

Web interface for extracting light curves from the TESS mission

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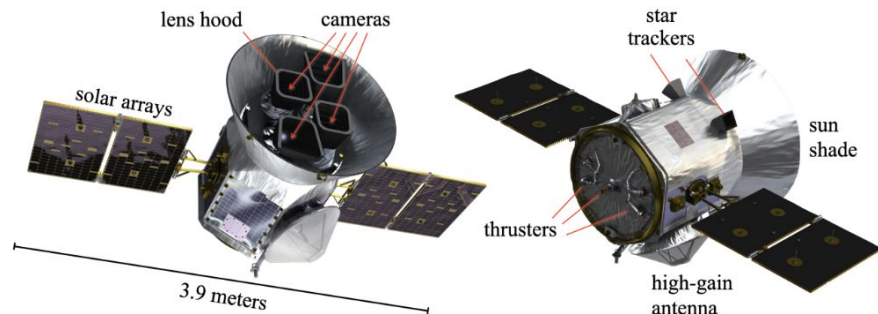
Institute of Physics, P. J. Šafárik University in Košice



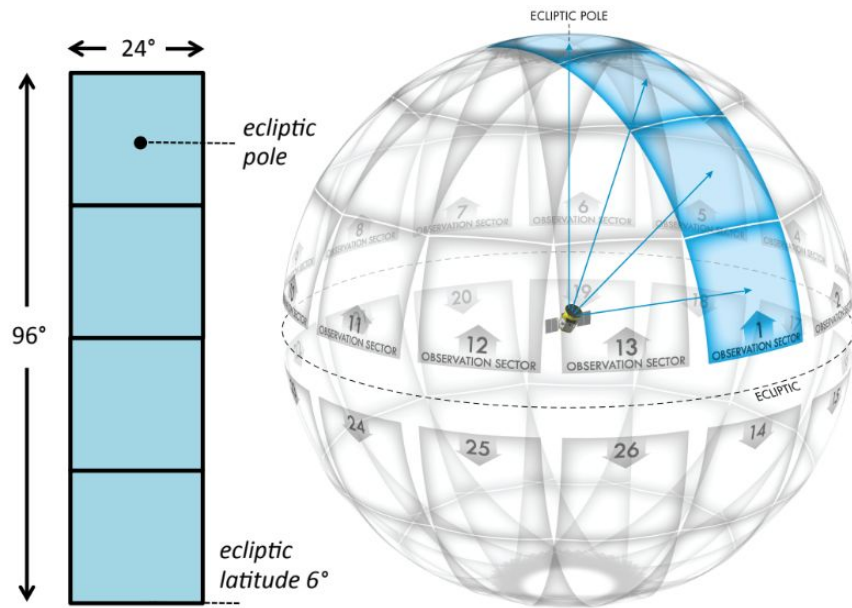
TESS

(Transiting Exoplanet Space Survey)

- The main purpose: to discover exoplanets around nearby, bright stars.
- Four identical cameras ($24^\circ \times 24^\circ$ 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 ($24^\circ \times 96^\circ$) observed for 27 days.



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



(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:

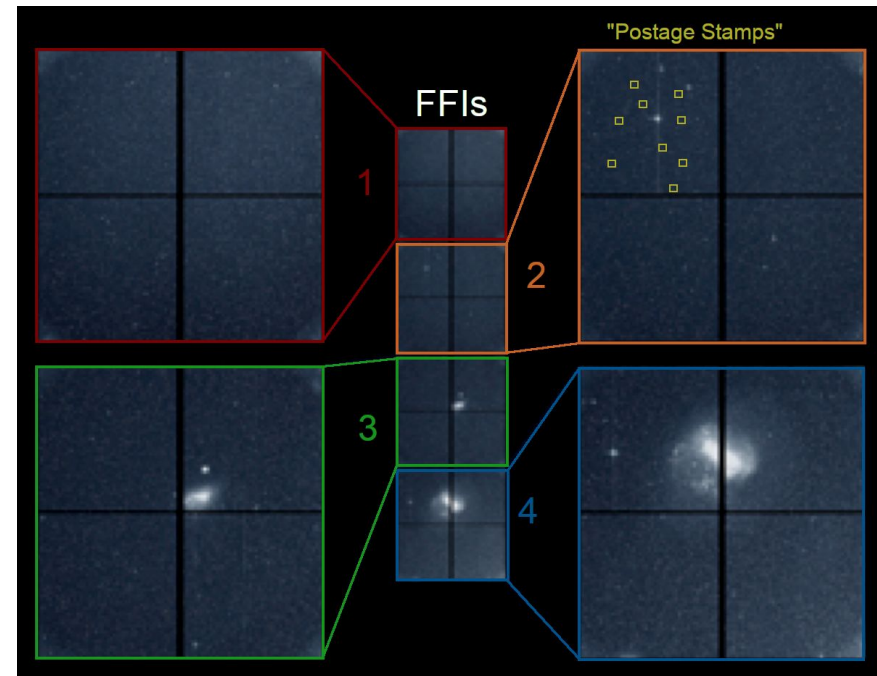
LCF (Light Curve File)

