Searching for Transiting Planets in NGC 6791

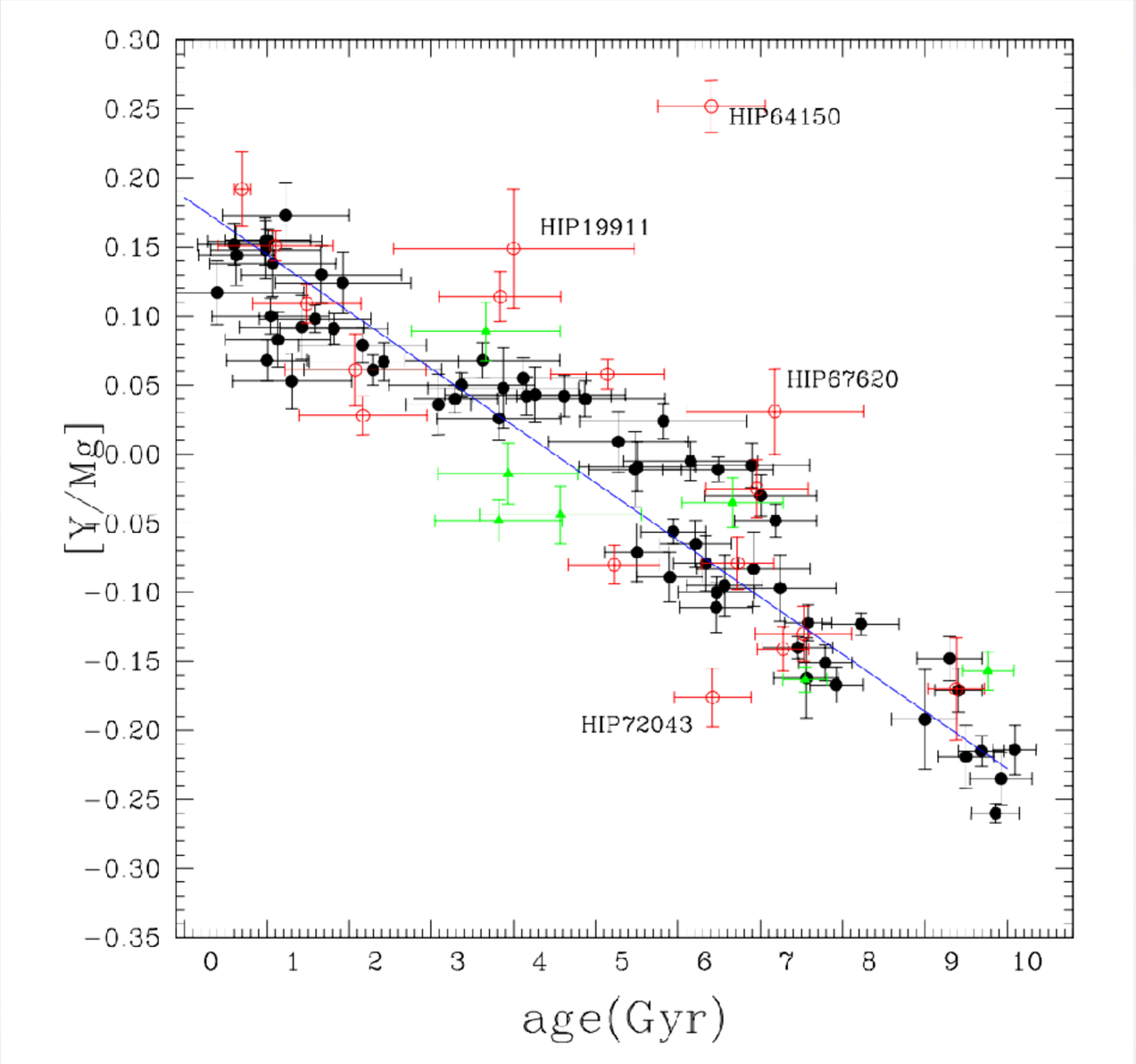
with Ze Vinicius, Megan Bedell, Christina Hedges, Geert Barentsen, Guadalupe Tovar, Rachael Amaro, Dan Scolnic, Ann Marie Cody

THE UNIVERSITY OF CHICAGO

Benjamin Montet
NASA Sagan Fellow
2018 Sagan/Michaelson Symposium
8 November 2018

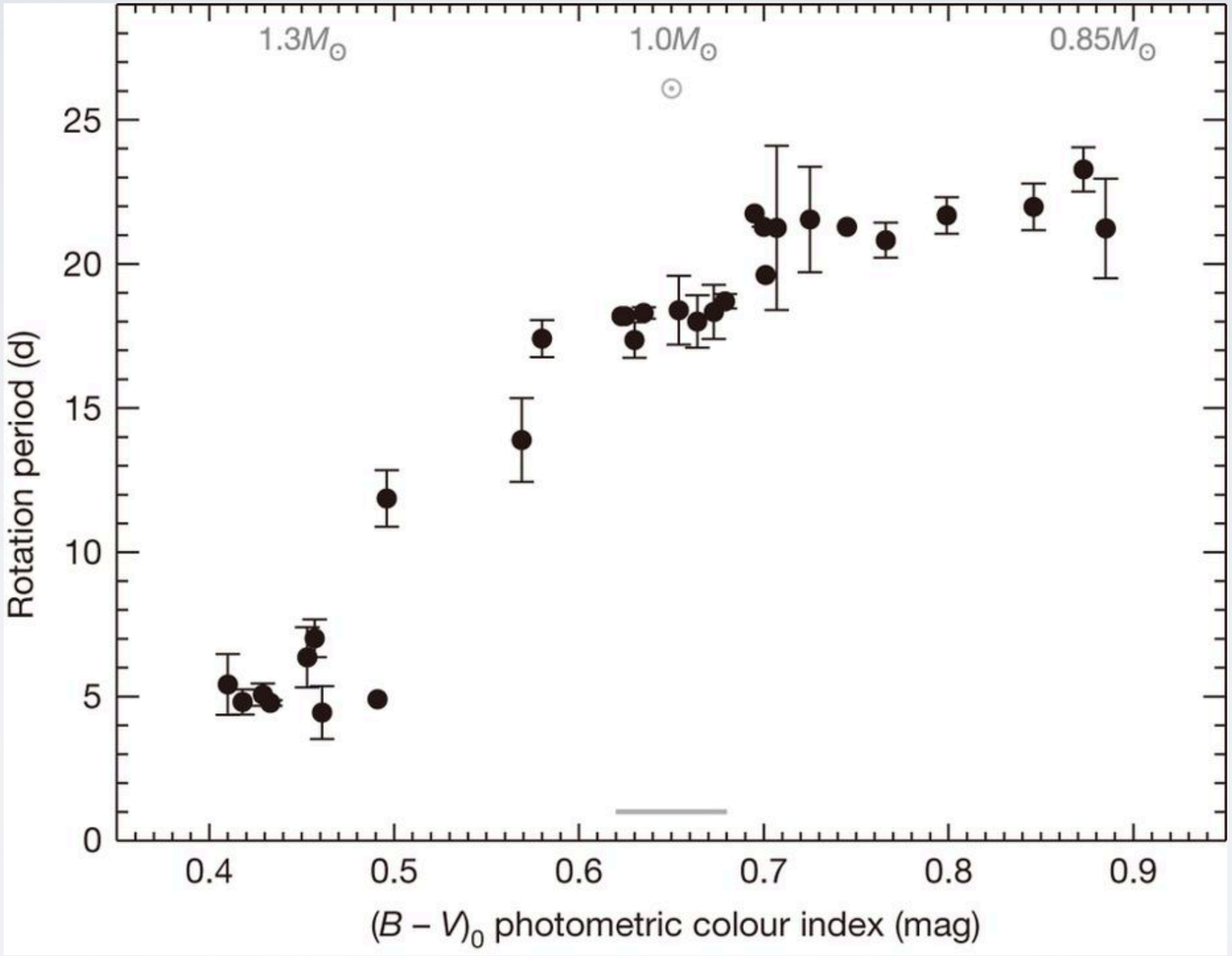
To understand how planetary populations evolve,
we want to know ages of planet host stars

Ages from spectra?



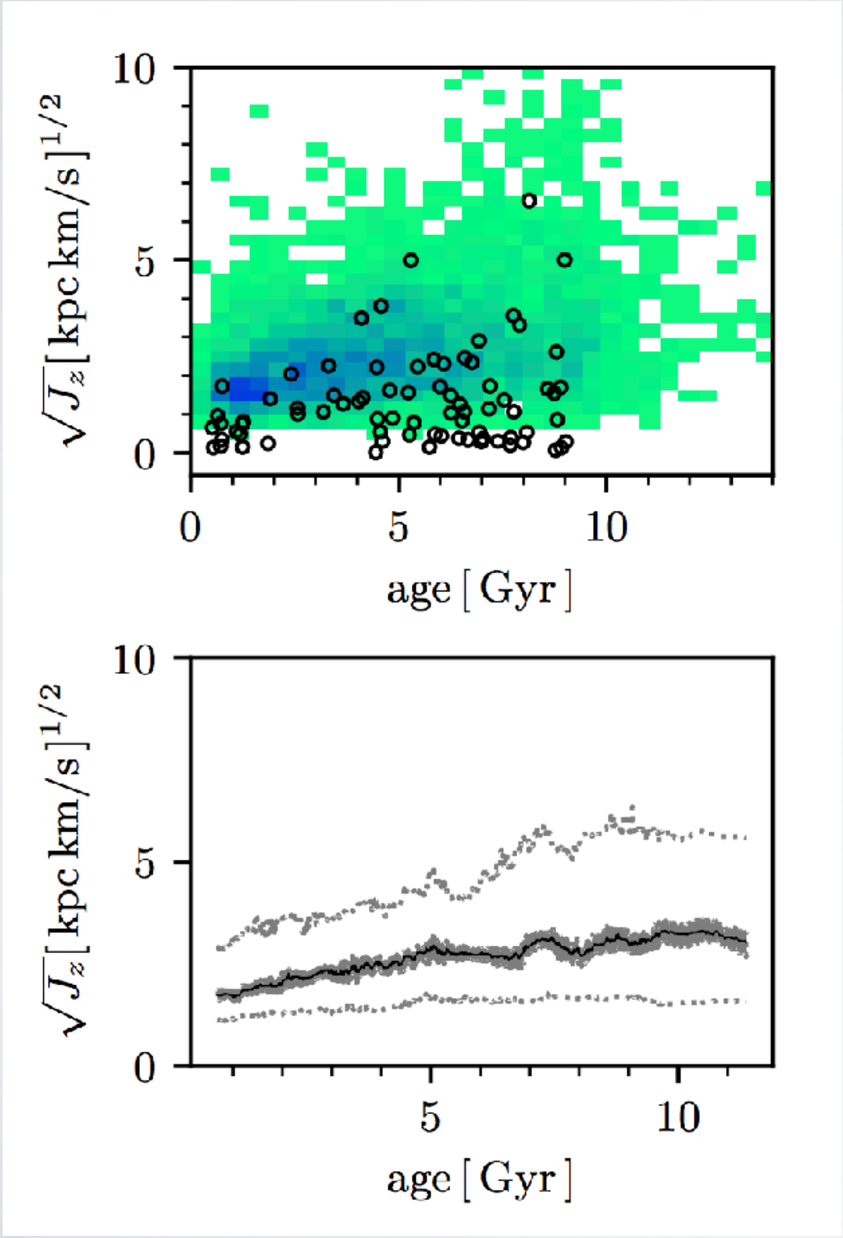
Tucci Maia et al. 2016

Ages from rotation?



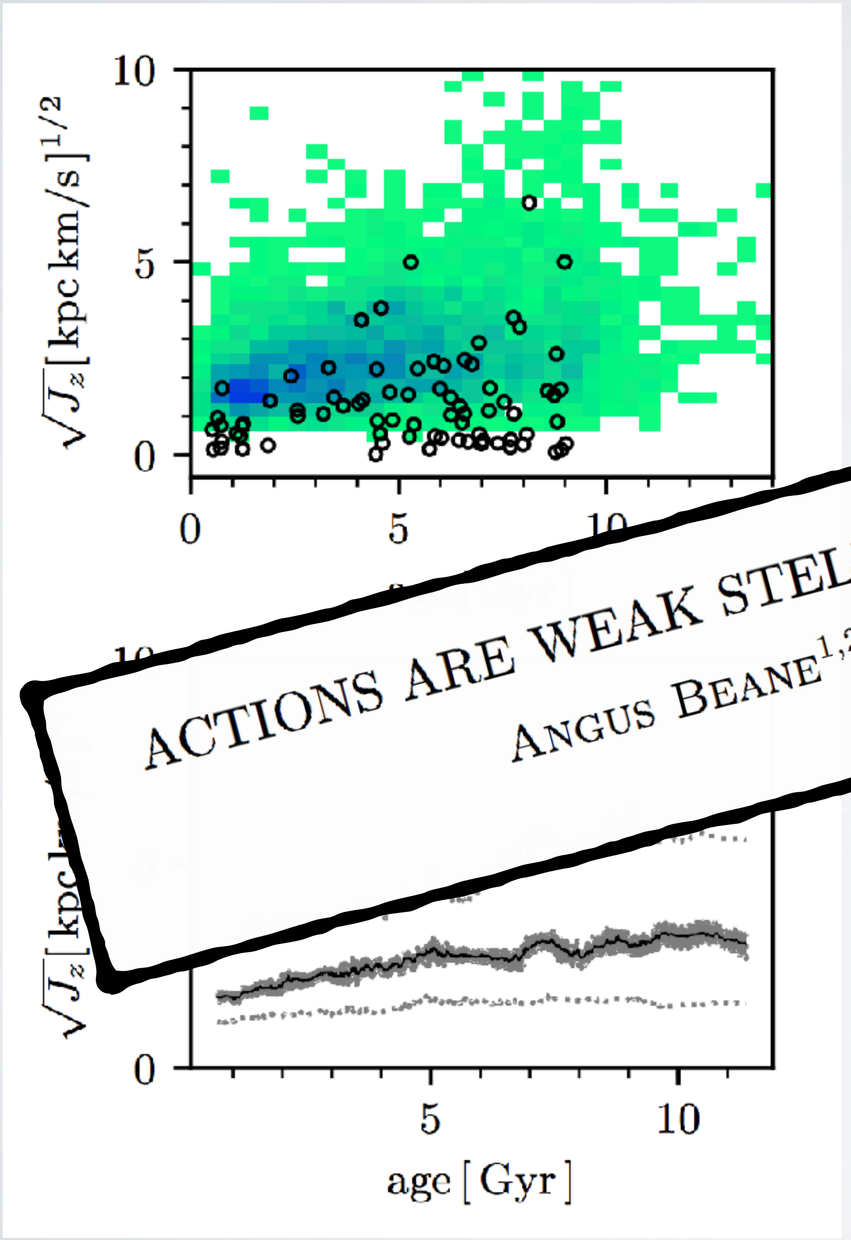
Meibom et al. 2012

Ages from dynamics?



Beane, Ness, and Bedell (2018)

Ages from dynamics?



