

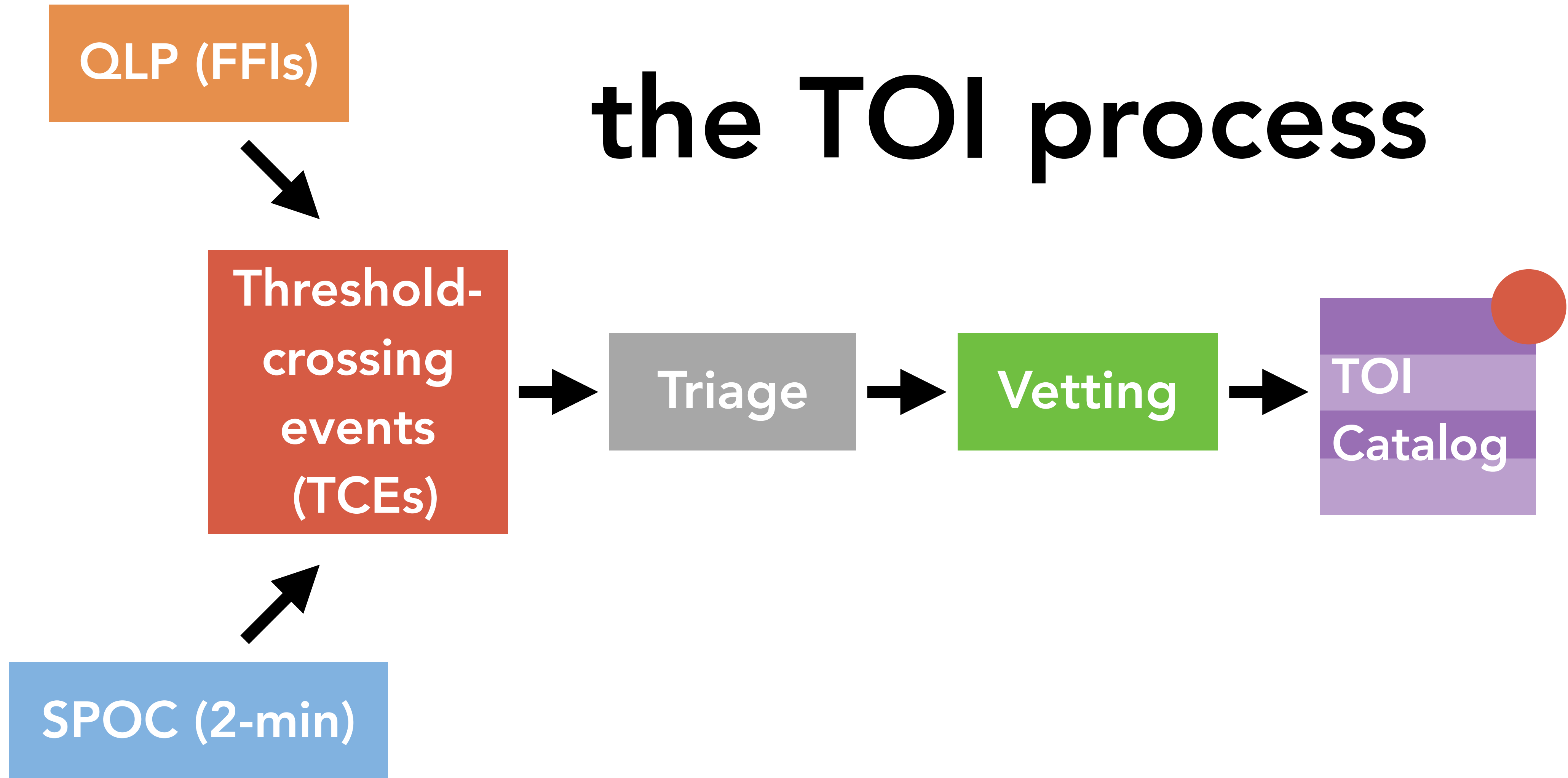
# TESS Objects of Interest Catalog

July 29, 2019 | MIT | TESS Science Conference

**Natalia Guerrero (nmg@mit.edu)**

Sara Seager, Chelsea Huang, Aylin García Soto, Ismael Mireles,  
Avi Shporer, Ana Glidden, Michael Fausnaugh, Scott Dynes,  
Karen Collins, Sam Quinn, George Ricker, Dave Latham, Roland  
Vanderspek

# the TOI process



Convolutional neural network **triages** phase-folded light curves into “transiting” and “non-transiting” categories. (Yu et al, [arxiv:1904.02726](https://arxiv.org/abs/1904.02726))

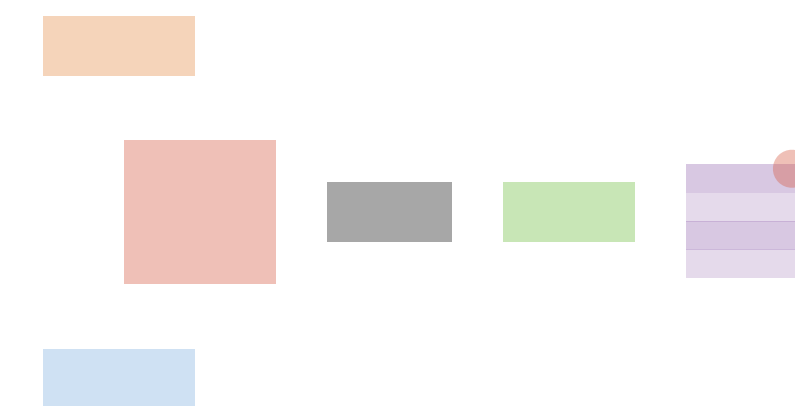
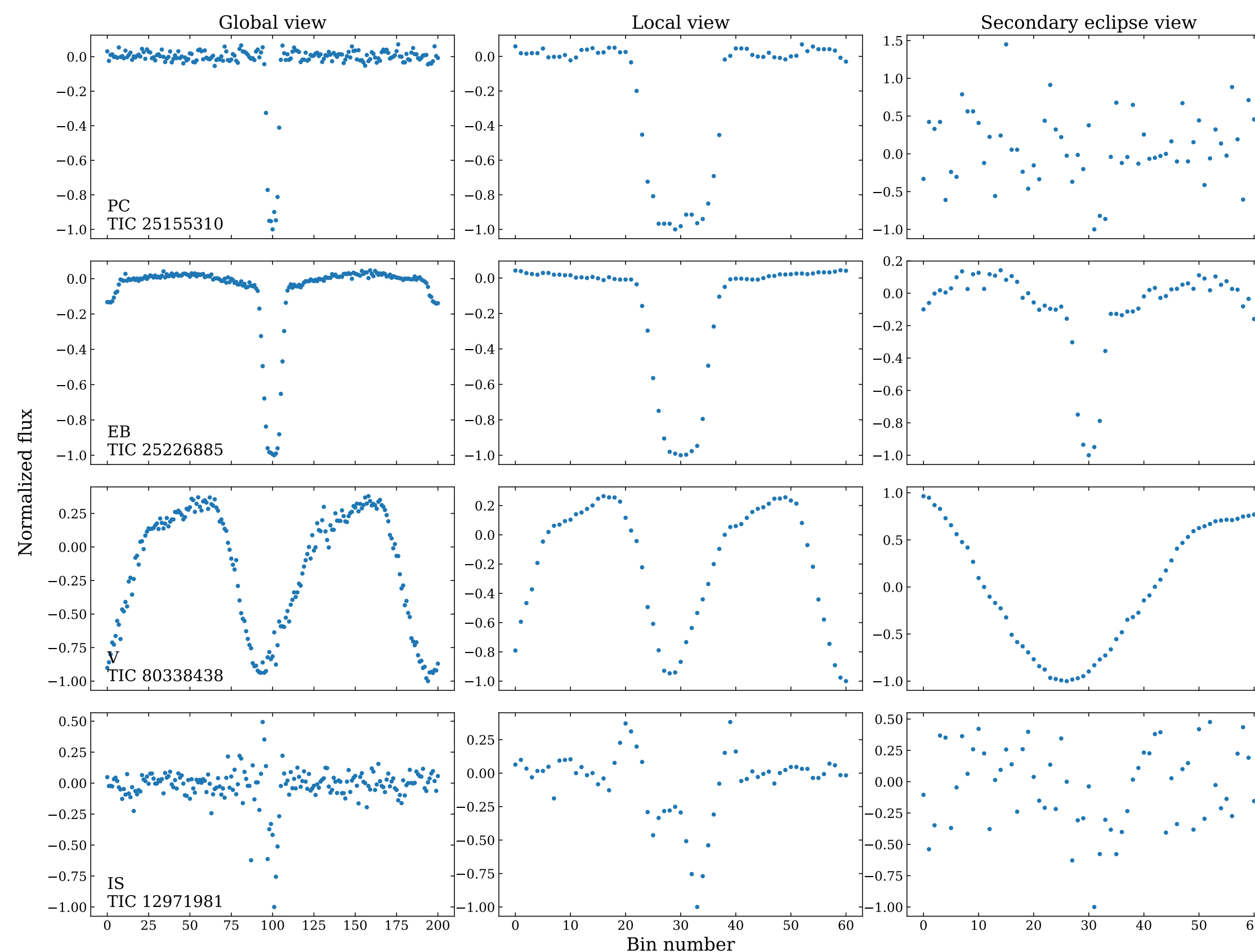
Applied to sector 5 onwards for QLP light curves from 30-minute FFI data.

