

**Count all the photons!
Best practices for extracting
accurate light curves for all
objects in the TESS FFIs.**



THE UNIVERSITY OF
CHICAGO



UNSW
SYDNEY

Benjamin Montet
NASA Sagan Fellow
#TessCon
1 August 2019

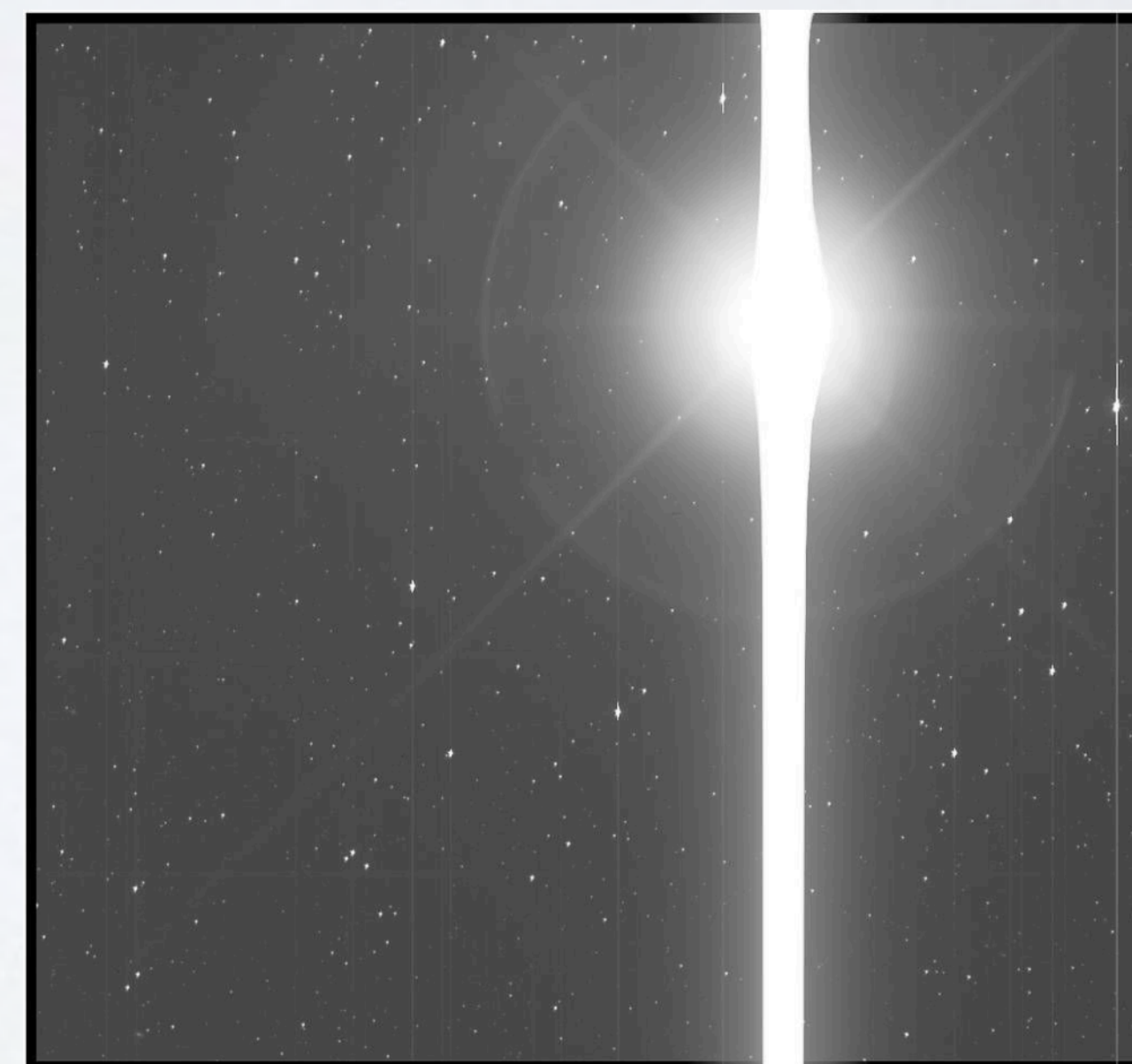


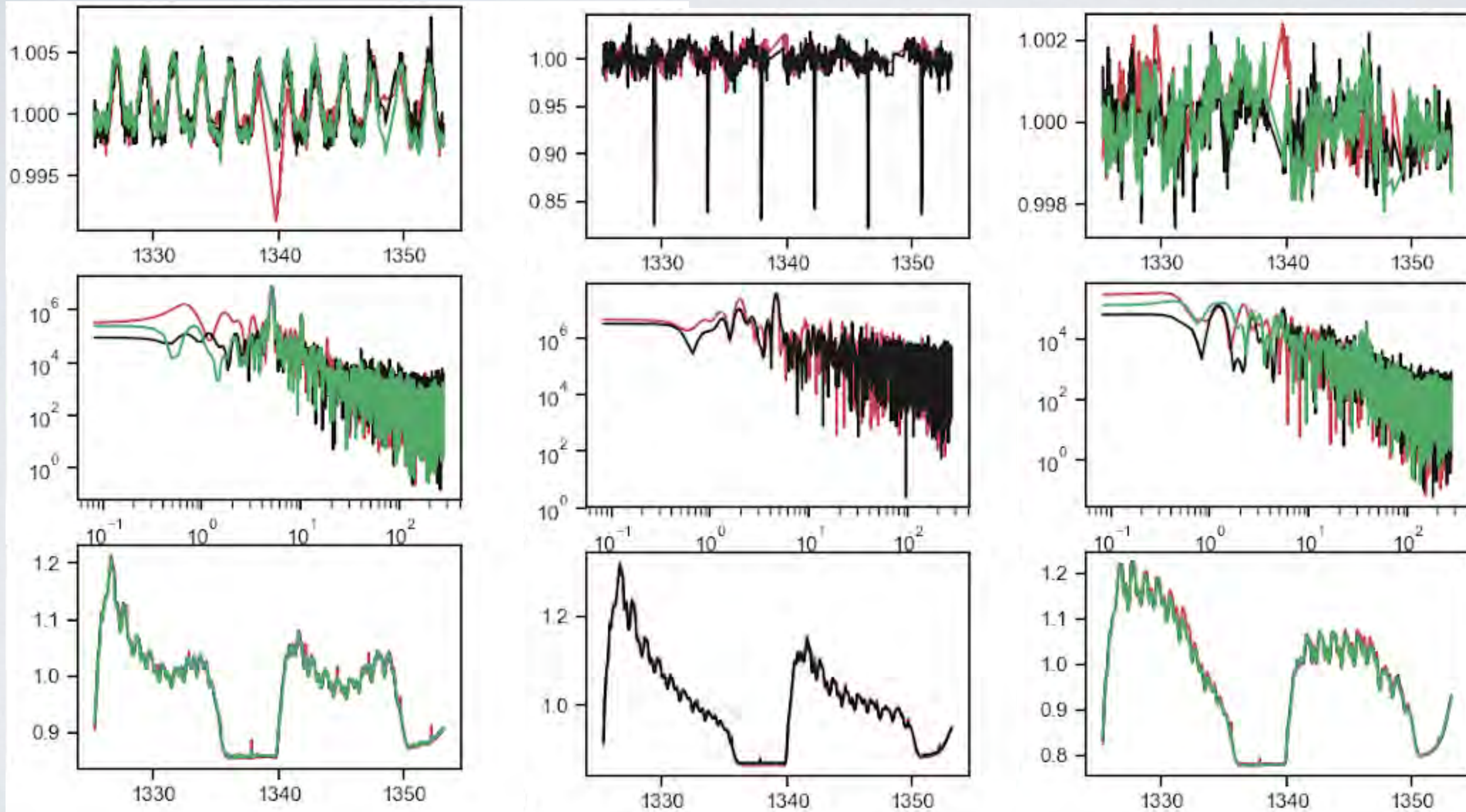


photo credit @moon

1) How do instrument systematics affect completeness?

(Really, if you have ideas please tell us)

It's easy to make sure your results are pipeline-insensitive!



Images Mikkel Lund

It's easy to make sure your results are pipeline-insensitive!

