Web interface for extracting light curves from the TESS mission

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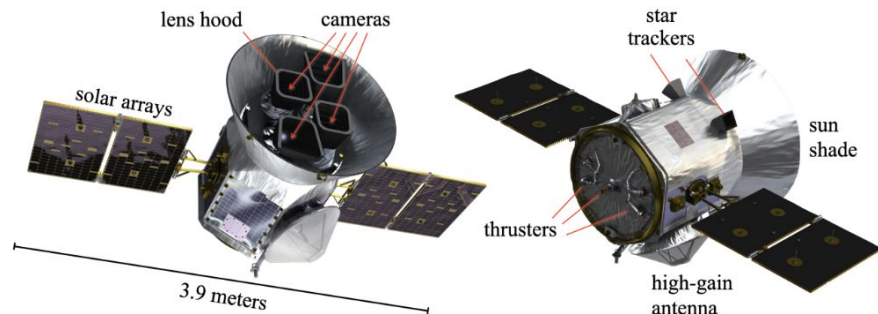
Institute of Physics, P. J. Šafárik University in Košice
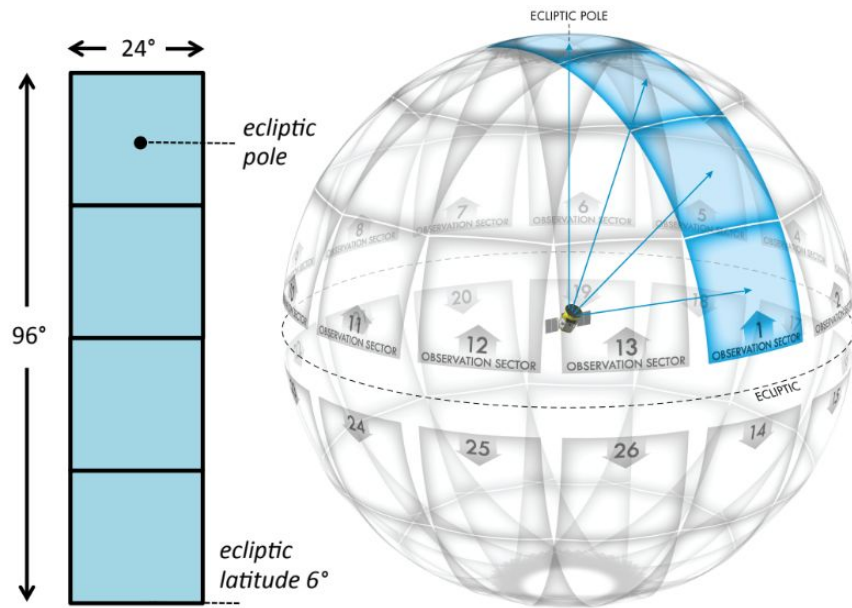
TESS

(Transiting Exoplanet Space Survey)

lens hood · cameras · star trackers · solar arrays · sun shade · thrusters · high-gain antenna · 3.9 meters

(Winn, J., 2024: *The Transiting Exoplanet Survey Satellite*)

- The main purpose: to discover exoplanets around nearby, bright stars.
- Four identical cameras (24°×24° field of view, aperture size cca 10 cm).
- Uses one red-optical passband (600 to 1000 nm).
- Read out continuously at 2-second intervals.
- Onboard processing: stacks the 2-second images to get chosen cadence (20s, 120s, 200s, 600s, 1800s…).
- 26 sectors (24°×96°) observed for 27 days.

24° · 96° · ecliptic pole · ecliptic latitude 6° · ECLIPTIC POLE · ECLIPTIC

(Ricker, G. R., et al. 2015: *The Transiting Exoplanet Survey Satellite*)

