EXOPLANETS

Hunting for Exoplanets in Deep Space

CAPSTONE PROJECT

Flatiron School Datascience Bootcamp (Full-time)

Author: Ru Keïn

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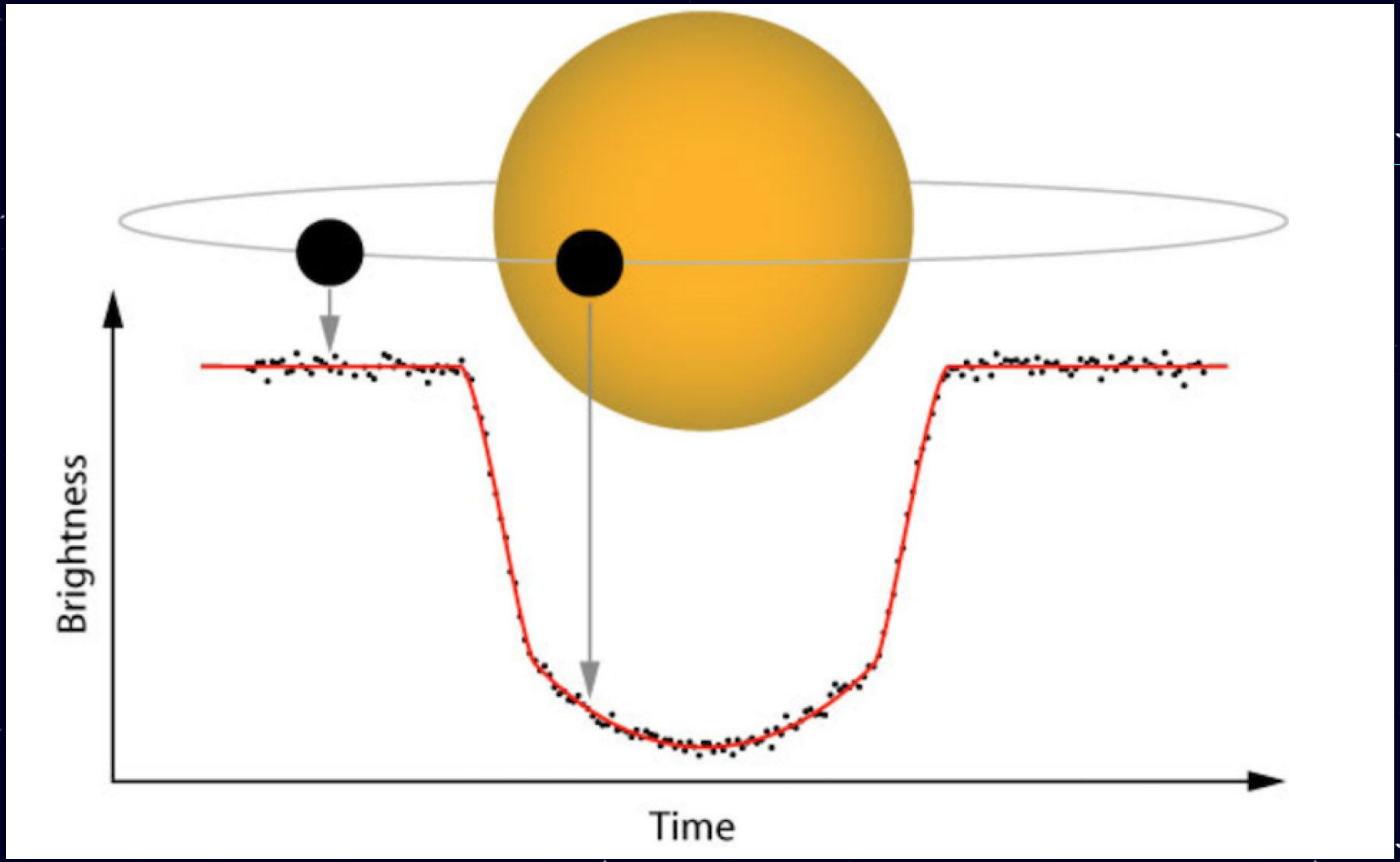
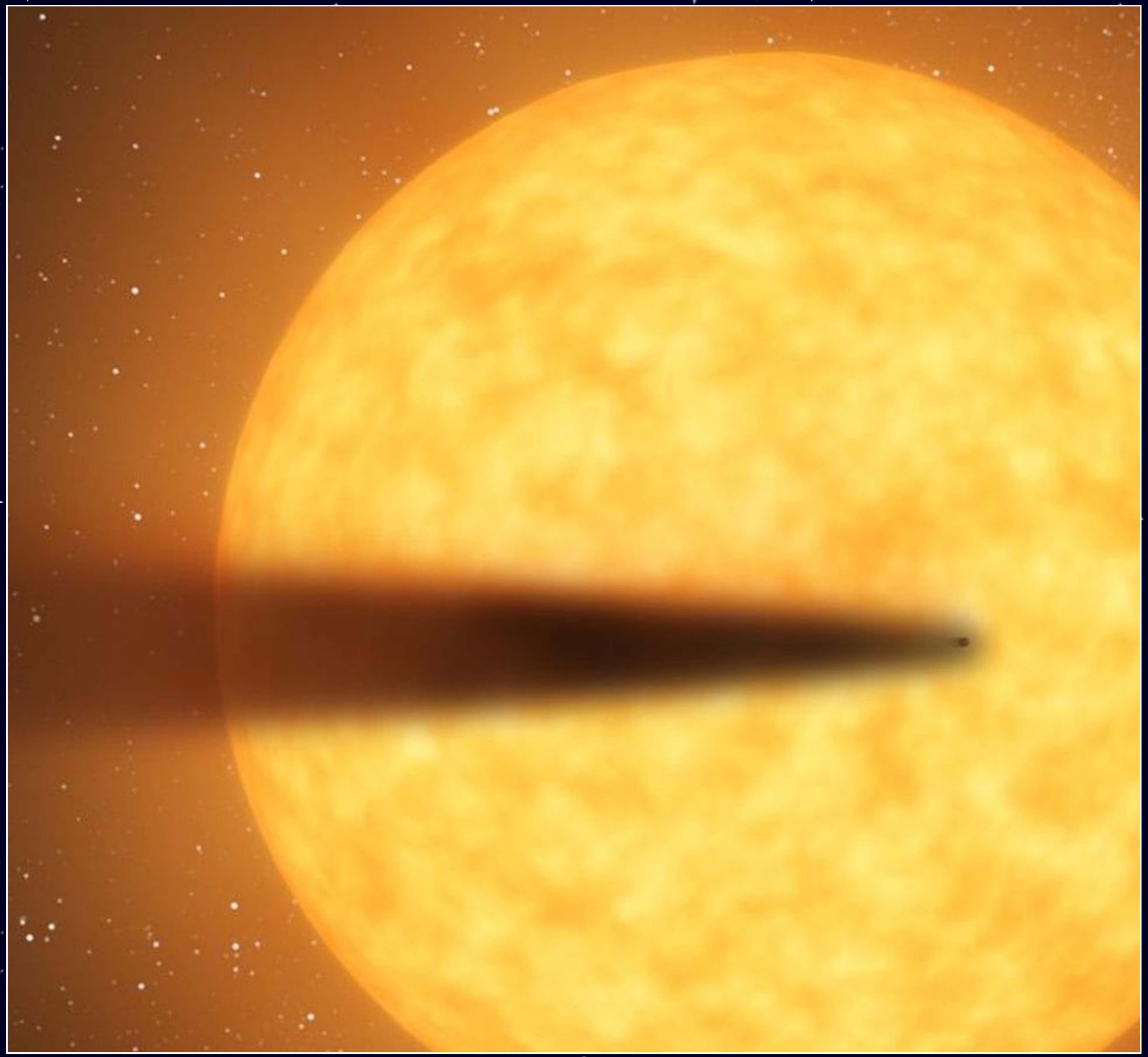