ACTIONS ARE WEAK STELLAR AGE INDICATORS IN THE MILKY WAY DISK

ANGUS BEANE[1,2], MELISSA K. NESS[2,3], & MEGAN BEDELL[2]

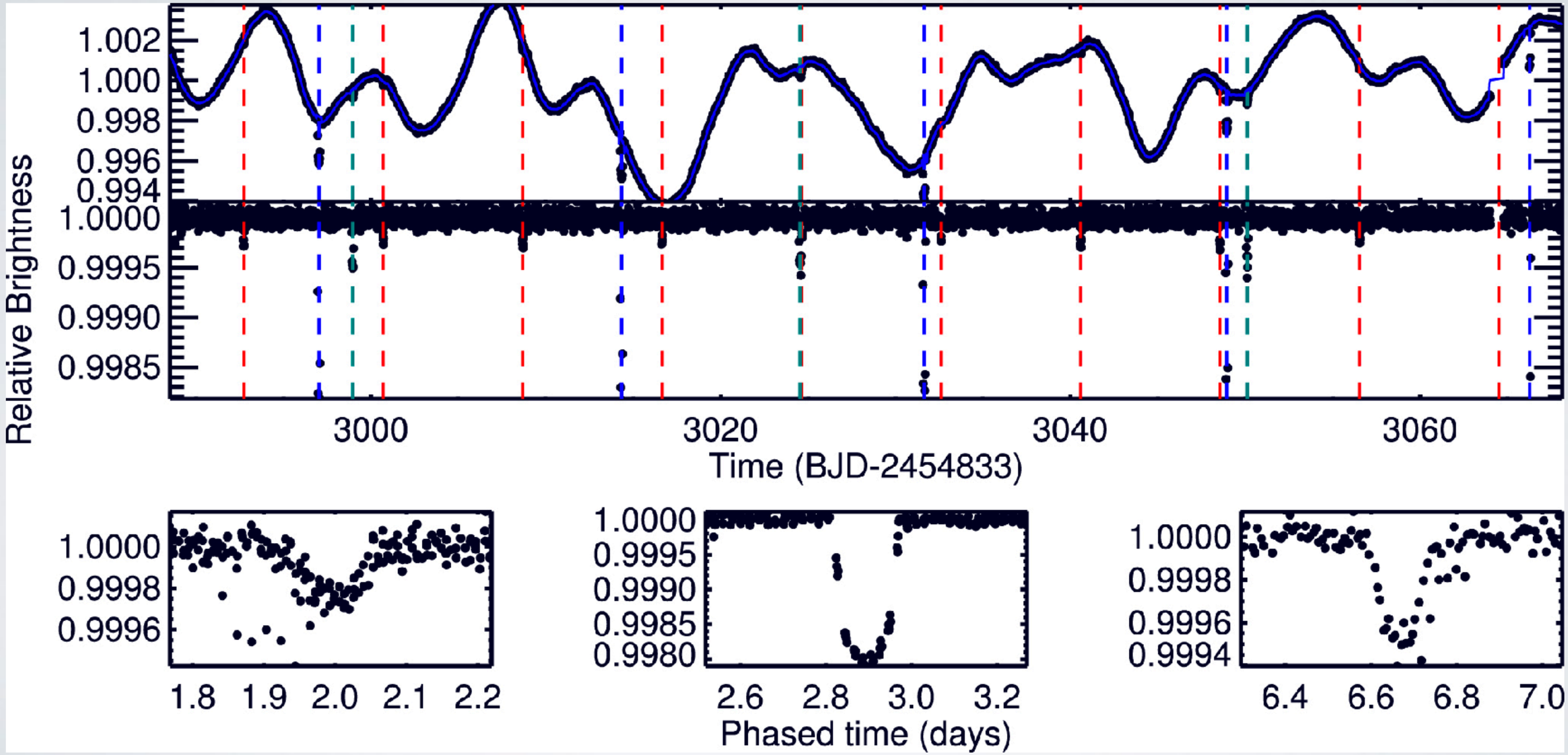
Draft version October 25, 2018

Beane, Ness, and Bedell (2018)

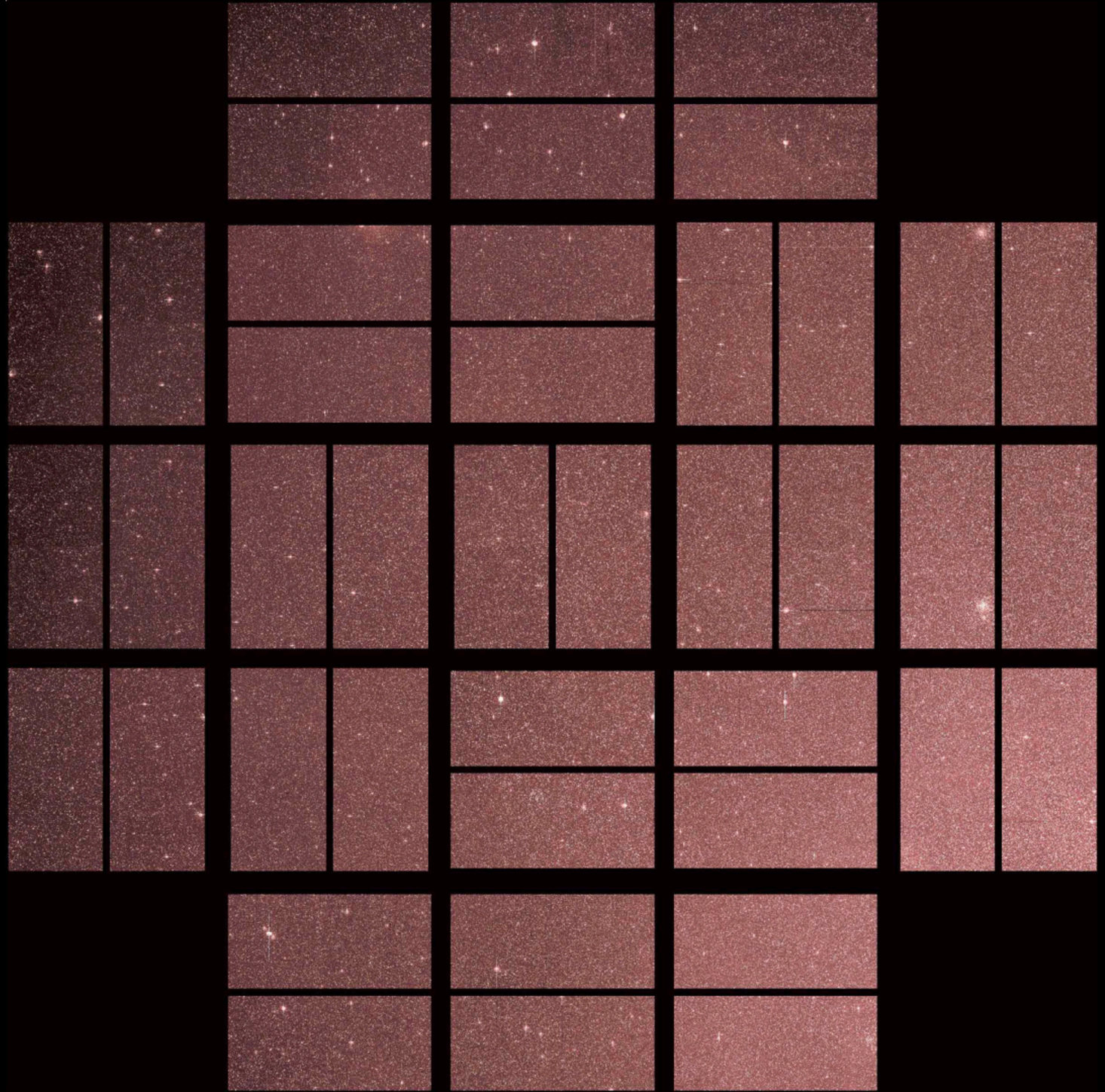
Ages from clusters!