- each sector should be processed separately
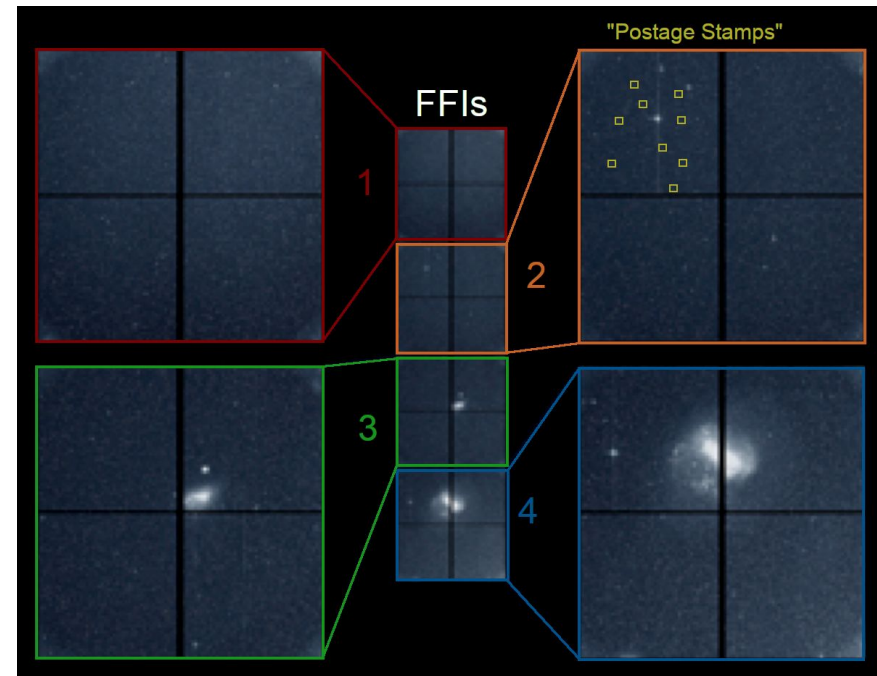- valuable for valuable for variable stars research

  Data formats:

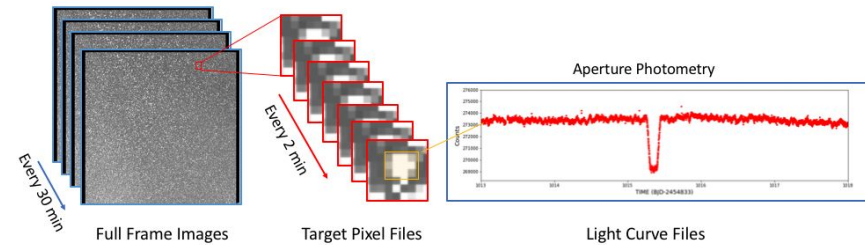 LCF (Light Curve File)

  FFI (Full Frame Images)

  TPF (Target Pixel Pile) - for objects from TIC (TESS Input Catalog)

Lightkurve - Python module

https://skvo.science.upjs.sk/igebc/tess

(https://tess.mit.edu/science/observations/)

(https://outerspace.stsci.edu/)

