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PyTranSpot - A TOOL FOR COMBINED TRANSIT AND STELLAR SPOT LIGHT-CURVE MODELING

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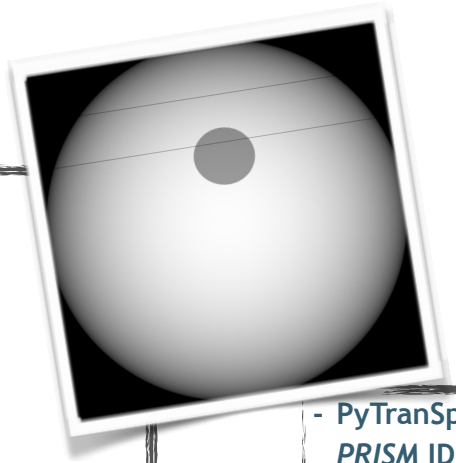
(1) Space Research Institute, Graz, Austria
(2) University of Graz, Austria
(3) Keele University, England
(4) University of Cambridge, England
(5) University of Geneva, Switzerland
(6) TLS Tautenburg, Germany

Idea

- Develop a python routine for *simultaneous transit & star stellar spot* modeling
- fast & easy-to-use
- combine with a multi-core MCMC algorithm (precise system parameters & reliable error calculations)



Why?

- upcoming satellite missions will provide a large set of data (CHEOPS, TESS, PLATO, …)
- number of observed transiting planets orbiting an *active* star will *increase*
- important tool for first steps of *exoplanet characterization*

PyTranSpot

- PyTranSpot follows the approach of the *PRISM* IDL Code by Tregloan-Reed et al. (2013, 2015), but includes certain modifications and improvements
- combined with *MCcubed*[1]
- can model transit light curves *with* & *without* stellar spot activity (also: multiple spots!)
- uses a *pixellation method* to model star & planetary transit on a 2-dim grid
- includes *limb darkening*, options for *polynom-fit* (time, external parameters)

[1] https://github.com/pcubillos/MCcubed

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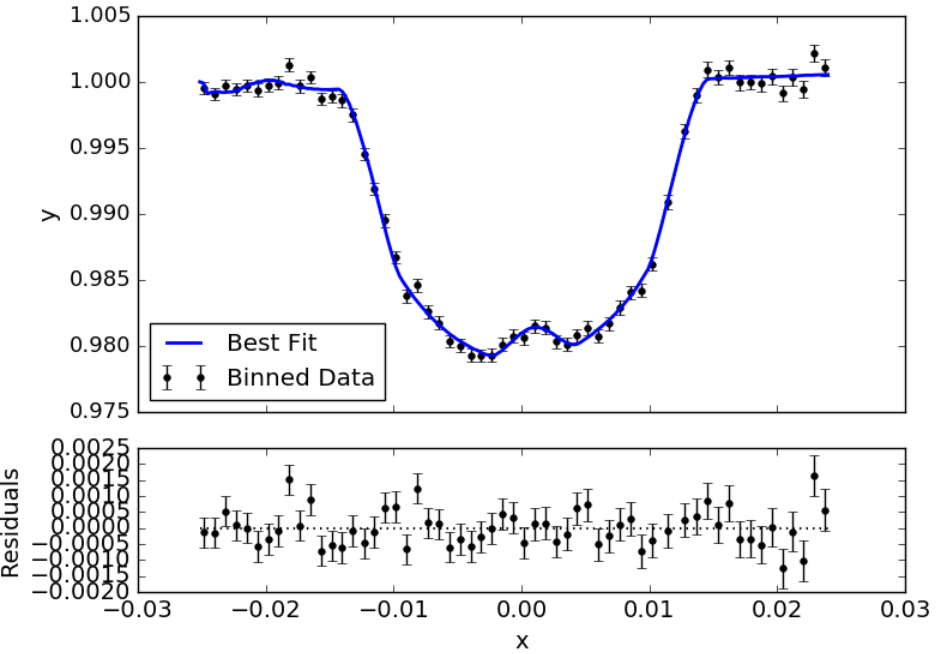
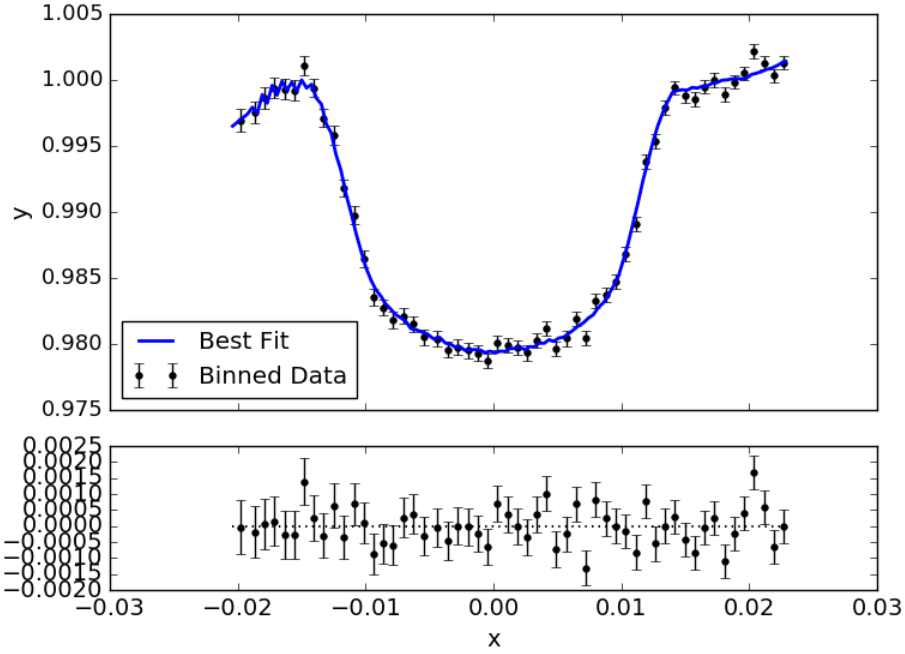
for more information, have a look at my poster!