Deep learning for automated vetting in development.

Code and training set are publicly available!

<https://github.com/yuliang419/AstroNet-Triage>

<https://github.com/yuliang419/AstroNet-Vetting>

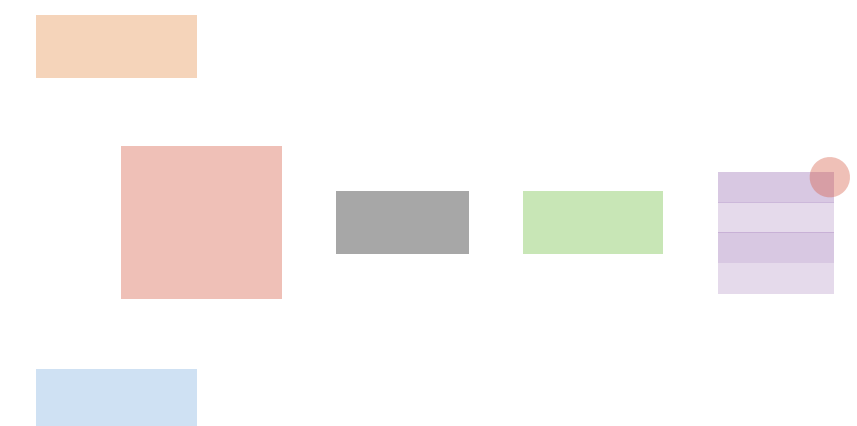
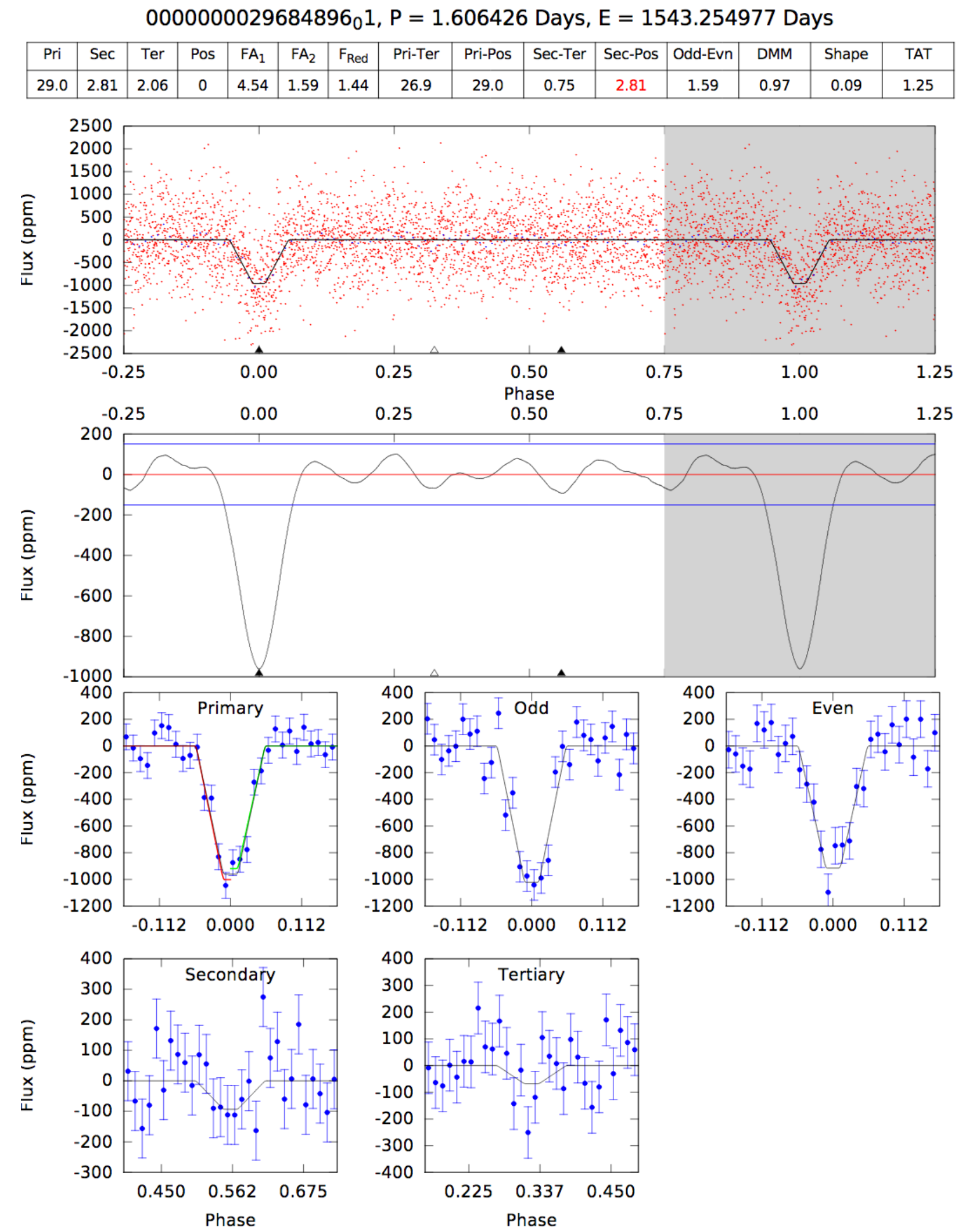


TESS Exo-Class (TEC) **triages** 2-minute targets with SPOC DV products using a decision tree and a database of attributes/metrics.

