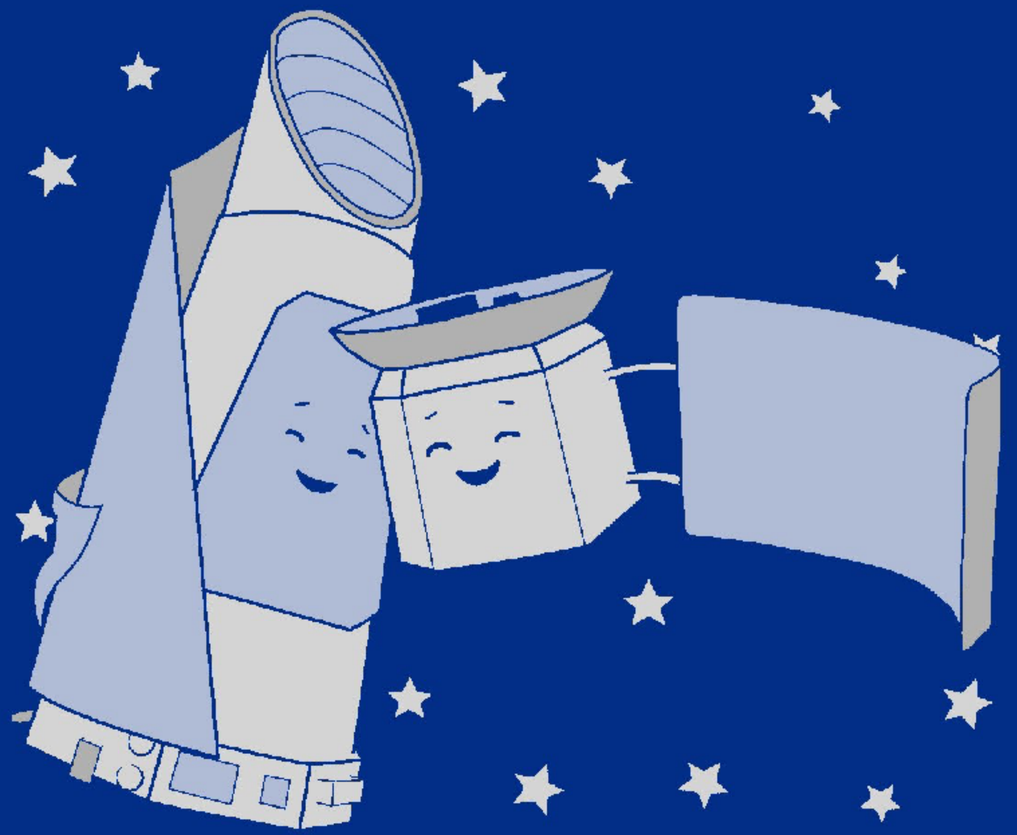
Three reasons why Kepler's discoveries will continue

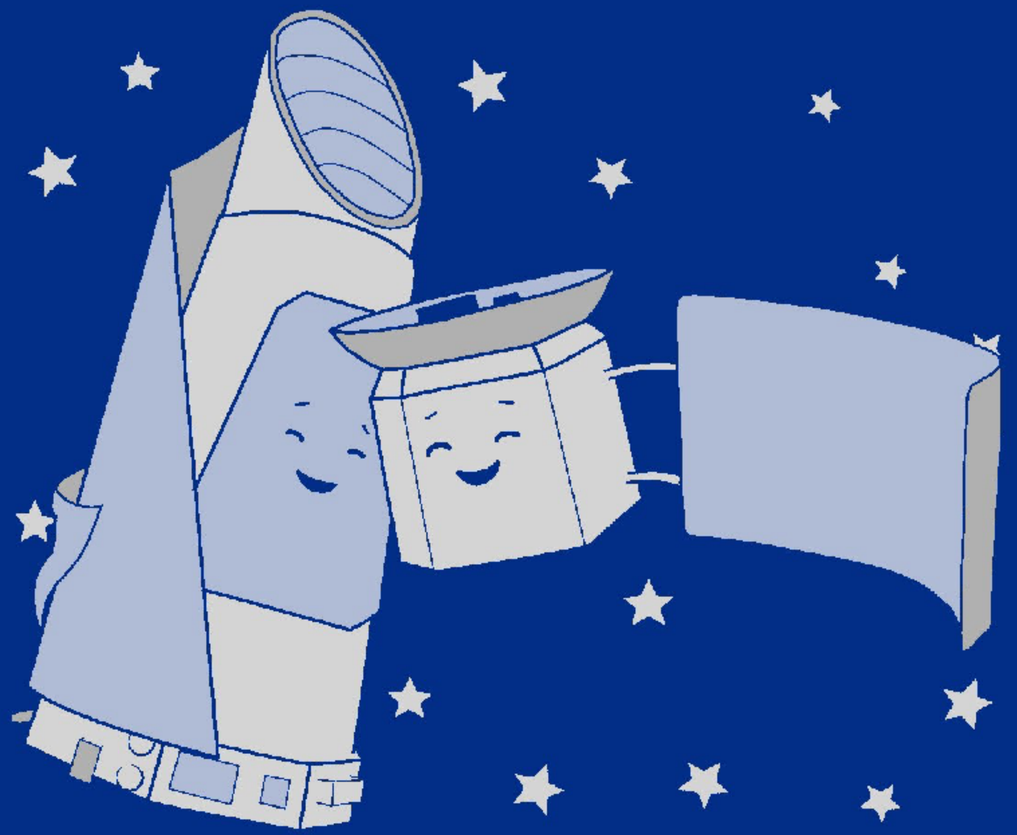


Jessie Dotson
Kepler/K2 Project Scientist
NASA Ames Research Center

Cartoon by Dr Christina Hedges

Three reasons why Kepler's discoveries will continue

& why I'm looking forward to Cool Stars 21!!!



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Cartoon by Dr Christina Hedges

Photo by Marc Schiele on unsplash.com

At present, 2.1 publications per day use Kepler or K2 data

2016: 1.2 per day
2013: 0.8 per day
2010: 0.2 per day

Photo credit: motorverso.com (cc-by)

Many of Kepler’s most intriguing discoveries are still emerging.