Typical workflow - screenshots

1. Find an object

1. Select a sector and download it

3. Select a sector and download it

4. Generate and plot light curve

5. Select, zoom, or cut specific parts of the light curve ➡ **download it**
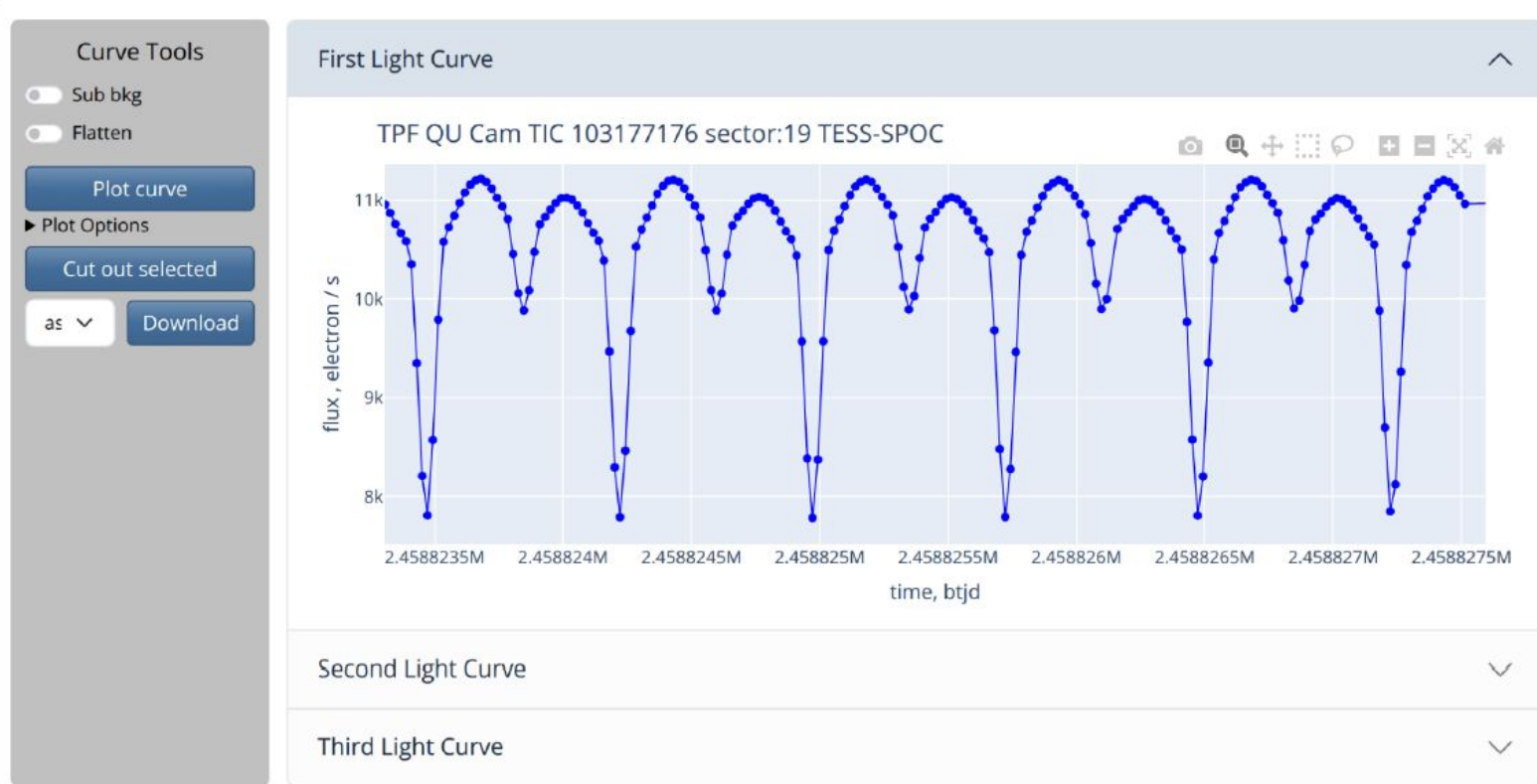
Additional features