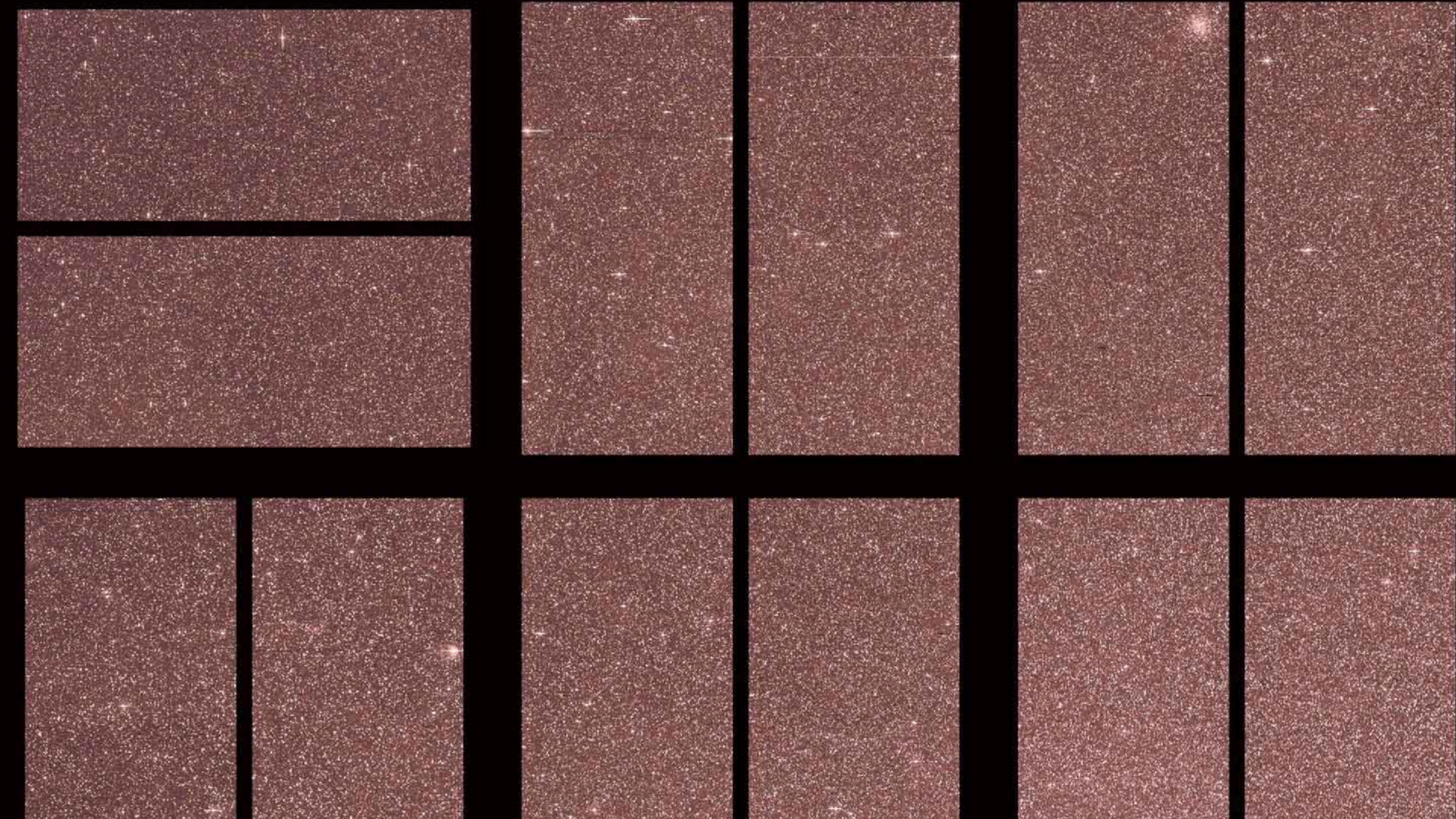
Jerry Lodrigass

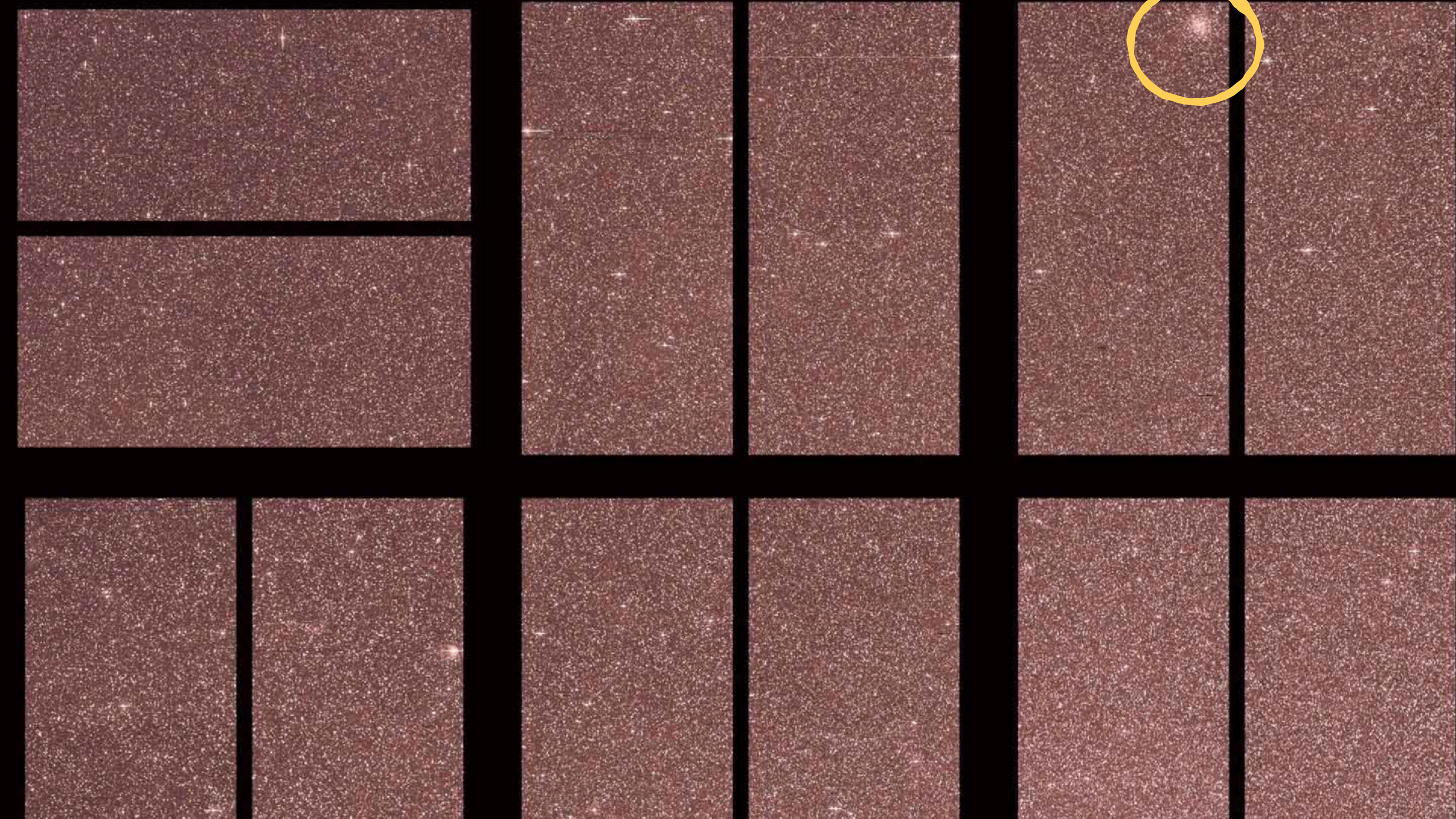
K2 has observed several young clusters



Mann et al. 2018



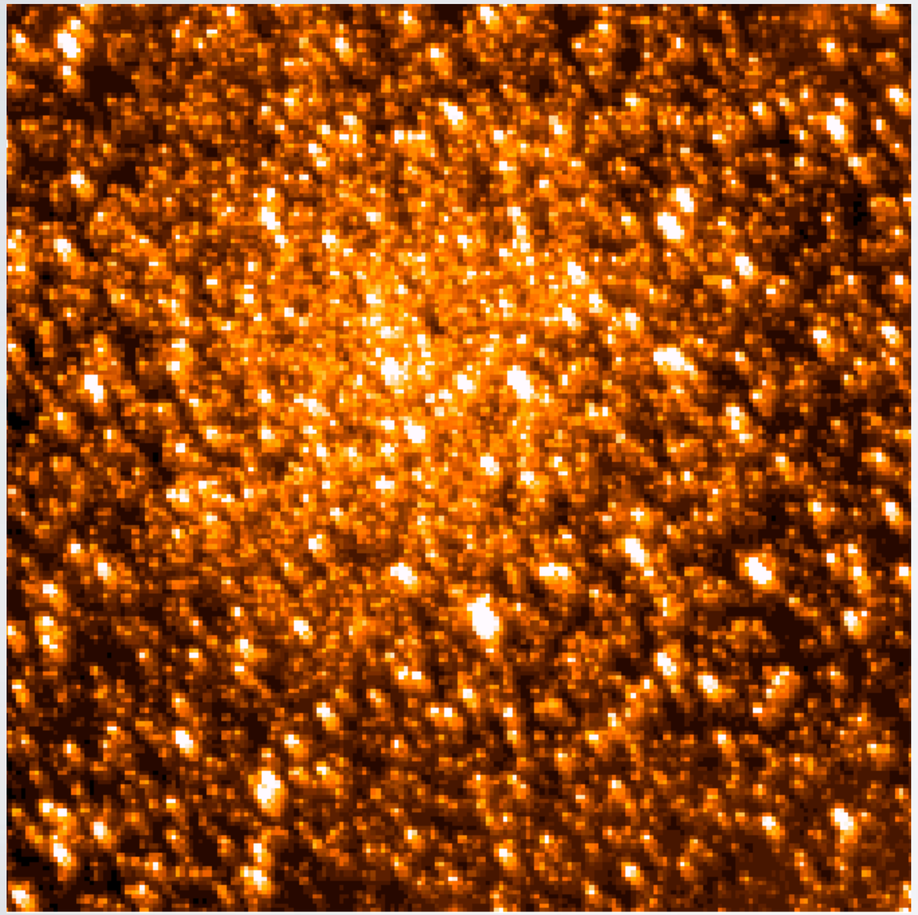




NGC 6791: an old, metal-rich cluster

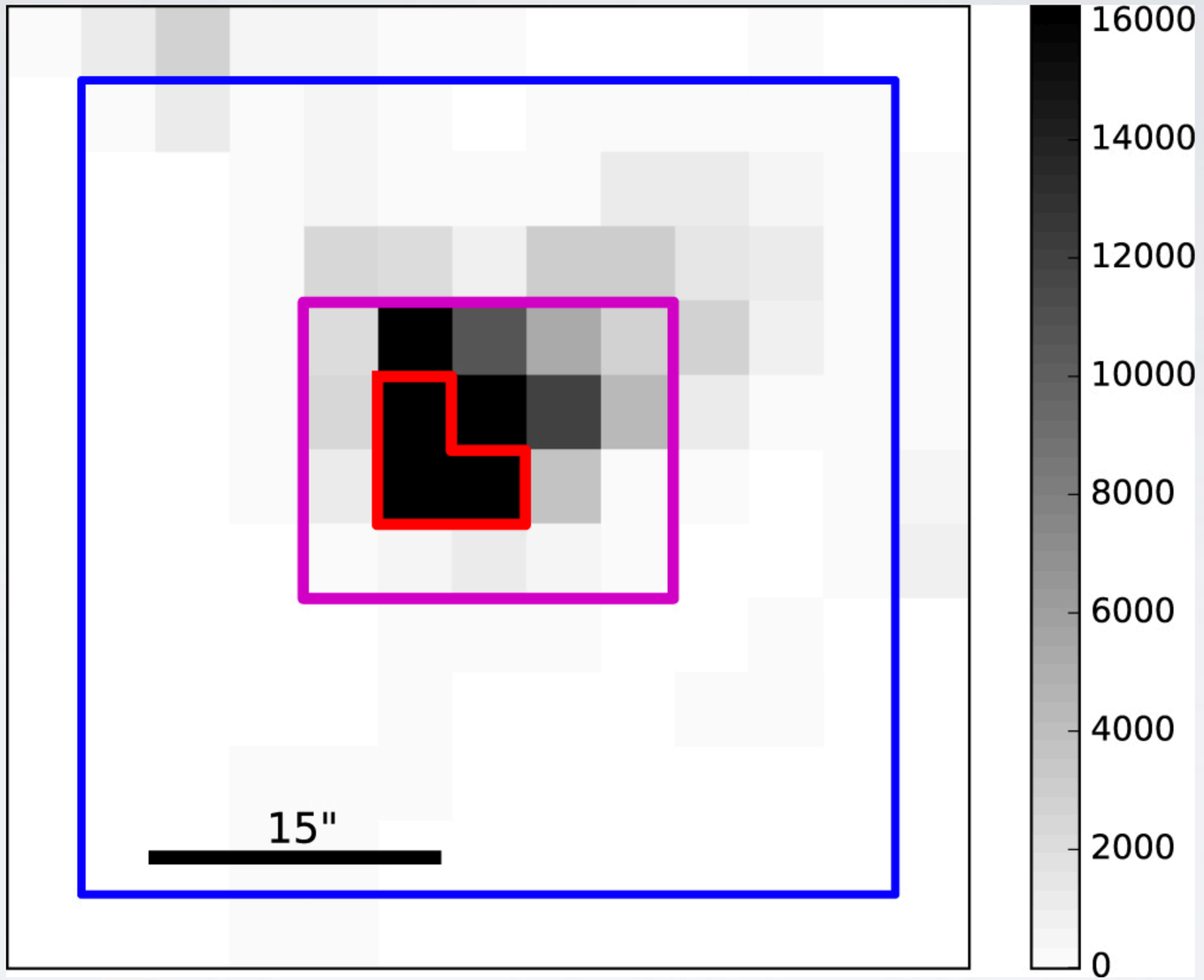
Dark Horse Observatory

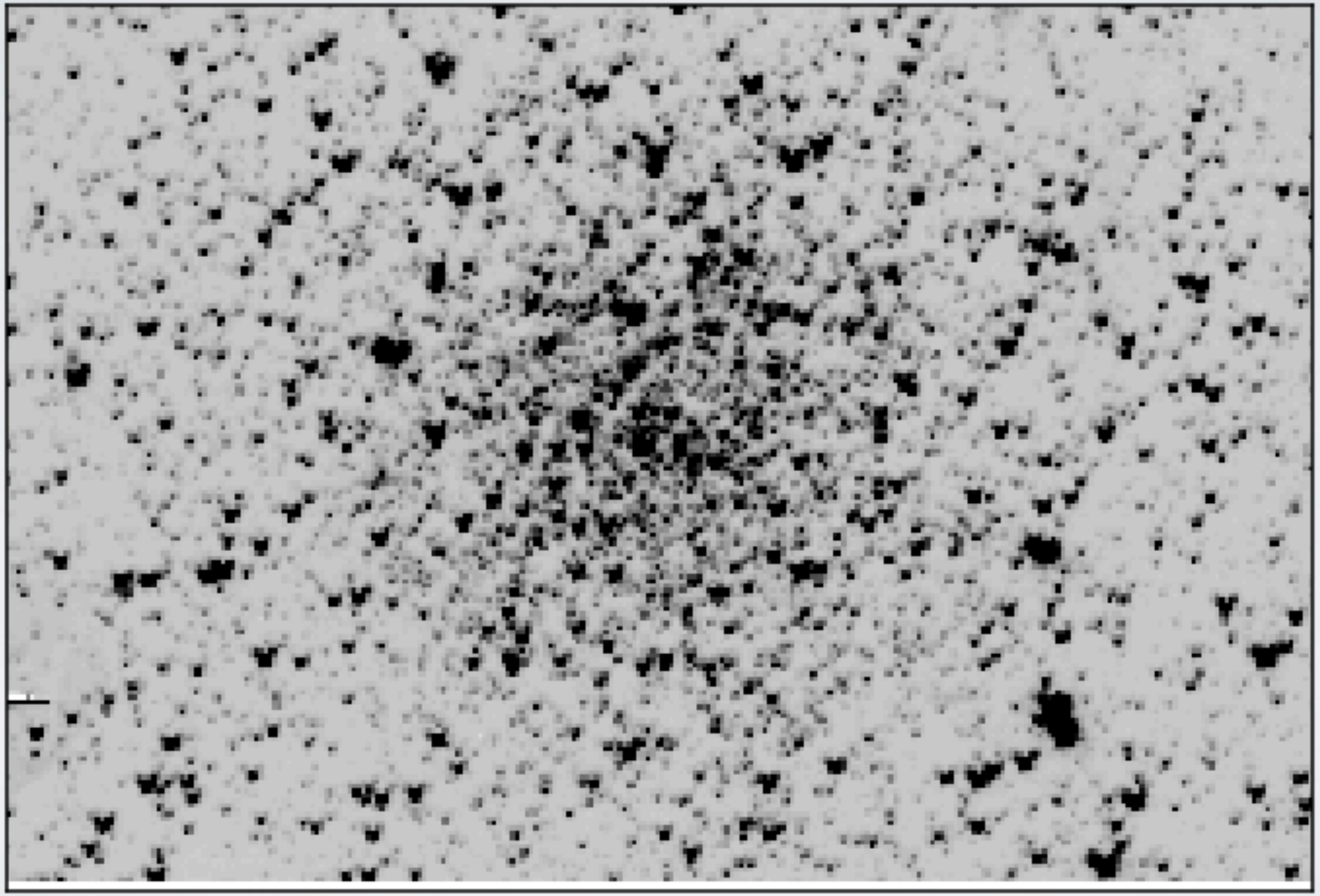
NGC 6791: an old, metal-rich cluster

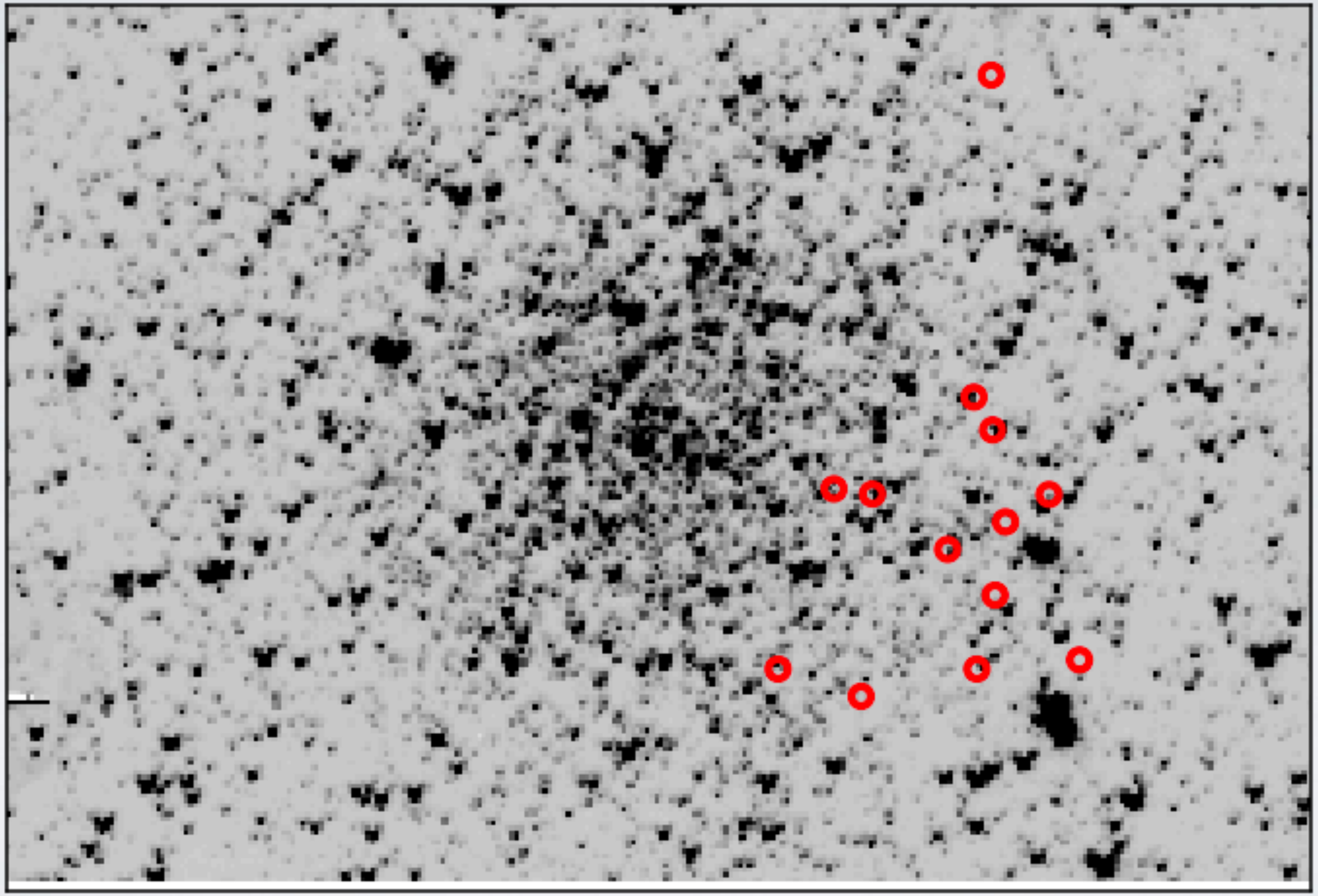


Montet+ 2018 in prep

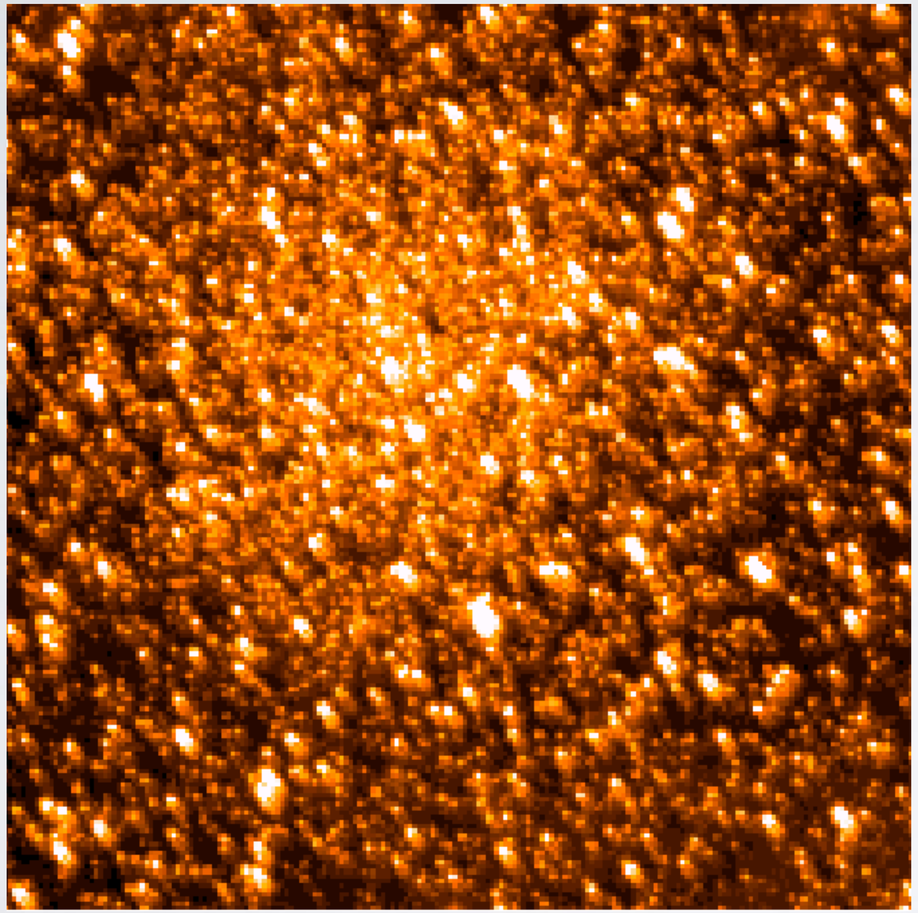
Dark Horse Observatory

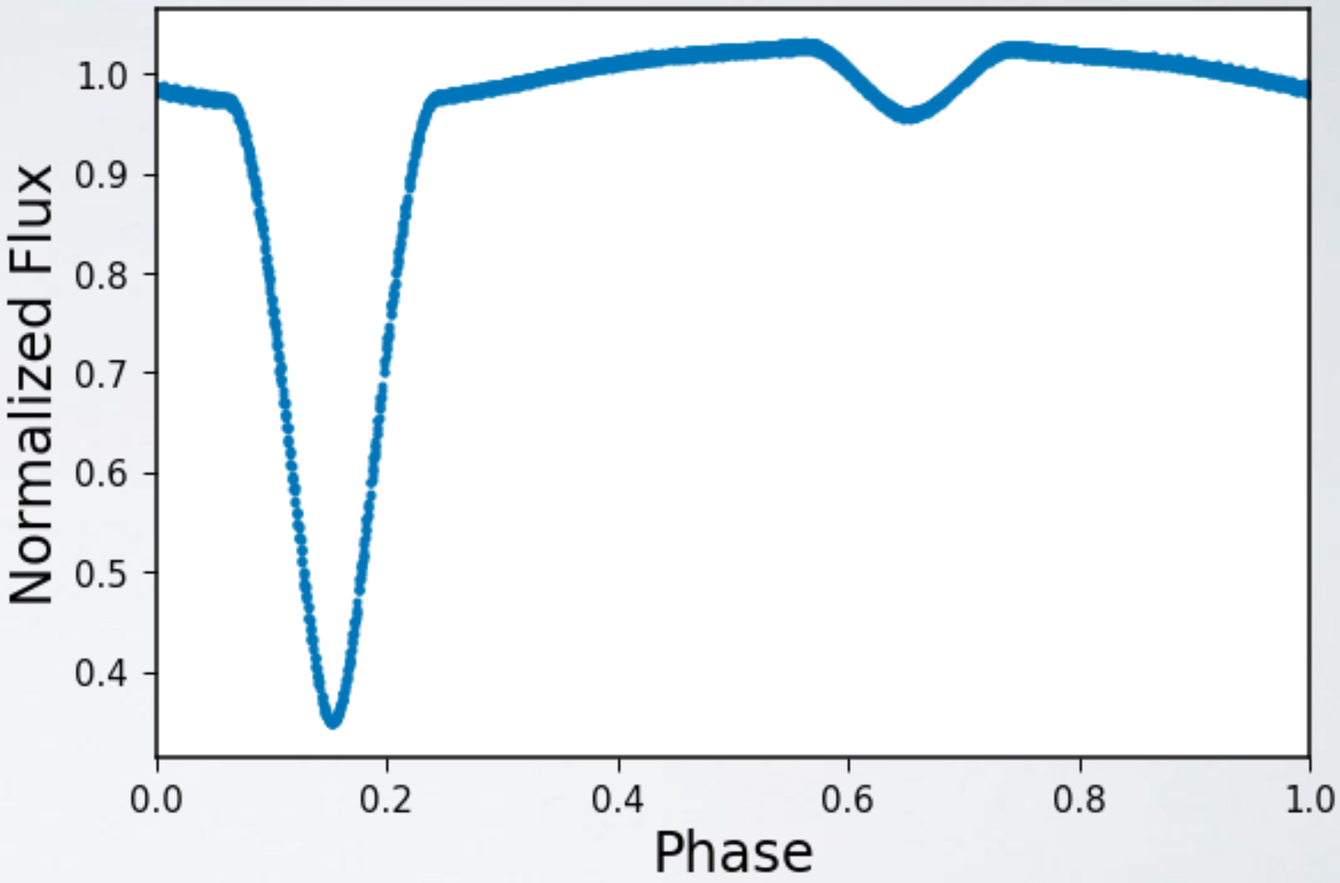

16000
14000
12000
10000
8000
6000
4000
2000
0
15"





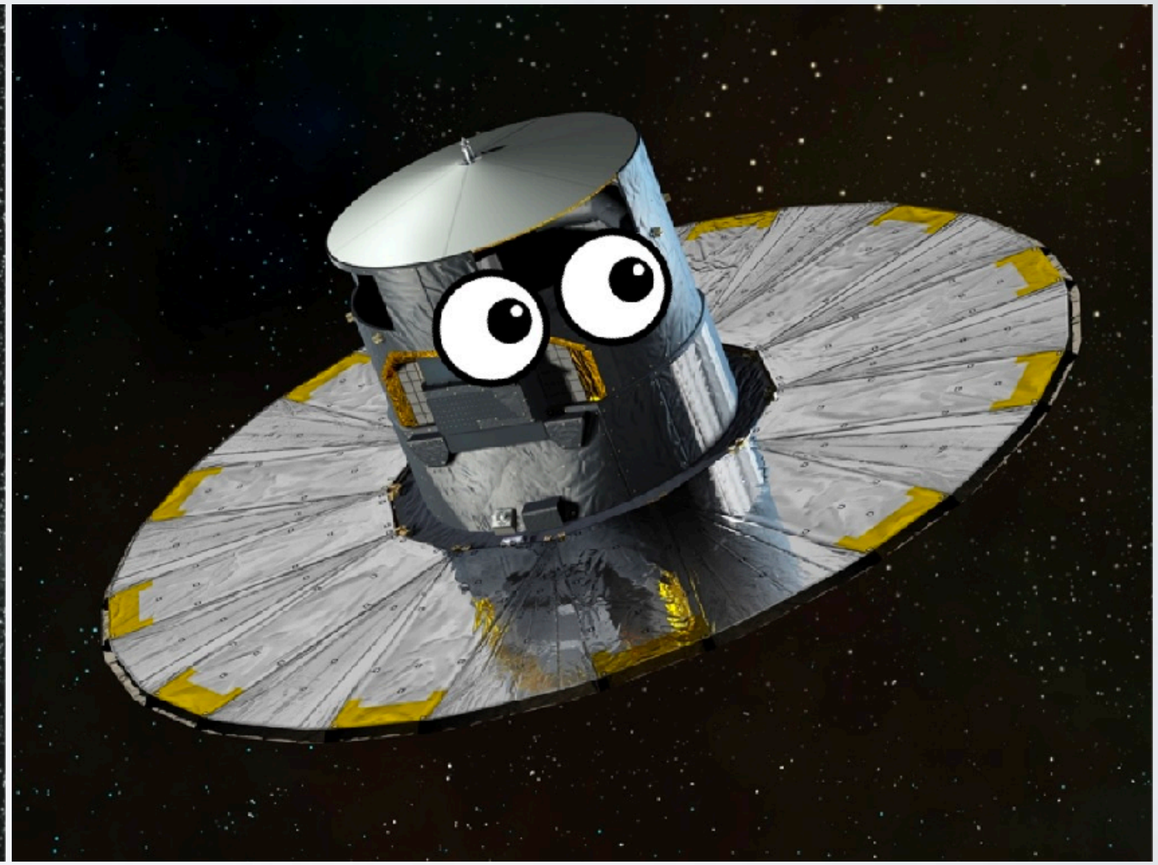
NGC 6791: an old, metal-rich cluster



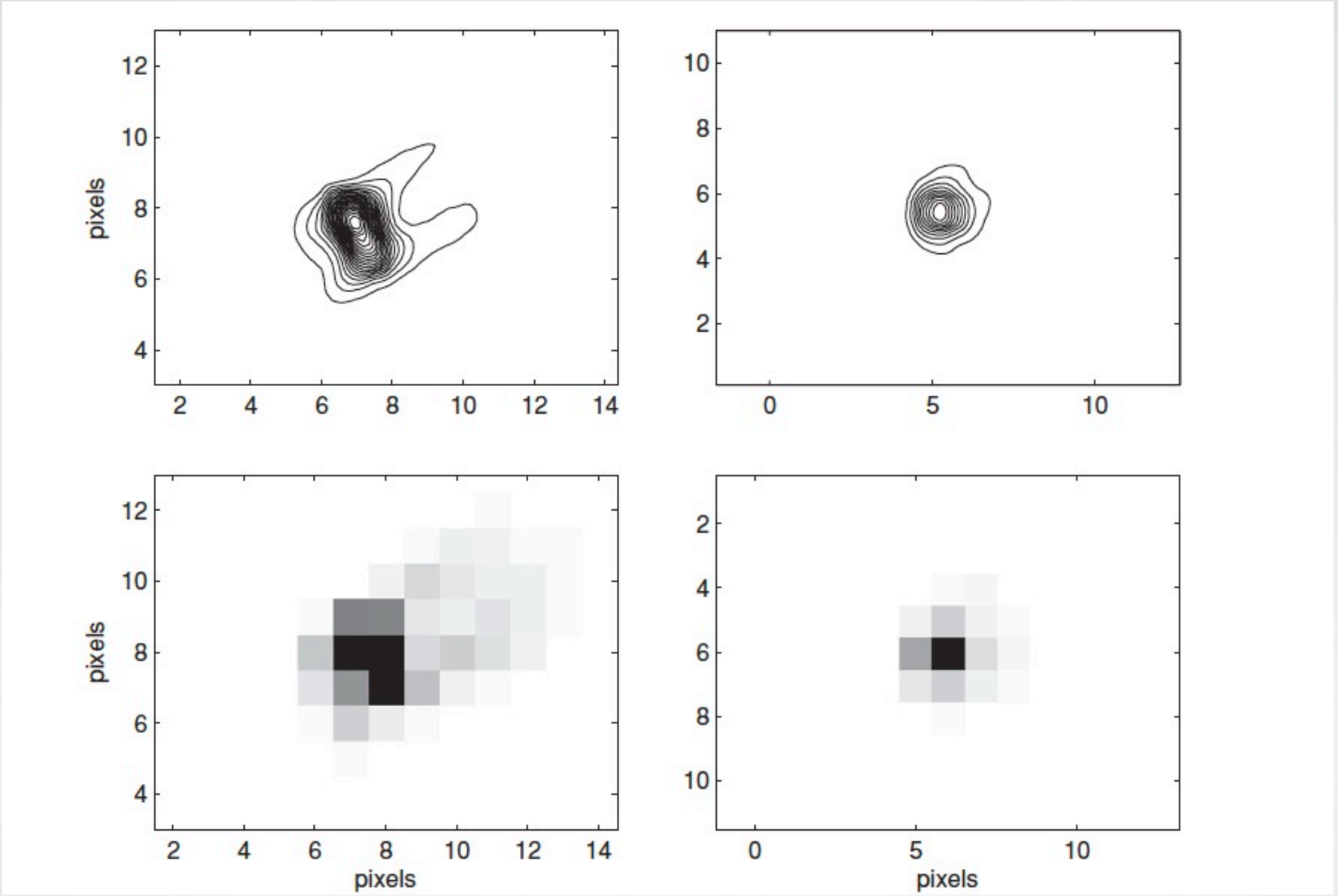


Montet+ 2018 in prep

