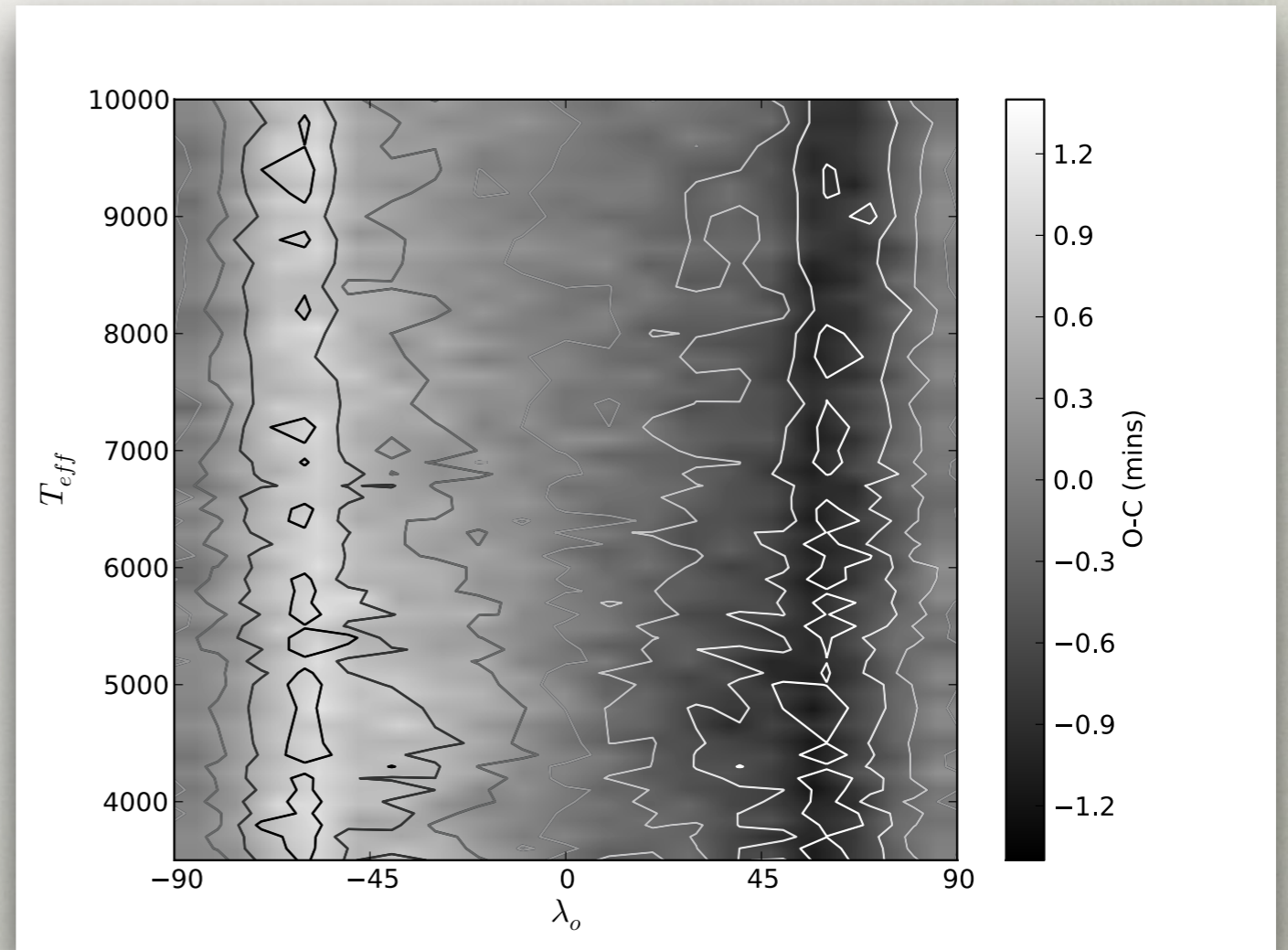
- Size / TSNR
 - Shape
 - Transit duration
 - Impact factor b
- ➔ Stellar temperature