GLOSSARY

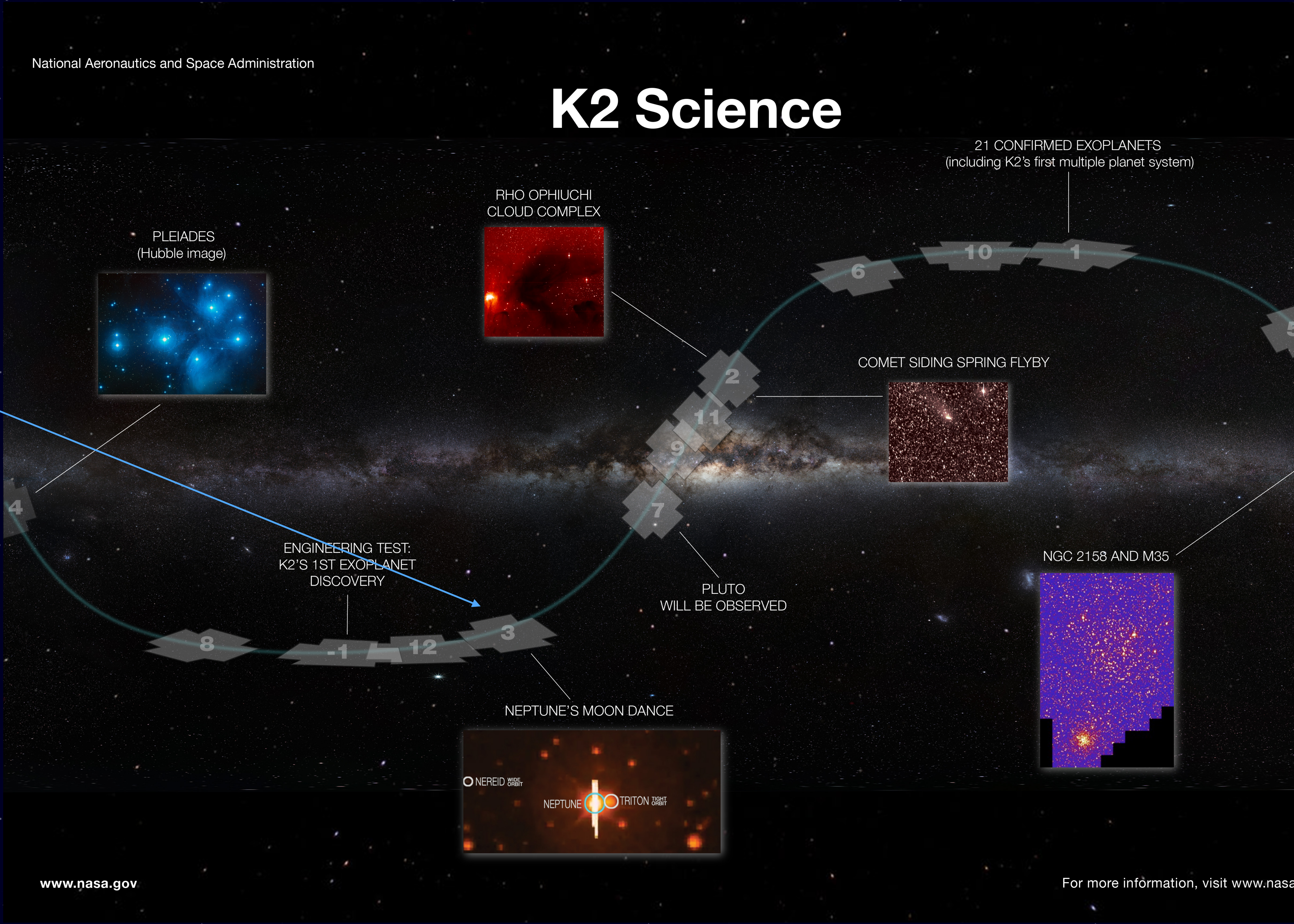
- EXOPLANET: planets outside of our solar system
- FLUX: variation or change in light values of stars

DATASET

- The training data including 3,197 flux observations for 5,087 stars.
- The test data included 570 stars for testing the model.
- All data comes from the K2 (Kepler) space telescope (NASA)