Modeling Kepler's response to NGC 6791



ESA



Bryson et al. 2010

mirca / vaneska

Unwatch 5 | Star 0 | Fork 0

Code | Issues 1 | Pull requests 0 | Projects 0 | Wiki | Insights

Sweet PSF modeling in TensorFlow

38 commits | 2 branches | 0 releases | 1 contributor | MIT

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

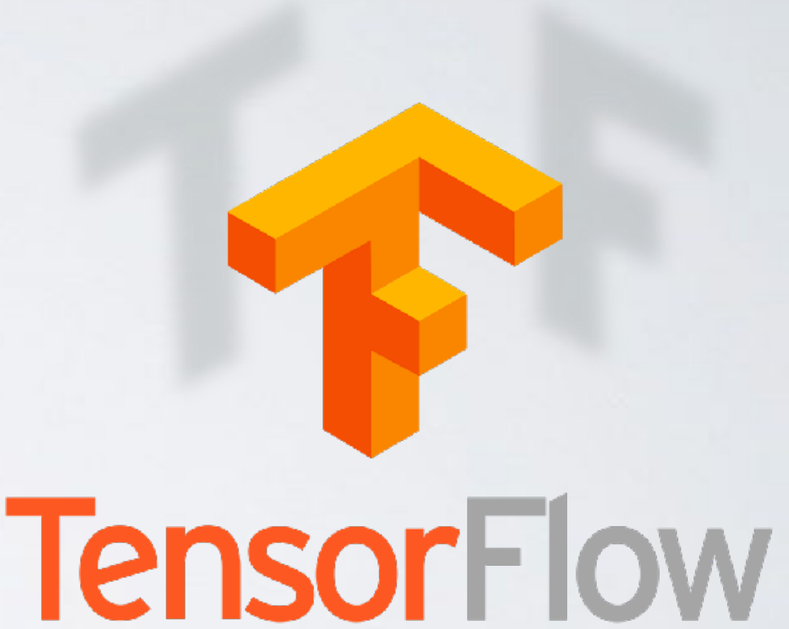
mirca Update README.rst — Latest commit 09d1a00 on Mar 11

data	bad-model	8 months ago
examples	update kepler10 example	8 months ago
vaneska	simplify init_prf method	8 months ago
.gitignore	update gitignore	8 months ago
.travis.yml	add Travis	8 months ago
LICENSE	Initial commit	9 months ago
README.rst	Update README.rst	8 months ago
requirements.txt	add Travis	8 months ago
setup.py	vapor is not allowed in version	8 months ago