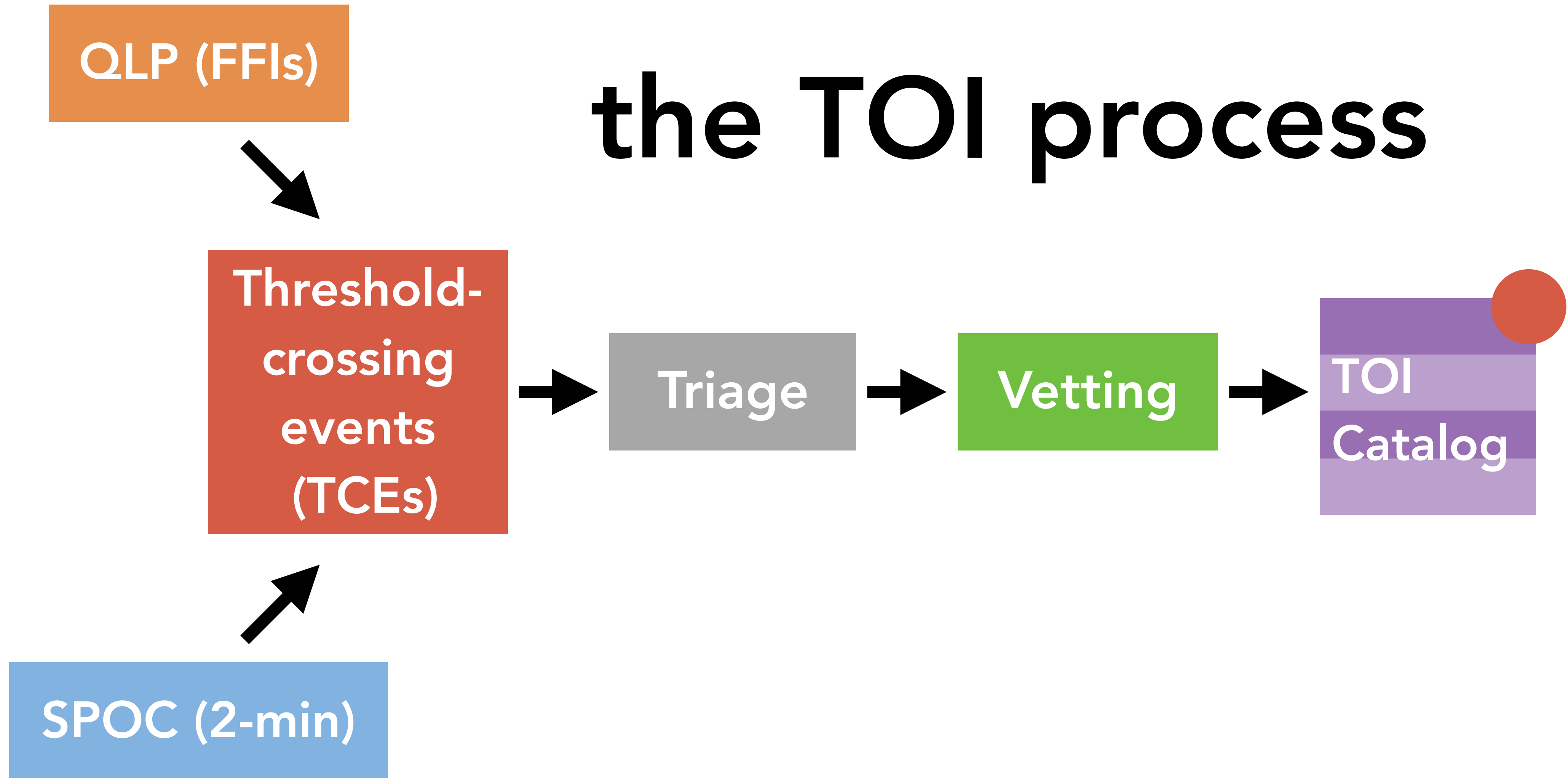
Applied from sector 2 onwards

Code is publicly available!

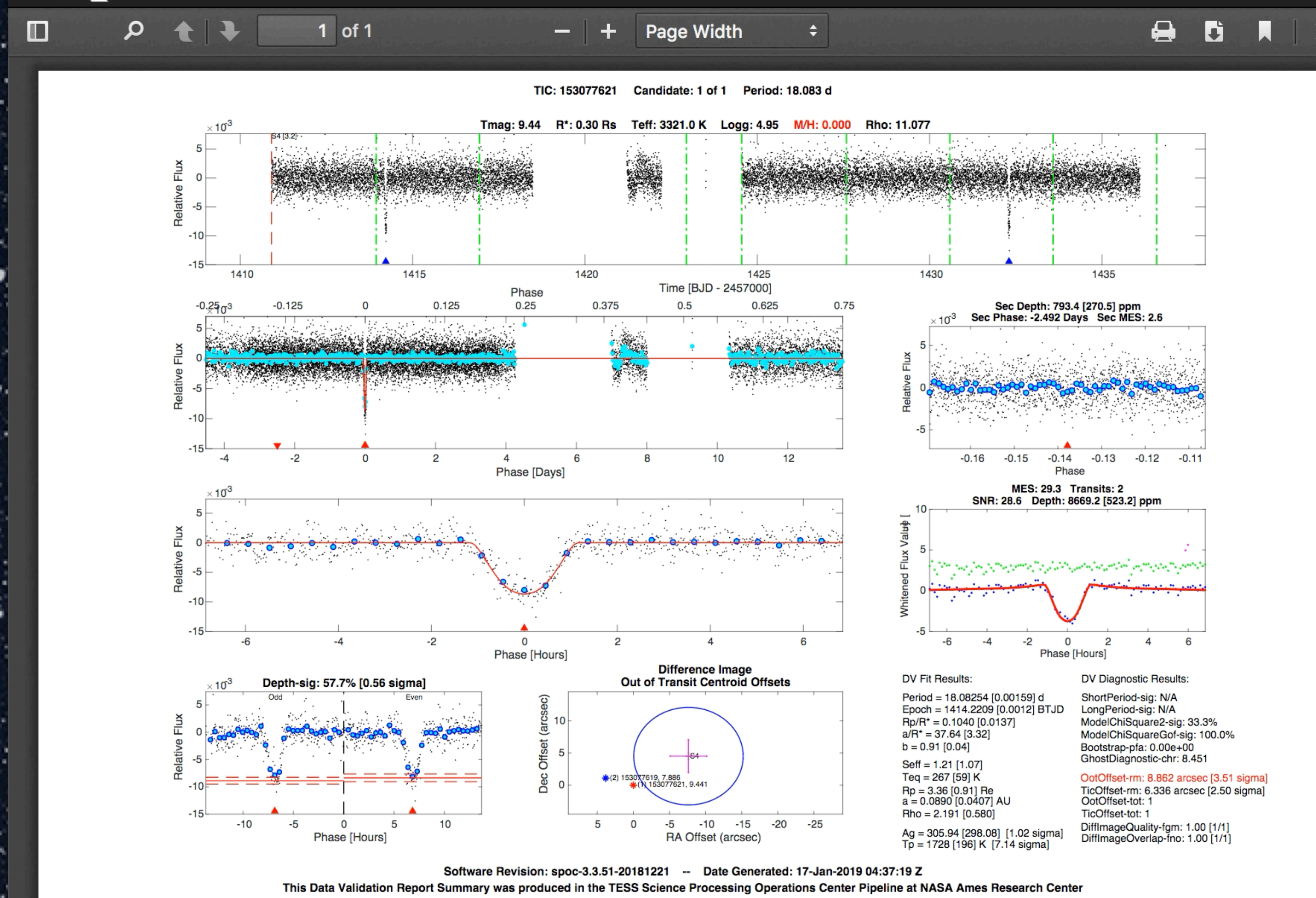
<https://github.com/christopherburke/TESS-ExoClass>