CAMPAIGN 3



National Aeronautics and Space Administration
K2 Science
21 CONFIRMED EXOPLANETS
(including K2's first multiple planet system)
RHO OPHIUCHI
CLOUD COMPLEX
PLEIADES
(Hubble image)
COMET SIDING SPRING FLYBY
NGC 2158 AND M35
ENGINEERING TEST:
K2'S 1ST EXOPLANET
DISCOVERY
PLUTO
WILL BE OBSERVED
NEPTUNE'S MOON DANCE
NEREID WIDE ORBIT
NEPTUNE
TRITON TIGHT ORBIT
6
10
1
2
11
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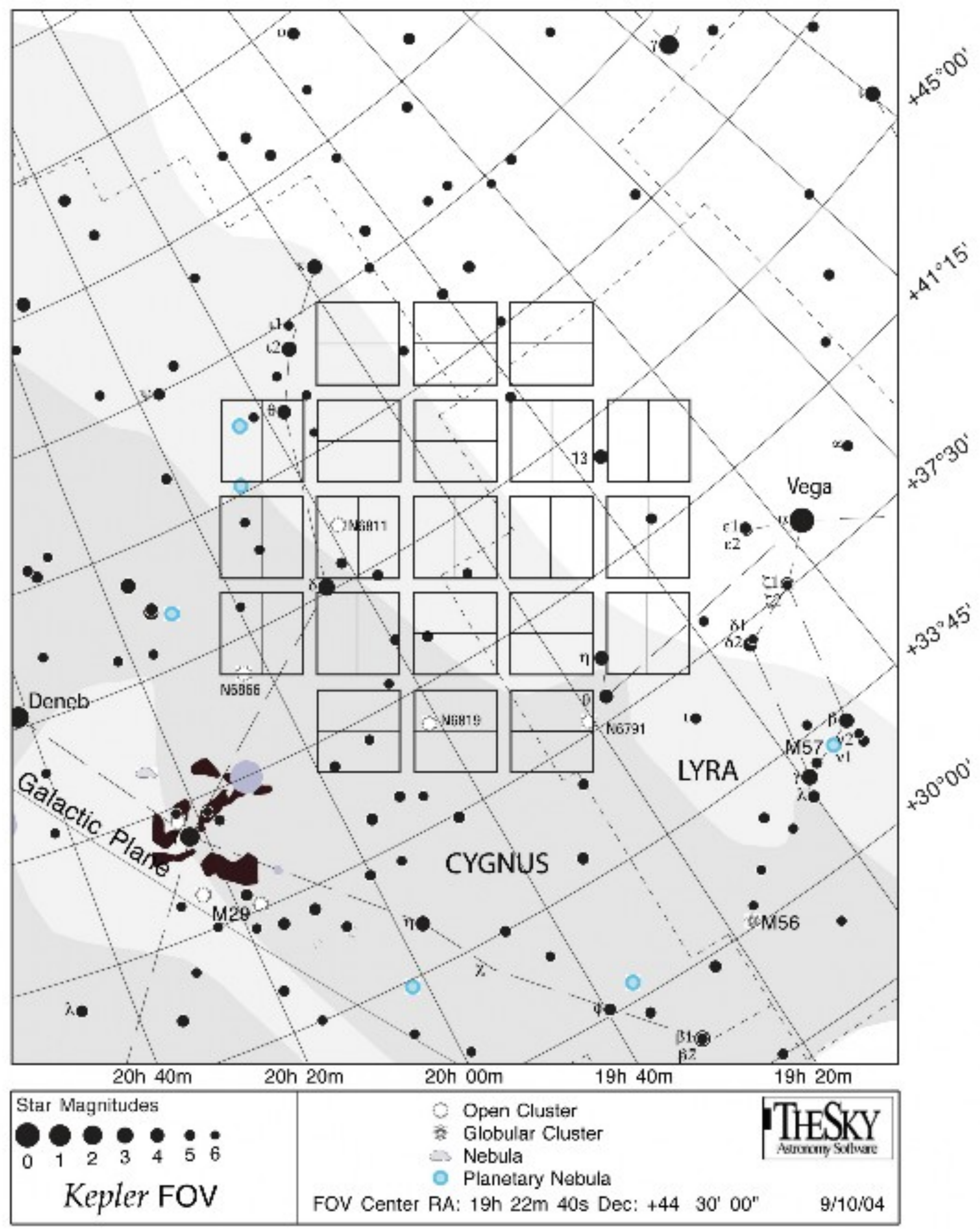
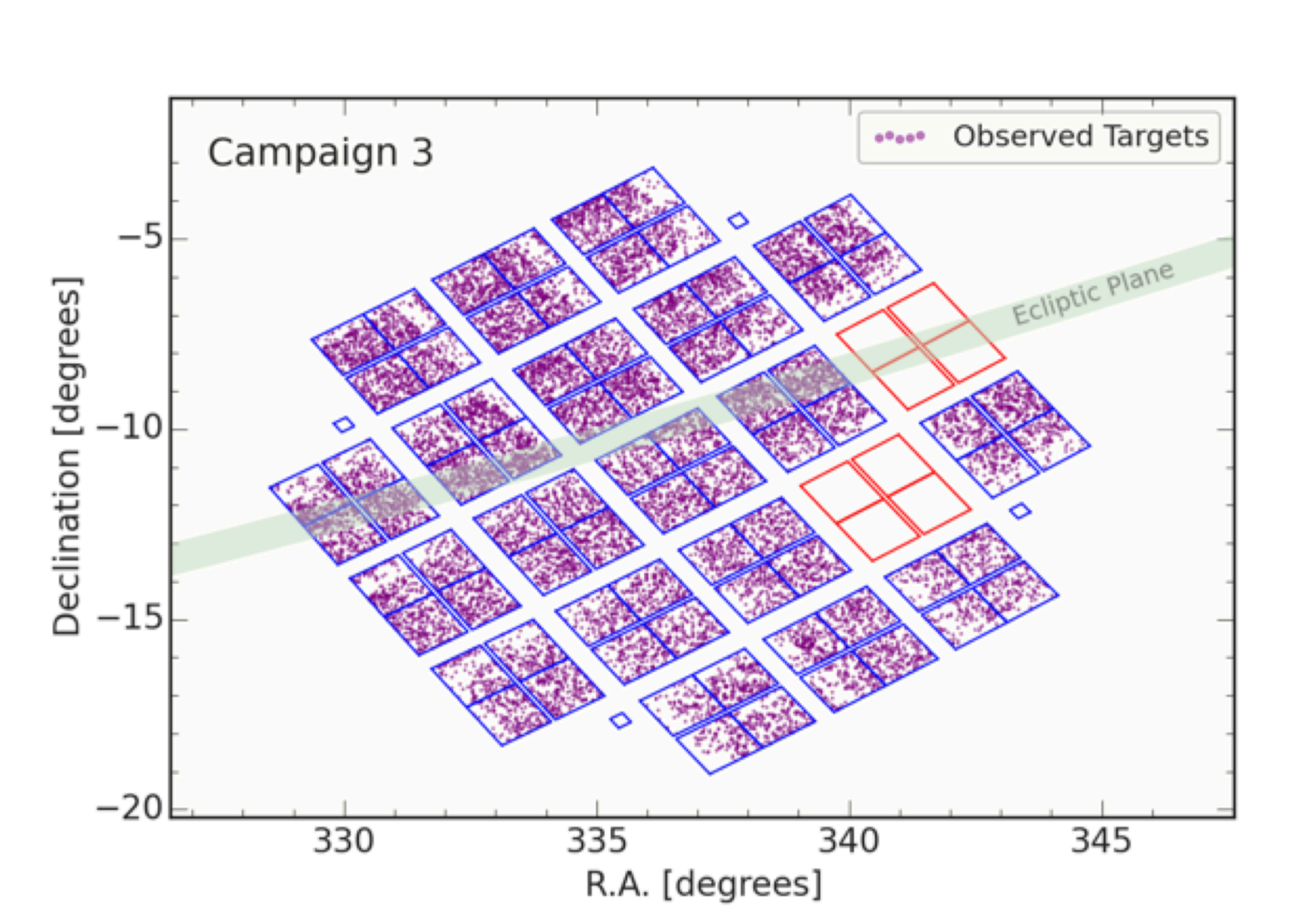
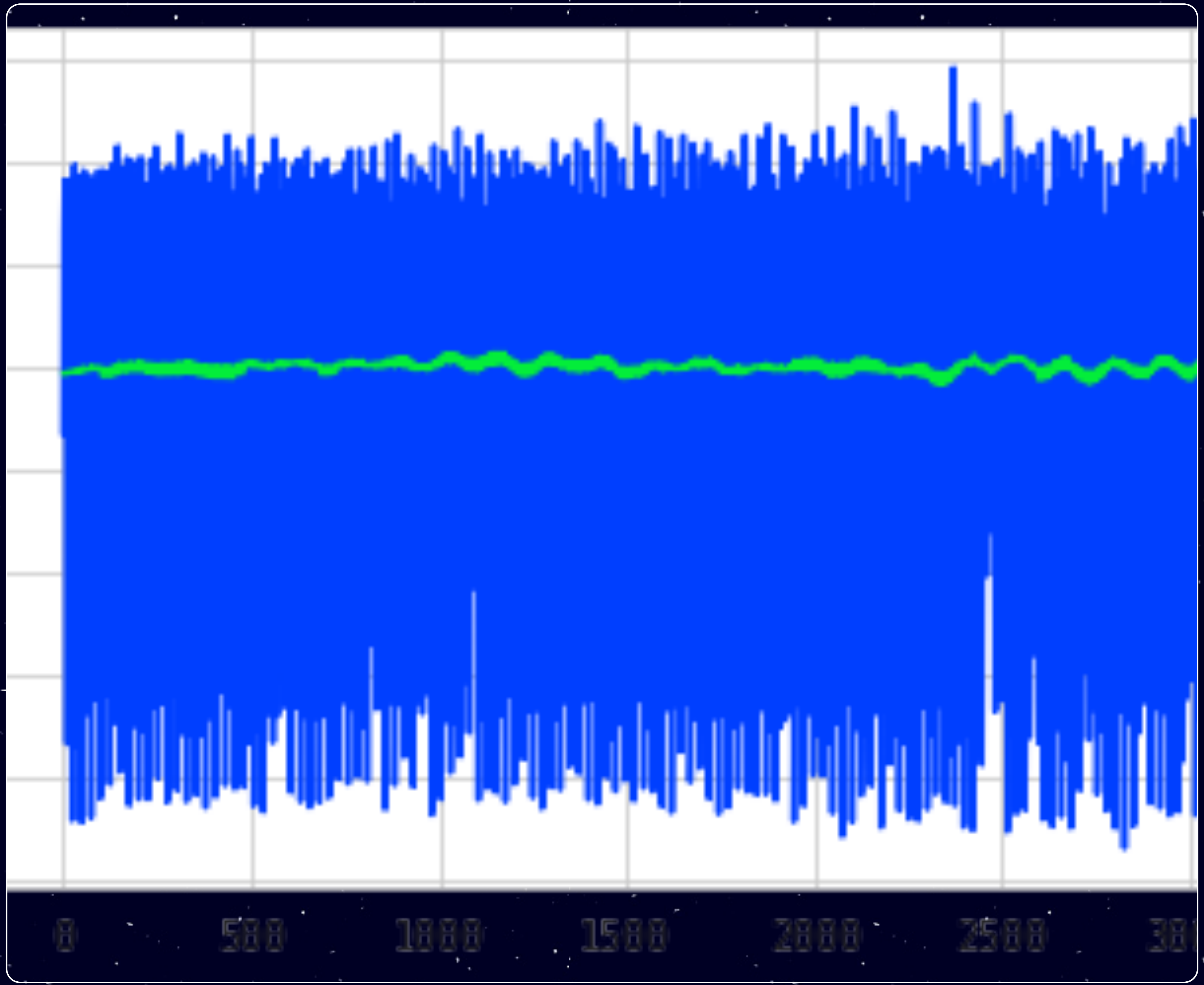
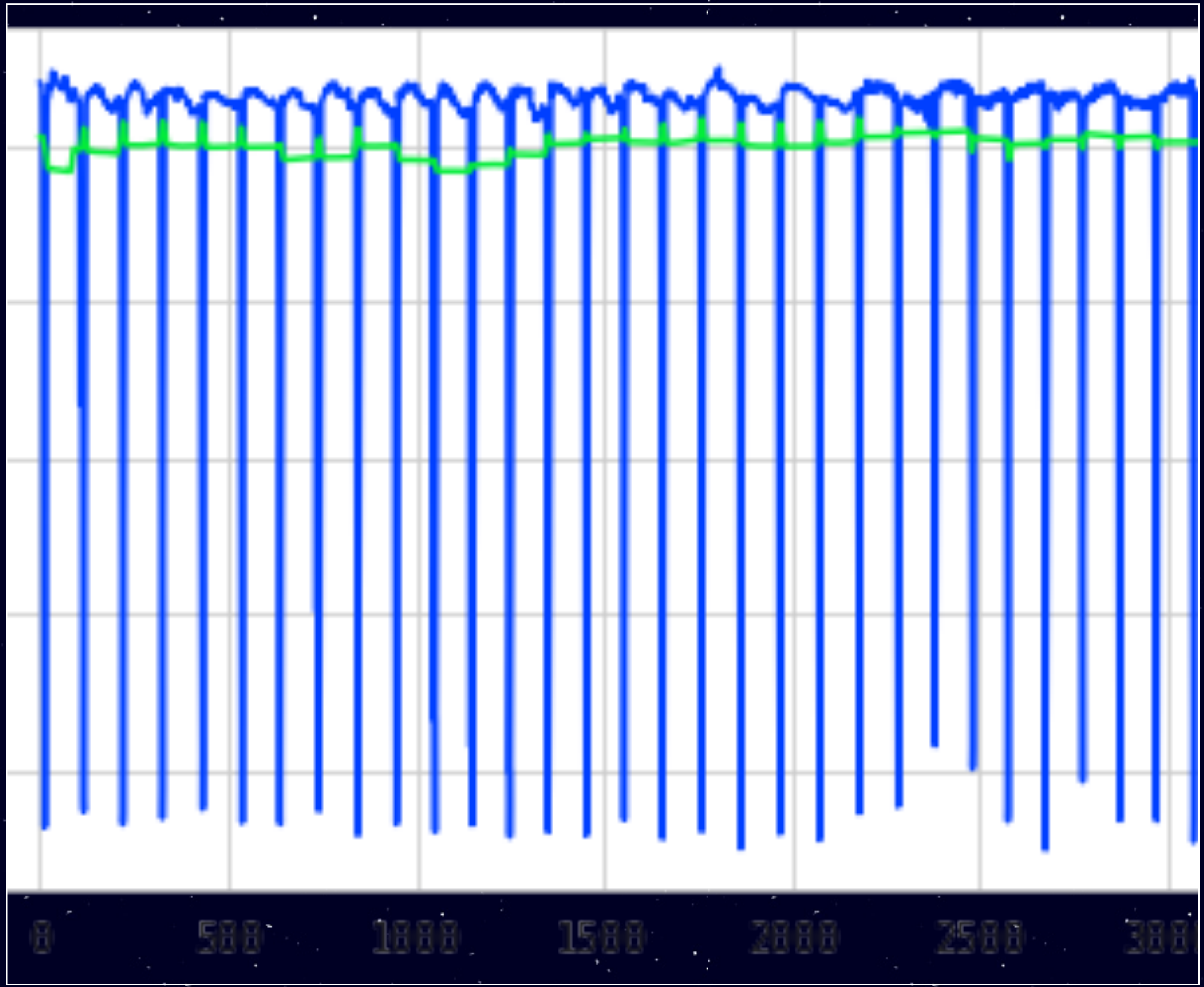
KEPLER FIELD OF VIEW