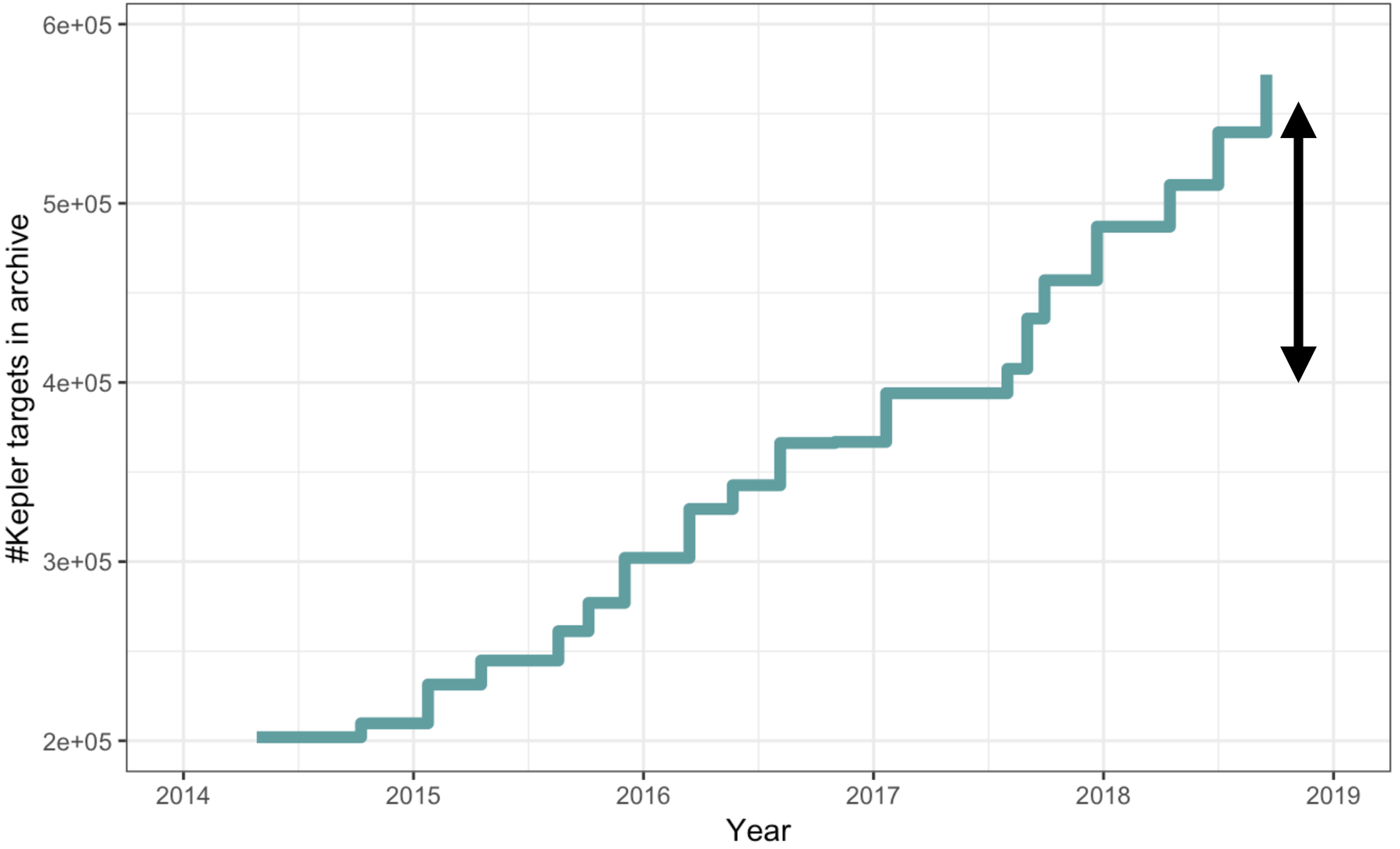
Kepler's discoveries will continue

1) new data
2) new methods
3) new tools

1. new data

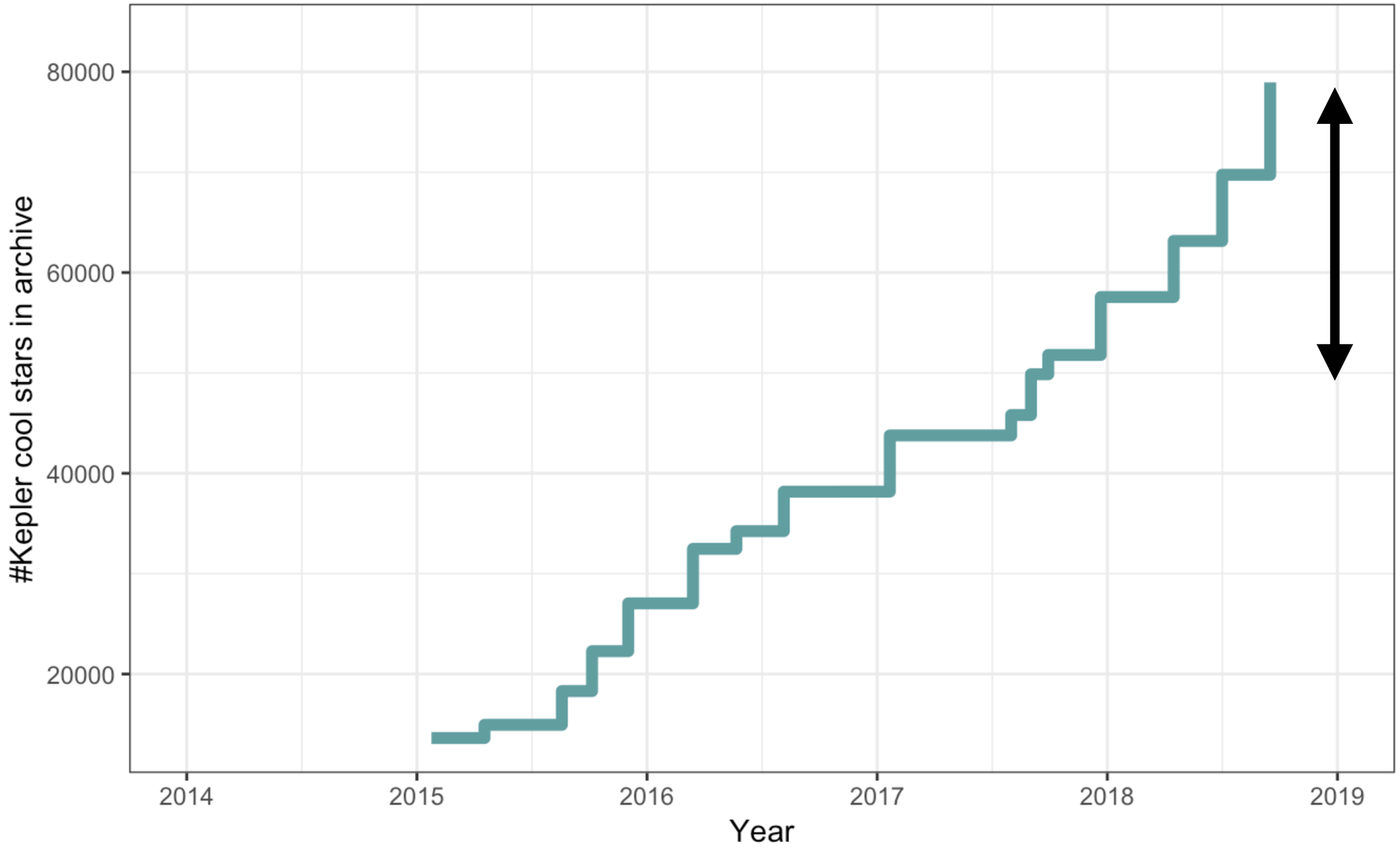
Photo by Samuel Zeller on unsplash.com

The number of targets with Kepler data increased by 30% over the past year



+150,000 targets

The number of cool stars with Kepler data has almost doubled over the past year



+35,000 cool stars

K2 has observed two dozen clusters across all ages

- Young open clusters (1-10 Myr)
  Taurus, Upper Sco, rho Ophiuchus, Lagoon (NGC 6530).

- Moderately young open clusters (0.1-1 Gyr)
  Pleiades, Hyades, M35, **M44 (Beehive)**, NGC 1647, NGC 1746, NGC 1750, NGC 1758, NGC 1817.

- Middle-aged clusters
  M67, Ruprecht 147, NGC 2158.

- Globular clusters
  M4, M9, M19, M80, Terzan 5.
  NGC 5897, NGC 6293, NGC 6355.

Campaigns 5, 16, & 18 overlap
=> M67 & M44 were observed for 3 x 80 days (3-yr baseline)

New High Level Science Product for star clusters