The WASP-53 System - Preliminary Results

WASP-53 light curve with spot



WASP-53 light curve without spot



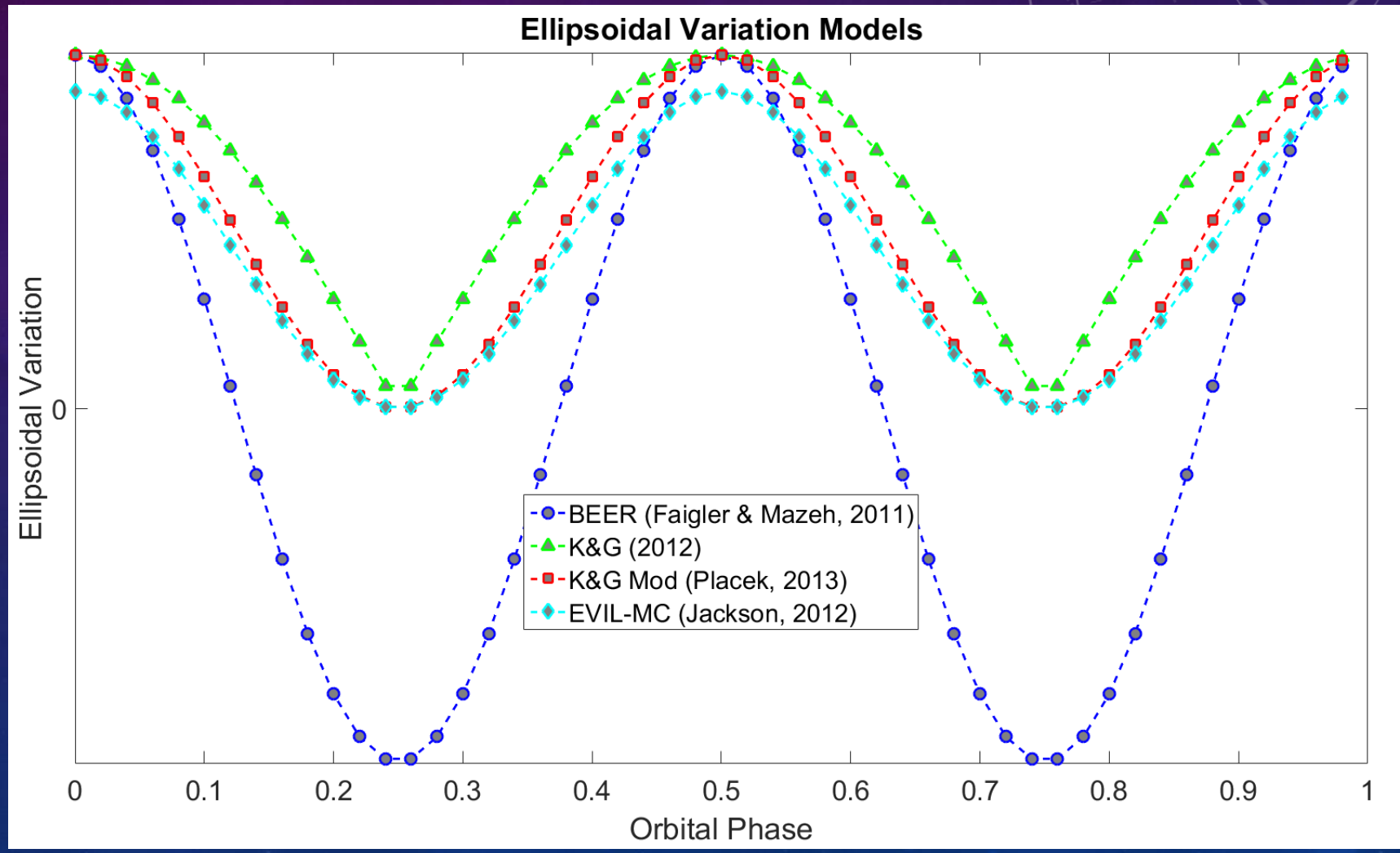
- VALIDATION of the code's performance & capabilities using WASP-53 transit LCs
- FUTURE OUTLOOK: simultaneous analysis of LCs, include Gaussian processes, add more LD-law options

ELLIPSOIDAL VARIATION MODEL TESTING

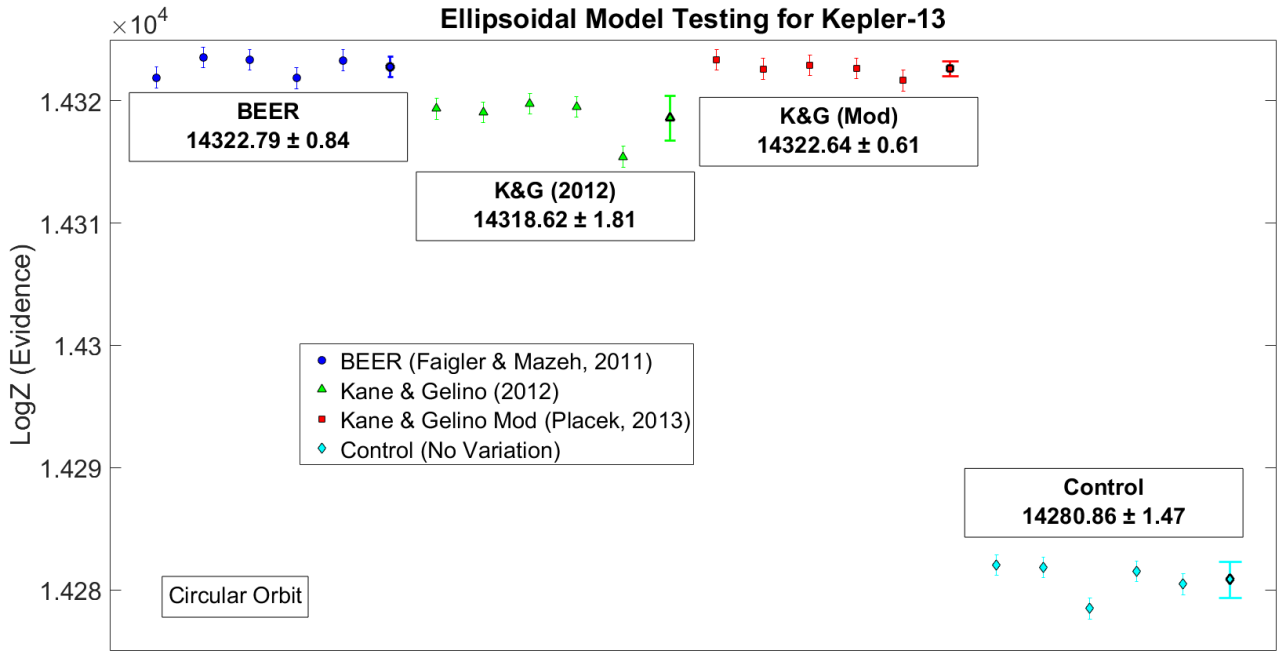
ANTHONY GAI – UNIVERSITY AT ALBANY

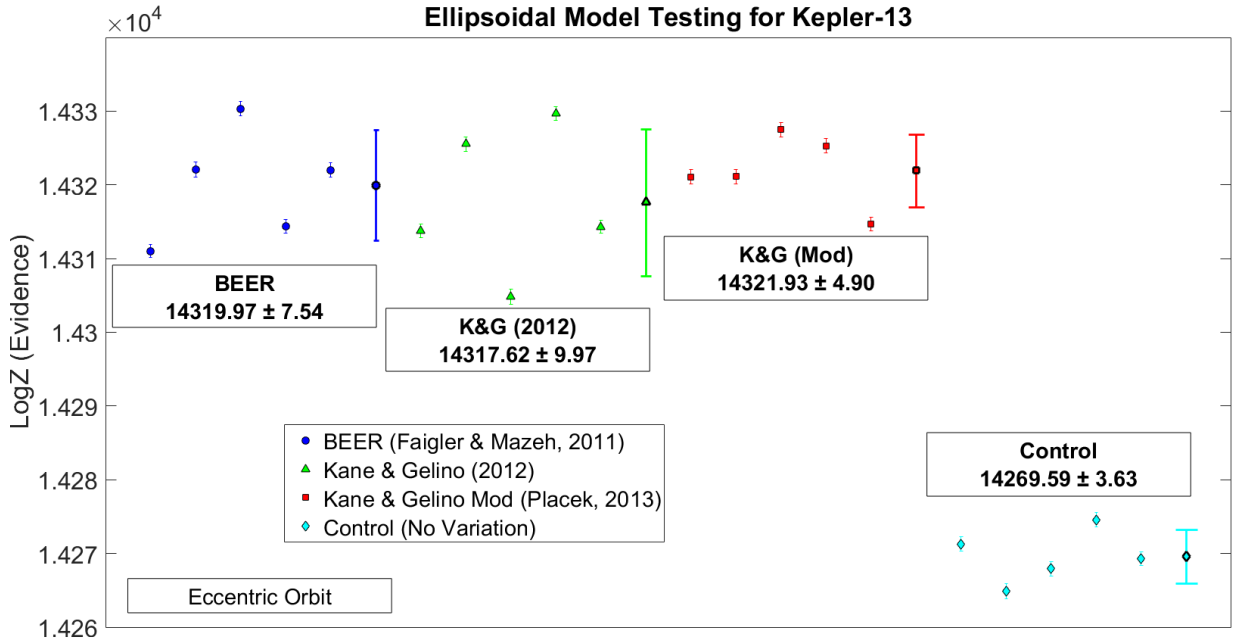
UNIVERSITY AT ALBANY
State University of New York