KEPLER FIELD OF VIEW





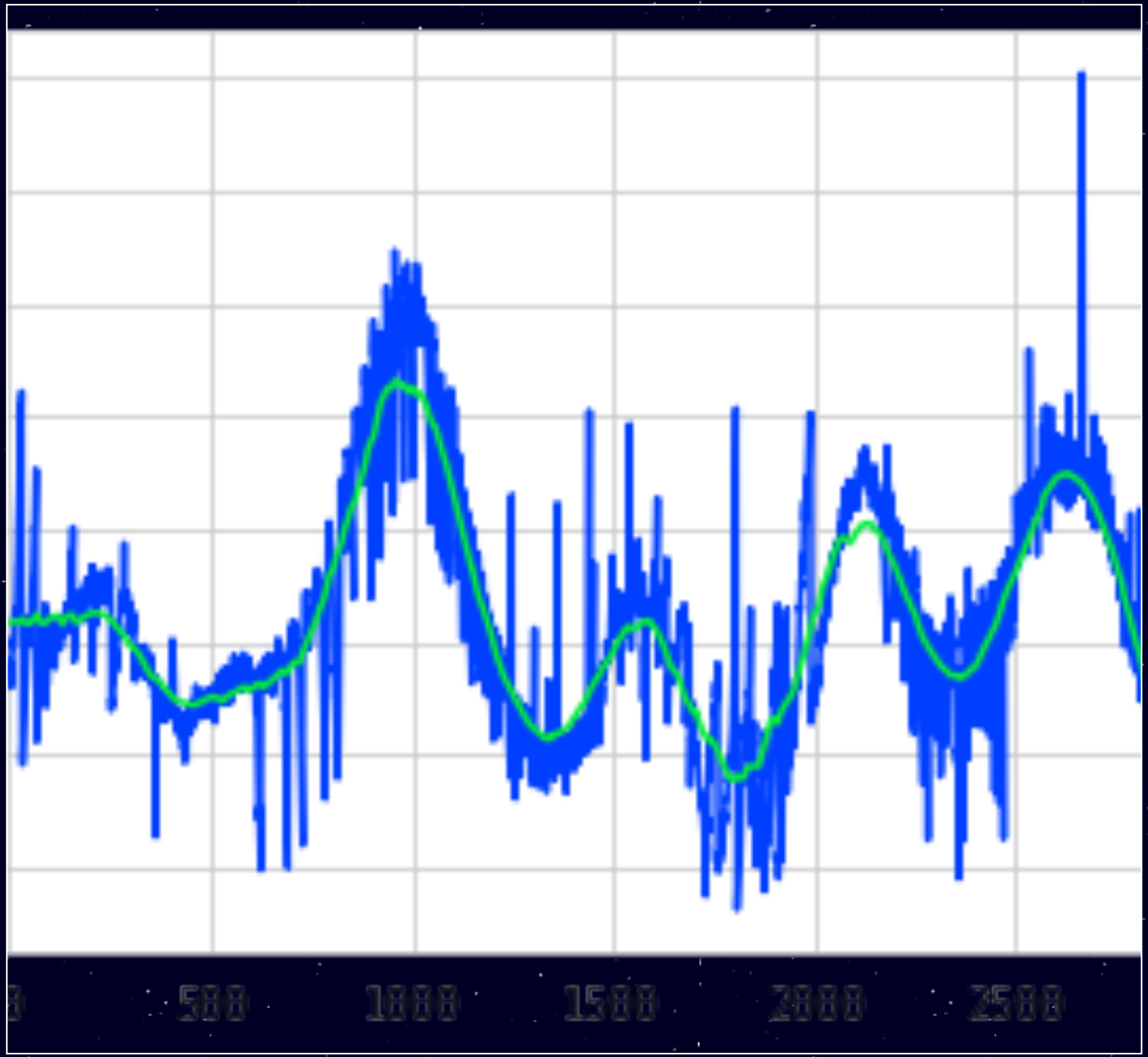


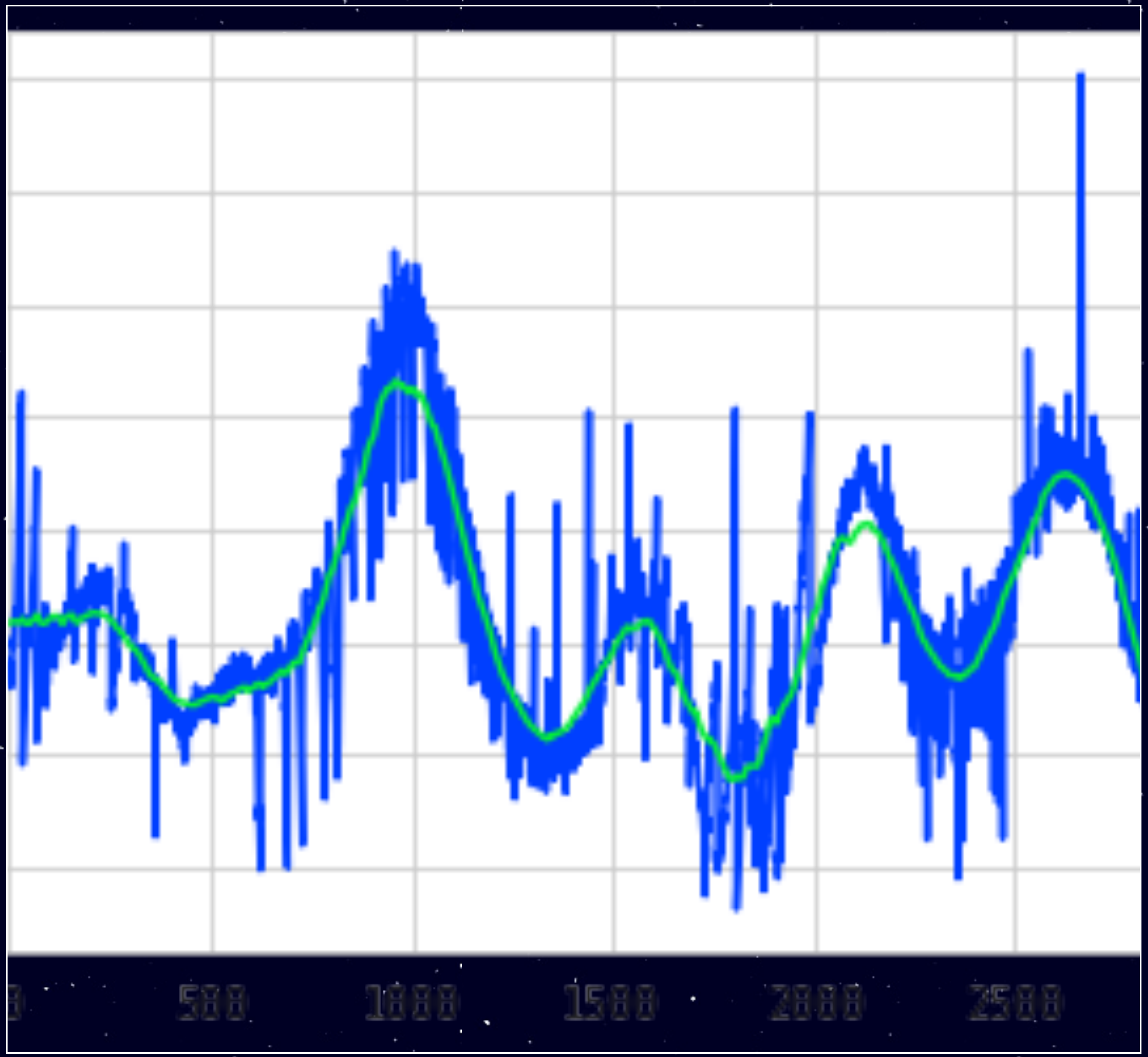
OBJECTIVE

Looking for "dips" (periodicity) in the light flux of stars (right image shows "dips")