HLSP

[Home](#)

High Level Science Products are observations, catalogs, or models that complement, or are derived from, MAST-supported missions. These include Hubble (HST), James Webb (JWST), TESS, PanSTARRS, Kepler/K2, GALEX, Swift, XMM, and others. HLSPs can include images, spectra, light curves, maps, source catalogs, or simulations. They can include observations from other telescopes, or data that have been processed in a way that differs from what's available in the originating archive. **Use the filters below to discover HLSP.**

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```
[3]: star = eleanor.Source(tic=38846515, sector=1, tc=True)
```

```
[5]: data = eleanor.TargetData(star, height=15, width=15, bkg_size=31, do_psf=True, do_pca=True)
```

```
[11]: from lightkurve.lightcurve import LightCurve as LC  
  
lk = LC(data.time[q], data.corr_flux[q]).plot()
```


2) How can we combine TESS with other data sets to understand variability?

TESS + Kepler

Observations of the *Kepler* Field with *TESS*: Predictions for Planet Yield and Observable Features

CALLISTA N. CHRIST,¹ BENJAMIN T. MONTET,^{1,*} AND DANIEL C. FABRYCKY¹

¹*Department of Astronomy and Astrophysics, University of Chicago, 5640 S. Ellis Ave, Chicago, IL 60637, USA*