# the TOI process



# Vetting identifies potential TOIs among the TCEs.



SPOC / spoc-s04-b03

## 153077621

Disposition:

- Planet Candidate
- Eclipsing Binary
- Stellar Variability (only/primary)
- Instrument Noise/systematic
- Other astrophysical
- Undecided

Centroid offset:

Comment:

Comment

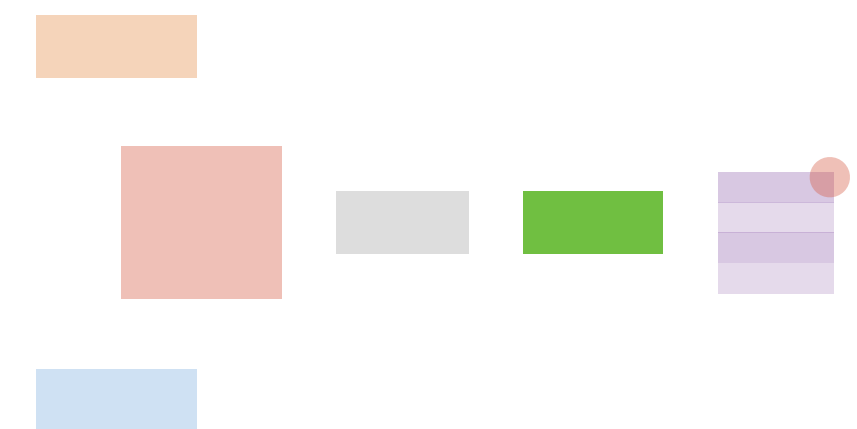
# vetting

Identify planet candidates that need follow-up:

- promising likely planets for TESS L1 requirement (50 planets,  $R_p < 4R_e$ , w/mass)
- promising non-L1 likely planets
- marginal candidates

Record TESS detection of known planets

Planet  
candidates



# TOI vetting team

Aylin Garcia Soto

Ismael Mireles

Chelsea Huang

Karen Collins

Avi Shporer

Tansu Daylan

Max Guenther

Steven Villanueva

Ana Glidden

Pam Rowden

Natalie Batalha

Ian Crossfield

Zahra Essack

Daniel Yahalomi

Prajwal Niraula

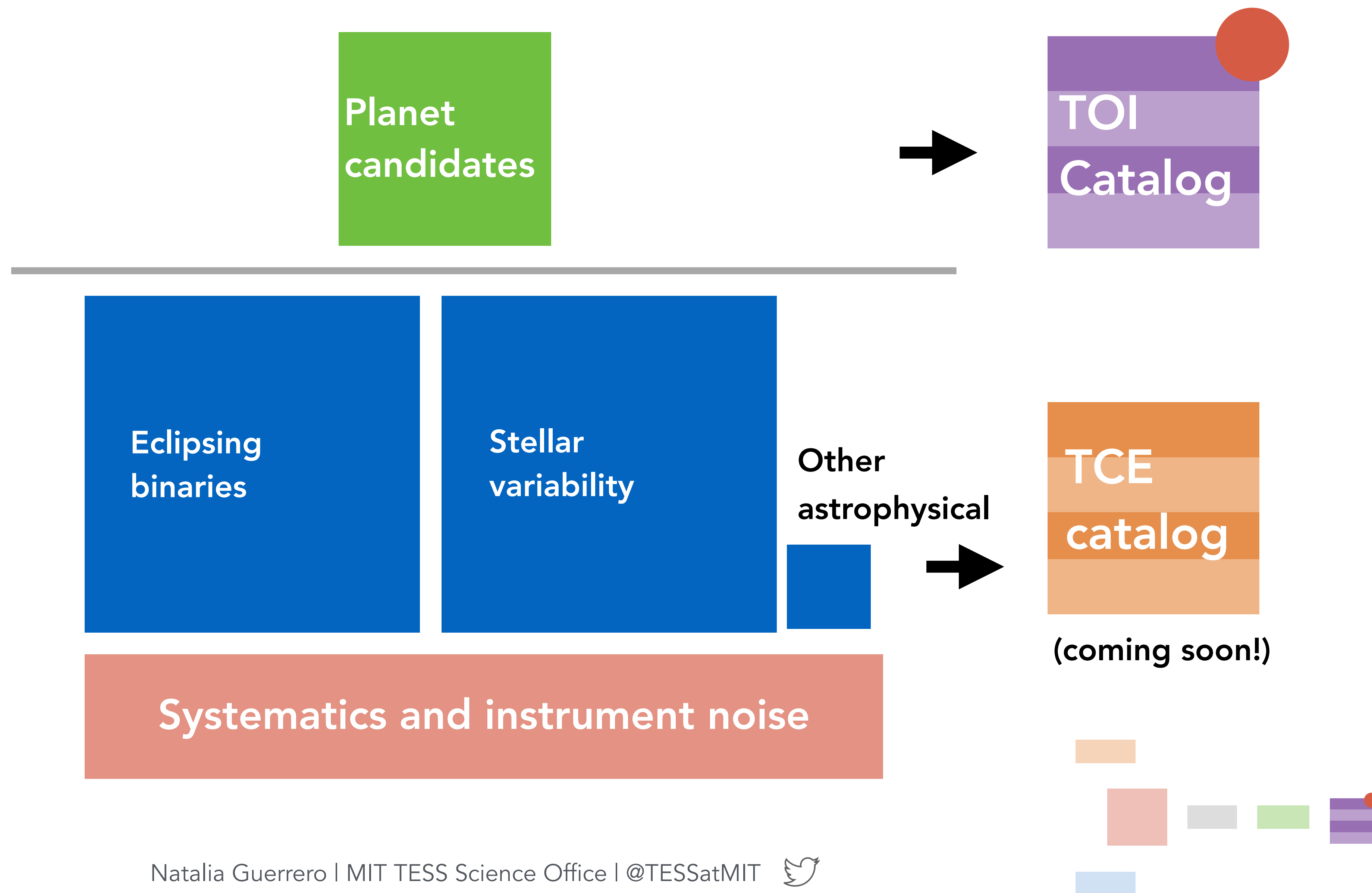
William Fong

Lizhou Sha

Dave Latham

Sam Quinn

...