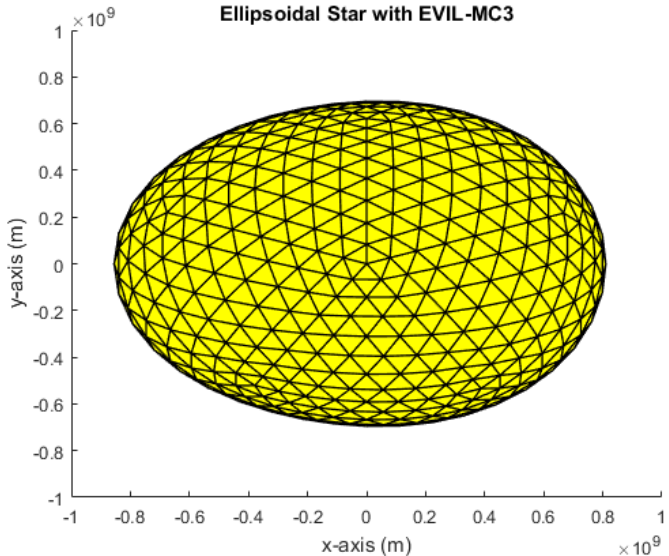
- BEER (Faigler & Mazeh, 2011)
- Kane & Gelino (2012)
- Kane & Gelino Modified (Placek, 2013)
- EVIL-MC (Jackson, 2012)
- Control (No Variation)



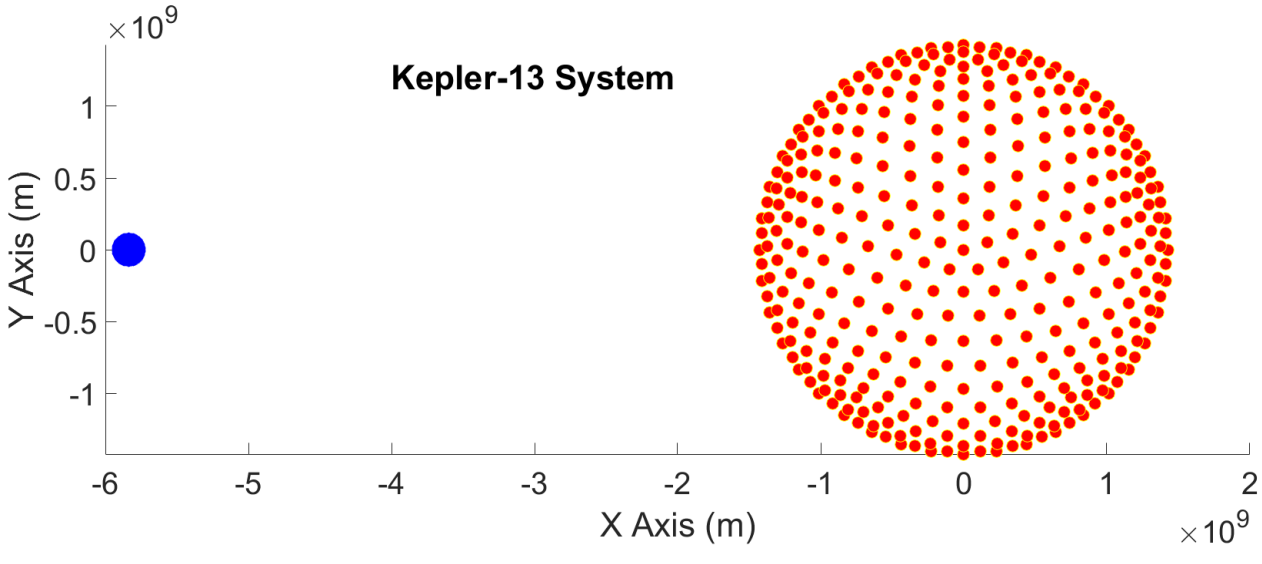
KEPLER-13







- Left - Exaggerated Ellipsoidal Star using EVIL-MC (Jackson 2012)
- Right – Kepler-13 System with ellipsoidal star using EVIL-MC

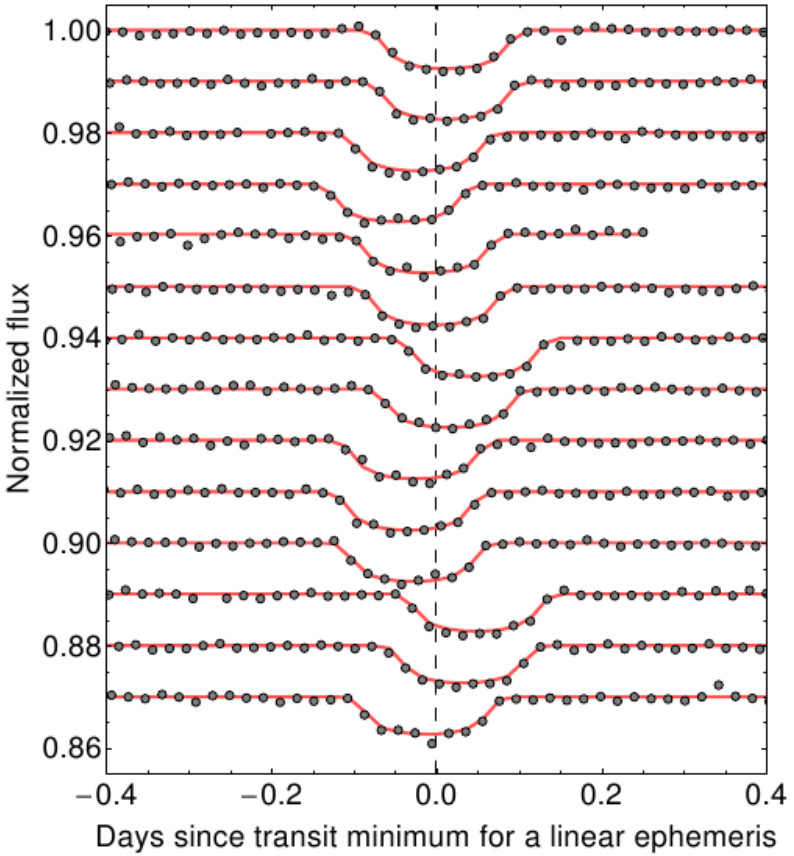


Searching for planets in southern stars via Transit Timing Variations

Emiliano Jofré, Romina Petrucci, & Mercedes Gómez

Astronomical Observatory of Córdoba (OAC), Argentina
National Scientific and Technical Research Council (CONICET), Argentina

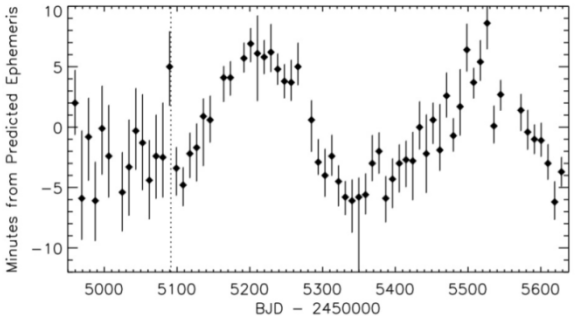
The Transit Timing Variations (TTVs) technique