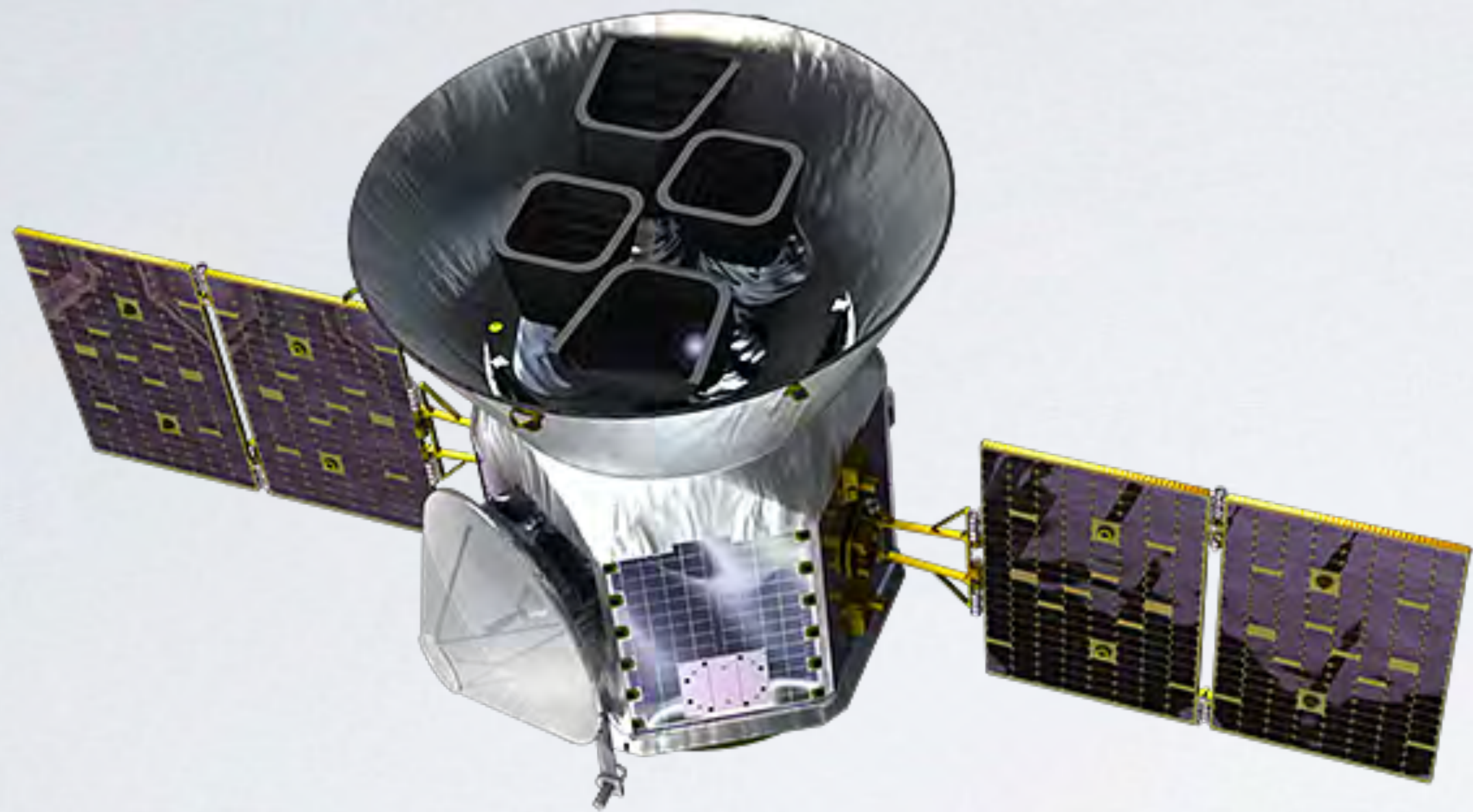
arXiv:1810.02826

PROSPECTS FOR REFINING KEPLER TTV MASSES USING TESS OBSERVATIONS

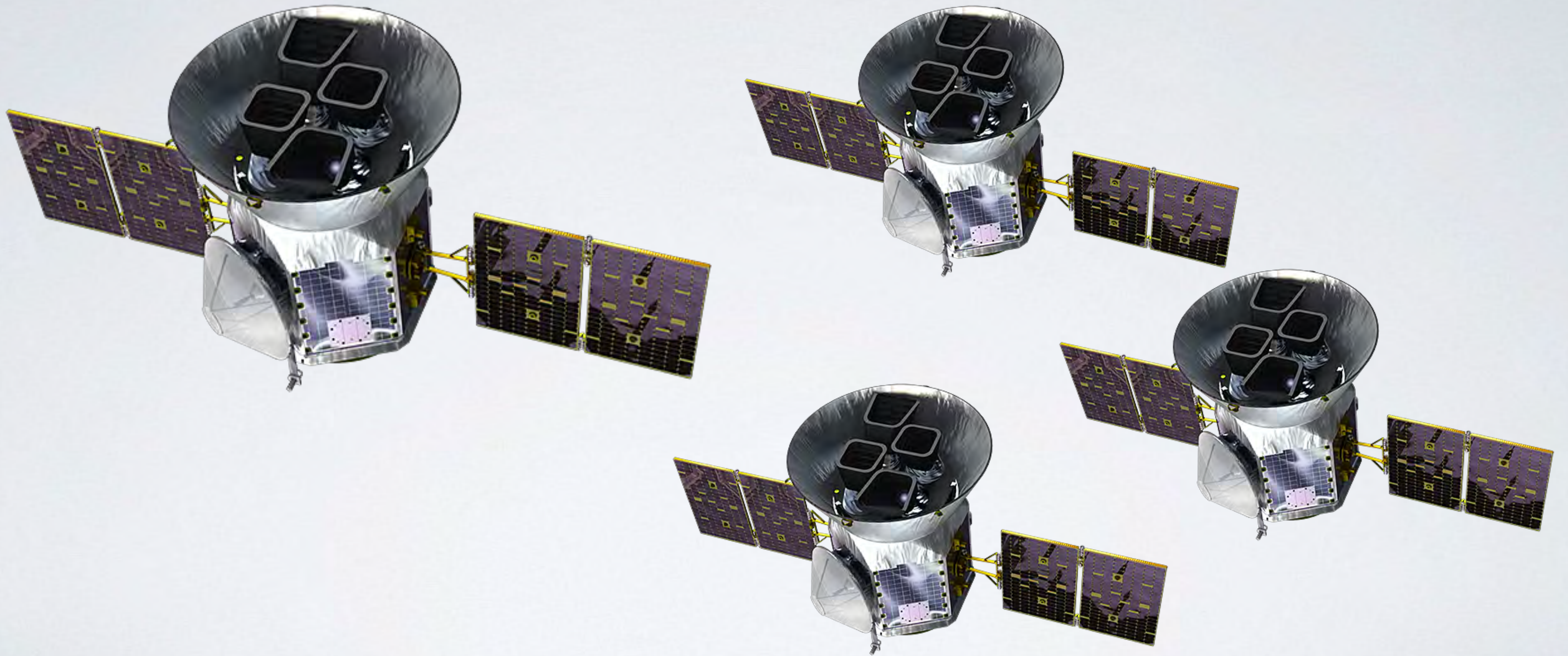
MAX GOLDBERG,¹ SAM HADDEN,² MATTHEW J. PAYNE,² AND MATTHEW J. HOLMAN²

arXiv:1810.02852

TESS + TESS

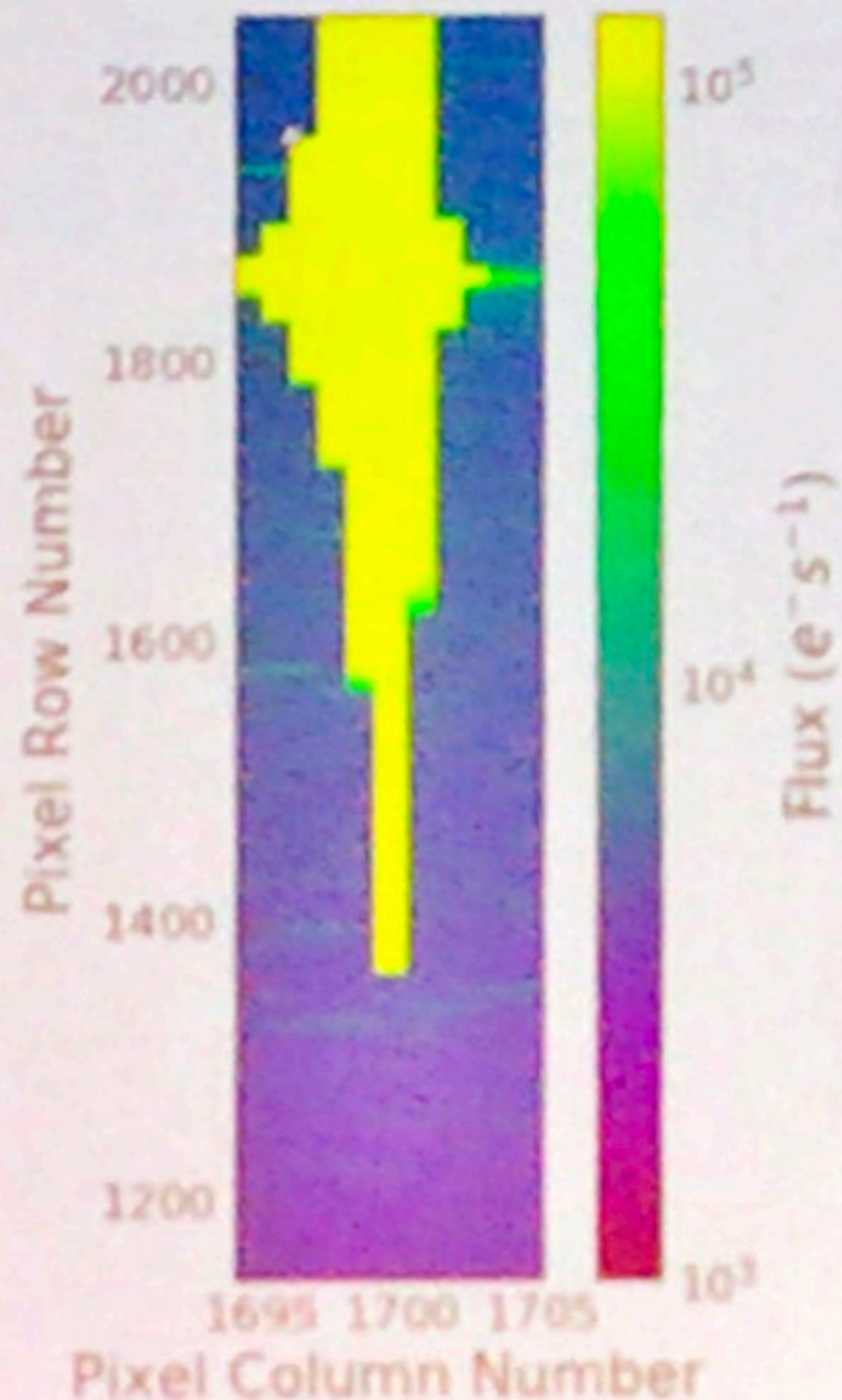


TESS + TESS



**3) So much TESS work is enabled by
open science**

Target ID: 399646462



Aperture Losses

'Halo' photometry

White et al. 2017

Pope et al. (in prep.)



Code:

<https://github.com/hvidy/halophot>



K2 light curves:

<https://github.com/benjaminpope/k2halo>