STARSPOTS AND TTVs

SINGLE TRANSIT

- Size / TSNR
- Shape
- Transit duration
- Impact factor b



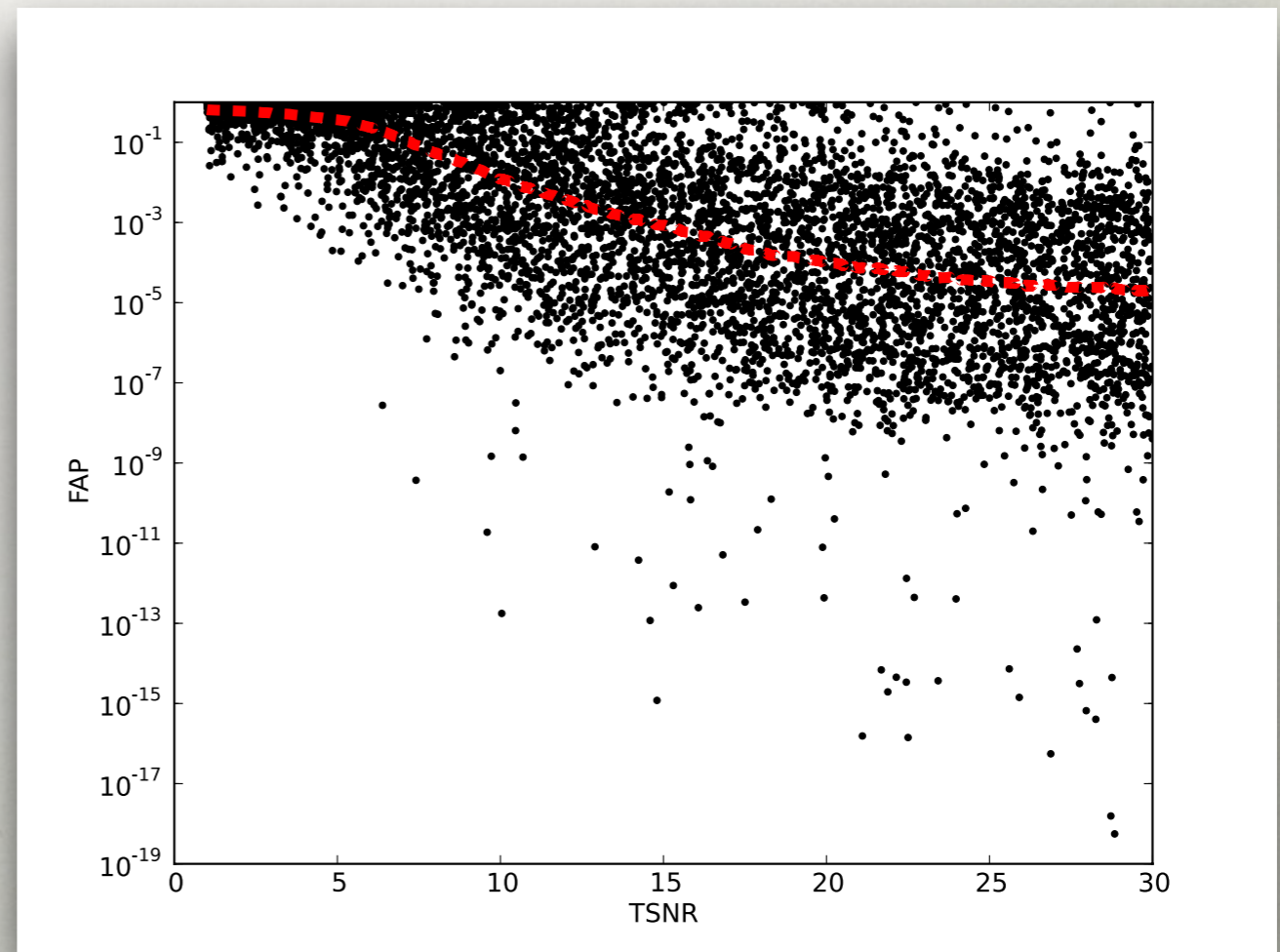