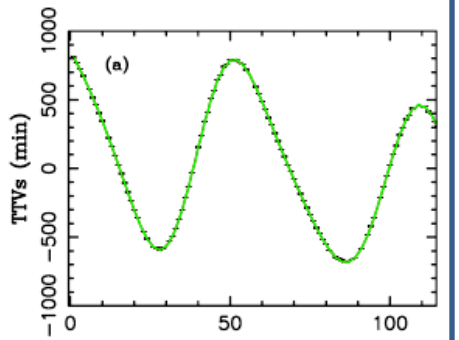
Nesvorný+2012

Several planets discovered, confirmed and characterized using TTVs (*Kepler* data)

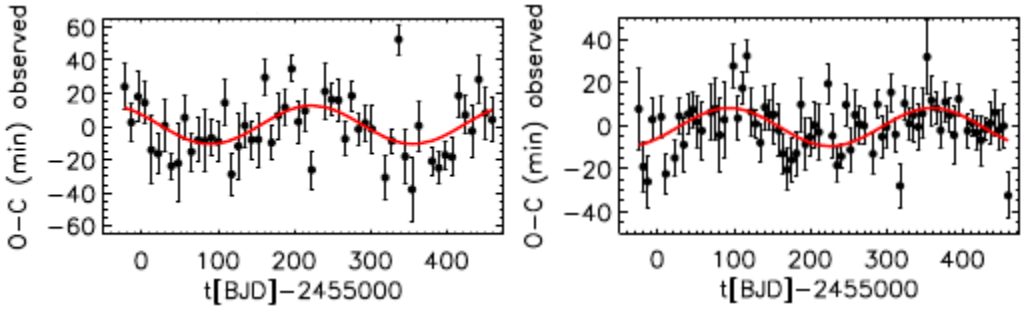
TTVs for Kepler-19b (Ballard+2011)



TTVs for Kepler-88b (Nesvorný+2013)



TTVs for Kepler-32b and Kepler-32c (Fabrycky+2012)



Searching for planets in southern stars via Transit Timing Variations

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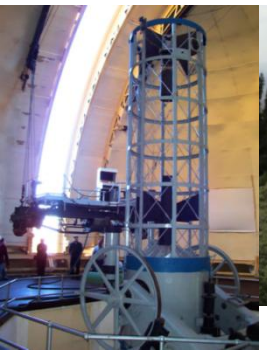
Astronomical Observatory of Córdoba (OAC), Argentina
National Scientific and Technical Research Council (CONICET), Argentina

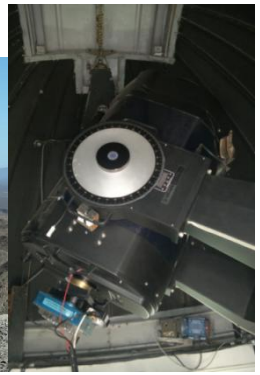
Our project:

2.15-m Telescope (CASLEO), San Juan - Argentina

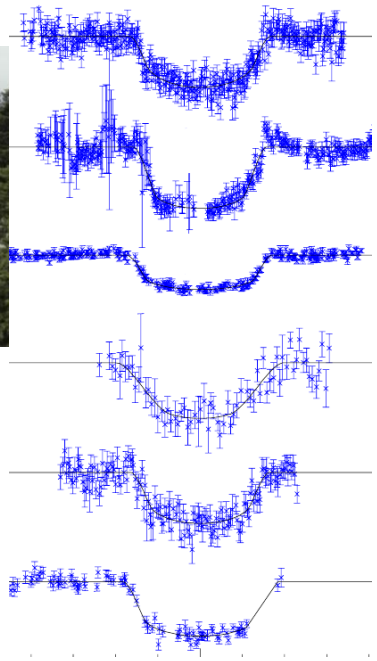

1.54-m Telescope (EABA), Córdoba - Argentina

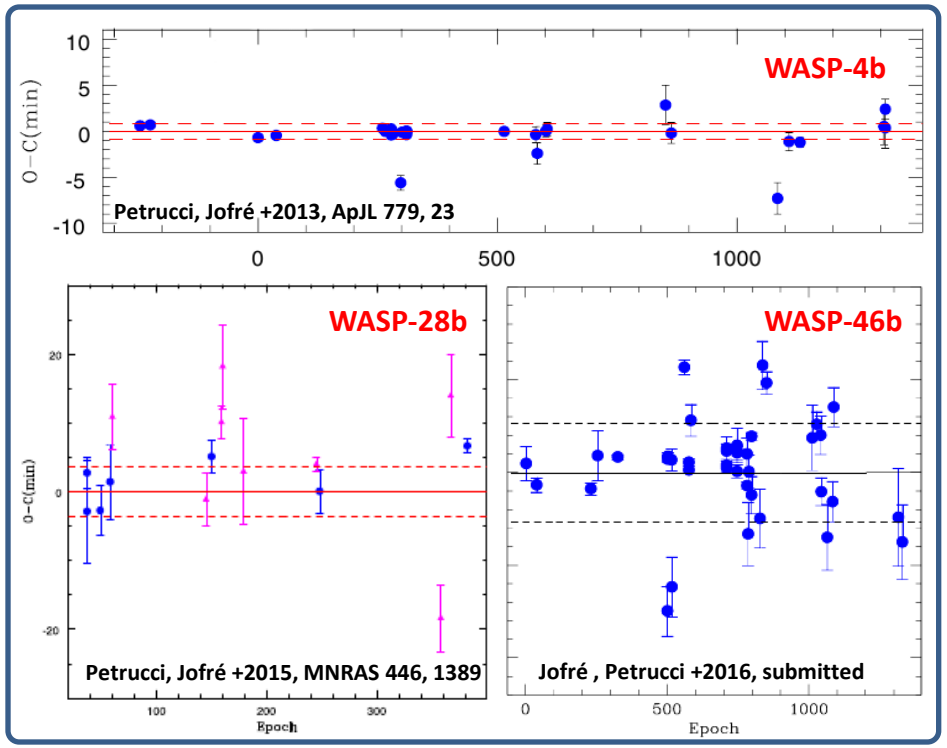



0.40-m (CASLEO)

- Photometric follow-up since mid-2011: 3 Argentinian telescopes
- Sample: Southern stars with transiting planets (V<14; *k*>~13 mmag)
- So far:
  - Over 50 transits of >10 exoplanets
  - Results for WASP-4b, WASP-28b, WASP-46b (more in preparation!)
  - No signs of additional planets…but we are still looking!