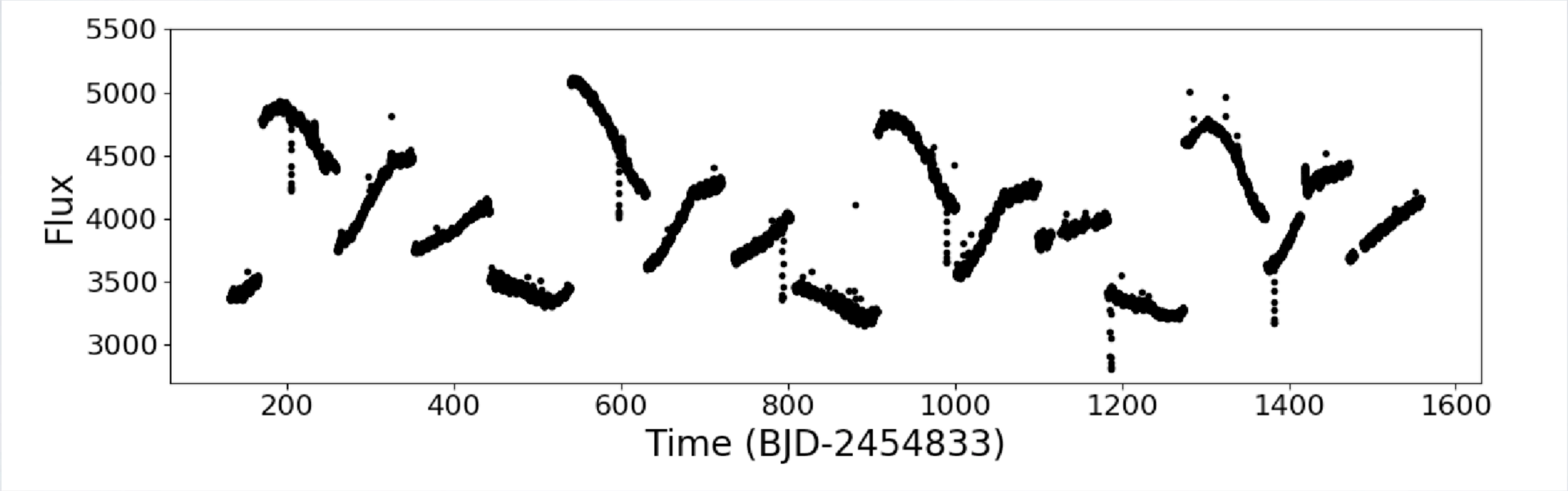
README.rst

build passing

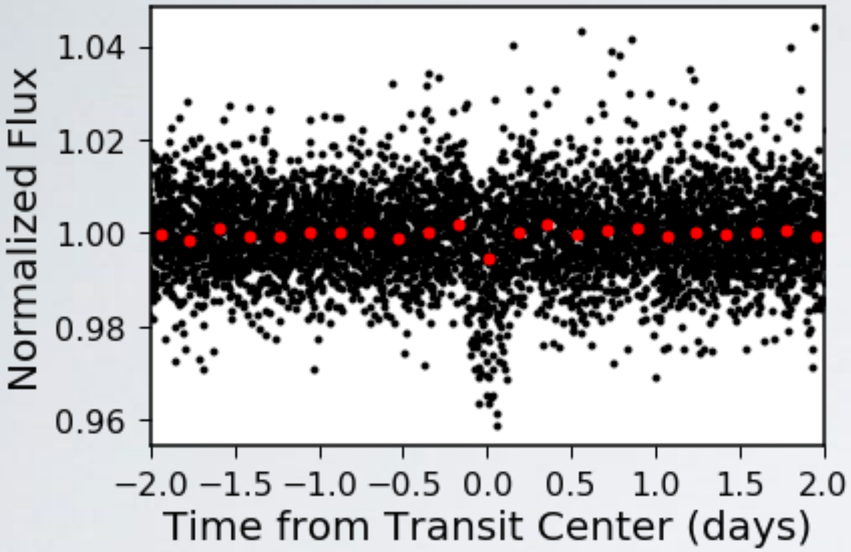
```
pip install git+https://github.com/mirca/vaneska.git
```



Light curves for the entire cluster

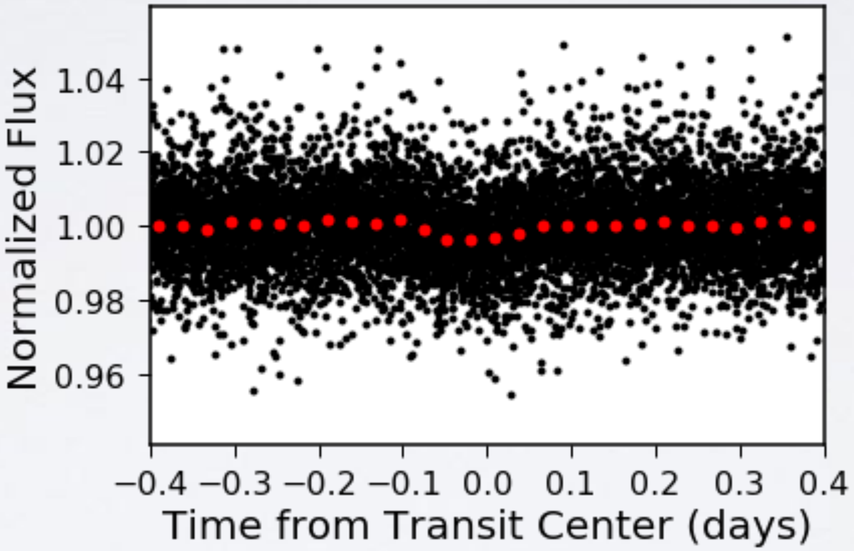


New planet candidates in NGC 6791

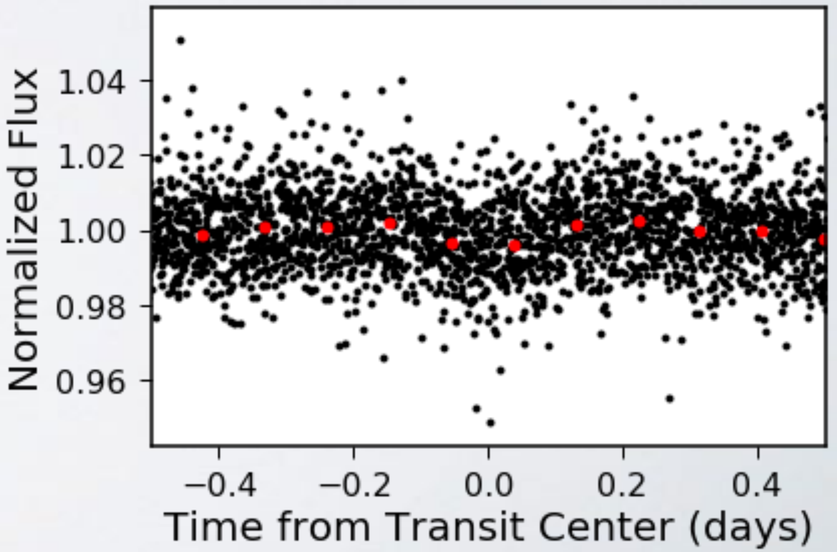


44 days

6 days



23 days



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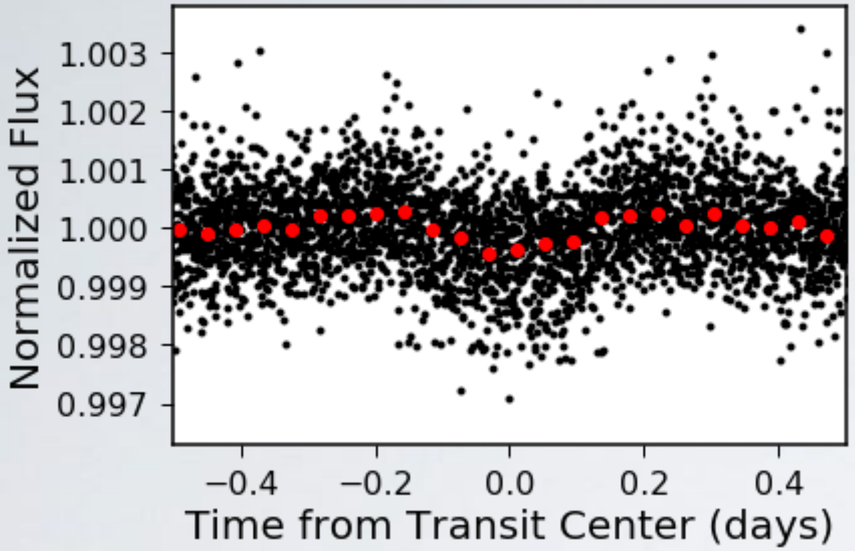
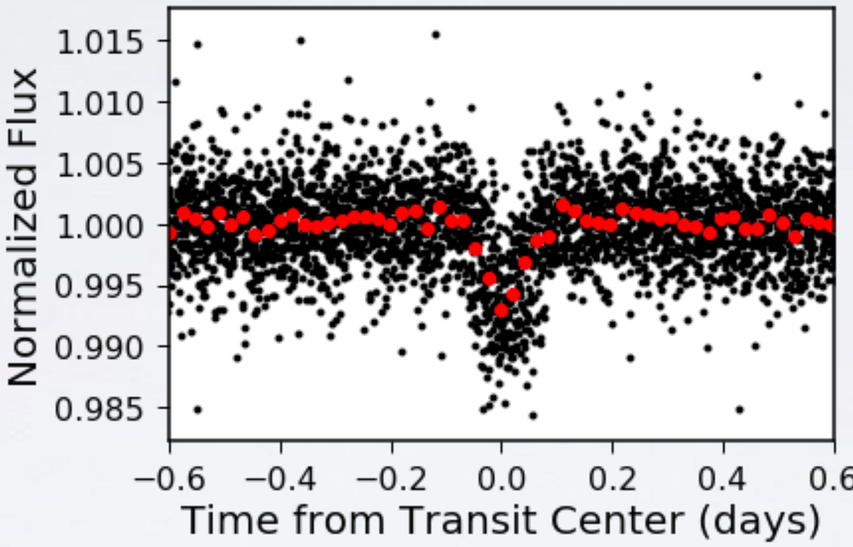
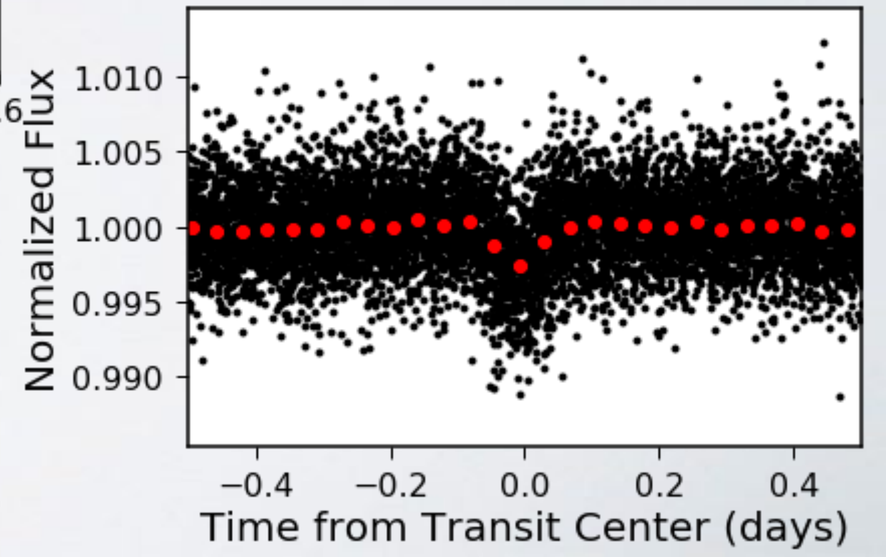
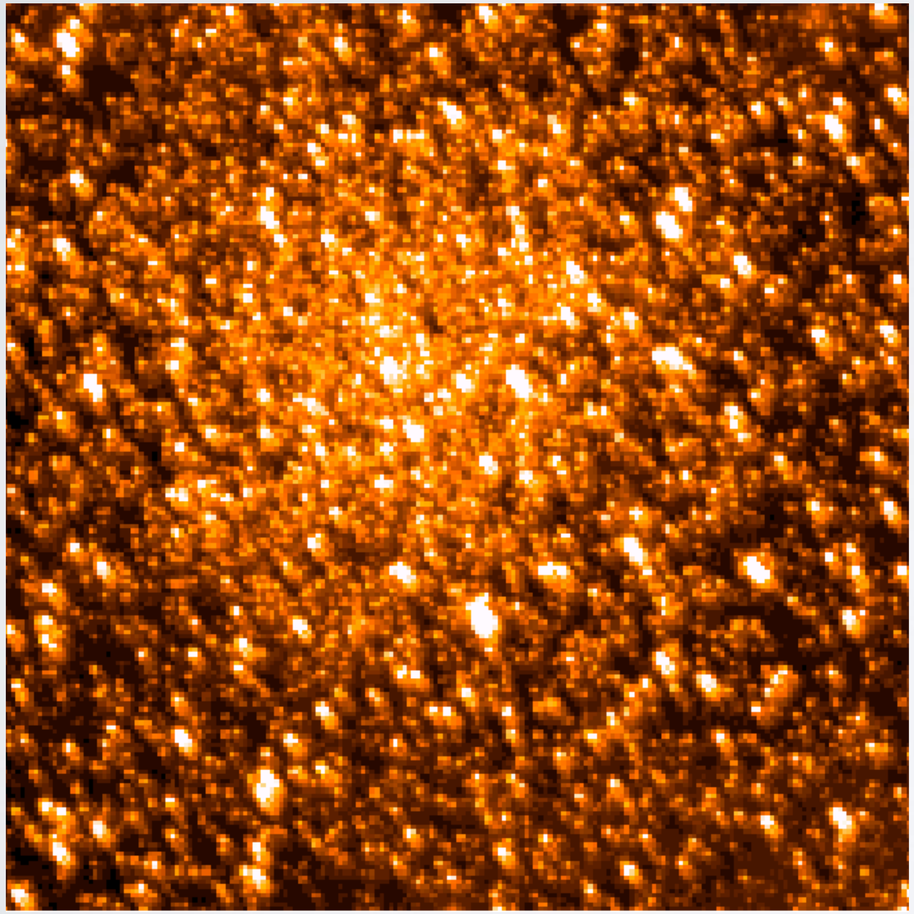
New planet candidates *near* NGC 6791