Barbara A. MIKULSKI ARCHIVE FOR SPACE TELESCOPES

MAST | STScI | Tools | Mission Search | Search Website | Follow Us | Register | Forum

About MAST | Getting Started

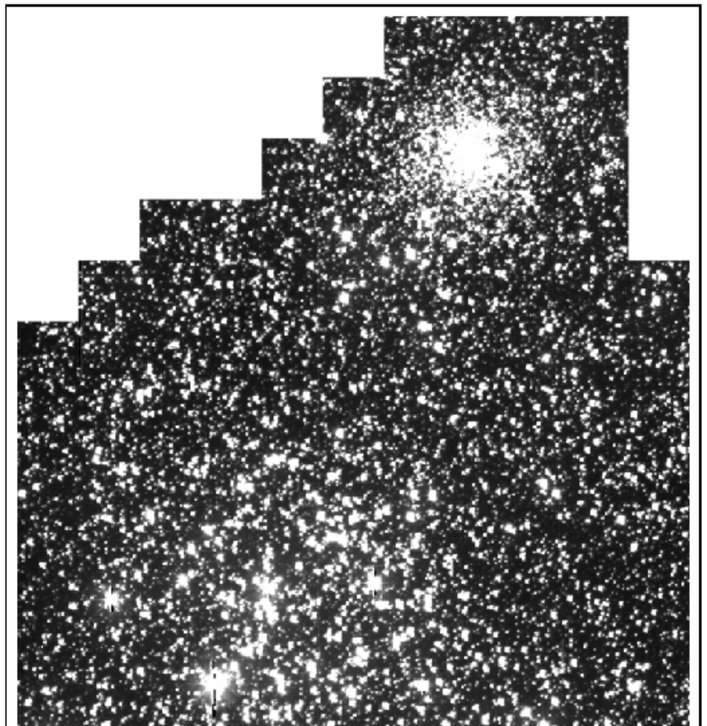
K2SUPERSTAMP

Cody et al. 2018, *RNAAS*, 2a, 25
Source code available on GitHub.

Introduction | Description of Data Products | Data Access | Download README

Introduction

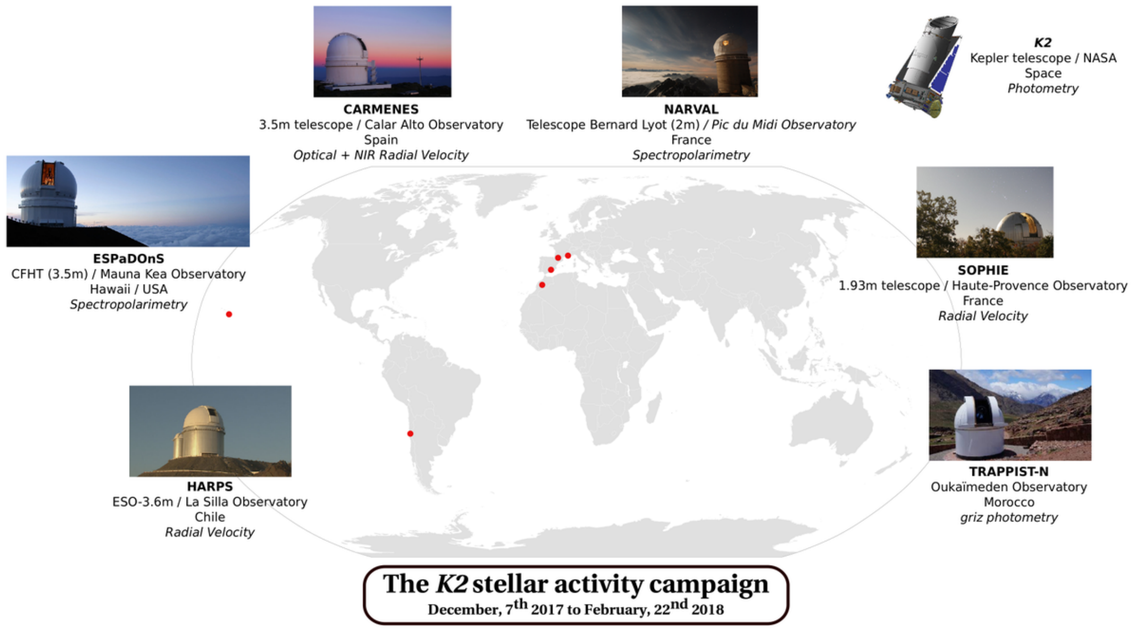
The K2SUPERSTAMP project consists of image data on four open clusters observed by the NASA K2 Mission. The clusters are M35, M67, Ruprecht 147, and NGC 6530-- the Lagoon Nebula Cluster (referred to here as the Lagoon). While data for these regions were previously released by K2, it consisted of small (~50x50) target pixel file stamps. In this release, the K2SUPERSTAMP team have stitched together all small stamps for each region to create one larger image for every epoch, and subsequently fit a world coordinate system (WCS) solution to each resulting FITS file.