For more details about this project, please check out our posters or contact us!

emiliano@oac.unc.edu.ar

Ground Based Follow Up Observations of Hot Jupiters

Sean McCloat[1]

UND Observatory

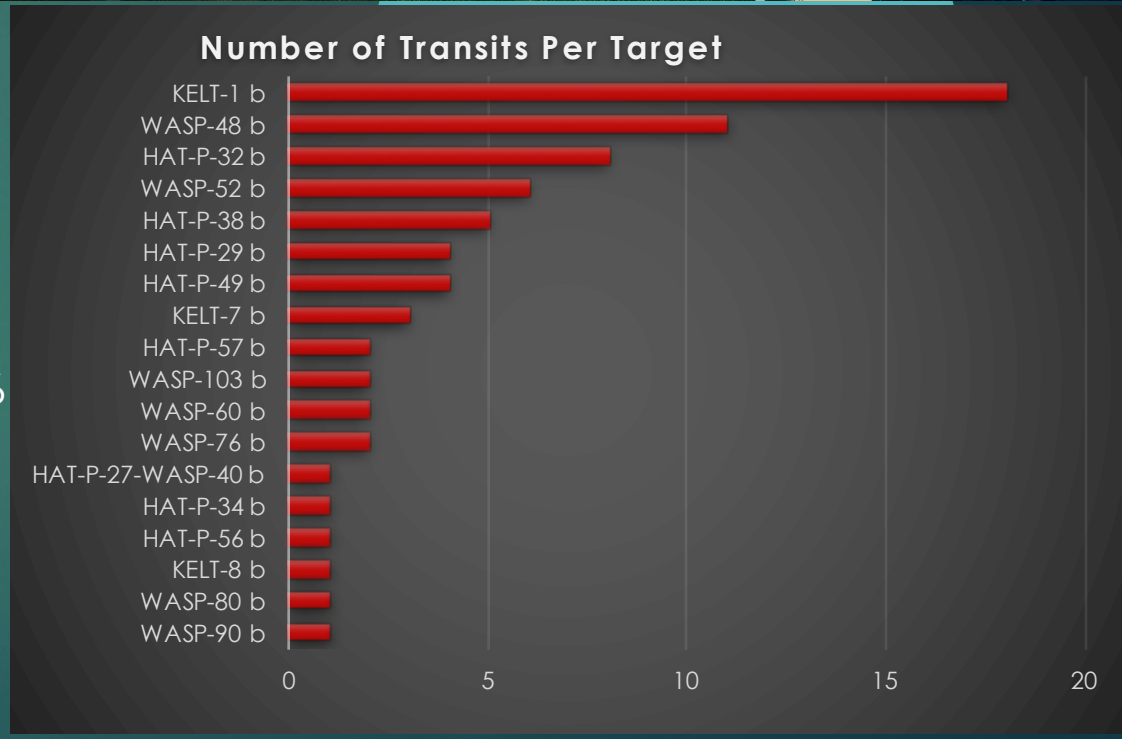
- 16-inch (0.4m) Meade LX200 SCT
- GEM, f/10 system
- Finger Lakes PL16803 CCD
- 4096 x 4096 array, 9x9 microns
- FOV = 30 x 30 arcminutes

Target Parameters:

- Radius: $\geq 0.5\ r_{jup}$
- Brightness: $\leq 13^{th}$ mag
- Discovered since 2011
- Visible from May – Nov 2016

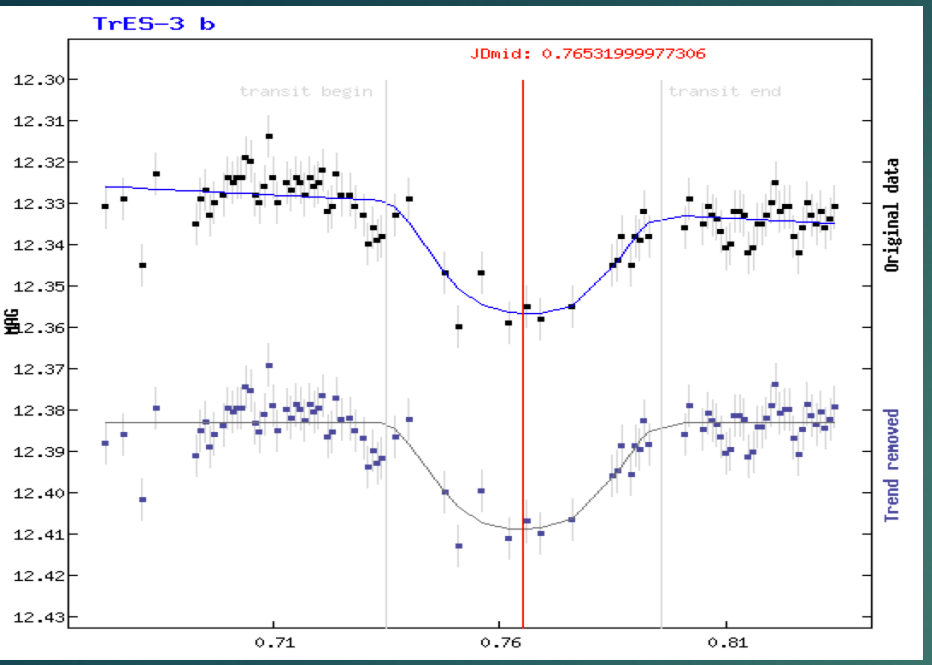
Result:

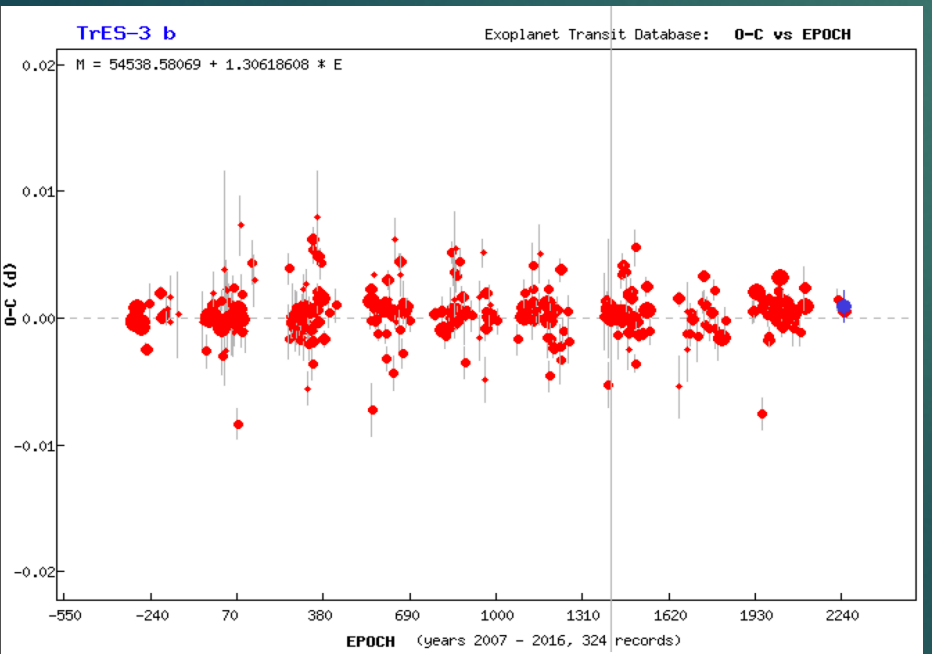
- 73 transit events
- 18 unique targets



1 – University of North Dakota, Graduate Student in Space Studies

Some Data for TrES-3 b





With the observations:

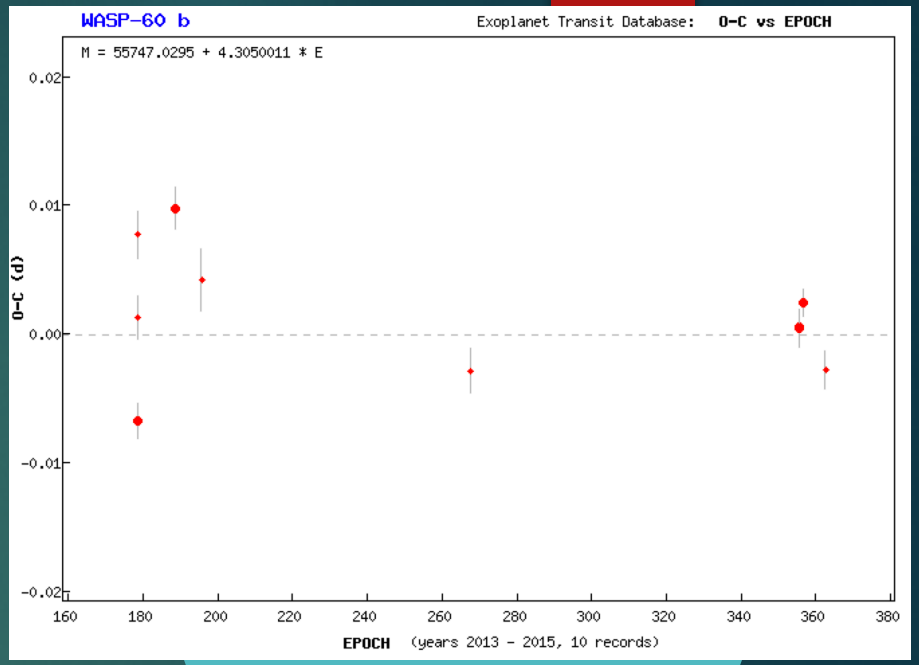
- Add to available transit dataset
- Orbital parameter refinement
- TTV analysis on targets with multiple observations (KELT-1b)

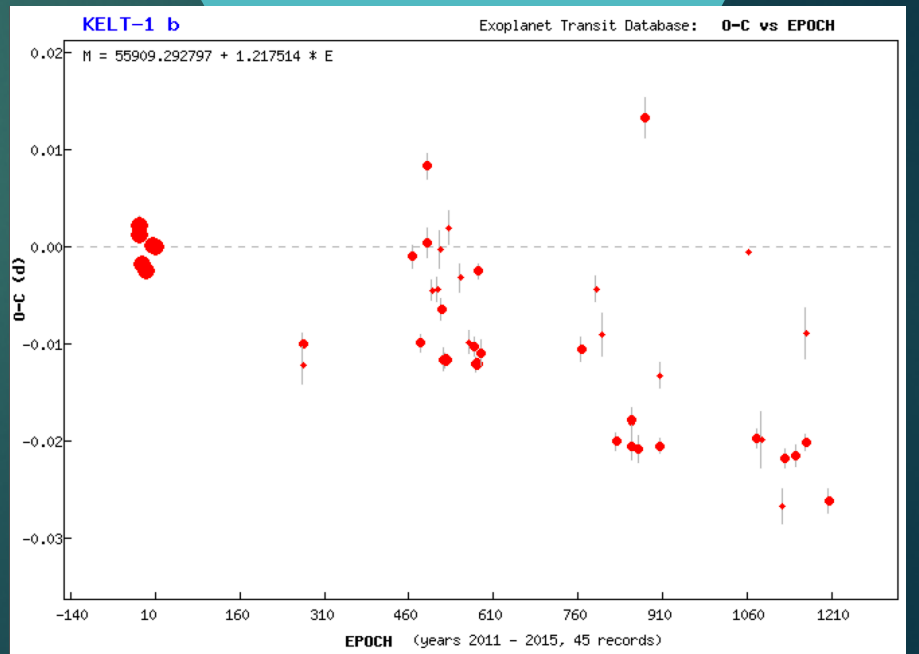
Currently working with:

- Dr. Paul Hardersen
  - Advisor at UND, Asteroid Spectroscopy
- Dr. Carolina von Essen
  - PI of KOINet

Current Project Status:

- astronomer, telescope operator, grounds keeper
- Overcoming pointing problems
- Learning IRAF, Python