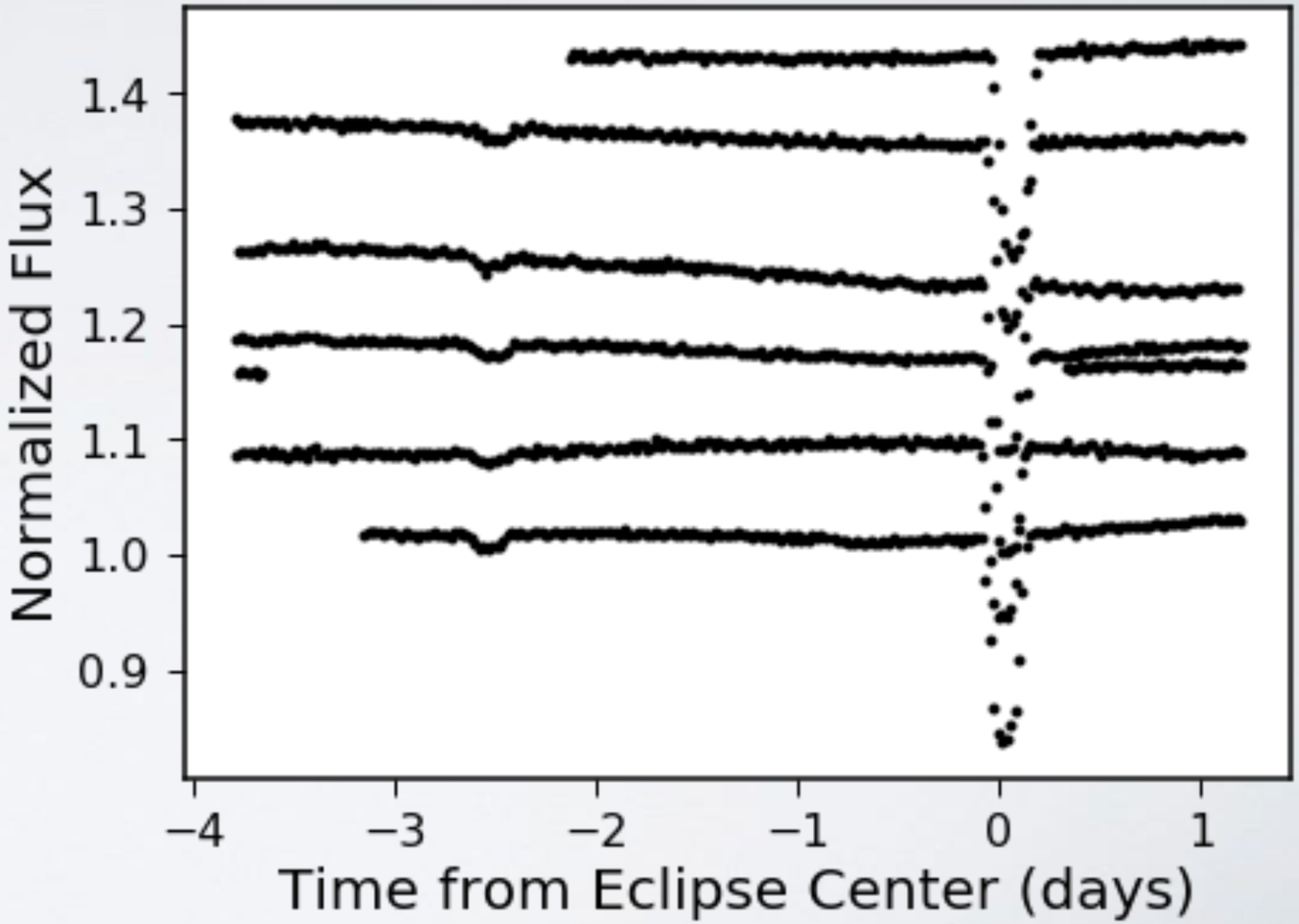






New eclipsing binaries in NGC 6791





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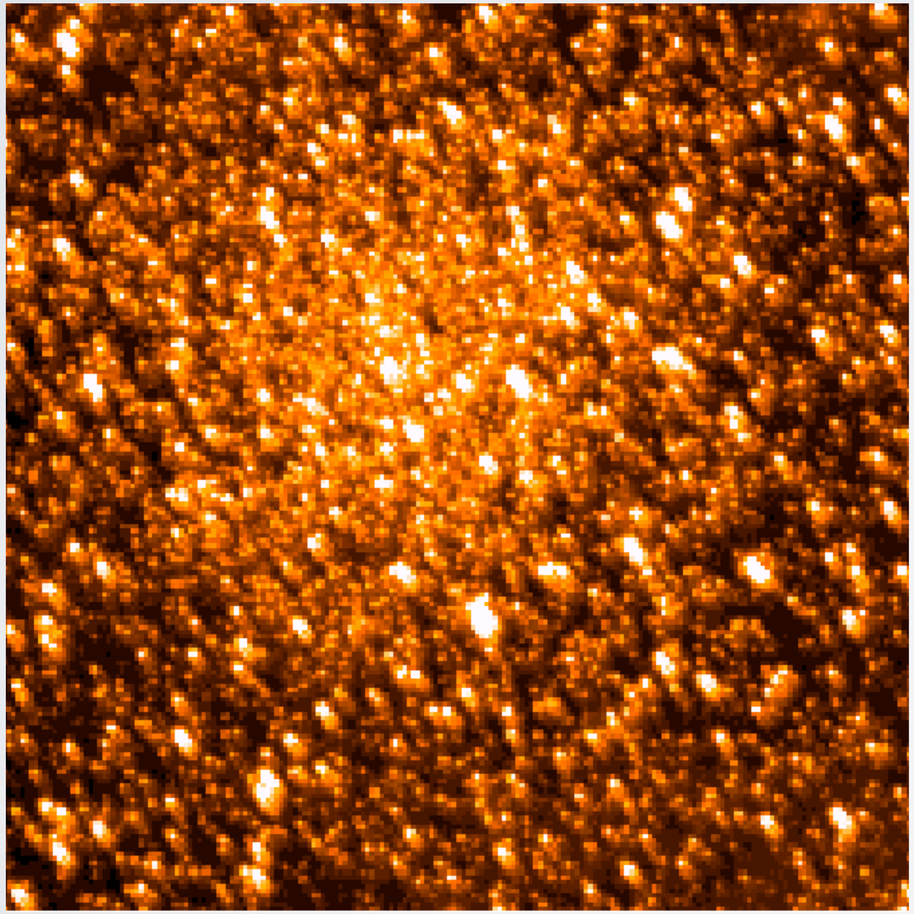
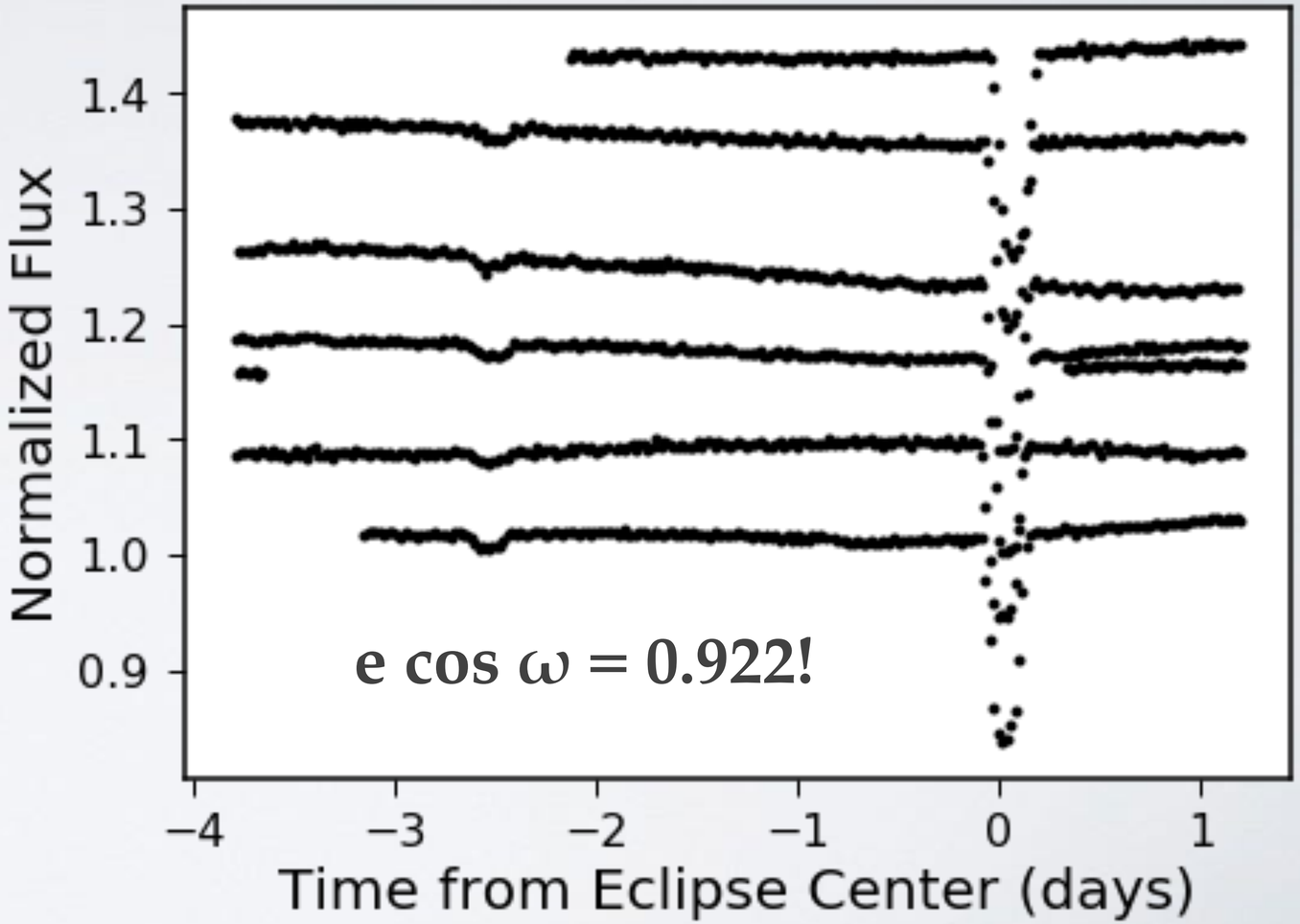
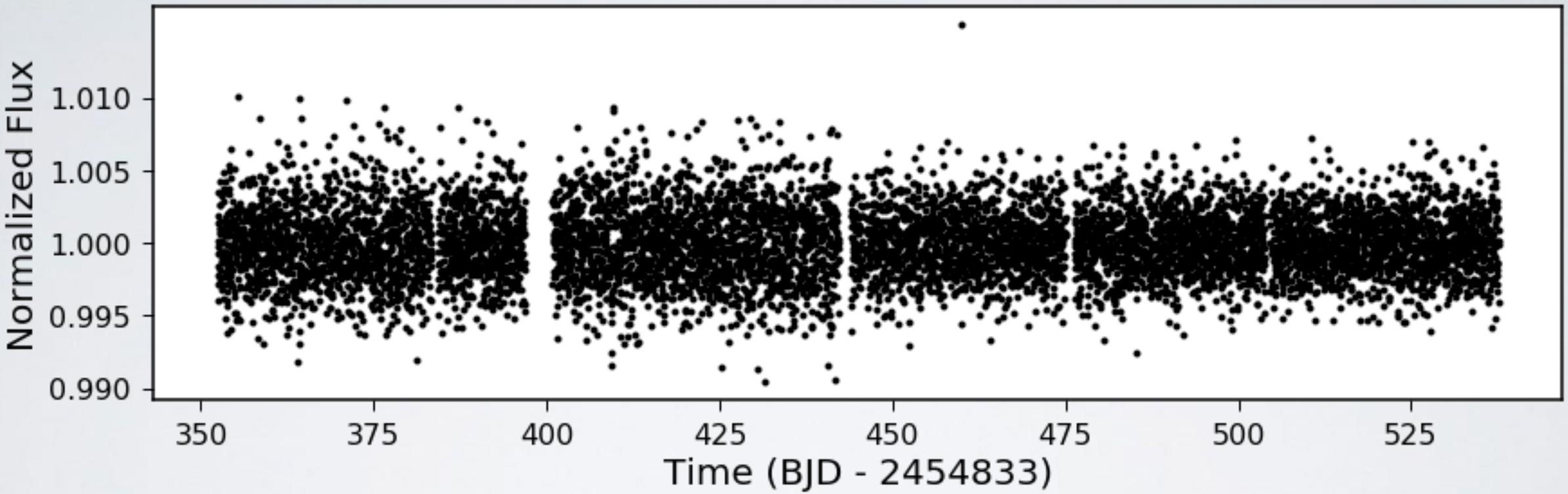
New extreme eclipsing binaries in NGC 6791