# TOIs go out first at [tev.mit.edu](http://tev.mit.edu)

Natalia Alerts **All Types** All Deliveries **CS**

Show  entries Search:

tic_id	toi_id	dsp	RA	Dec	Tmag	Rp	Period	Duration	Transit Depth	src				...
231663901	00101.01	PC	318.73698	-55.87178	12.4	13.1	1.43	1.64	2.05e+4	spoc				
149603524	00102.01	KP	87.13996	-63.98843	9.72	15.4	4.41	3.78	1.40e+4	spoc				
336732616	00103.01	PC	312.45744	-24.42880	11.5	14.6	3.55	3.49	1.04e+4	spoc				
231670397	00104.01	PC	319.94961	-58.14888	9.85	12.7	4.09	5.59	3.59e+3	spoc				
144065872	00105.01	PC	337.45720	-48.00309	9.48	12.5	2.18	2.87	1.18e+4	spoc				
38846515	00106.01	KP	68.95973	-64.02704	10.3	9.14	2.85	3.83	7.47e+3	spoc				
92352620	00107.01	PC	313.78311	-34.13557	9.64	18.8	3.95	4.56	1.30e+4	spoc				
289793076	00108.01	PC	316.96147	-26.09666	13.1	14.0	3.04	2.66	2.41e+4	spoc				
29344935	00109.01	PC	313.21548	-25.68734	13.2	11.7	2.77	2.57	1.57e+4	spoc				
281459670	00110.01	KP	5.61869	-59.94255	11.6	13.7	3.17	2.72	1.56e+4	spoc				
355703913	00111.01	KP	0.77448	-62.46934	13.1	16.7	2.11	1.57	1.24e+4	spoc				
388104525	00112.01	KP	55.93344	-65.19386	11.5	14.7	2.50	2.87	1.49e+4	spoc				
97409519	00113.01	PC	332.71432	-30.74967	12.1	14.2	3.37	2.63	1.72e+4	spoc				
25155310	00114.01	KP	63.37389	-69.22679	10.6	10.9	3.29	3.41	7.16e+3	spoc				

# ExoFOP shares TOIs with the follow-up community.

Natalia Alerts All Types All Deliveries CS +

Show View a entries Search:

tic_id	toi_id	dsp	RA	Dec	Tmag	Rp	Period	Duration	Transit Depth	src
231663901	00101.01	PC	318.73698	-55.87178	12.4	13.1	1.43	1.64	2.05e+4	spoc
149603524	0010									
336732616	0010									
231670397	0010									
144065872	0010									
38846515	0010									
92352620	0010									
289793076	0010									
29344935	0010									
281459670	0011									
355703913	0011									
388104525	0011									
97409519	0011									
25155310	0011									

**ExoFOP TESS** Home Search Help Login

**CTOIs (115)** Download Table Clear All Filters & Sorts Help with Table Filtering & Sorting

TIC ID	CTOI ↑	TFOPWG on	TESS mag	RA (degrees)	Dec (degrees)	PM RA (mas/yr)	PM Dec (mas/yr)	Midpoint (BJD)	Period (days)	Duration (hours)
29478974	29478974.01		10.568 ± 0.019	314.081683	-26.588692	14.6 ± 2.9	-36.9 ± 2.6	2458326.465 ±	24.903 ±	3.333 ±
29478974	29478974.02		10.568 ± 0.019	314.081683	-26.588692	14.6 ± 2.9	-36.9 ± 2.6	2458333.785 ±	12.458 ±	3.333 ±
29667425	29667425.01		10.223 ± 0.019	315.330872	-27.317507	9.2 ± 2.9	-22.5 ± 2.6	2458335.958 ±		2 ±
29986808	29986808.01		10.379 ± 0.018	72.912405	-68.270355	33.472 ± 0.983	62.749 ± 0.91	2458325.632 ±	2.134 ±	1.267 ±
29986808	29986808.02		10.379 ± 0.018	72.912405	-68.270355	33.472 ± 0.983	62.749 ± 0.91	2458326.692 ±	2.123 ±	1.333 ±
32150630	32150630.01		11.793 ± 0.018	59.244566	-68.625977	35.835 ± 4.138	37.421 ± 4.138	2458325.719 ±	1.494 ±	1.833 ±
32150630	32150630.02		11.793 ± 0.018	59.244566	-68.625977	35.835 ± 4.138	37.421 ± 4.138	2458326.47 ±	1.489 ±	1.433 ±
49678165	49678165.01		12.909 ± 0.076	351.516742	-10.62382	153.78 ± 2	0.24 ± 2	24581371.195 ± 0.004	35.64 ± 32.19	
50309953	50309953.01		9.7819996 ± 0.02	30.198449	-77.610371	58.97 ± 1.223	-34.367 ± 0.994		7.04 ±	

CTOIs (115)

Download Table ▾

Clear All Filters &amp; Sorts

Help with Table Filtering &amp; Sorting

TIC ID	CTOI ↑	TFOPWG on	TESS mag	RA (degrees)	Dec (degrees)	PM RA (mas/yr)	PM Dec (mas/yr)	Midpoint (BJD)	Period (days)	Duration (hours)
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ExoFOP hosts Community TOIs (cTOIs)

syntax: <TIC ID>.<index>

example: 100000001.01

TOI team reviews cTOIs and can add in targets the project missed.

syntax: <TOI ID>.<index>

example: 101.01

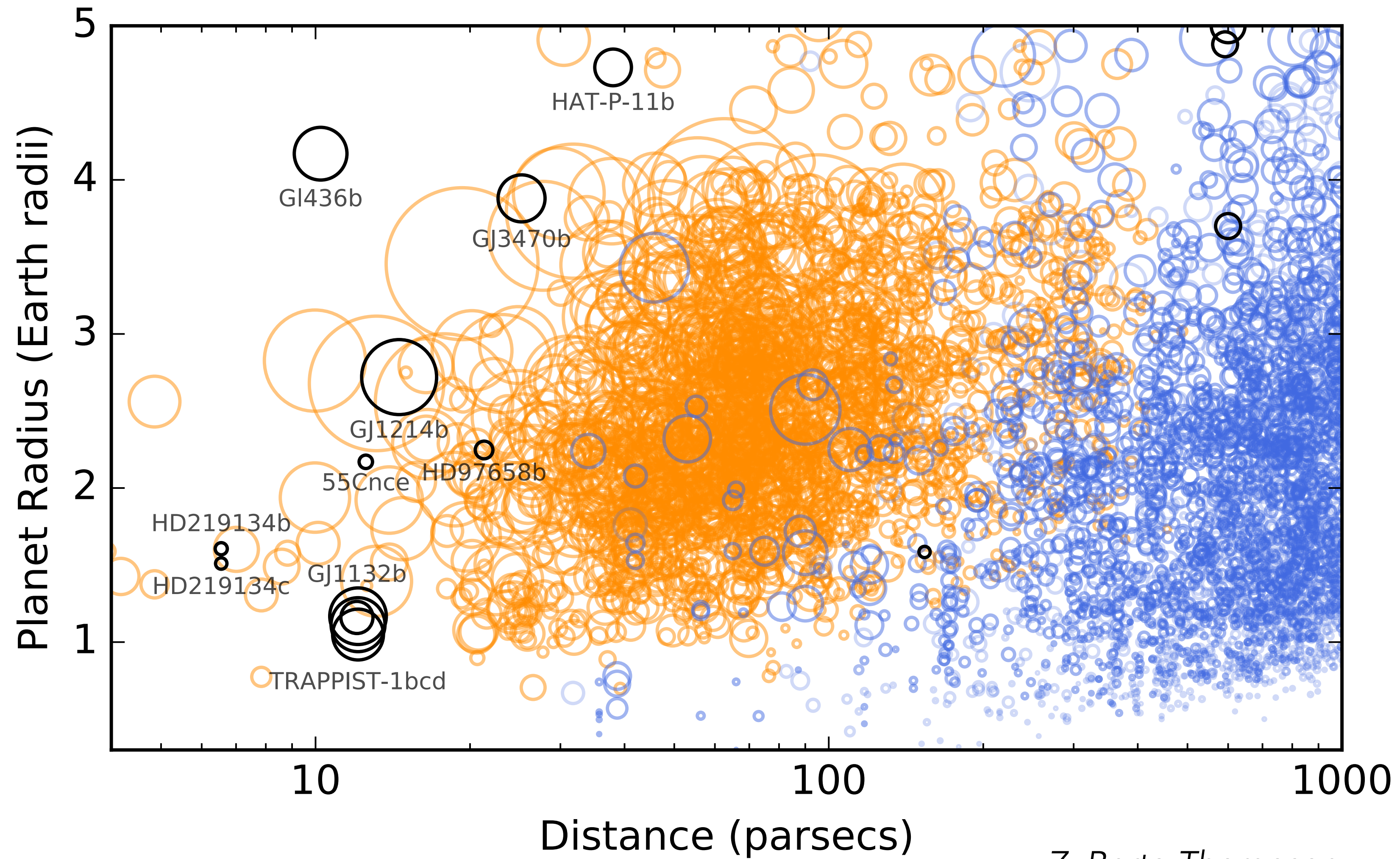
**993 planet candidates** (so far!)