With these products it is now possible to identify any and all stars in these open cluster regions via their right ascension and declination. Most stars that fell across the edge of the target pixel files now have spatially continous data. The data is flux in counts (e-/s), and for M67 and Ruprecht 147 only, it has been background subtracted (background was not estimated by the K2 pipeline for M35 and the Lagoon). Each file corresponds to a single timestamp at the 30 minute long cadence of K2, and may be read in via standard FITS handling programs (e.g. IRAF or Python/astropy). This format enables the production of time series photometry for cluster stars, and the resulting light curves are now being used to study stellar rotation in M35 (Cody et al. 2018, in prep.) and M67 (Giampapa et al. 2018, submitted) as well as pre-main sequence star variability in the Lagoon (Cody et al. 2018, in prep.)

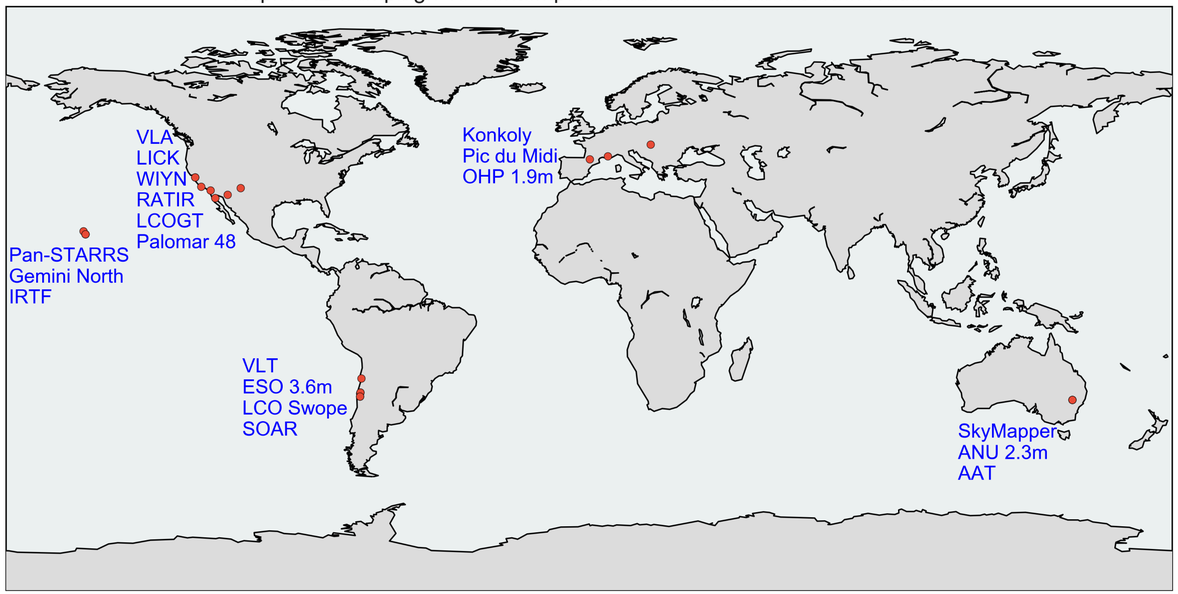
work by @astronomcody

Simultaneous Data —>
C16 & C17 were “forward facing”



Supernova Campaign

Kepler/K2 Campaign 16 Contemporaneous Ground-based Observations

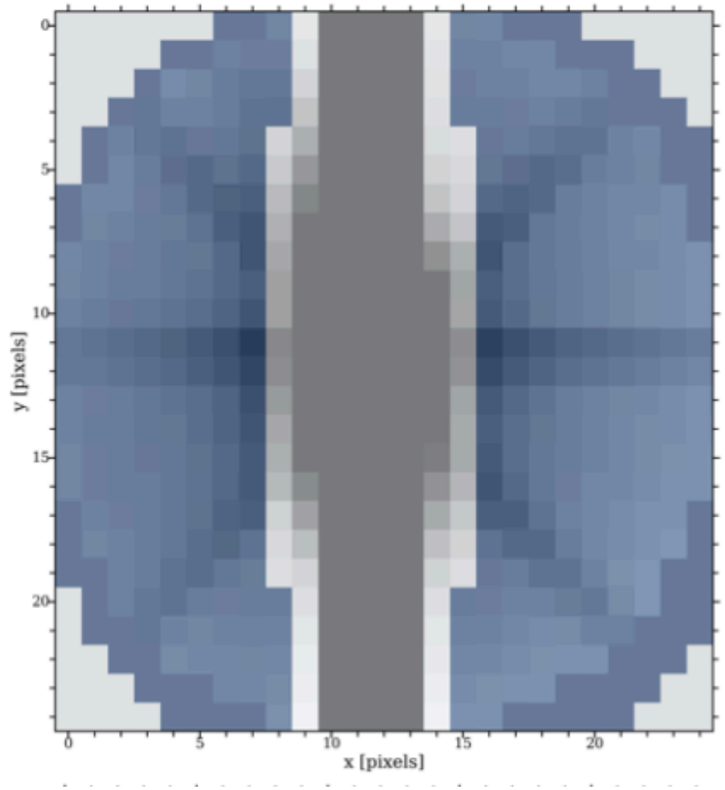


PanStarrs images will be released at MAST this month!