```
In [1]: import halophot
import numpy as np
from halophot.halo_tools import halo_tpf
```

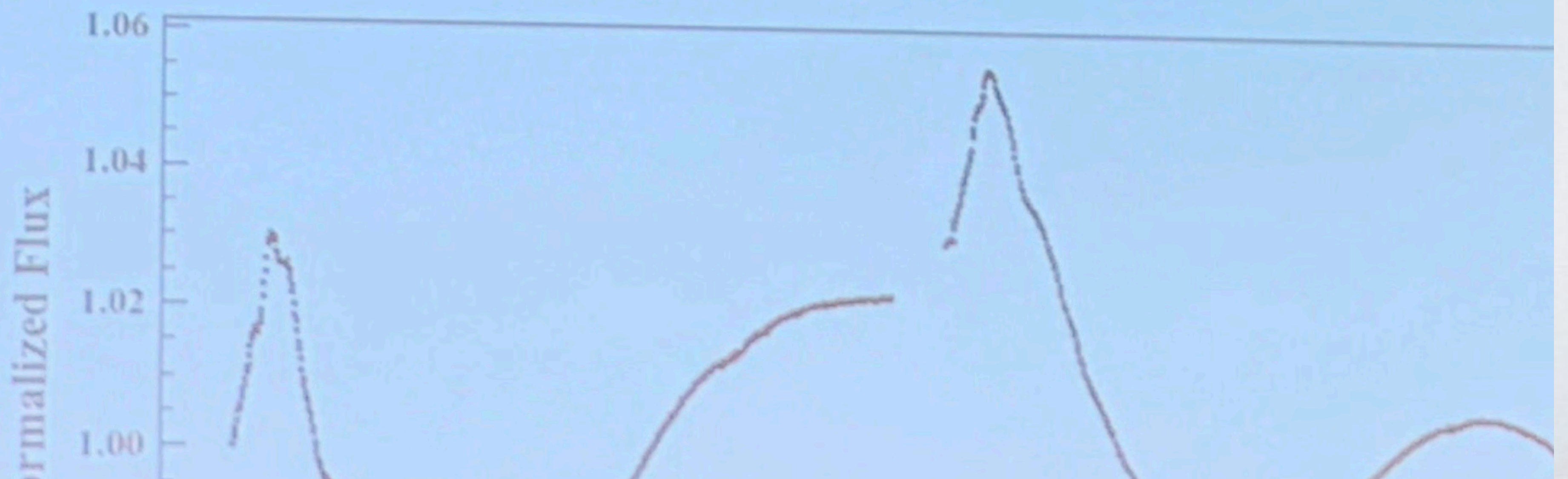
```
In [2]: fname = '../data/gamCru/tess-s0011-2-1_187.791498_-57.113213_25x25_astrocut.fits.gz'
tpf = halo_tpf(fname)
```