from twelve sectors

271 candidates less than Neptune size

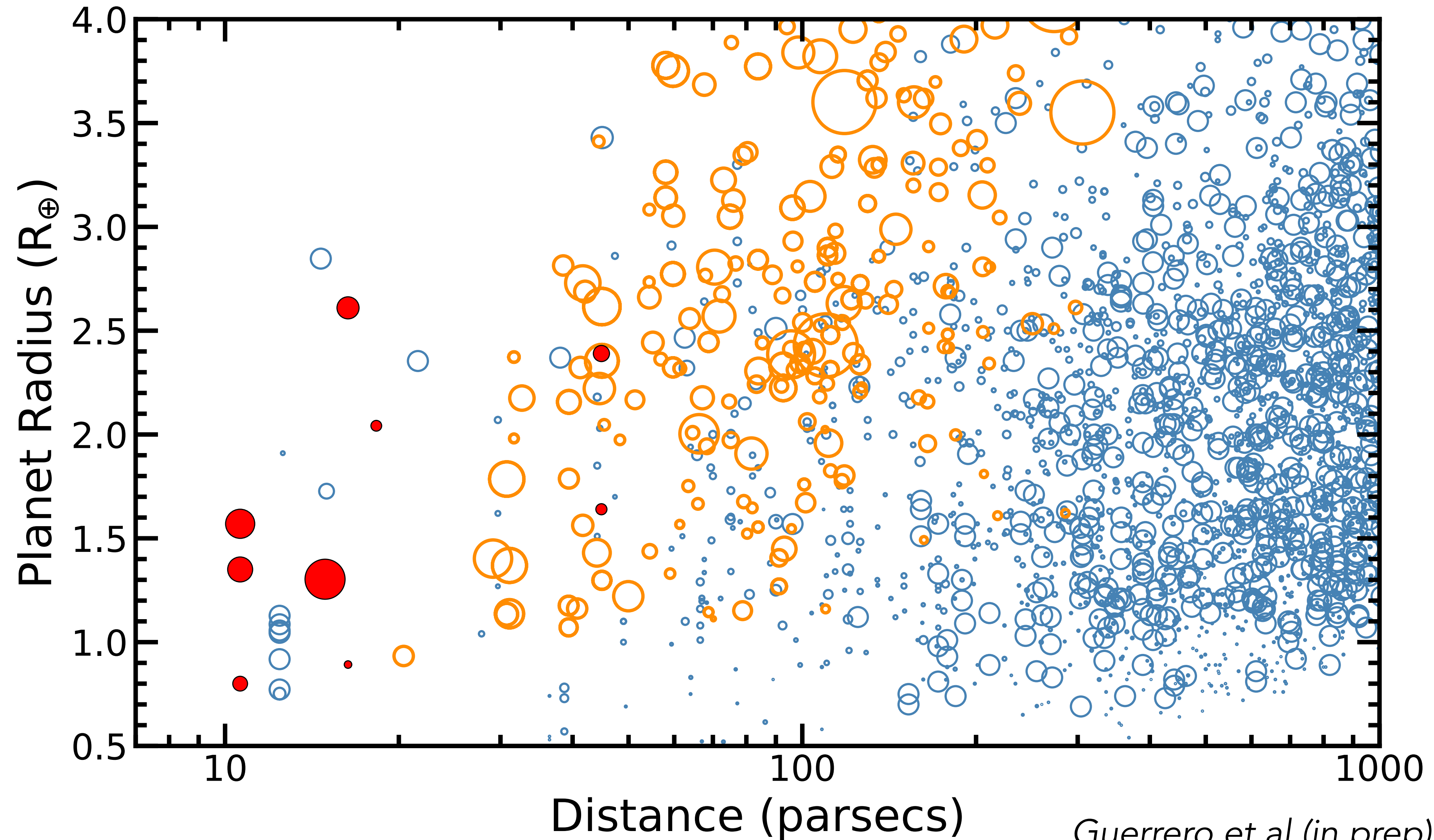
24 published planets and many more to come...

We predicted TESS would fill in this region:

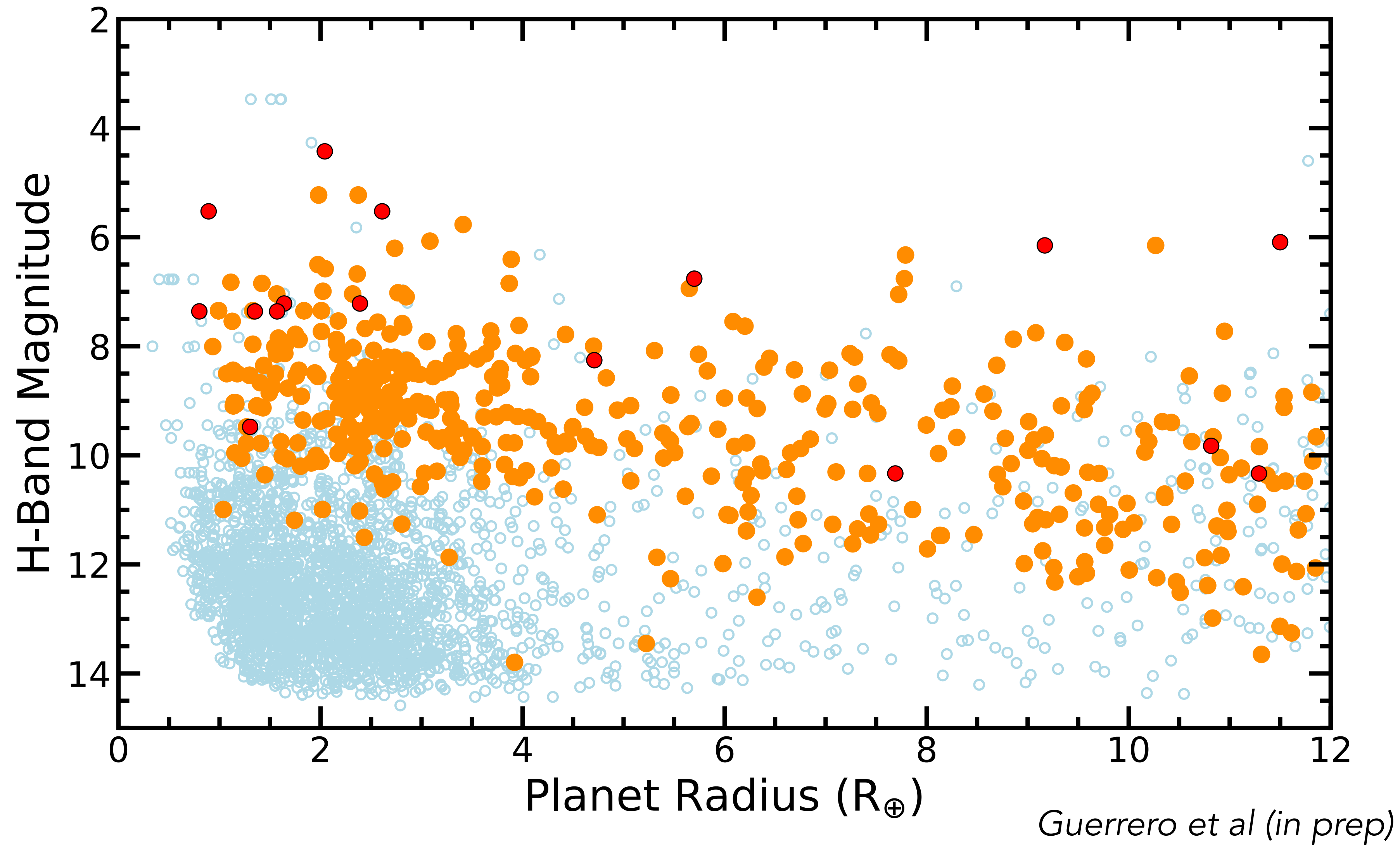


*Z. Berta-Thompson*

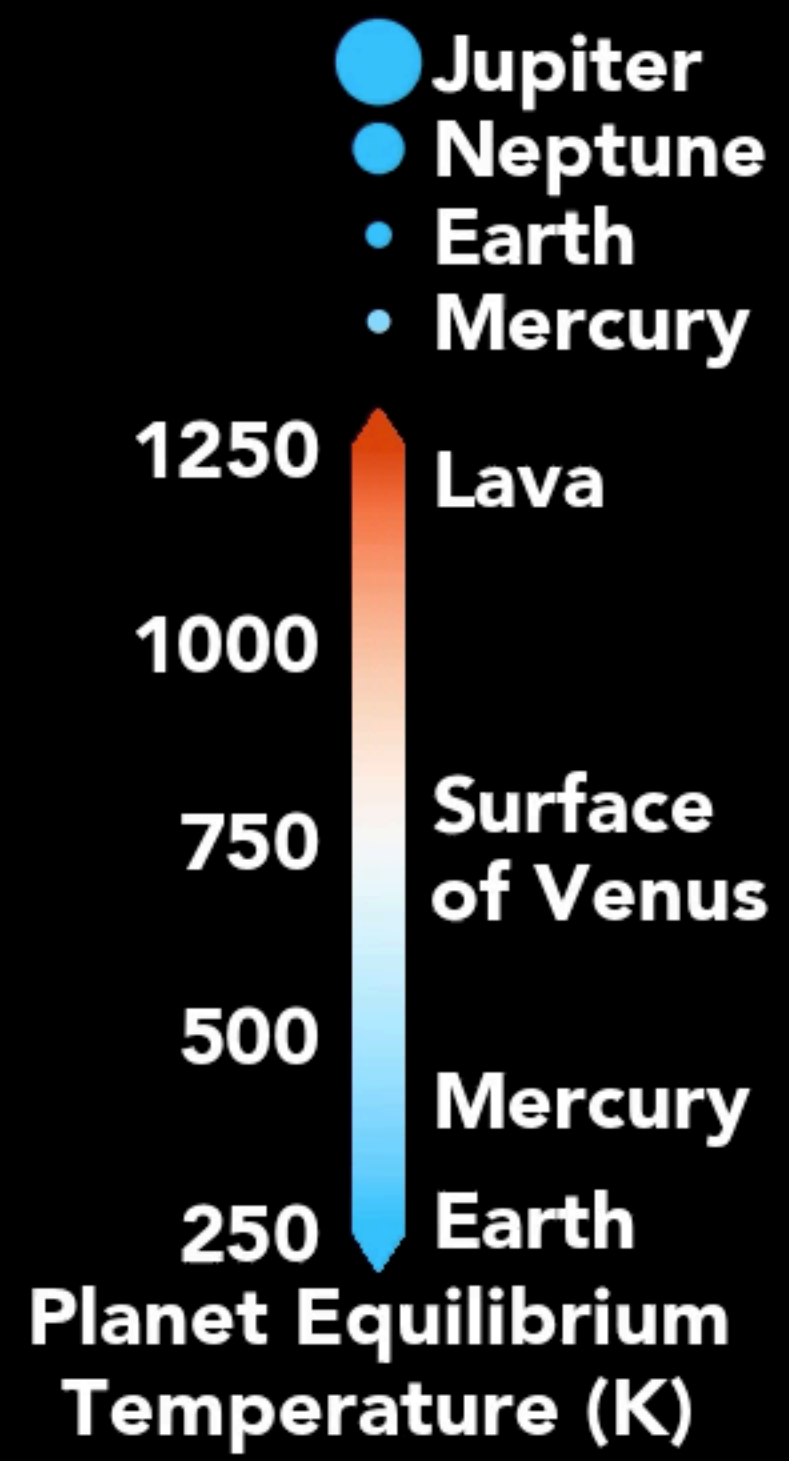
We are mapping the "neighborhood" of TESS planets