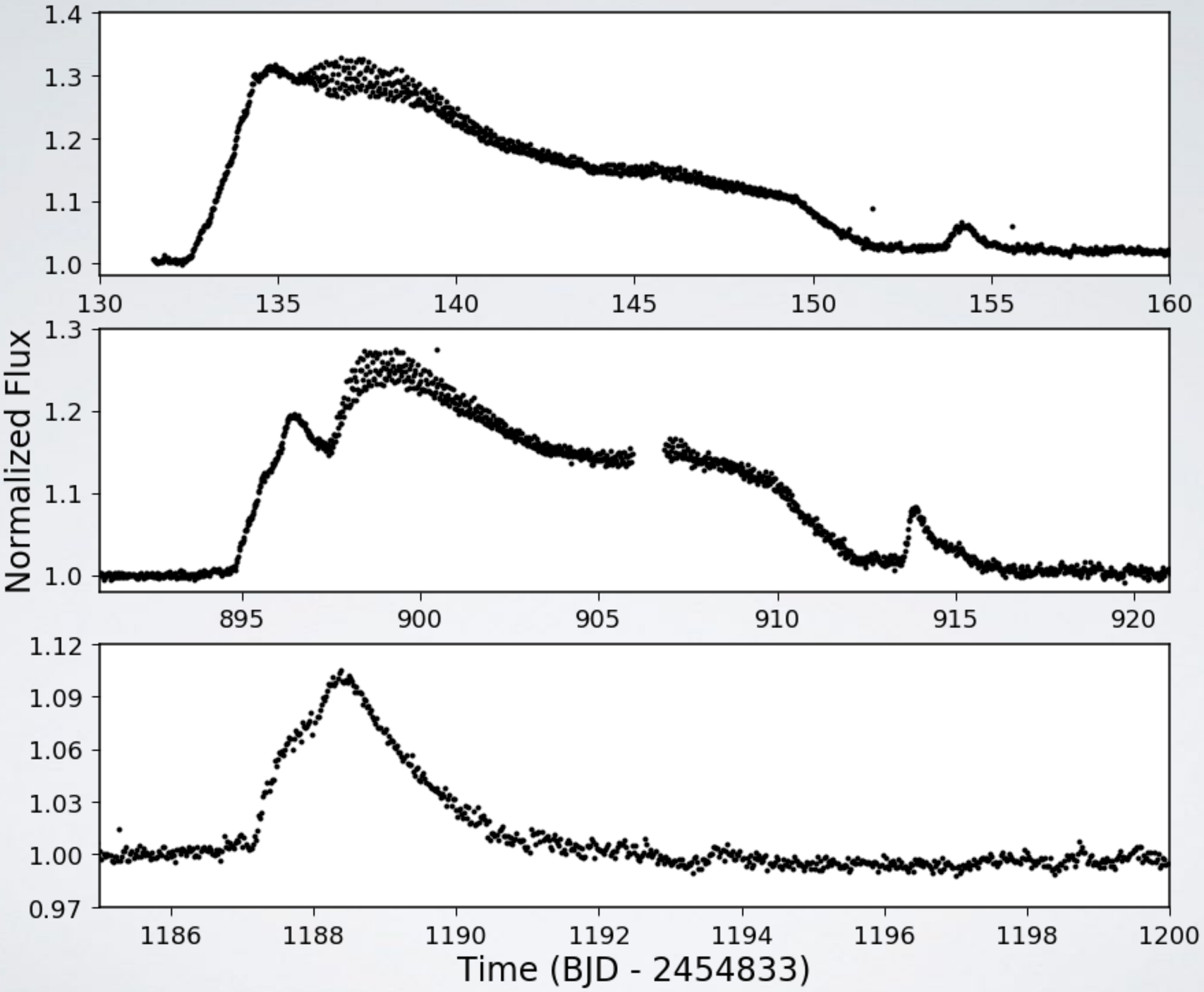




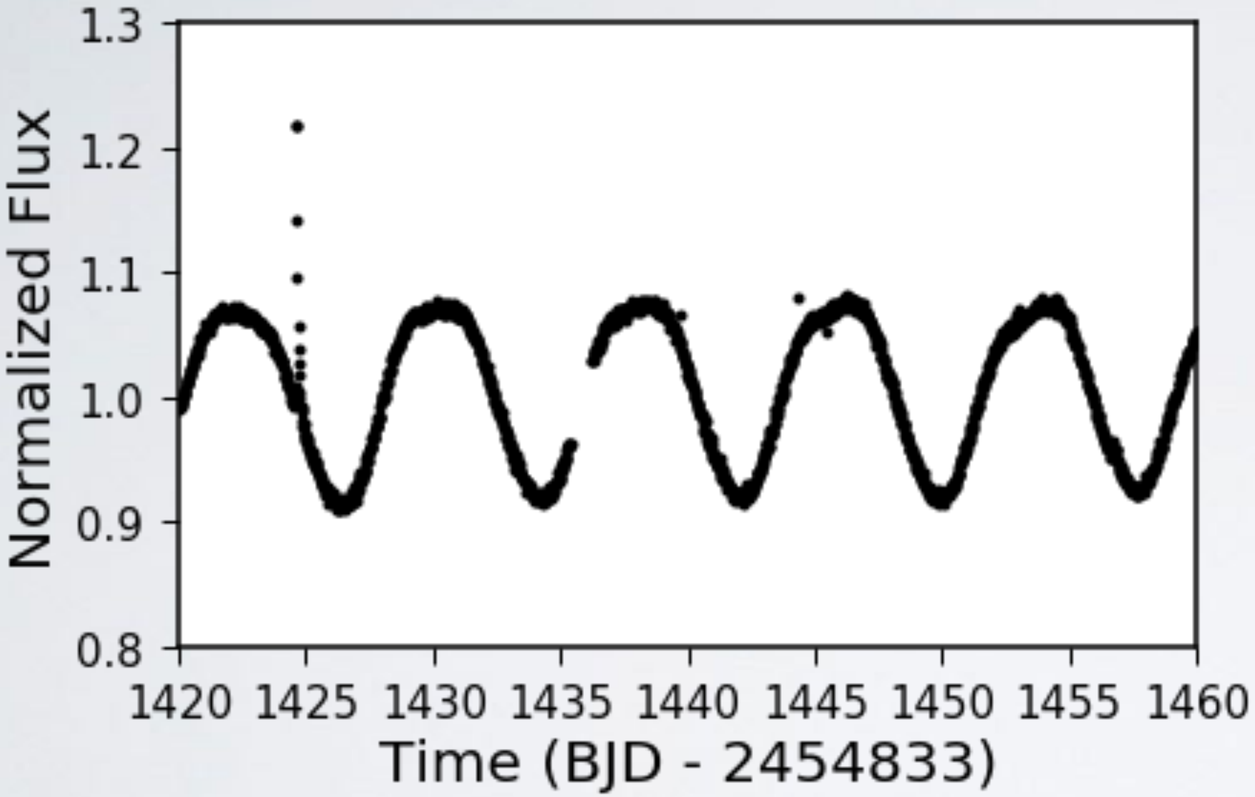
Montet+ 2018 in prep

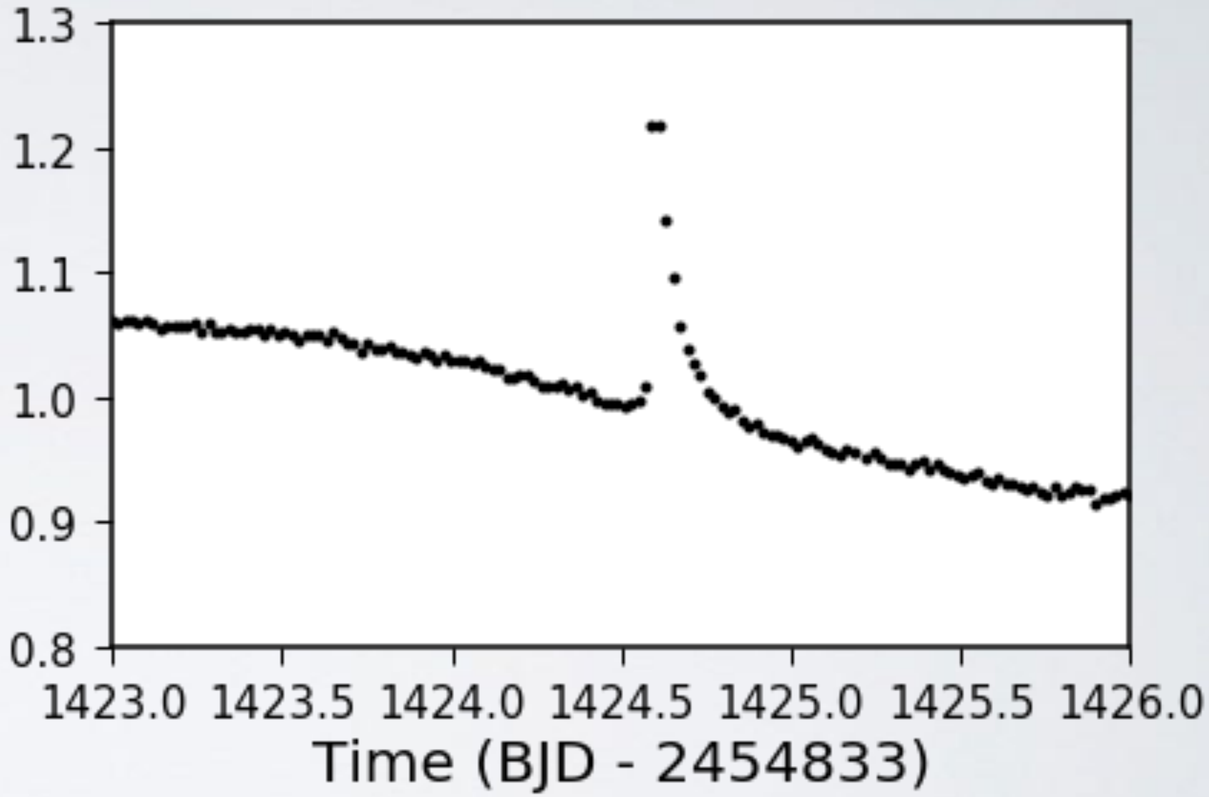
Other stellar variability



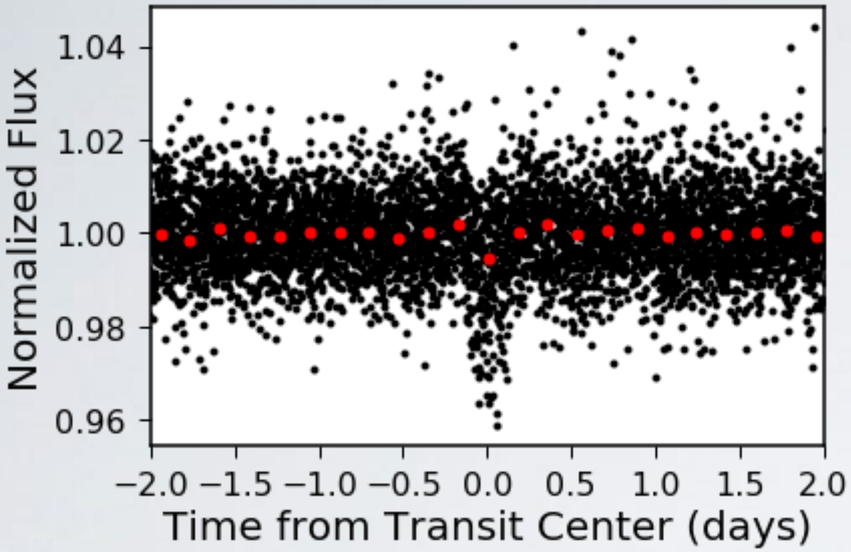

Normalized Flux
Time (BJD - 2454833)
1.4
1.3
1.2
1.1
1.0
130
135
140
145
150
155
160
1.3
1.2
1.1
1.0
895
900
905
910
915
920
1.12
1.09
1.06
1.03
1.00
0.97
1186
1188
1190
1192
1194
1196
1198
1200

Other stellar variability





Where are the shorter period planets?



44 days

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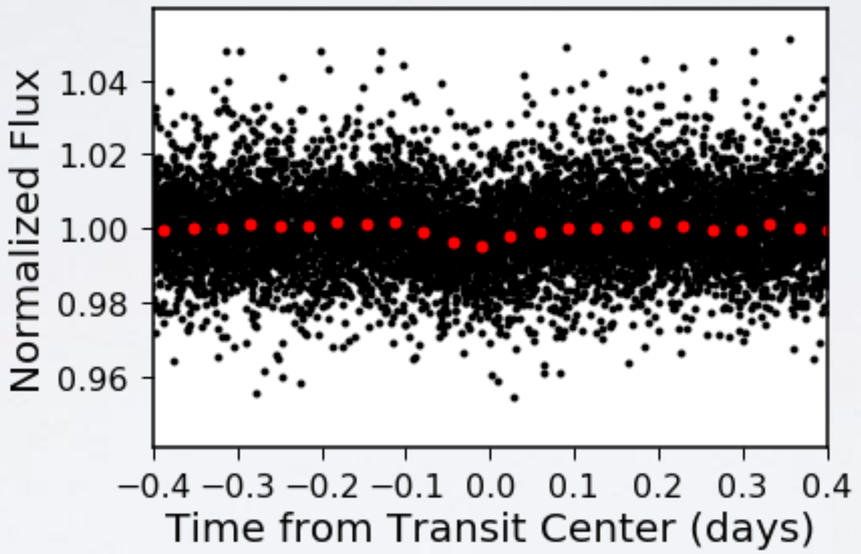
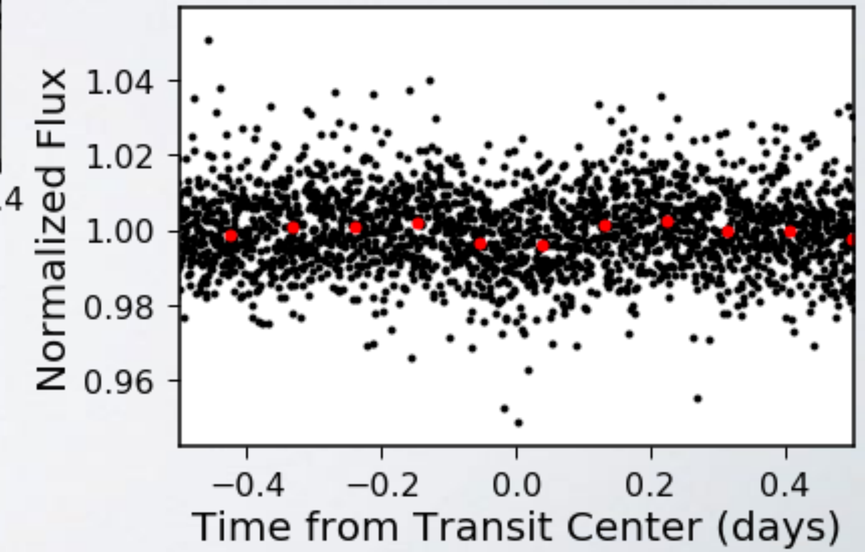
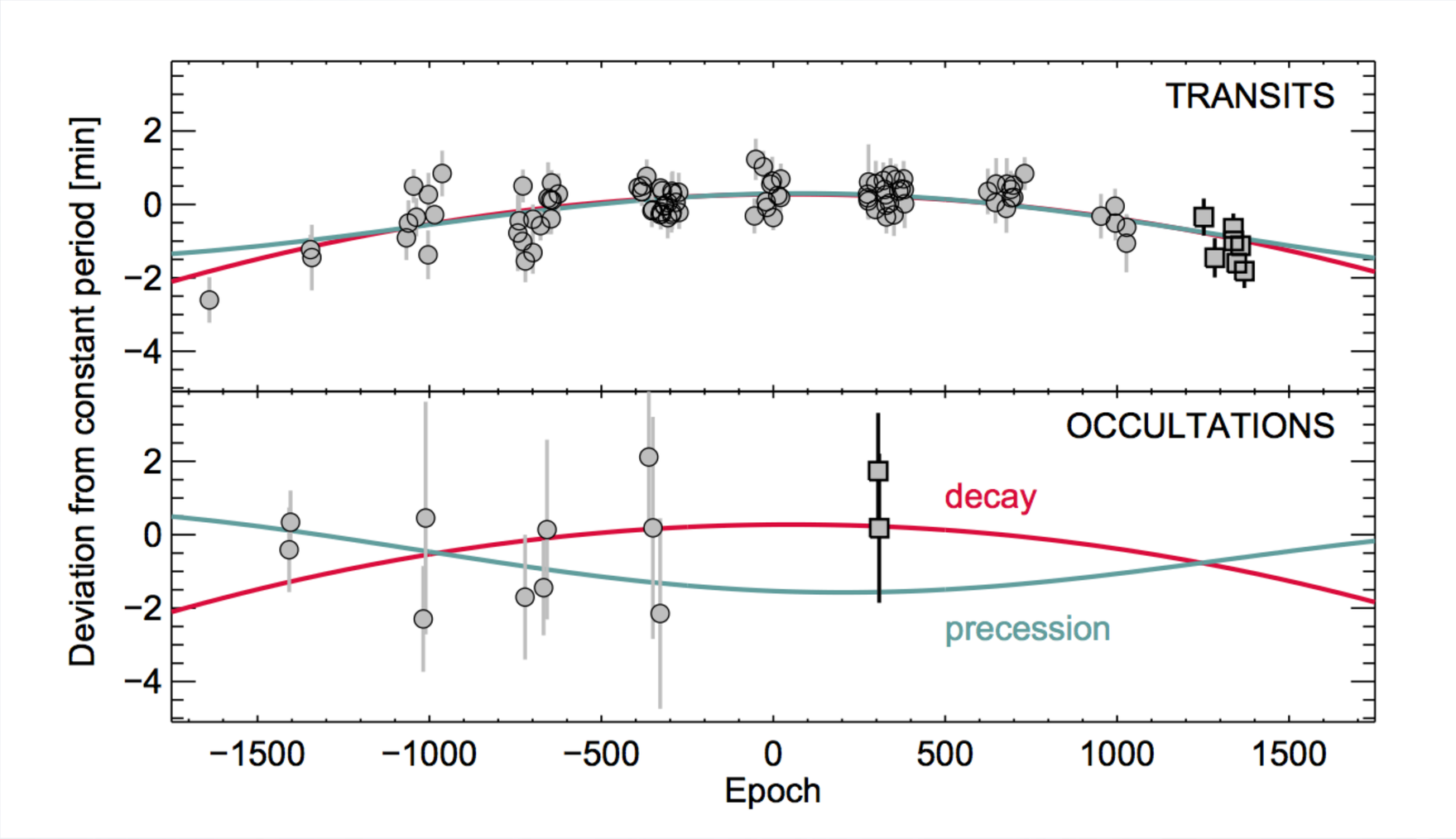