```
In [3]: newmask = np.ones((tpf.flux.shape[1], tpf.flux.shape[2]), dtype='bool')
```

```
In [4]: %time
weightmap, corr_lc = tpf.halo(objective='tv', verbose=False, mask=newmask, minflux=-450, thr
CPU times: user 1.53 s, sys: 4.37 ms, total: 1.54 s
Wall time: 834 ms
```

```
In [5]: corr_lc.scatter()
```

```
Out[5]: <matplotlib.axes._subplots.AxesSubplot at 0x7f2fb17b3860>
```



KeplerGO / lightkurve

Used by 31 Watch 14 Unstar 110 Fork 62

Code Issues 80 Pull requests 26 Projects 0 Wiki Security Insights

A friendly package for Kepler & TESS time series analysis in Python. <https://docs.lightkurve.org>

kepler k2 tess astrophysics astronomy python time-series timeseries

861 commits 2 branches 20 releases 20 contributors MIT

Branch: master New pull request Create new file Upload files Find File Clone or download

barentsen Update README.rst Latest commit b461d06 2 days ago

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dfm / exoplanet

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Fast & scalable MCMC for all your exoplanet needs! <https://exoplanet.dfm.io>

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time-series-analysis astronomy astrophysics exoplanets

904 commits 10 branches 7 releases 6 contributors MIT

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dfm switching to integrated limbdark light curves Latest commit e10d21f yesterday

.ci simpler travis build 3 months ago

.vscode in place integration of light curves 2 days ago

docs switching to integrated limbdark light curves yesterday

Code Issues 80 Pull requests 26 Projects 0 Wiki

A friendly package for Kepler & TESS time series analysis in Python. <https://github.com/KeplerGO/lightkurve>

kepler k2 tess astrophysics astronomy python time-series timeseries

861 commits 2 branches 20 releases

Branch: master New pull request

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904 commits 10 branches 7 releases

Branch: master New pull request

- dfm switching to integrated limbdark light curves
- .ci simpler travis build
- .vscode in place integration of light curves
- docs switching to integrated limbdark light

Code Issues 3 Pull requests 0 Projects 0 Security Insights

The basic photometry setup for TASOC

photometry space

601 commits 10 branches 9 releases 4 contributors GPL-3.0

Branch: devel New pull request Create new file Upload files Find File Clone or download

- rhandberg Bugfix for radial background of really bad images Latest commit b33cf91 7 hours ago
- notes Eliminate leftovers from supporting Python 2.7 9 hours ago
- photometry Bugfix for radial background of really bad images 7 hours ago

Code Issues 6 Pull requests 0 Projects 0 Wiki Security Insights

No description, website, or topics provided.

951 commits 5 branches 1 release 1 environment 11 contributors MIT

Branch: master New pull request Create new file Upload files Find File Clone or download

- afeinstein20 Merge branch 'master' of <https://github.com/afeinstein20/eleanor> Latest commit 4c4395e 13 hours ago
- .ci this might do it last month
- docs updating tutorial 6 days ago
- eleanor Merge branch 'master' of <https://github.com/afeinstein20/eleanor> 13 hours ago

TESS Chromatic PSF Tools

18 commits 2 branches 0 releases 2 contributors

Branch: master New pull request Create new file Upload files Find File Clone or download