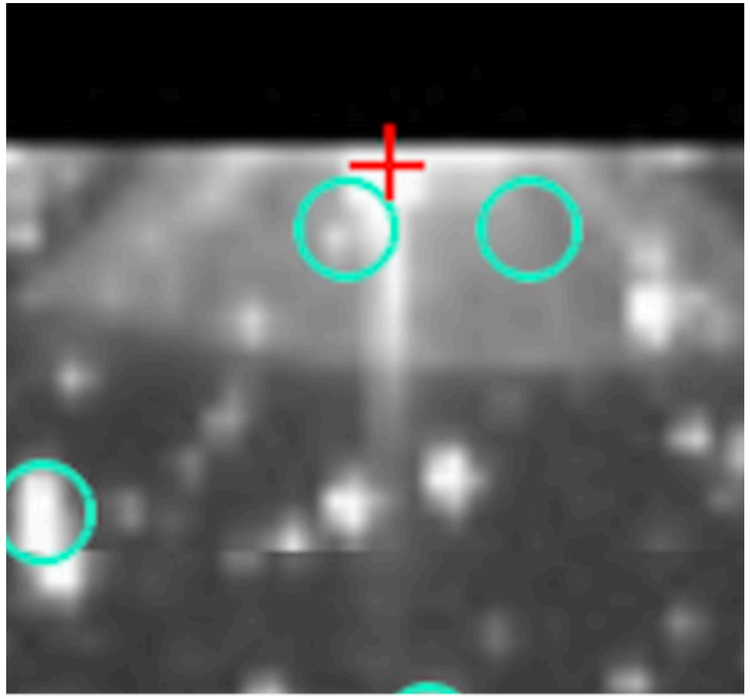

GAIA!
Photo by Sebastian Davenport on unsplash.com

Photo by Jens Lelie on unsplash.com

Creative analyses enable the study of stars brighter than ~5th magnitude



rho Leo (B1Iab)

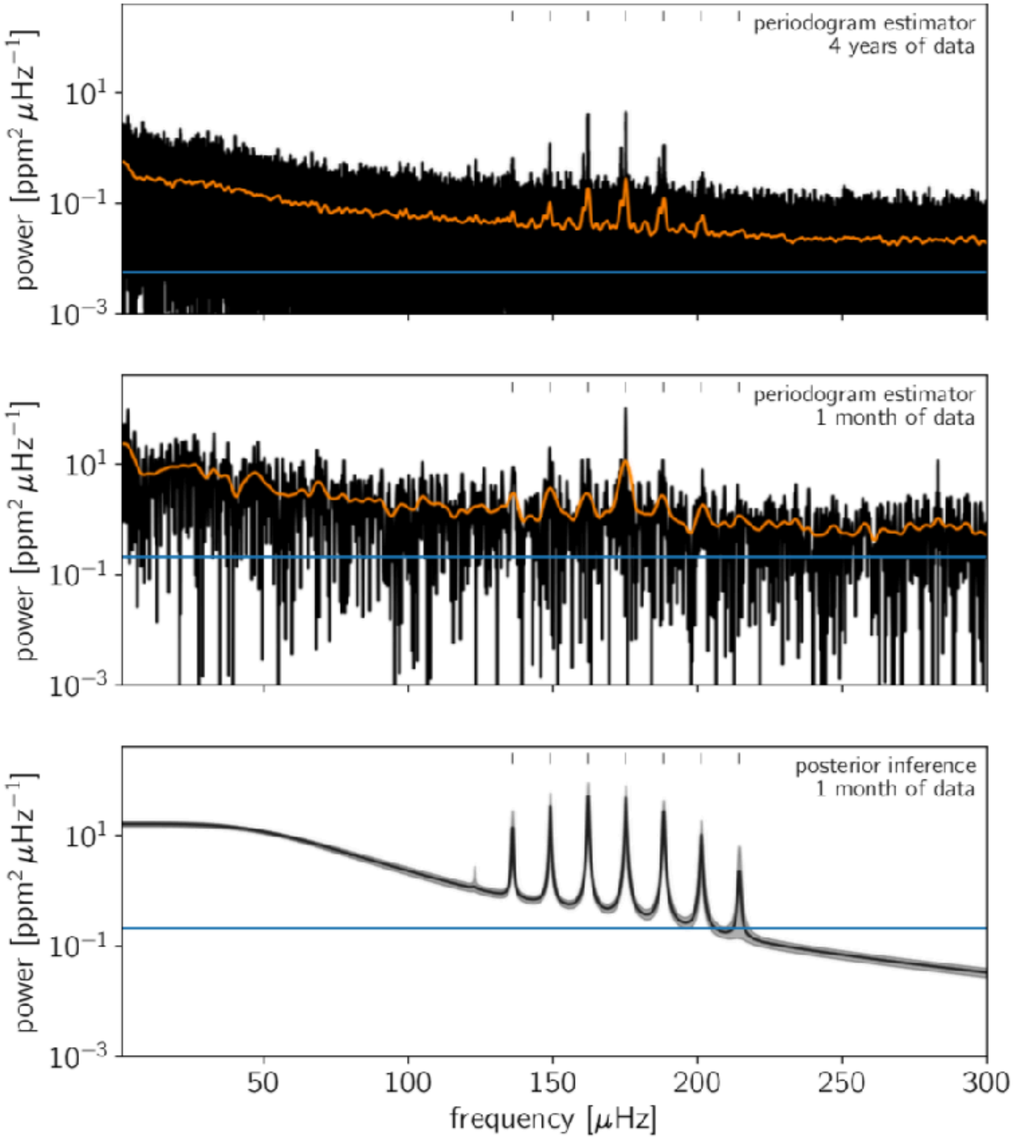


HD 188209 (O9.5Iab)

Creative use of pixels in the PSF wings of bright stars enables the investigation of bright stars, including OB-type supergiants.