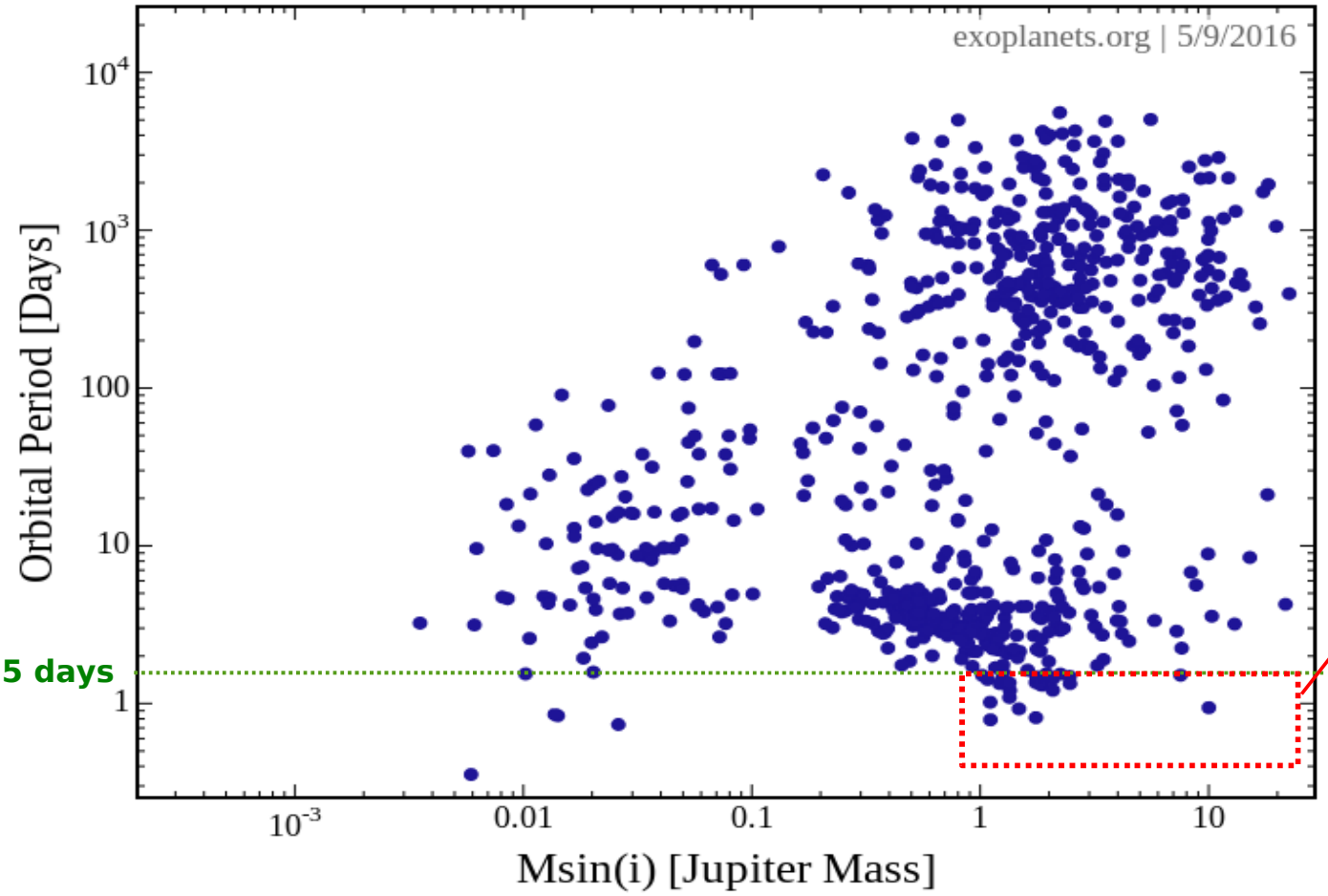


A SEARCH FOR ORBITAL DECAY IN SOUTHERN TRANSITING PLANETS

Romina Petrucci, Emiliano Jofré & Mercedes Gómez

CONICET

OAC Observatorio Astronómico de Córdoba



JUPITER-LIKE PLANETS

Many of them will spiral in toward their host stars

Challenge for theories of formation and evolution of planetary systems

A SEARCH FOR ORBITAL DECAY IN SOUTHERN TRANSITING PLANETS

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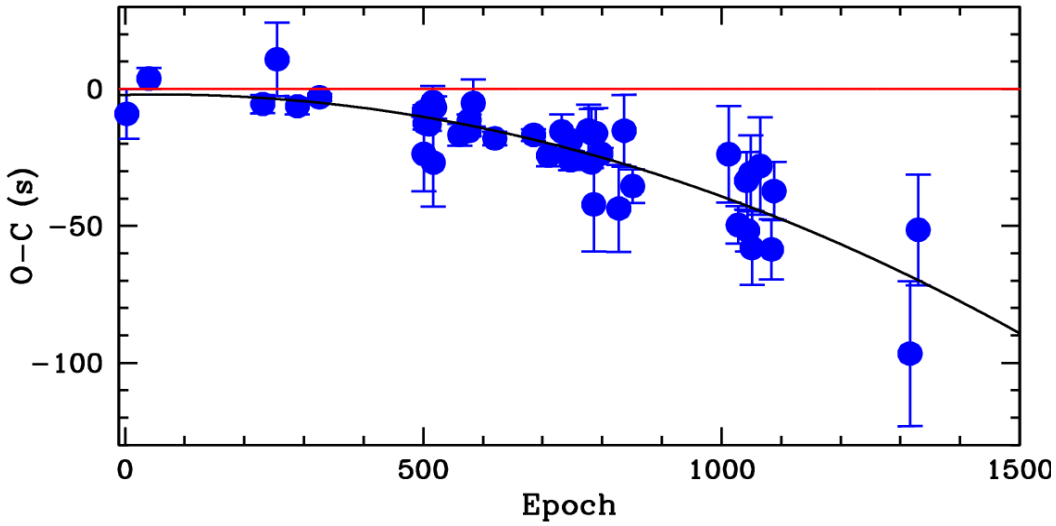
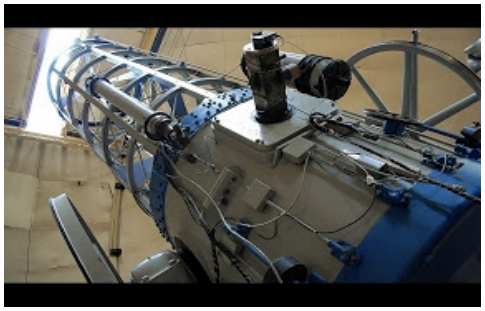
ORBITAL DECAY



OUR PROJECT

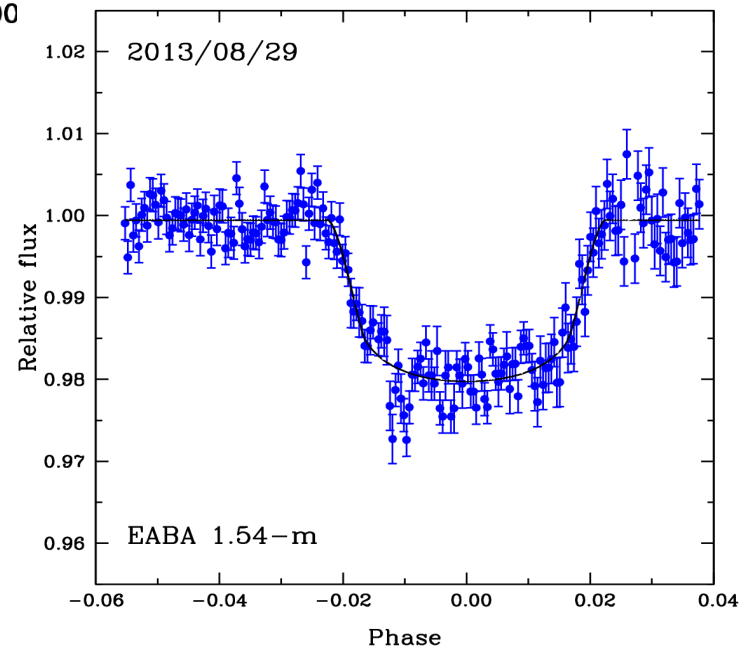
To perform a photometric follow-up of stars with Hot-Jupiters and short orbital periods to assess the presence of orbital decay

TELESCOPES

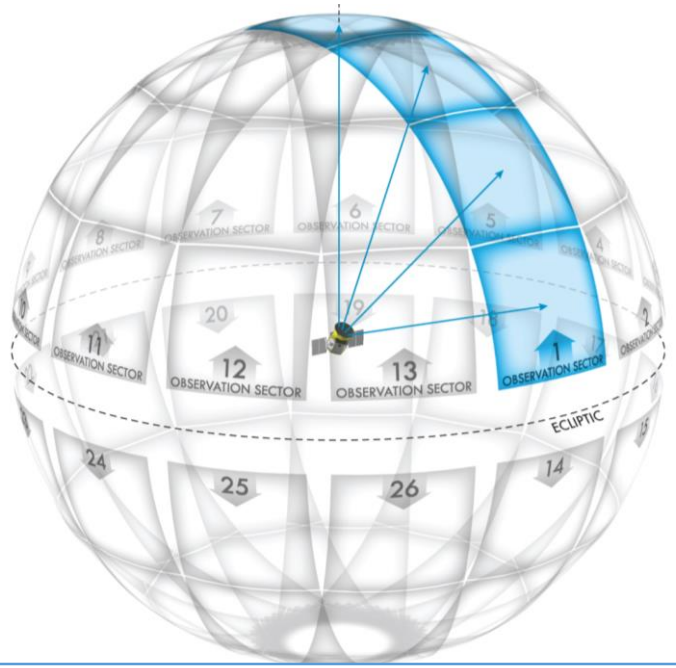


1.54-m telescope
(EABA, Argentina)

2.15-m “Jorge Sahade” telescope
(CASLEO, Argentina)

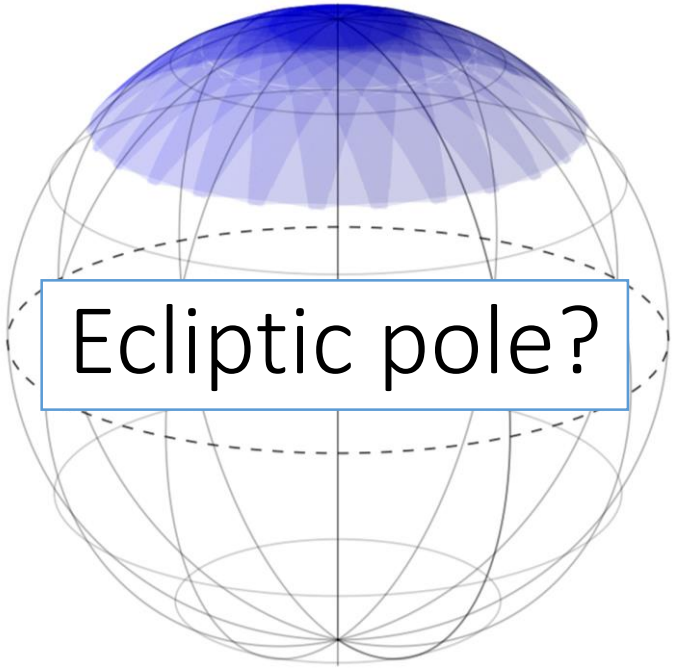


What should we do next with the Transiting Exoplanet Survey Satellite?