Aladin applet

AA And TESScut

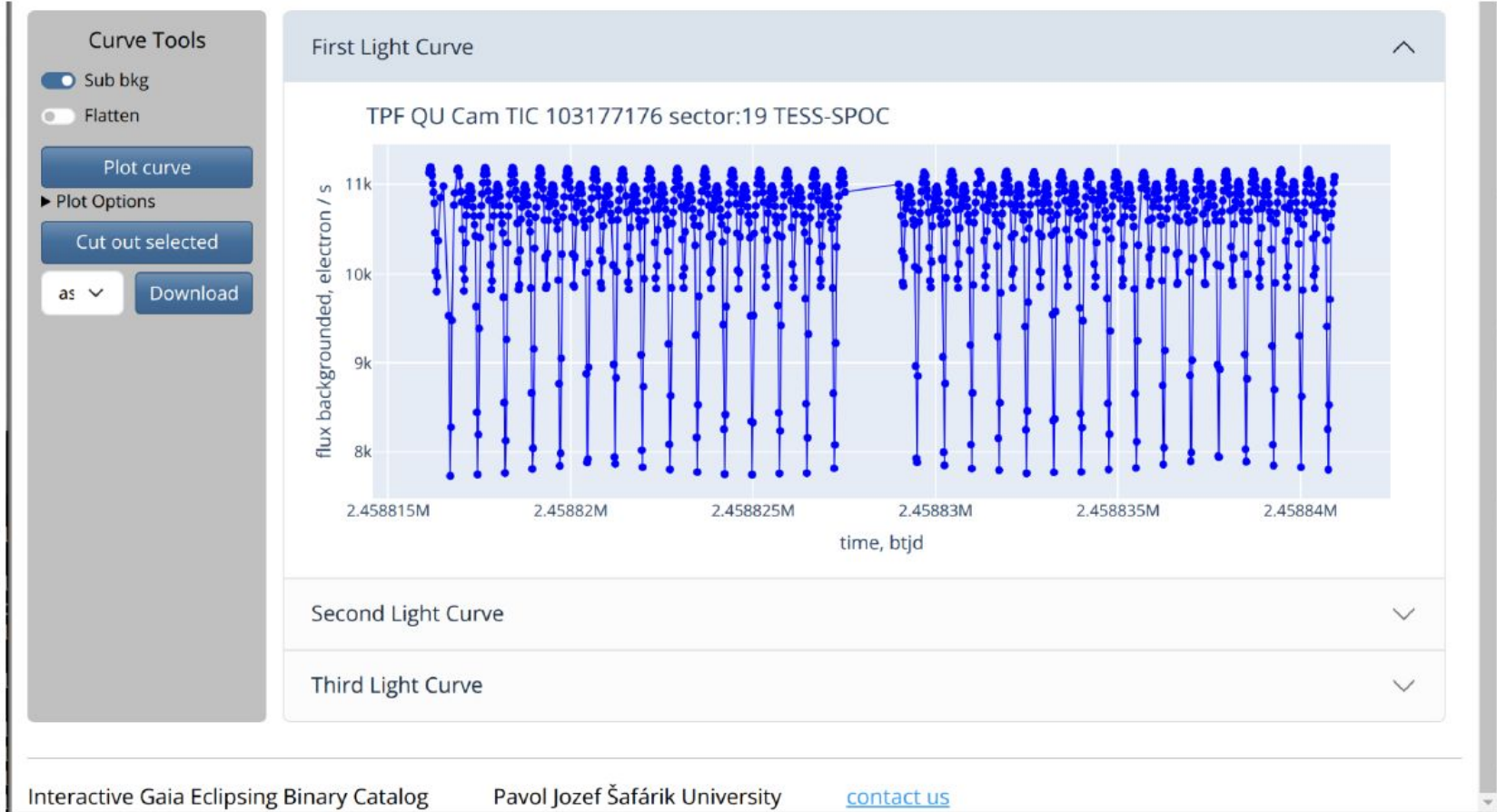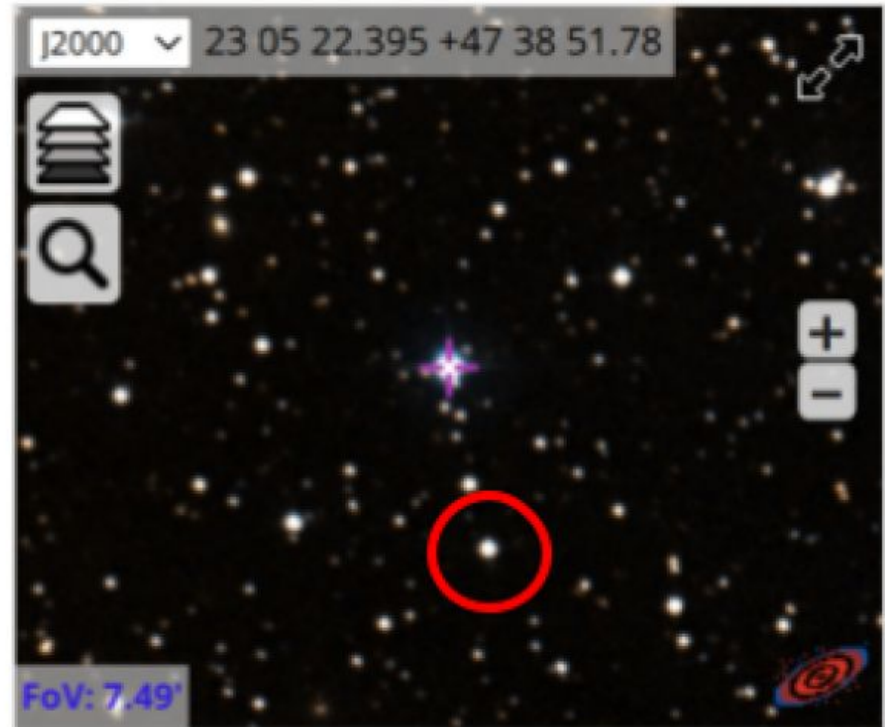