Pope+ 2016
White+ 2017
Aerts+ 2017
Aerts+ 2018

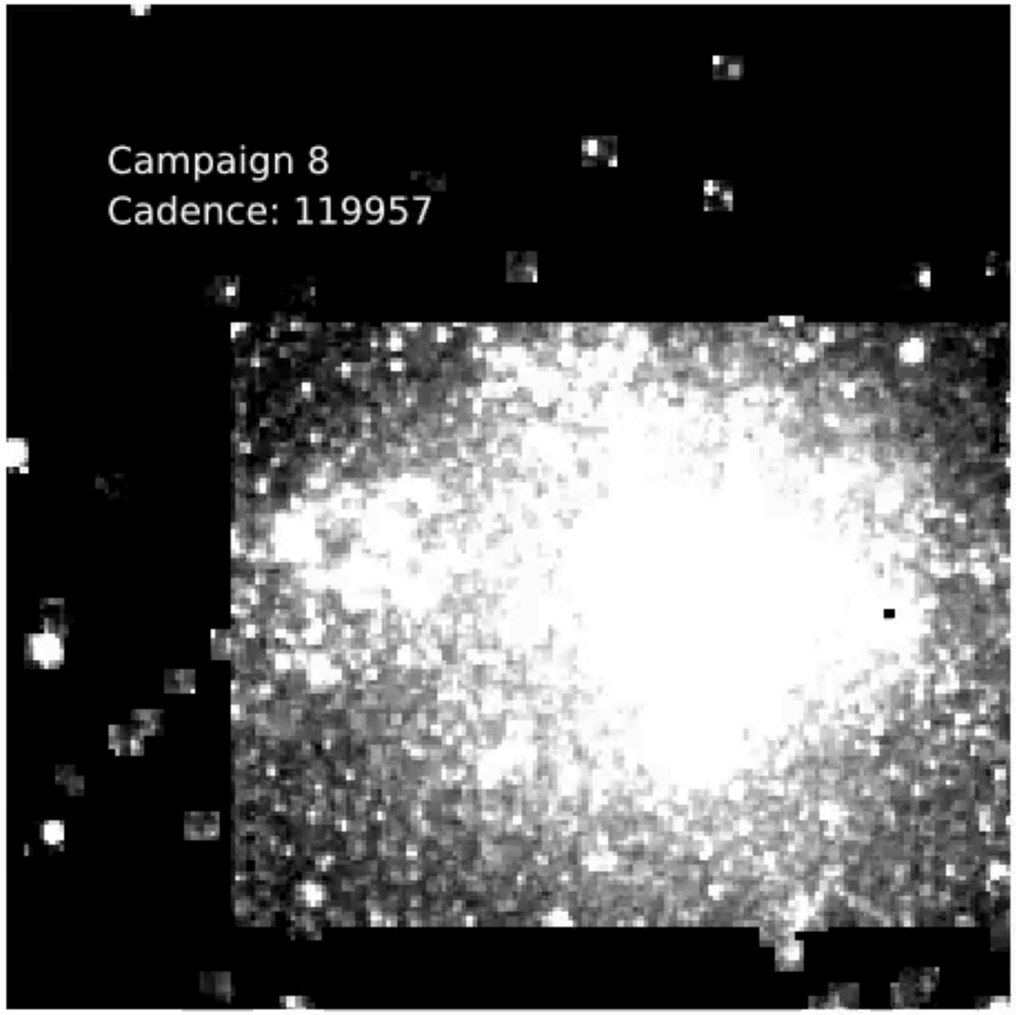
Gaussian Processes



Probabilistic measurements of asteroseismic parameters in the time domain are becoming computationally tractable.

Foreman-Mackey+ 2017
Ambikasaran+ 2015

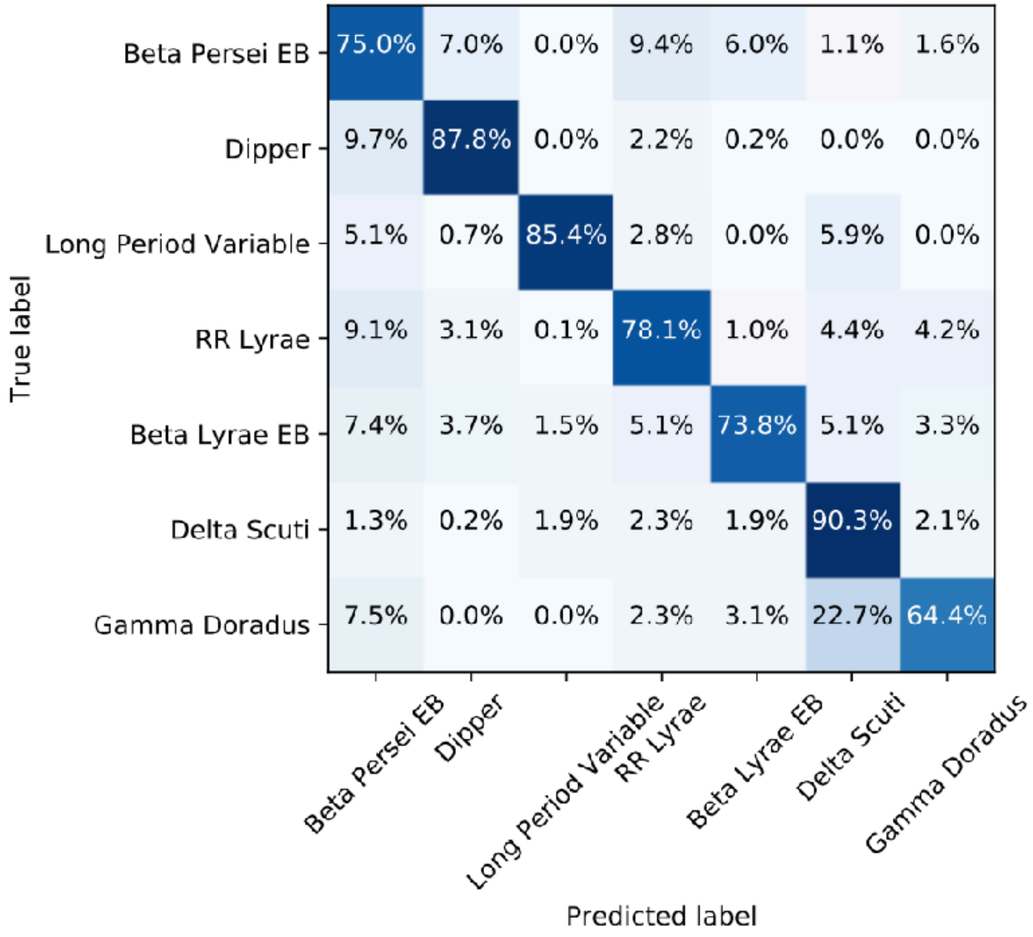
Our ability to model Kepler's background systematics is improving