➔ Stellar temperature

STARSPOTS AND TTVs

CONSEQUENT TRANSITS

➔ FAP vs TSNR

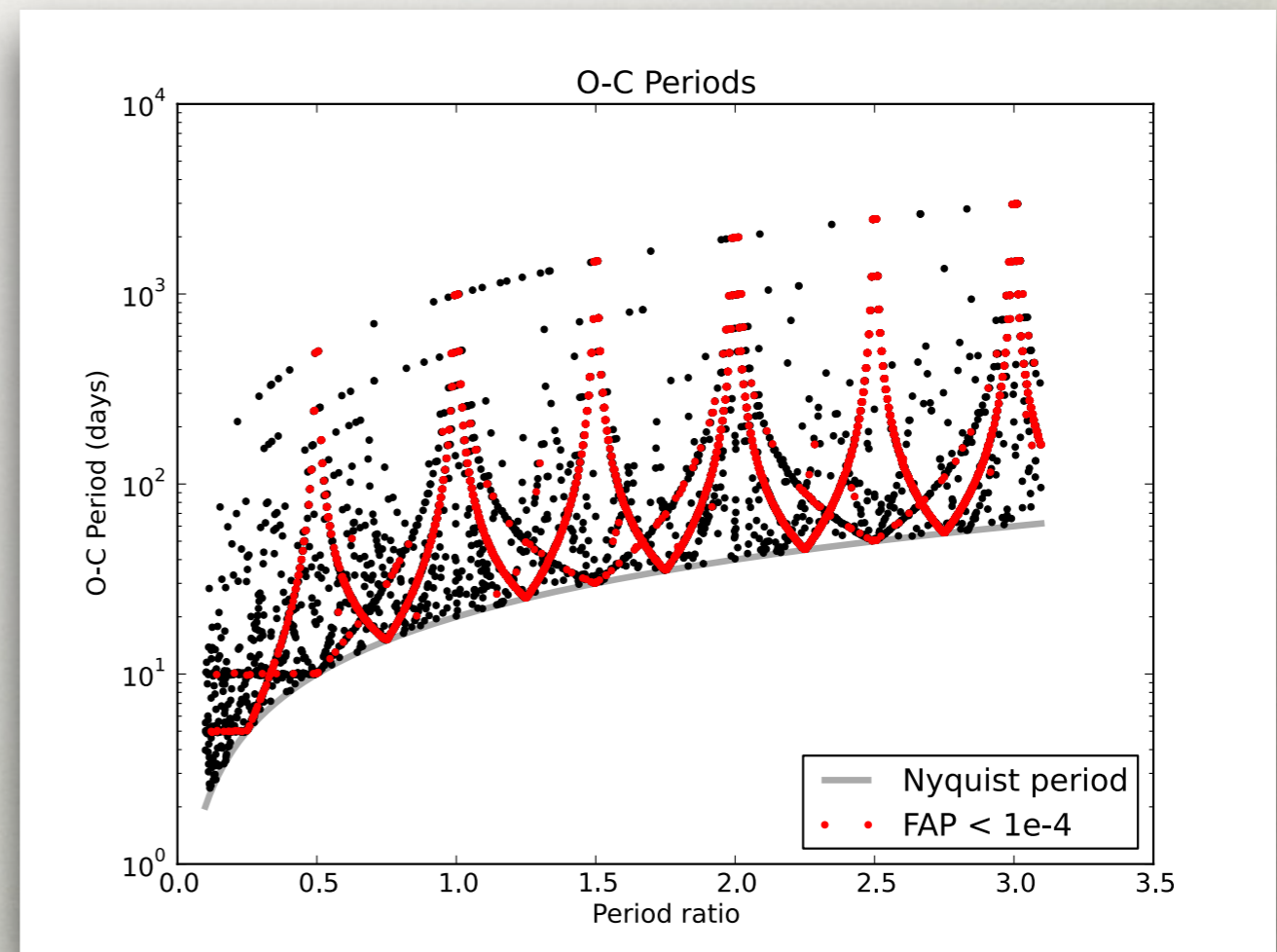
- O-C Periods
- O-C Amplitudes