christinahedges bugfix Latest commit

chromo bugfix

demos bugfix

rhandberg Bugfix for radial background of really bad images

notes Eliminate leftovers from supporting Python 2.7

photometry Bugfix for radial background of really bad images

For characterizing flares in the TESS FFIs

45 commits 1 branch 0 releases 1 contributor MIT

Branch: master New pull request Create new file Upload files Find File Clone or download

afeinstein20 version 0.0.3? Latest commit 06a5f54 7 days

figures new logo 28 days ago

stella.egg-info version 0.0.3? 7 days ago

K2 Halo Photometry

An adapted version of Appaloosa with lightkurve I/O. Uses a version of K2SC for systematics/variability removal. Instructive jupyter notebooks inside. https://altaipony.readthedocs.io/en/l...

235 commits 1 branch 0 releases 3 contributors MIT

Branch: master New pull request Create new file Upload files Find File Clone or download

ekaterinailin Added injrec to docs Latest commit 4208fbc 16 hours ago

.github deprecated from fits_file in favor of fewer more specific io routines 2 months ago

altaipony Improved sigma clipping 19 hours ago

docs Added injrec to docs 16 hours ago

Simulated CCD Observations for Photometric Experimentation

407 commits 4 branches 5 releases 3 contributors MIT

Branch: master New pull request Create new file Upload files Find File Clone or download

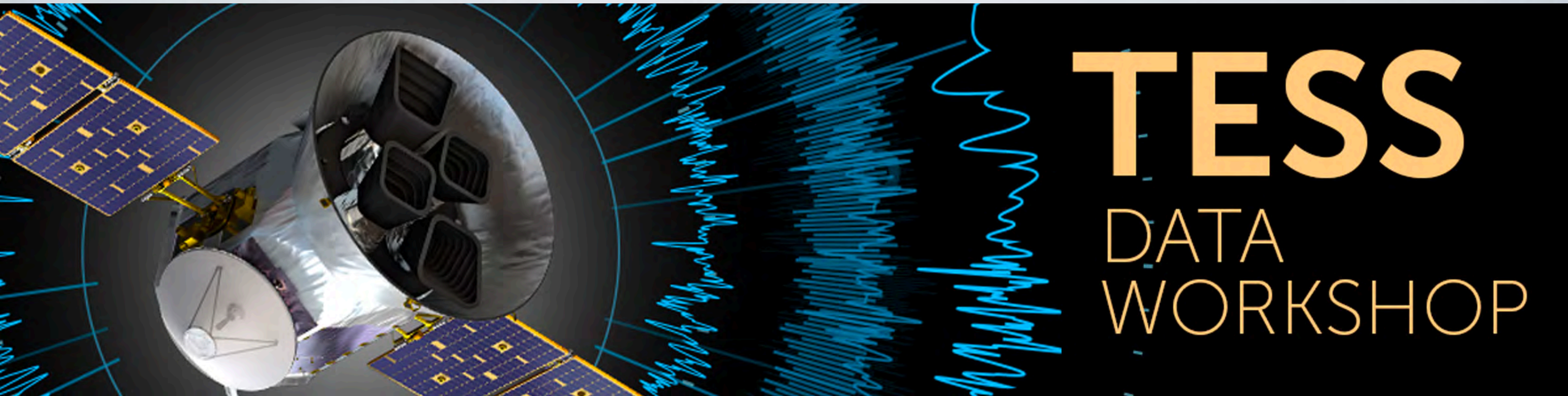
nksaunders add george install Latest commit 9bb5257 21 days

.ci makefile fix last

.kplr/data/k2/target_pixel_files/205998445 tpf last

Earthshine in TESS

12 commits 1 branch 0 releases 2 contributors



Preparing for TESS

March 5-9, 2018 / Flatiron Institute / New York City

This workshop (inspired by the [Gaia Sprints](#)) is designed to bring together a group of people with a common interest in scientific discovery using data from NASA's forthcoming [TESS Mission](#). This meeting is intended to build new collaborations, minimize duplication of effort, and facilitate the development of open-source tools for working with this new dataset. This is not a traditional scientific

Building Early Science with TESS

March 25-29, 2019 / University of Chicago

This workshop is designed to bring together a group of people with a common interest in scientific discovery using data from NASA's [TESS Mission](#). This meeting is intended to build new collaborations, minimize duplication of effort, and facilitate the development of open-source tools for working with this new dataset. This is not a traditional scientific conference and there will not be any formal talks. Instead, the time will be spent in informal discussions and co-working, with the goal of having tangible results by the end of the week. We welcome people interested in all potential uses of TESS data. This project is designed to help build and support the broader TESS community, and we welcome applications from people both inside and outside the TESS project.

[tess.ninja](#)

[tess.science](#)

Announcing...

TESS NINJA 3

10-14 Feb 2020

Univ. of Sydney

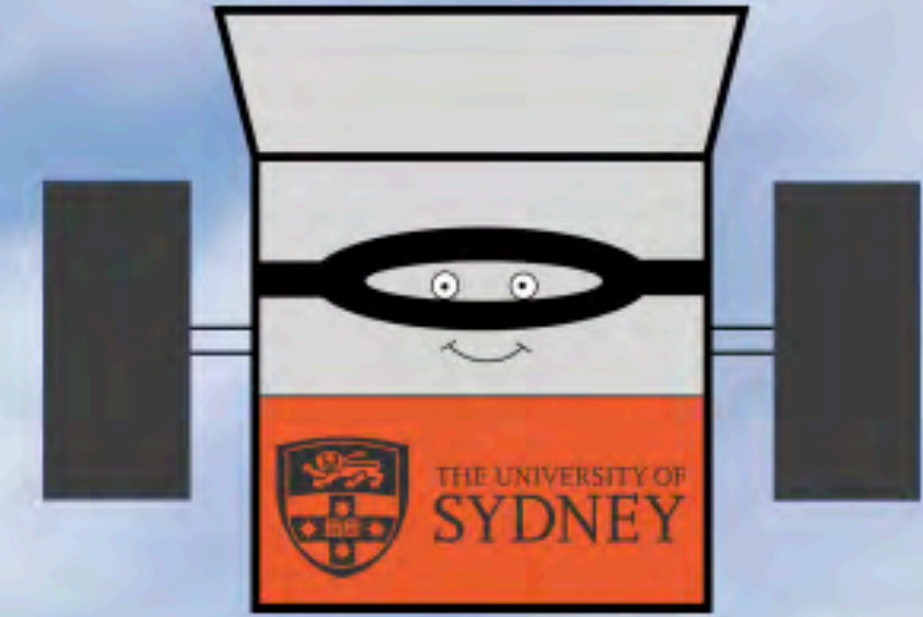


Announcing...

TESS NINJA 3

10–14 Feb 2020

Univ. of Sydney



Thank you:

To the conference organizers!

To the speakers:

Derek Buzasi

Adina Feinstein

Marco Montalto

Domenico Nardiello

Tim White

To the panelists:

Krista Lynne Smith

Luke Bouma

Susan Mullally

(plus the speakers above)