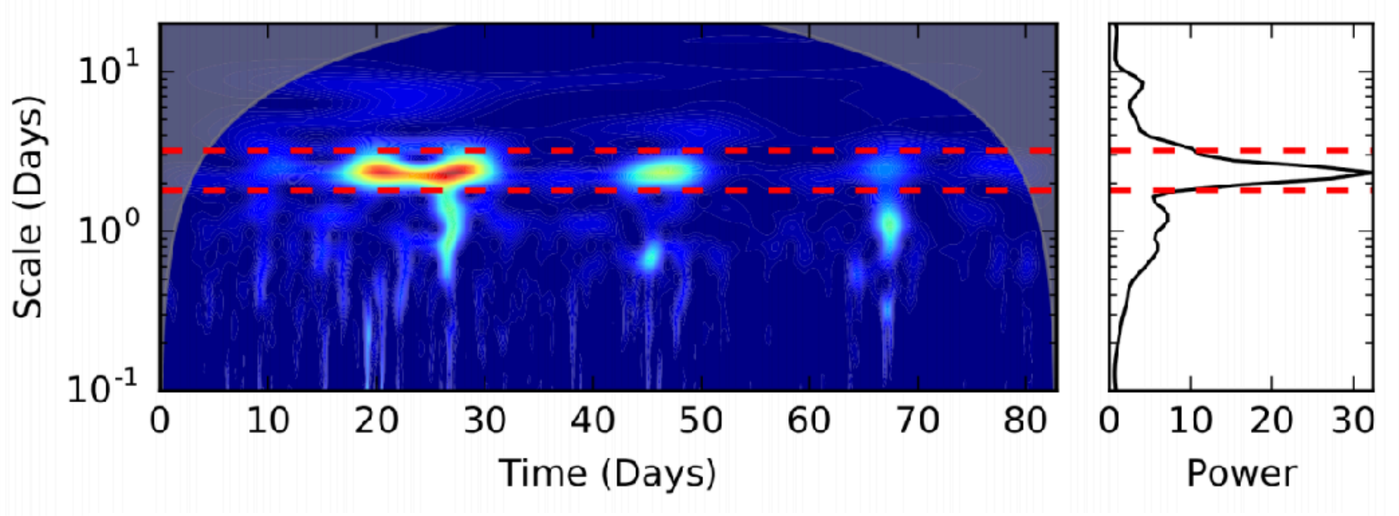


Electronic "rolling band" noise limits Kepler's sensitivity, but progress is being made towards modeling the varying background, e.g. using 2D Gaussian Processes.

Hedges+ in prep

The community is getting ever better at leveraging AI & machine learning





Careful feature engineering allows a classifier to provide a complete and unbiased census of different types of stars.

Hedges+ 2018
and others

3. new tools

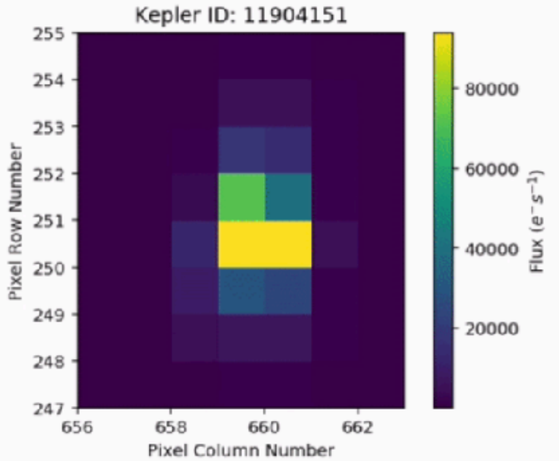
Photo by Todd Quackenbush on unsplash.com

Welcome to lightkurve!