STARSPOTS AND TTVs

CONSEQUENT TRANSITS

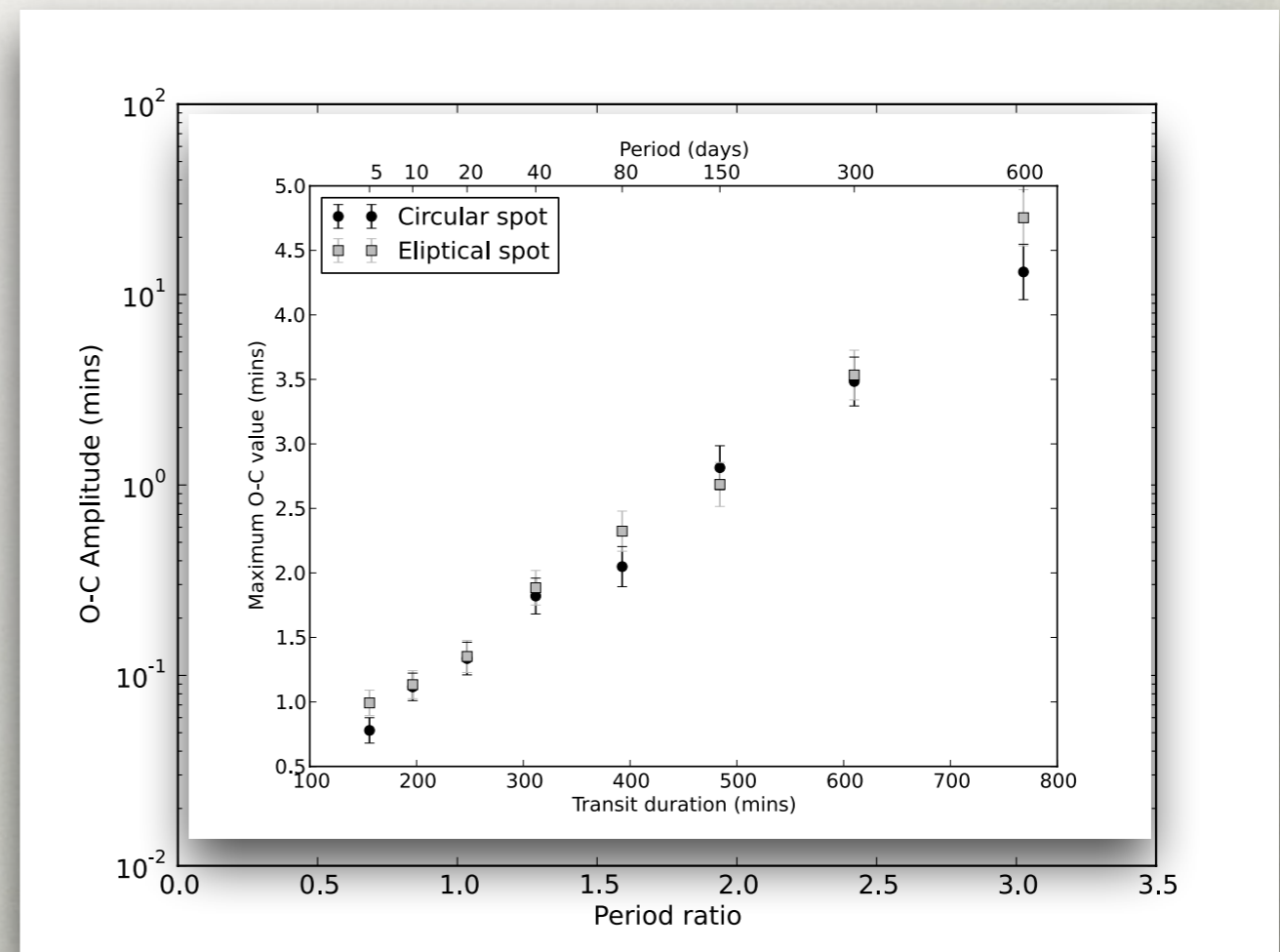
- FAP vs TSNR
- ➔ O-C Periods
- O-C Amplitudes