MODEL

Training a Keras Neural Network



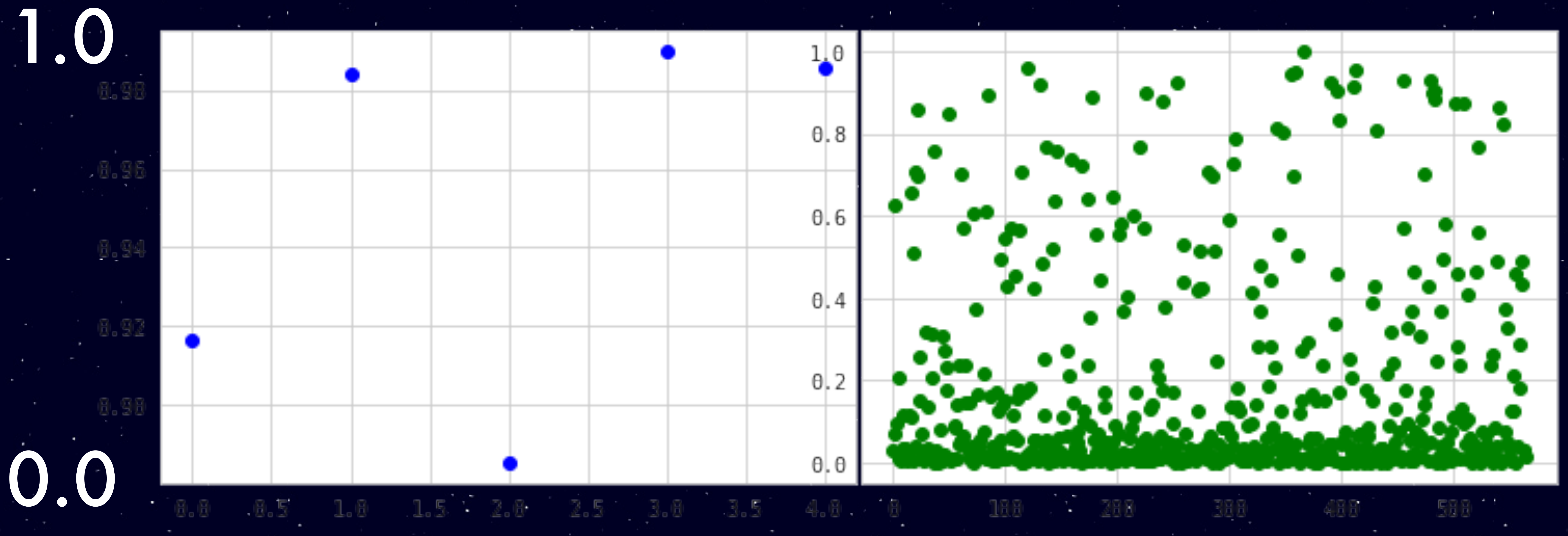


FIND 5 PLANETS?

- Using a Neural Network machine learning algorithm, the goal was to correctly classify 5 stars as having exoplanets in their orbit.

RESULTS

88% Accuracy



RECOMMENDATIONS

#1

1. Use datasets from the MAST website (via API) to incorporate other calculations of the star's properties as features to be used for classification algorithms. Furthermore, attempt other types of transformations and normalizations on the data before running the model - for instance, apply a Fourier transform.

#2

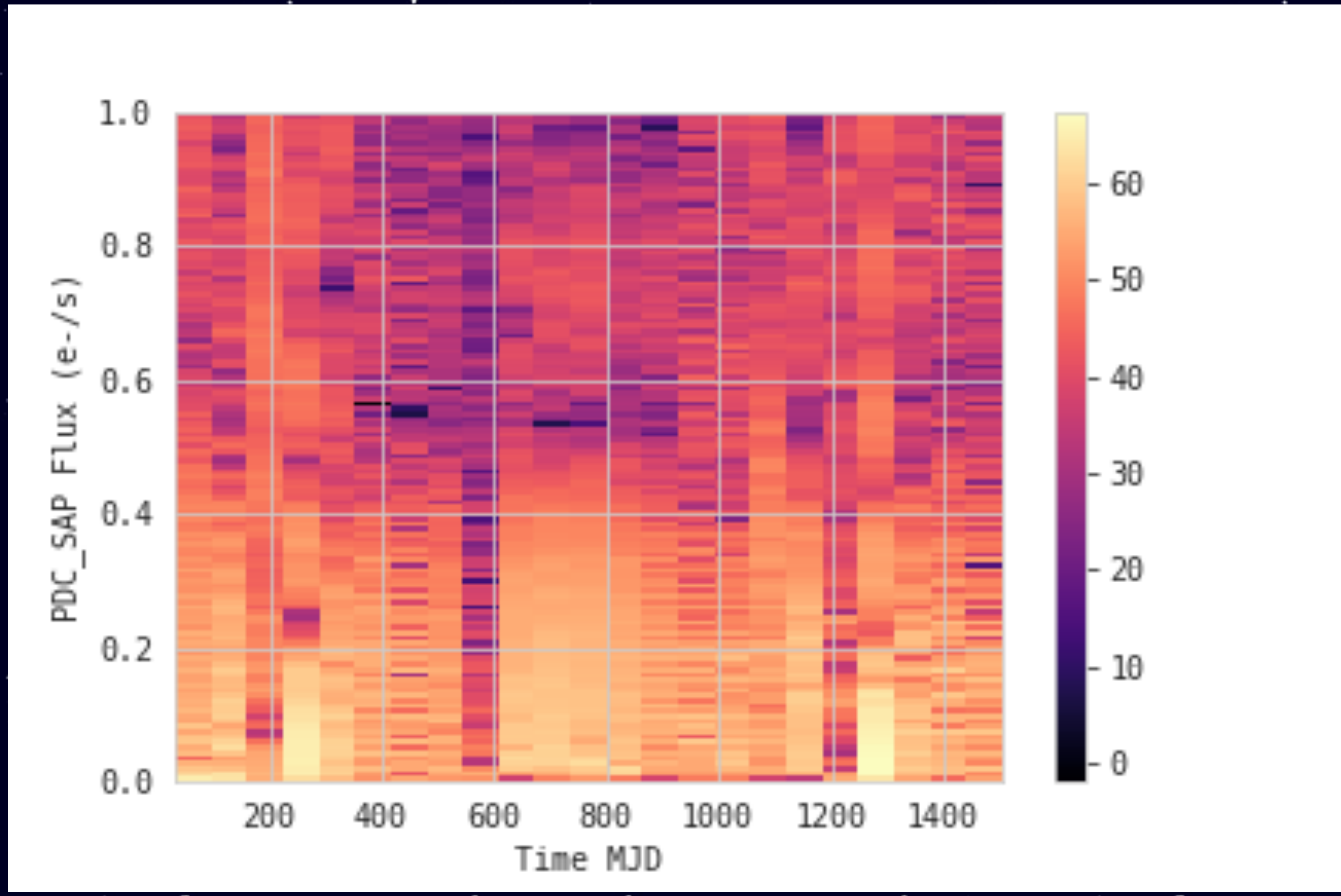
2. Combine data from multiple campaigns and perhaps even multiple telescopes (for instance, matching sky coordinates and time intervals between K2, Kepler, and TESS for a batch of stars that have overlapping observations - this would be critical for finding transit periods that are longer than the campaigns of a single telecope's observation period).

