



# The TESS Mission

## Data Products, Data Analysis and the Proposal Process

The **Transiting Exoplanet Survey Satellite (TESS)** is a NASA-sponsored Astrophysics Explorer-class mission, operated by MIT that is performing a near all-sky survey to search for planets transiting nearby stars. Launched on April 18, 2018, TESS successfully completed its prime mission (Cycles 1 and 2) on July 4, 2020. Since then, TESS has entered its extended mission (Cycle 3 and onward), during which it has continued to scan the sky for exoplanets and transient events.

TESS's extended mission is more science community-focused, with the Guest Investigator (GI) Program having significantly increased scope. This program enables teams to propose new 2-minute and 20-second cadence targets for observation; provides funding to US investigators to analyze 2-minute and 20-second cadence and full-frame image (FFI) data; and provides funding for US investigators to collect ground-based data that supports TESS science. The GI Program is managed by NASA's Goddard Space Flight Center.

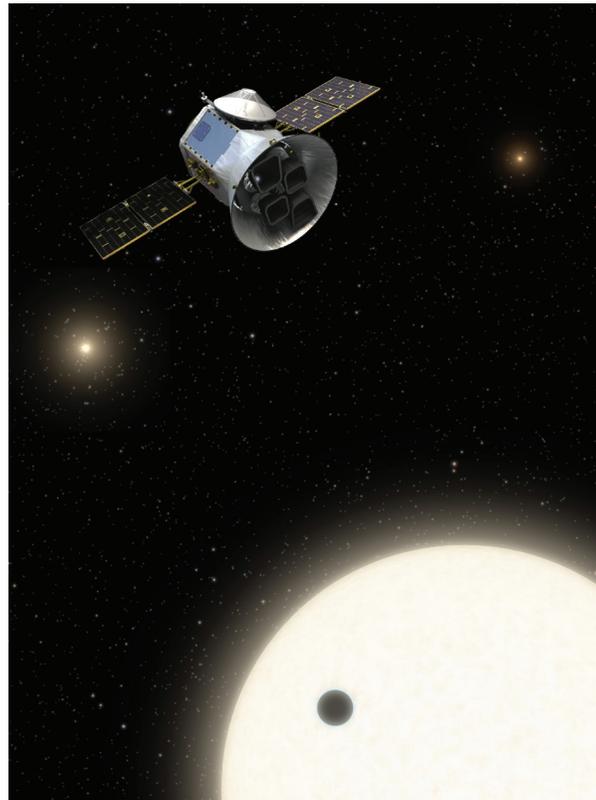
There is no exclusive-use data rights to observations collected by TESS. All data are made available through the MAST public archive once data processing and validation is complete. Anyone can use TESS data!

### Types of Data Products

During science operations, TESS takes a continuous stream of images in a broad red bandpass. Each image has a 2-second exposure, and they are stacked/summed in different ways to create several data products:

- Full-frame images (FFIs): These are stacked images from each of the four TESS cameras. They were created at a cadence of 30 minutes during Cycles 1 and 2 and 10 minutes during Cycles 3 and 4.

- Target Pixel Files (TPFs): These are "postage stamps" of selected targets stacked in either a 2-minute (all Cycles) or 20-second cadence (Cycles 3 and 4).



This illustration shows the planet KOI-5Ab transiting across the face of a Sun-like star, which is part of a triple-star system located 1,800 light-years away in the Cygnus constellation. Image Credits: Caltech/R. Hurt (Infrared Processing and Analysis Center, or IPAC) and NASA's Goddard Space Flight Center.

- Light Curve Files: These contain time series data and are produced for every 2-minute and 20-second cadenced target (from the TPFs). The light curves are corrected for noise and instrumental effects.

You can find out more about the TESS mission and its data products via the following links:

<https://heasarc.gsfc.nasa.gov/docs/tess/>

<https://tess.mit.edu>

<https://archive.stsci.edu/missions-and-data/tess>

# Lightkurve

Lightkurve offers a user-friendly way to analyze time series data on the brightness of planets, stars, and galaxies. The package is focused on supporting science with NASA's Kepler and TESS space telescopes, but can also be used to analyze light curves obtained by backyard telescopes.

To get started with Lightkurve, you will need to download and install a copy of it. First, you need a working version of Python (<https://www.python.org>) on your computer, then follow the instructions listed here:

<https://docs.lightkurve.org/about/install>

If you have no experience using Python but would still like to learn how to reduce TESS data using Lightkurve, you can play with all of the tutorials listed here:

<https://docs.lightkurve.org/tutorials/index.html>

This is possible via the Google Colab feature. Each tutorial can be opened via the Colab button placed in the top right. If you have a Google/Gmail account, the notebook will then open for you and you can interact and run each cell once you have first pasted in the following command at the start of the tutorial.

`!pip install lightkurve --quiet`

The best way to learn is by working on an example. If you have an object you are particularly interested in studying and aren't sure if it

has been observed by TESS, check out our viewing tool:

<https://heasarc.gsfc.nasa.gov/cgi-bin/tess/webtess/wtv.py>

This will tell you if your object was observed by TESS, and if so, in which sector and with which camera.

Struggling for an object to examine? Check out the TESS Objects of Interest catalog, which is a treasure trove of intriguing targets!

<https://tess.mit.edu/toi-releases/>

## Proposing

Additional tools to help you plan a TESS investigation can be found on our Proposal and observation tools page, our Guest Investigator proposals page, and the MIT Director's Discretionary Targets page:

<https://heasarc.gsfc.nasa.gov/docs/tess/proposal-tools.html>

<https://heasarc.gsfc.nasa.gov/docs/tess/proposing-investigations.html>

<https://tess.mit.edu/science/ddt/>

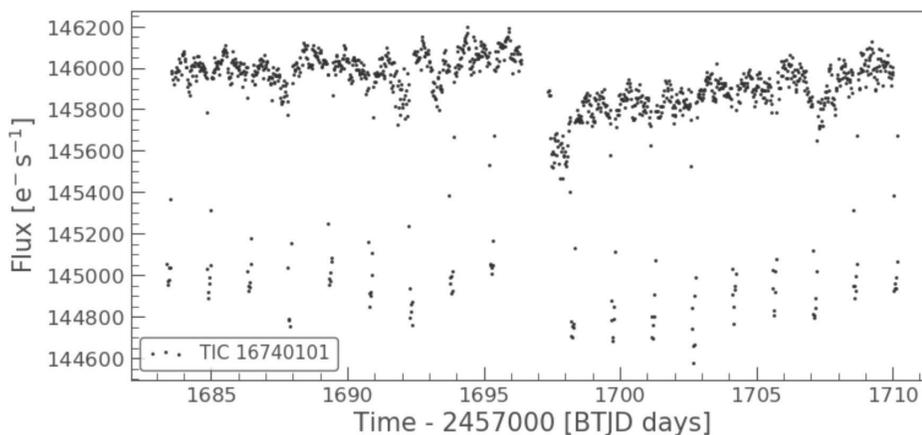
We look forward to working with you all in the future and if you have any questions, please contact us at:

<https://heasarc.gsfc.nasa.gov/docs/tess/helpdesk.html>

The TESS GI Office

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In [3]: import lightkurve as lk
pixelfile = lk.search_targetpixelfile("Kelt-9")[1].download()
pixelfile.to_lightcurve(method="pld").remove_outliers().scatter()

Out[3]: <matplotlib.axes._subplots.AxesSubplot at 0x7f960a4891d0>
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