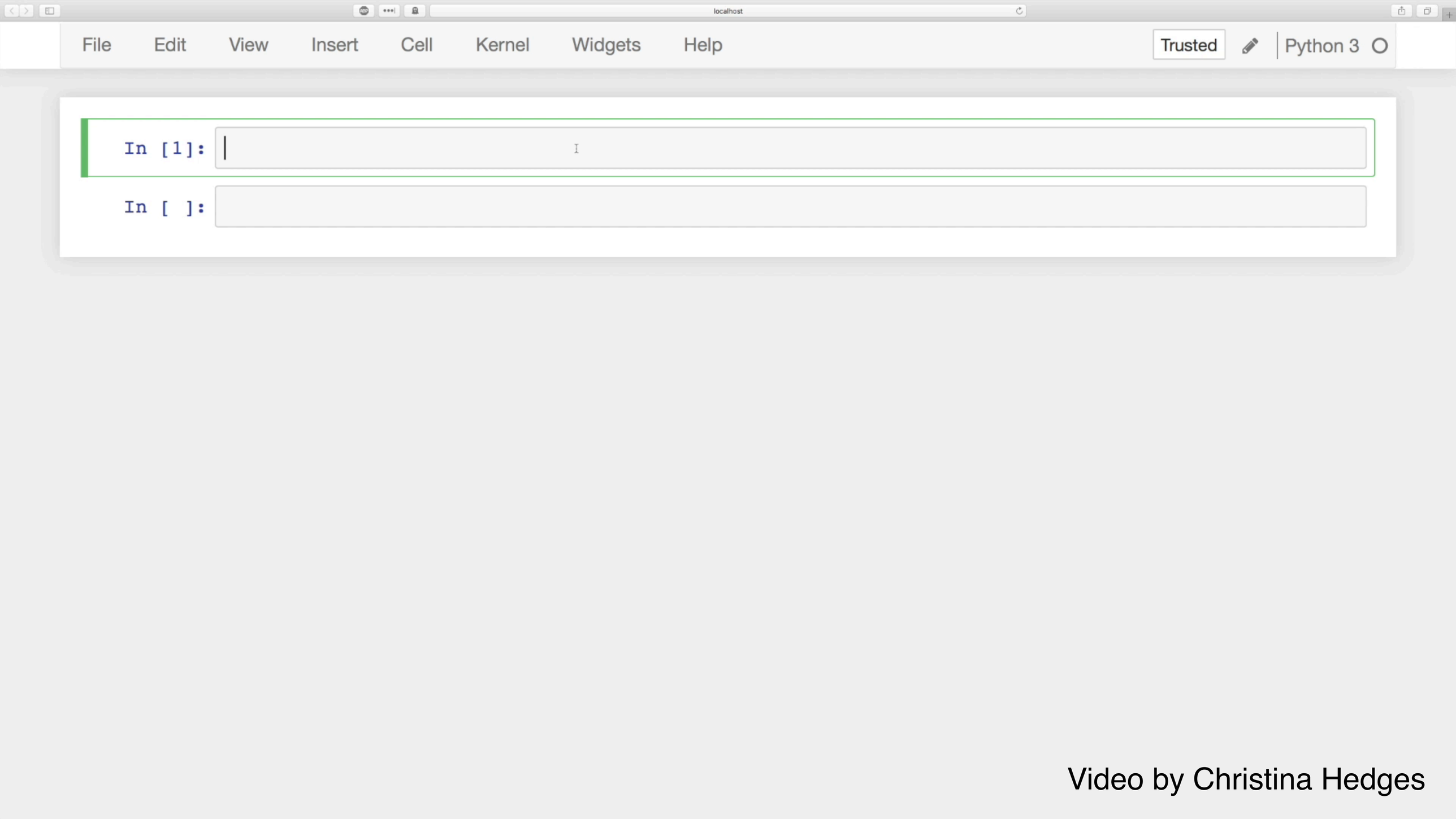
The **lightkurve** Python package offers a beautiful and user-friendly way to analyze astronomical flux time series data, in particular the pixels and lightcurves obtained by **NASA's Kepler, K2, and TESS missions.**

```
%%capture
tpf = KeplerTargetPixelFile.from_archive('kepler-10', quarter=5)
```

```
tpf.to_lightcurve().plot();
```

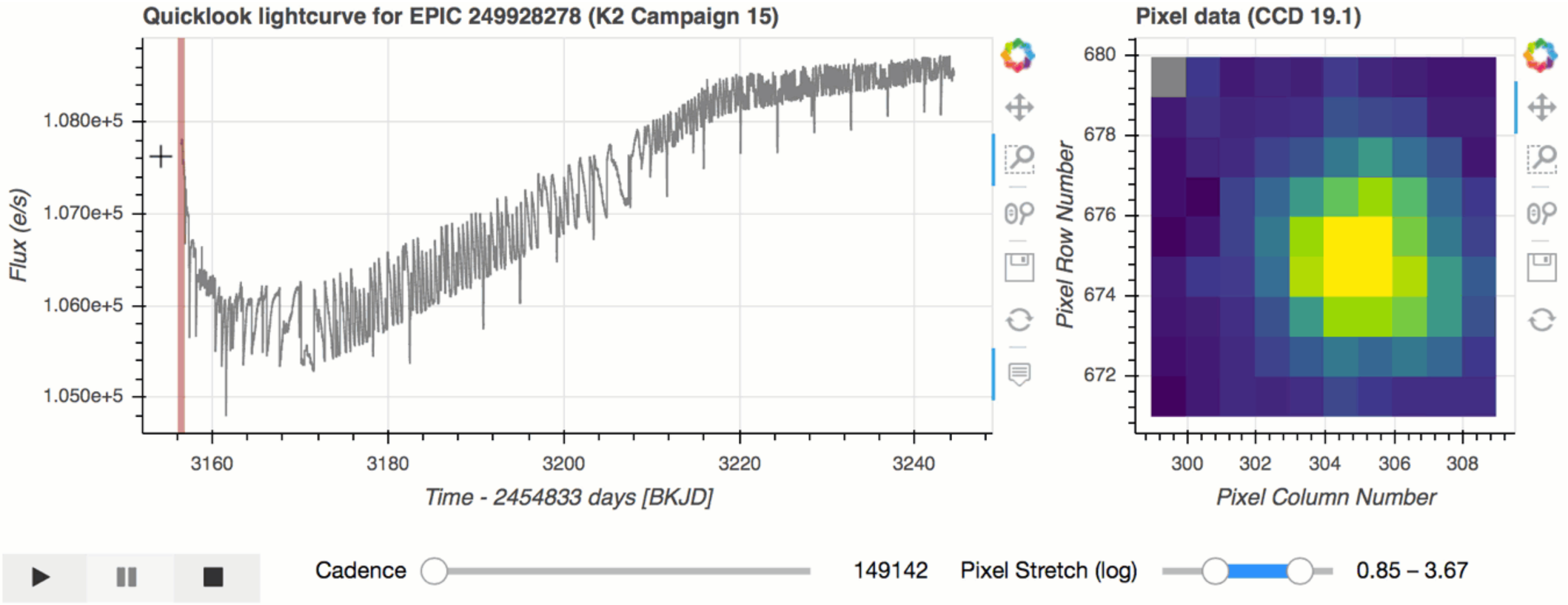


This package aims to lower the barrier for both students, astronomers, and citizen scientists interested in analyzing Kepler and TESS space telescope data. It does this by providing **high-quality**



Video by Christina Hedges

KeplerTargetPixelFile(filename).interact()



Work led by Michael-Gully Santiago (@gully_)

Tutorials

lightkurve

1.0b10

Search docs

Tutorials

See Poster #266
(Sagear et al; @_ssagear)
for upcoming functionality

KEPLER&K2 2019 SciConV

10 YEARS SINCE LAUNCH

March 4 – 8, 2019
Glendale, CA

Abstracts due Nov 15, 2018

Want to chat Kepler/K2?
Find one of us…

Jessie Dotson
@jessiedotson

Ann Marie Cody
@astronomcody

Michael Gully-Santiago
@gully_

Knicole Colon
@super_knova

Sarah Sagear
@_ssagear

or go to keplerscience.arc.nasa.gov to learn more