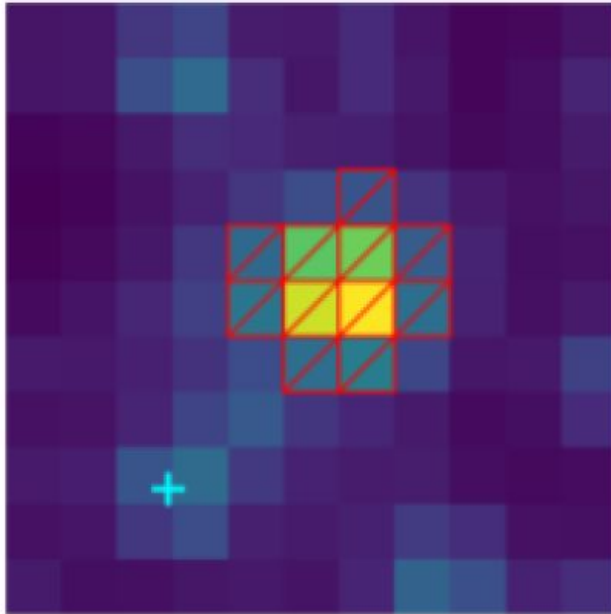J2000 ∨ 23 05 22.395 +47 38 51.78