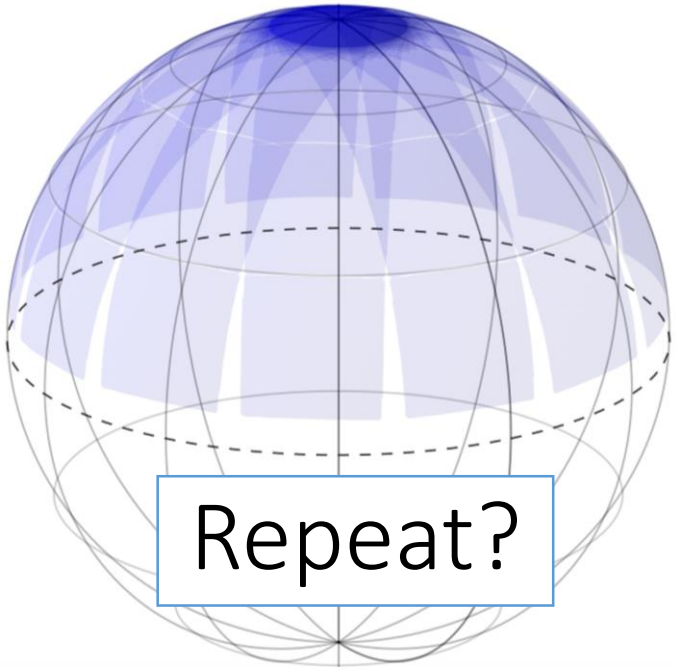


Ricker, et al. (2014)

Primary mission (2017-19)

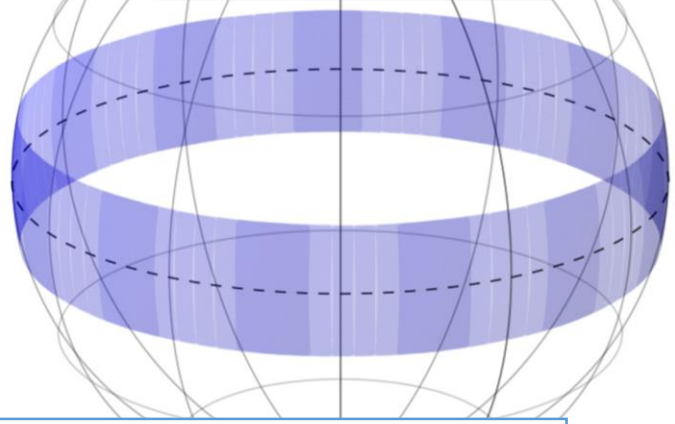


Ecliptic pole?



Repeat?

Ecliptic?



Extended mission (≥ 2020)

Luke Bouma • lgbouma@mit.edu

Ecliptic pole maximizes the number of newly detected…
…planets with long orbital periods
…habitable zone planets
…multiple-planet systems.

Ecliptic plane detects…
… fewer new planets
orbiting brighter host stars,
which makes them more amenable to atmospheric characterization.

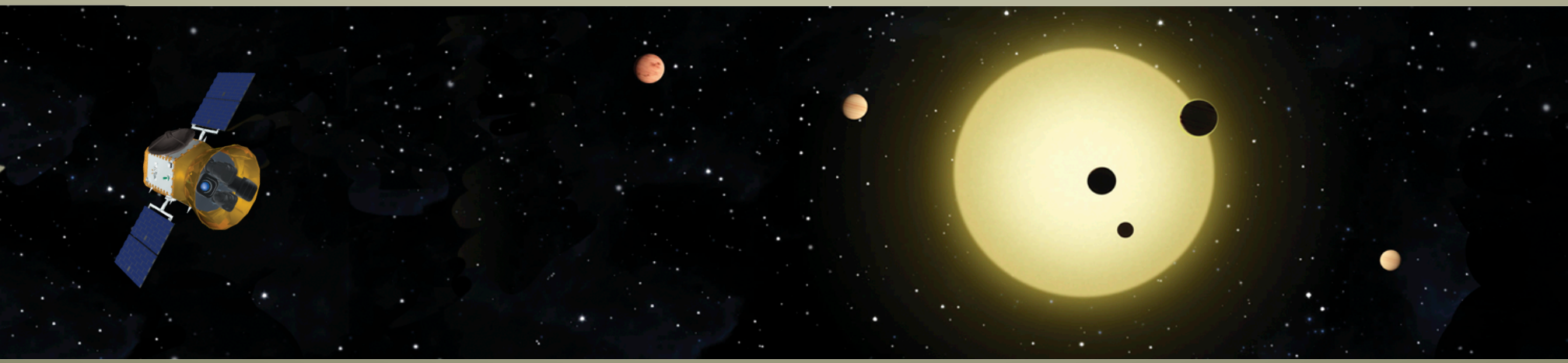
Luke Bouma • lgbouma@mit.edu

Visit poster 6 for discussion & details!

An Optical Test Bench for Precision Characterization of the TESS CCD Detectors

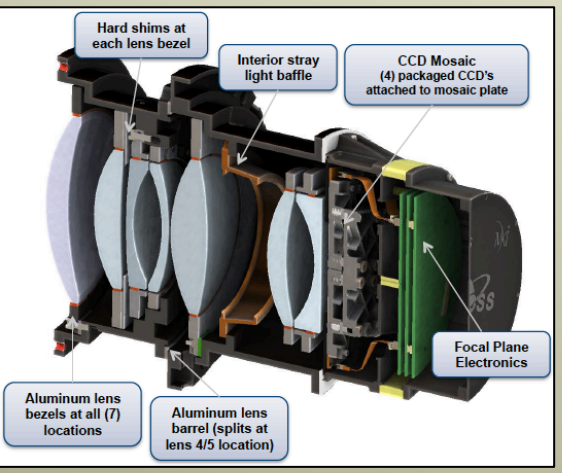
Akshata Krishnamurthy

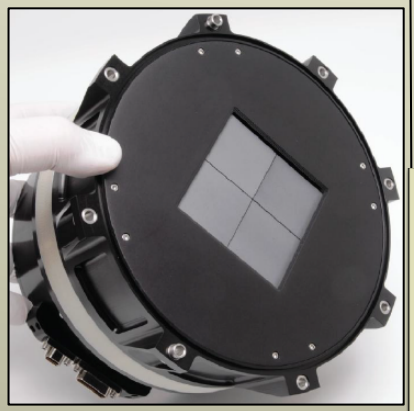
MIT Kavli Institute for Astrophysics and Space Research



Sagan Summer Workshop, July 18-22, 2016

Motivation





- Four wide-field optical charge-coupled device (CCD) cameras, band-pass of 650 nm – 1050 nm
- Four back-illuminated MIT Lincoln Lab CCID-80 devices with 2kx2k imaging array
- 62 x 62 mm square area with 15 μm square pixels
- The measurement of absolute quantum efficiency of the CCD detectors will hugely aid in data analysis, especially over redder wavelengths
- A higher QE will yield a higher photon count and a higher signal, and yield higher planetary detection

Precision Absolute QE Test Setup

The design goal is to develop a test bench capable of automated absolute quantum efficiency measurements over the spectral range of 650-1050 nm with an absolute error of 1.5 – 2.0 %.