23 days



Montet+ 2018 in prep

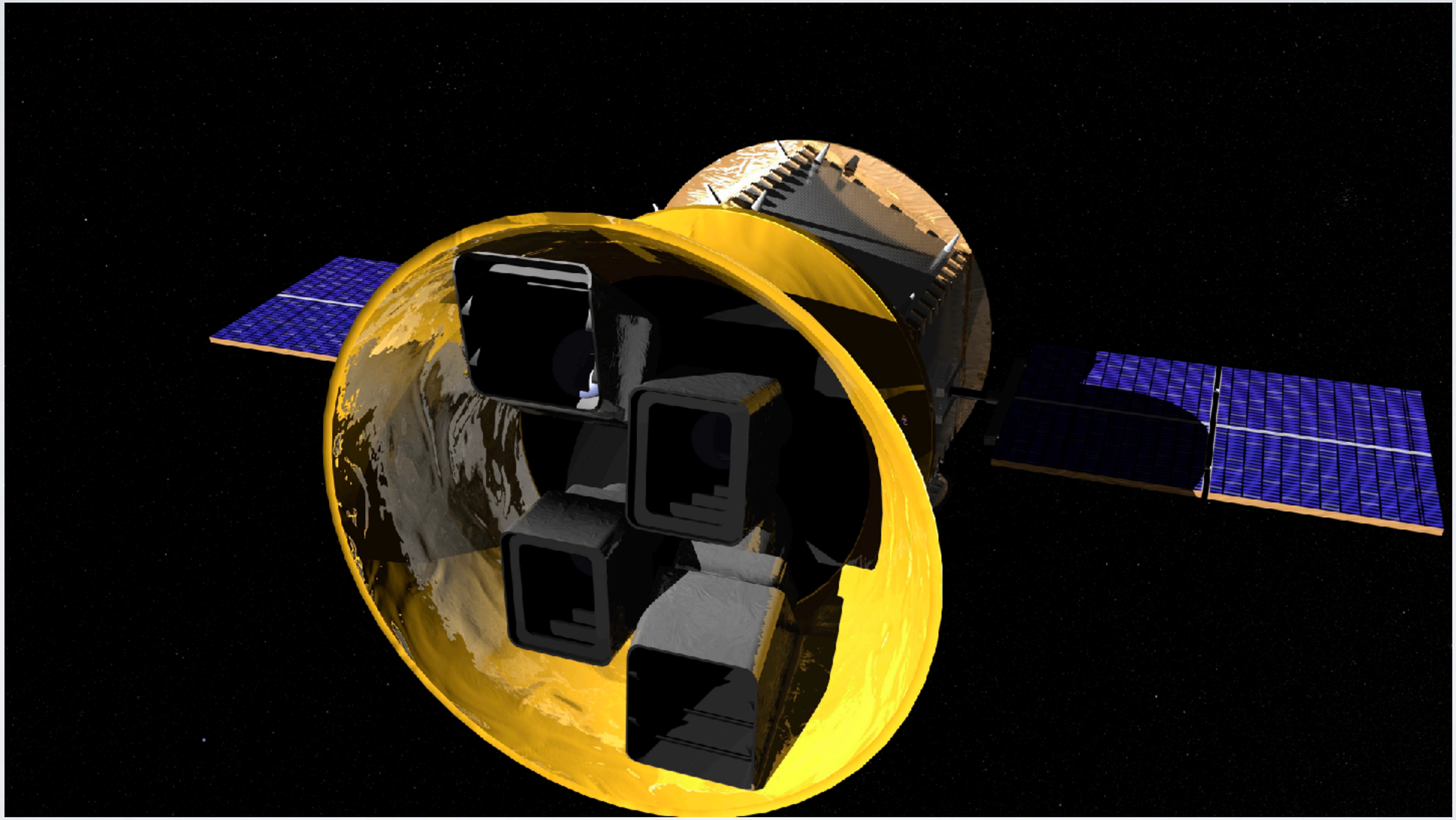
Tidal inspiral destroys hot Jupiters



Patra et al 2017

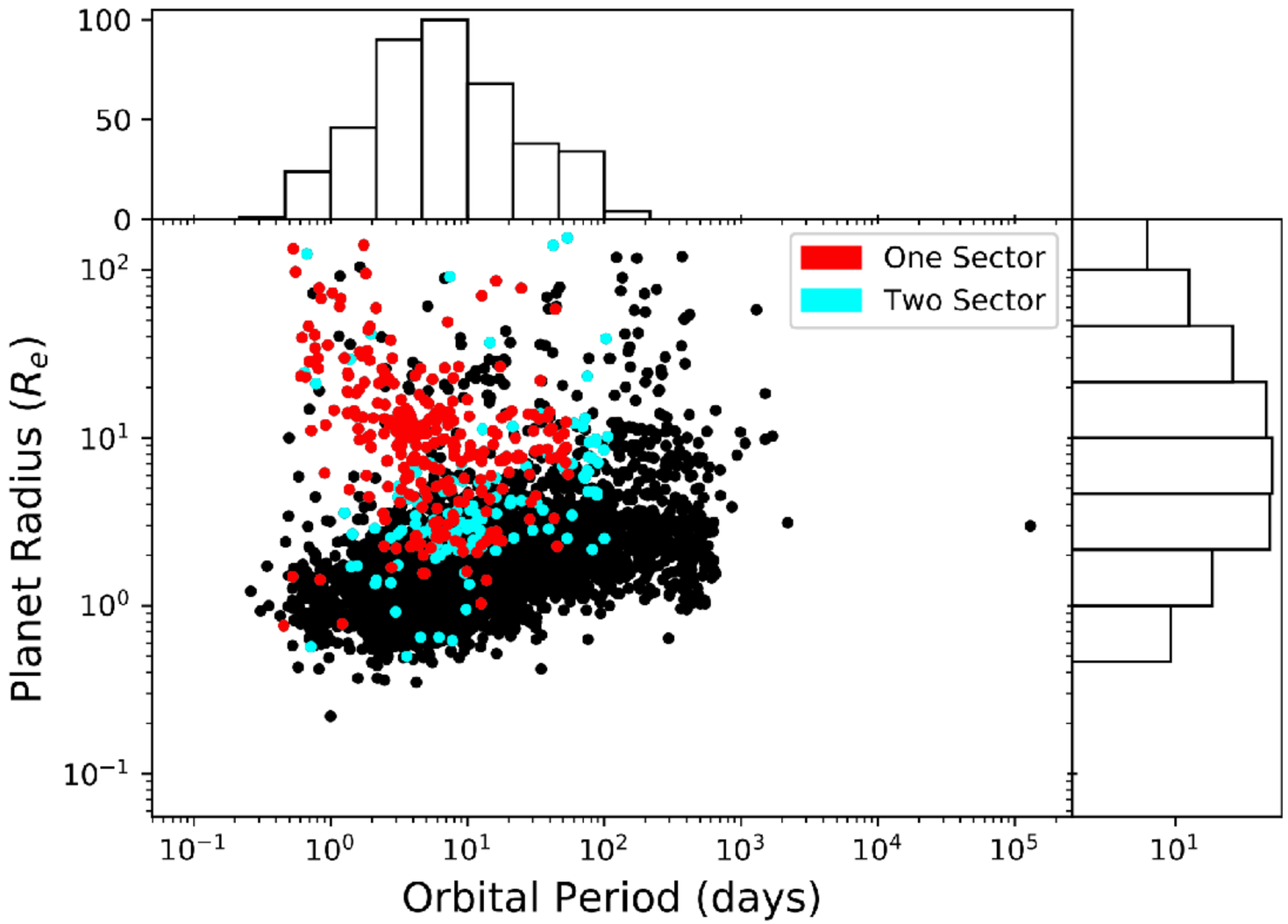
Q_* of ~10^6 removes enough hot Jupiters to inhibit detection for NGC 6791

What are typical values of Q?



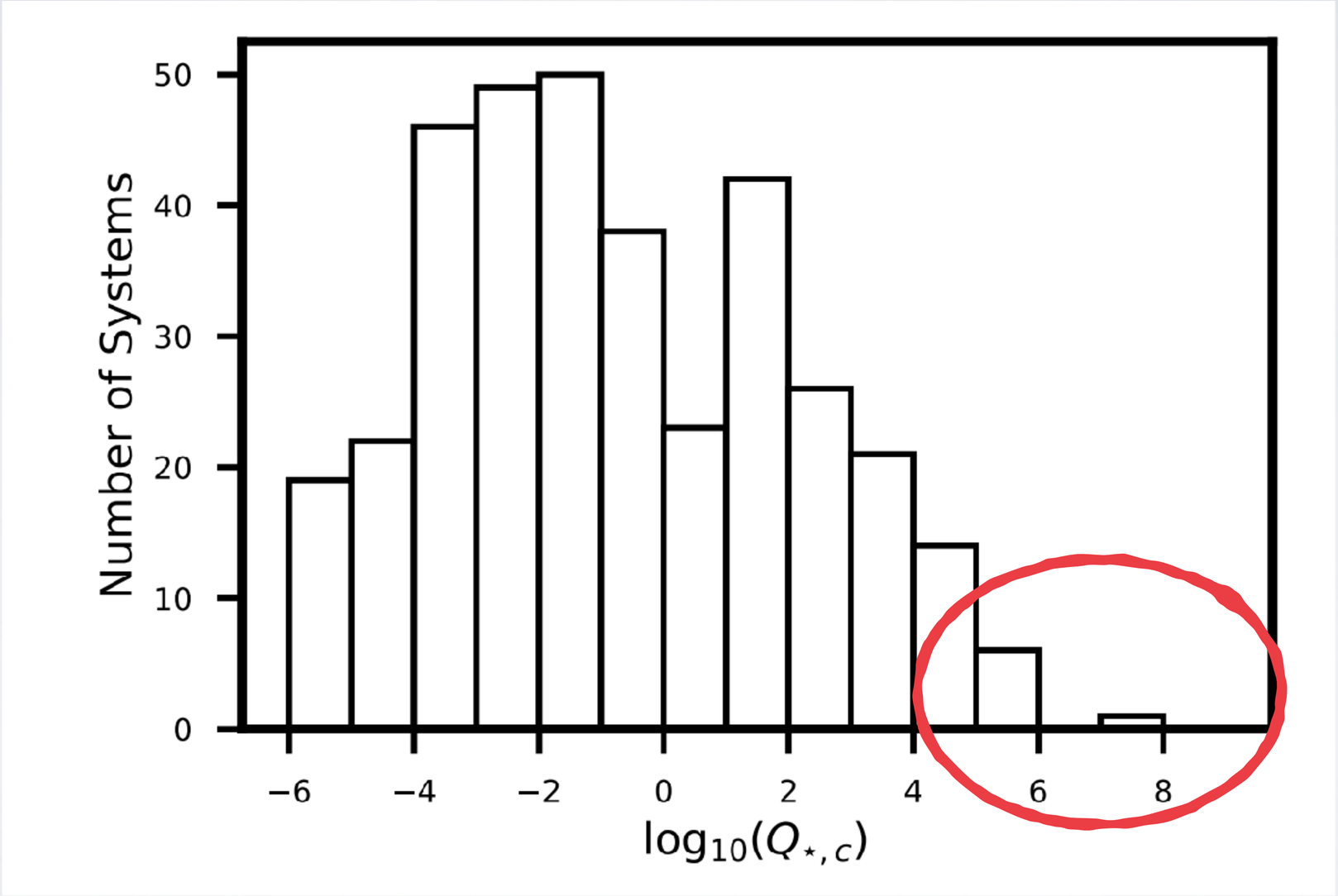
NASA

TESS will detect Kepler's hot Jupiters



Christ et al. 2018

TESS could find inspiraling Kepler hot Jupiters

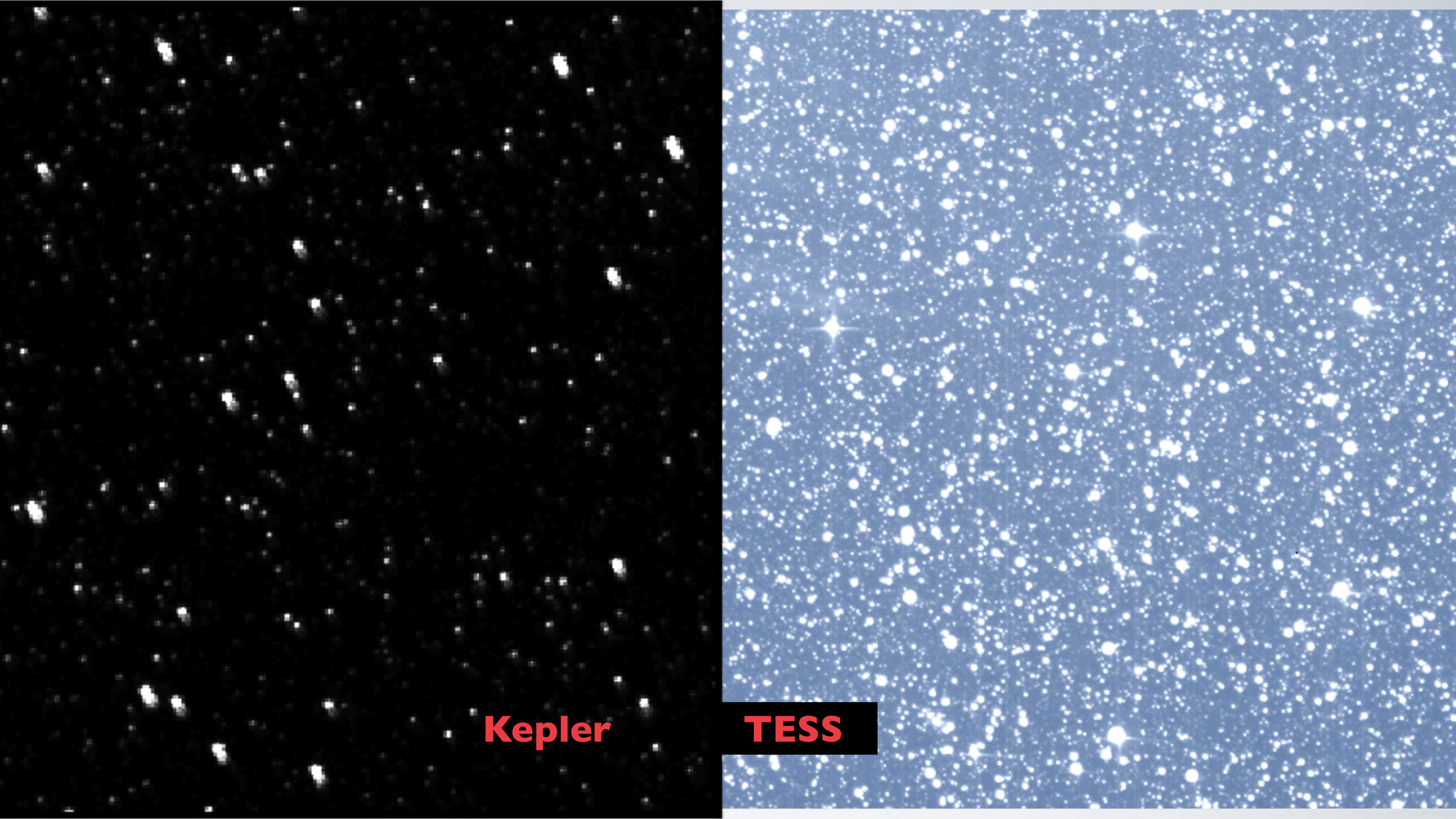


Christ et al. 2018

NGC 6791 hosts some of the
oldest planets we know

We can use these planets to understand
the long-term evolution of planetary systems

Crowded *Kepler* fields are preparing us for TESS data!


Kepler
TESS

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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.

Applications Will Open Soon

The deadline for applications is TBD. Applicants will be selected using entrofy with the goal of selecting a diverse group of participants. Preference will be strongly given to those who can commit to attending all five days. Limited travel assistance may be available for those who could not otherwise attend.

Schedule and Location

The *Building Early Science with TESS* workshop will take place March 25-29, 2019 at the University of Chicago.

Scientific Organizing Committee

- **Megan Bedell** (Flatiron)
- **Dan Foreman-Mackey** (Flatiron)
- **Christina Hedges** (NASA Ames)
- **Ben Montet** (University of Chicago), Chair
- **Rachael Roettenbacher** (Yale)

http://tess.science

Thank you!

Backup slides