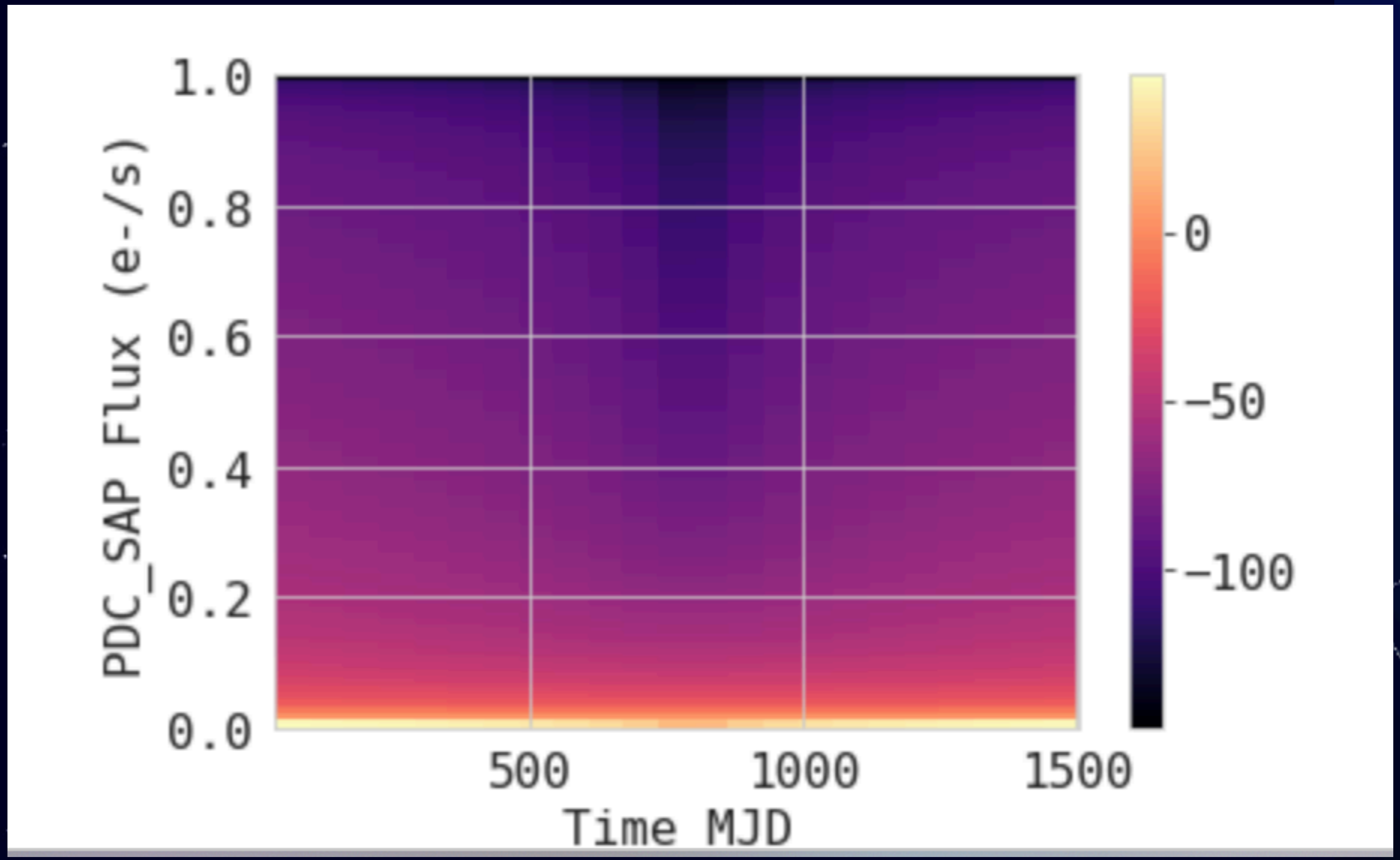
#3

3. Explore using computer vision on not only the Full Frame images we can collect from telescopes like TESS, but also on spectographs of the flux values themselves. The beauty of machine learning is our ability to rely on the computer to pick up very small nuances in differences that we ourselves cannot see with our own eyes.

#4

4. Explore using autoencoded machine learning algorithms with Restricted Boltzmann Machines - this type of model has proven to be incredibly effective in the image analysis of handwriting as we've seen applied the MNIST dataset - let's find out if the same is true for images of stars, be they the Full Frame Images or spectographs.





FUTURE WORK To continue this project, I'll take another approach for detecting exoplanets using computer vision to analyze images of spectographs of this same star flux data set. I will use a Restricted Boltzmann Machines neural network model to classify stars as exoplanet hosts using spectograph images of the flux values to find transiting exoplanets. Following this, I will apply the same algorithm to spectographs of Fourier transformed data.

STARSKØPE

Additional future work following this project will be to develop my "cyberoptic artificial telescope" as a machine learning driven application that any astrophysicist can use to look at a single or collection of stars and have the model classify them according not only to exoplanet predictions, but also predict what type of star it is, and other key properties that would be of interest for astrophysical science applications.