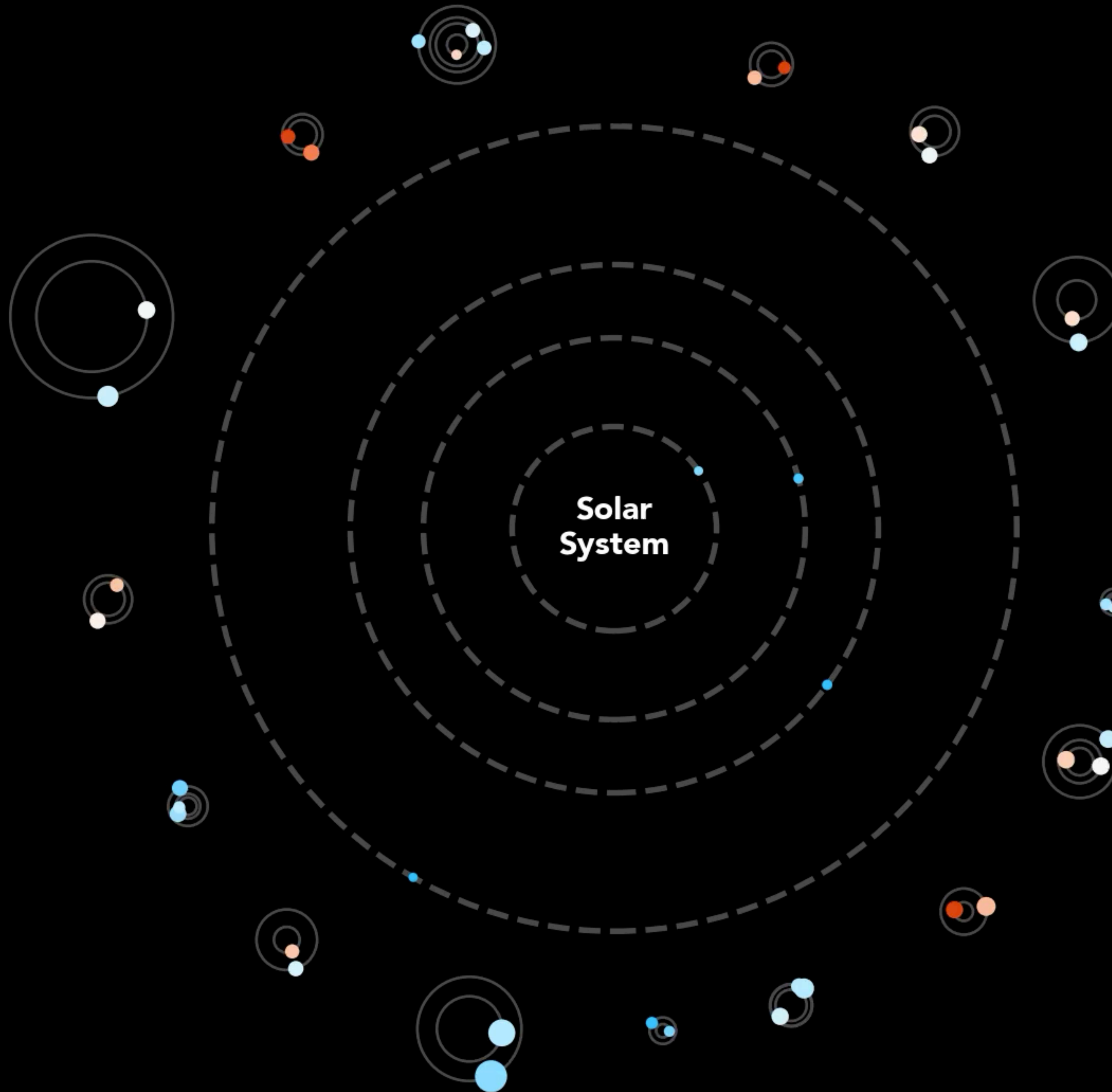
# TESS sees many bright, small(ish) planets to follow up!



**TESS Orrery I**  
**25 Jul 2018**  
By Ethan Kruse  
@ethan\_kruse



- Jupiter
- Neptune
- Earth
- Mercury





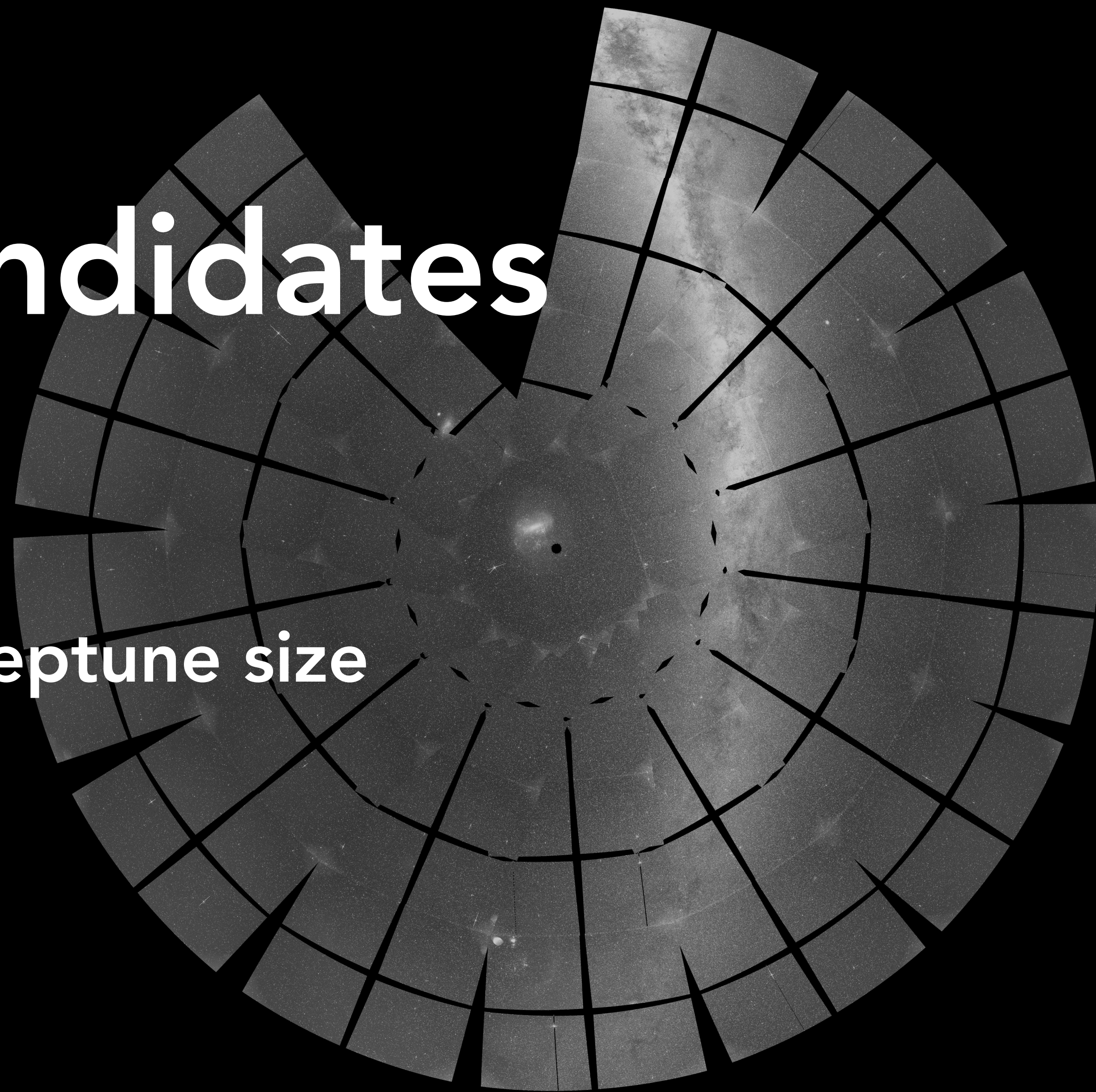
# 993 planet candidates

(so far!)

from twelve sectors

271 candidates less than Neptune size

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many more to come...



# Backup slides

SPOC is the pipeline of record.  
QLP is MIT-internal, primarily intended to supplement SPOC for the first four sectors and for FFIs.