STARSPOTS AND TTVs

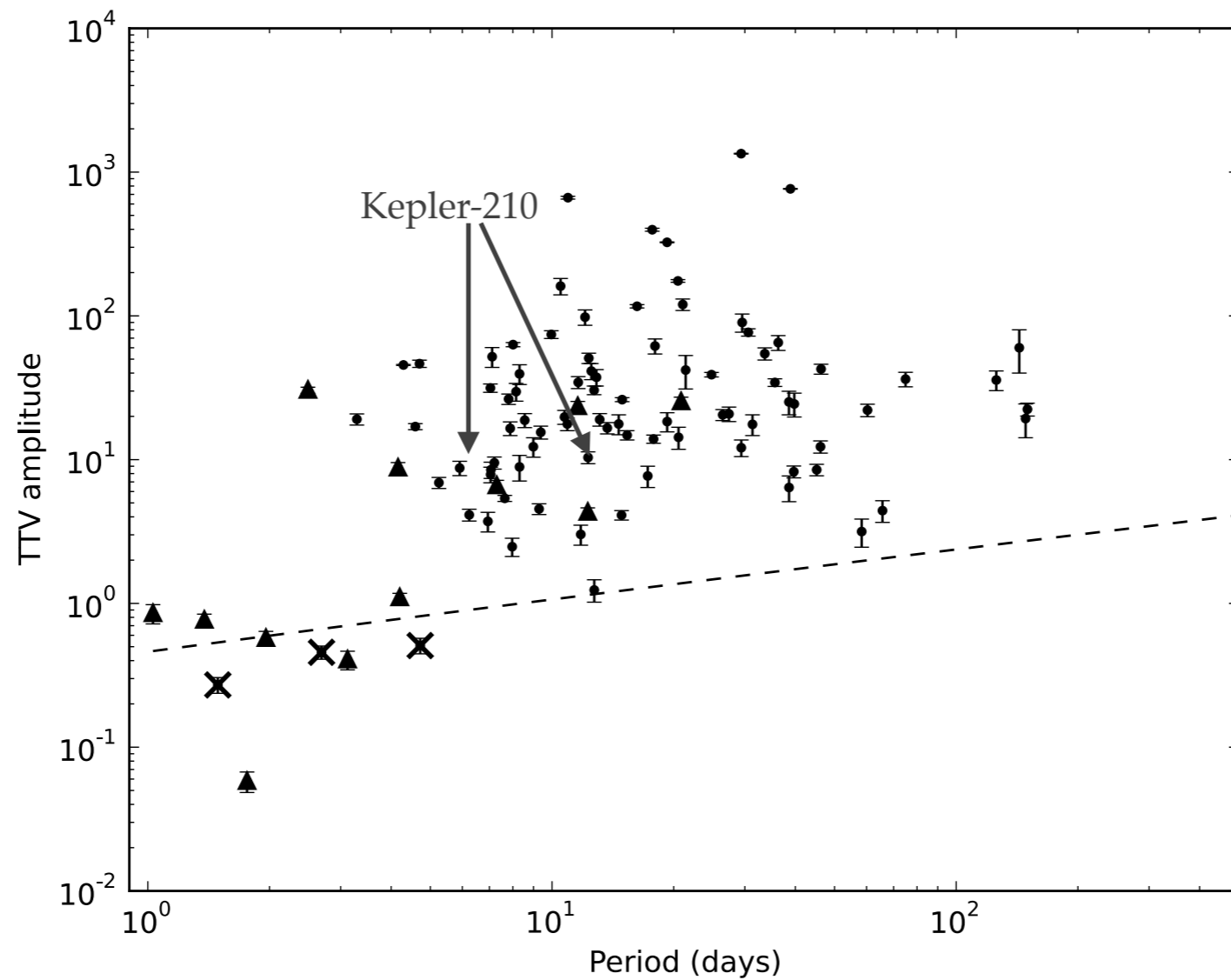
CONSEQUENT TRANSITS

- FAP vs TSNR
- O-C Periods
- ➔ O-C Amplitudes



STARSPOTS AND TTVs

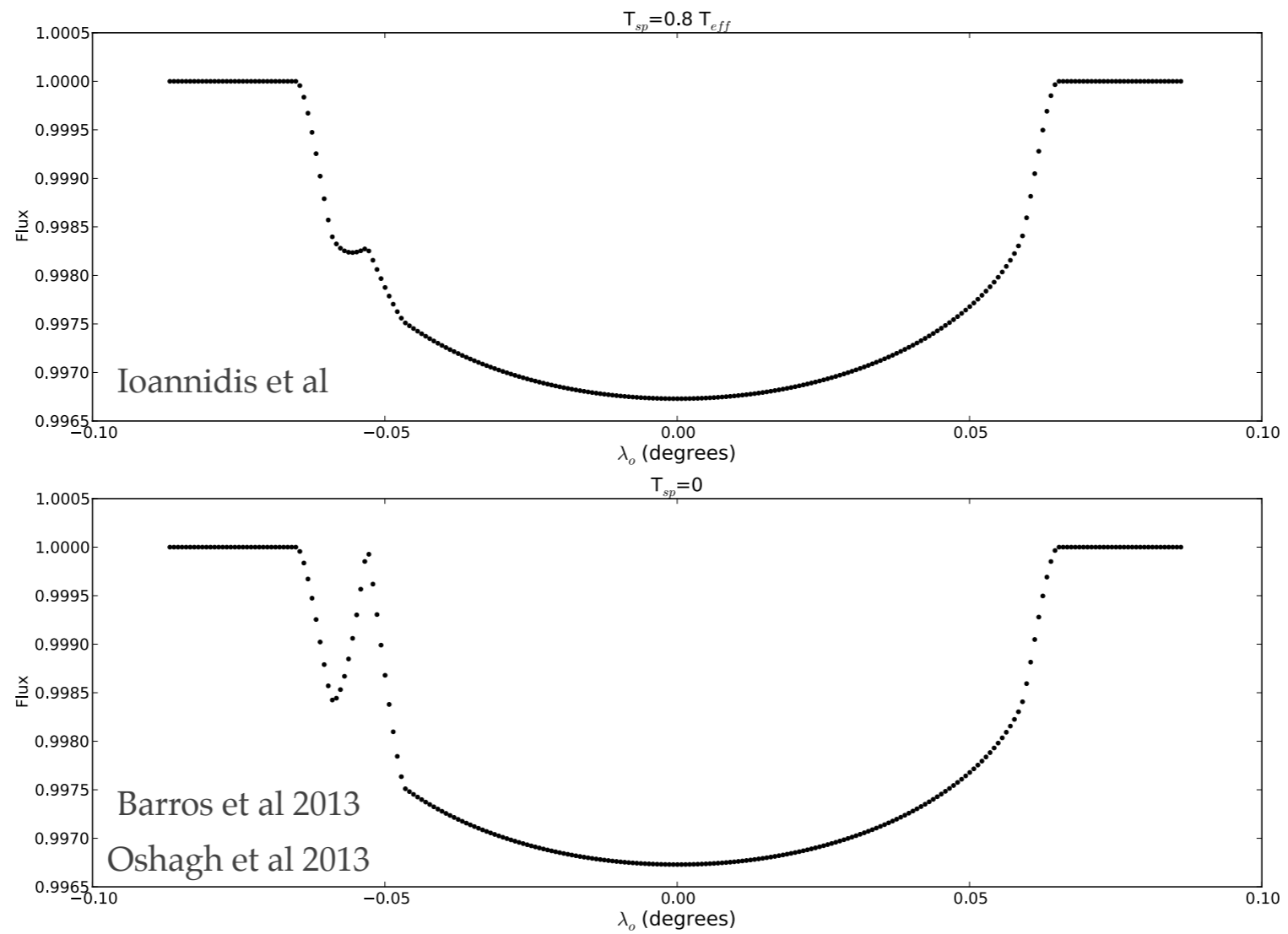
MAZEH ET AL 2013



SUMMARY

- Activity (spots) can affect the measurement of TTVs of planets
- It is related to the transit duration and TSNR
- It is less dependent from the impact factor and the T_{eff} of the star
- The fake TTVs are not accompanied by relative errors
- There is a limit between 1 to 4 mins over which the spots can only disturb and not totally fake TTVs

STARSPOTS AND TTVs



STARSPOTS AND TTVs