FoV: 7.49'
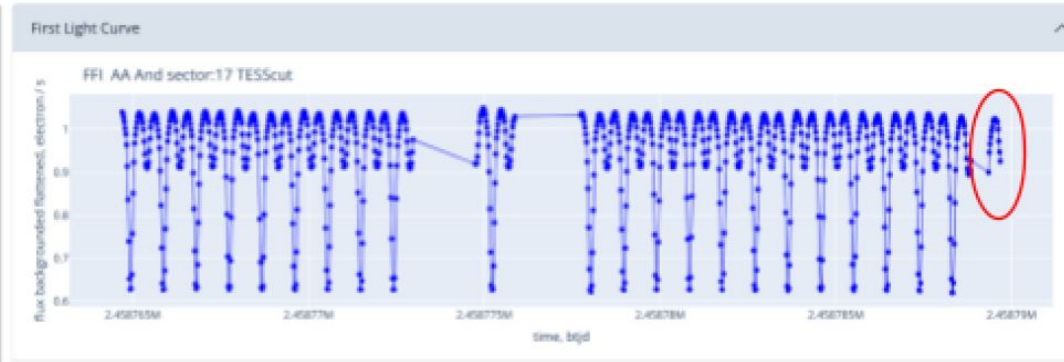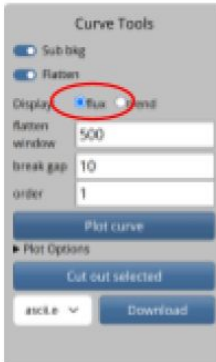
Background subtraction
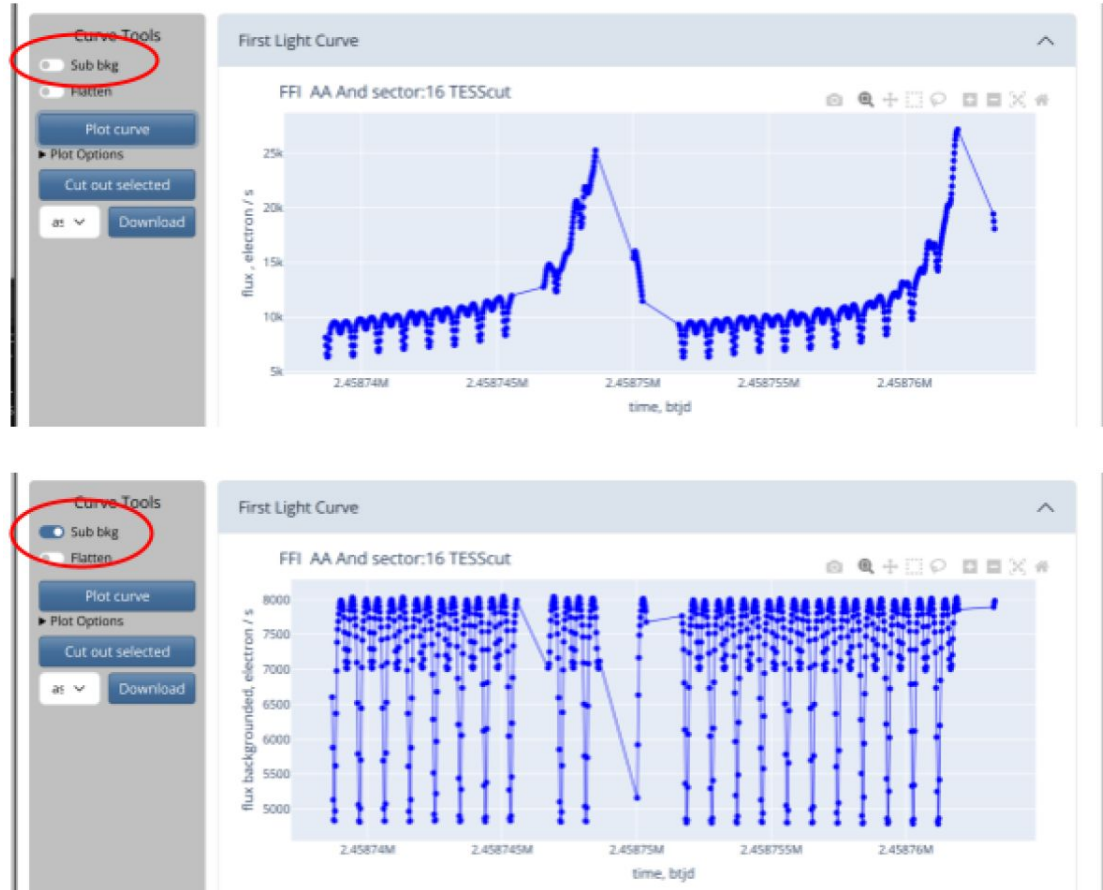
Flattening - removal of long-term trends using a Savitzky–Golay filter. Options: window length (to control trend smoothness), handling exclusion gaps, polynomial order.
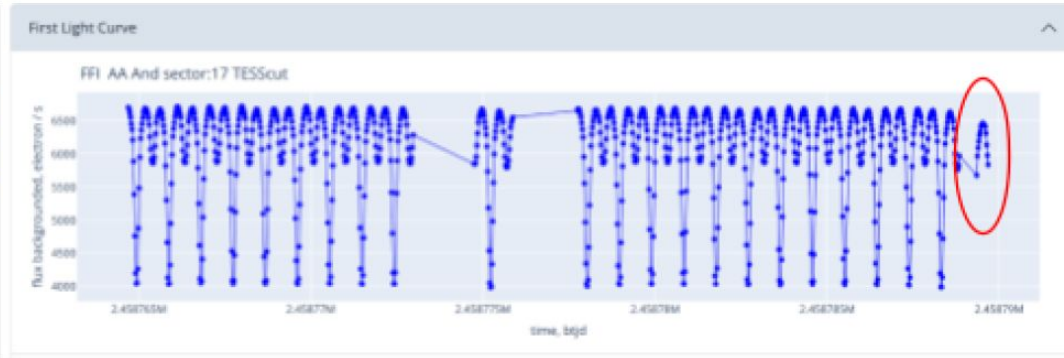
Details:

Dash Plotly framework (Plotly Technologies Inc., 2024)
- supports the development of complex multi-page applications
- enables the use of JavaScript for fast client-side callbacks, improving the responsiveness of the application

Lightkurve package (Lightkurve Collaboration, 2018)
- slight adjustments were required to adapt it for integration with the Plotly-based interface
- includes useful tools such as periodogram analysis, which we plan to incorporate in future versions of the portal

Conclusions and Future Plans:

- user-friendly graphical environment, enabling light curve generation without coding
- helps researchers find and process observations more easily and efficiently through an intuitive interface
- makes access to TESS data more straightforward, opening it up to a broader community
- we plan to develop a dedicated page for working with TESS light curves, including advanced tools such as periodograms and O–C (Observed minus Calculated) analysis

References:
Lightkurve Collaboration, 2018. Lightkurve: Kepler and TESS time series analysis in Python. In: Astrophysics Source Code Library, record ascl:1812.013.
Plotly Technologies Inc., 2024. Dash Layout. https://dash.plotly.com/layout [Accessed: 15 May 2025]