FFI (Full Frame Images)

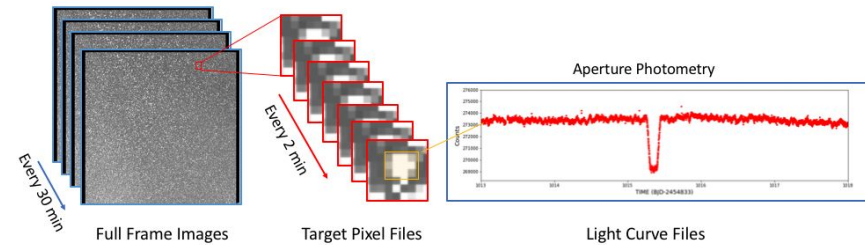
TPF (Target Pixel Pile) - for objects from TIC (TESS Input Catalog)

Lightcurve - Python module

<https://skvo.science.upjs.sk/igebc/teess>



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



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

Typical workflow - screenshots

1. Find an object

The screenshot displays the 'TESS Cutout Tool' web interface. At the top, there is a navigation bar with links: 'Home', 'Search', 'ASAS-SN', 'TESS cutout' (highlighted in blue), and 'TESS curve'. The main heading is 'TESS Cutout Tool'. Below this, there are two tabs: 'Search Sector' (active) and 'Plot'. The search form includes fields for 'Object' (containing 'QU Cam'), 'RA', 'DEC', and 'Radius' (containing '11'). There are 'Search' and 'Cancel' buttons. At the bottom of the form, there are radio buttons for 'FFI' and 'TPF', with 'TPF' selected. The footer contains the text 'Interactive Gaia Eclipsing Binary Catalog', 'Pavol Jozef Šafárik University', and a 'contact us' link.

VEB Gaia

Home Search ASAS-SN **TESS cutout** TESS curve

TESS Cutout Tool

Search Sector Plot

Object QU Cam

RA

DEC

Radius 11

Search Cancel

☐ FFI ☒ TPF

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1. Select a sector and download it

VEB Gaia

Home Search ASAS-SN TESS cutout TESS curve

TESS Cutout Tool

Search Sector Plot

Object

QU Cam

RA

DEC

Radius

11

Search

Cancel

☐ FFI ☒ TPF

TPF QU Cam

Size

11

Download sector

Cancel

	#	mission	year	author	exptime	target	di
<input checked="" type="radio"/>	0	TESS Sector 19	2019	TESS-SP0C	1800	103177176	0
<input type="radio"/>	1	TESS Sector 25	2020	TESS-SP0C	1800	103177176	0
<input type="radio"/>	2	TESS Sector 26	2020	TESS-SP0C	1800	103177176	0
<input type="radio"/>	3	TESS Sector 59	2022	TESS-SP0C	200	103177176	0

Press Download to get the lightcurve

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3. Select a sector and download it

VEB Gaia

Home Search ASAS-SN TESS cutout TESS curve

TESS Cutout Tool

Search Sector Plot

Cutout Tools

► Plot options

Plot pixel

▼ Mask

☒ Auto ☐ Handmade

☐ pipe ☒ thresh

Mask thresh

Select mask and build the lightcurve:

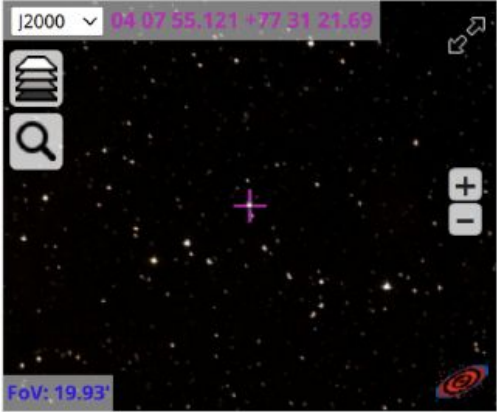
- Click on a star in the **Aladin** applet to mark it on the pixel image
- **Handmade Mask:** Click on a pixel to set/unset mask
- **Auto-mask:** Click on a pixel to create a threshold mask around it
- **Pipeline mask:** Use the mask provided by the team

QU Cam 103177176 TESS-SPOC



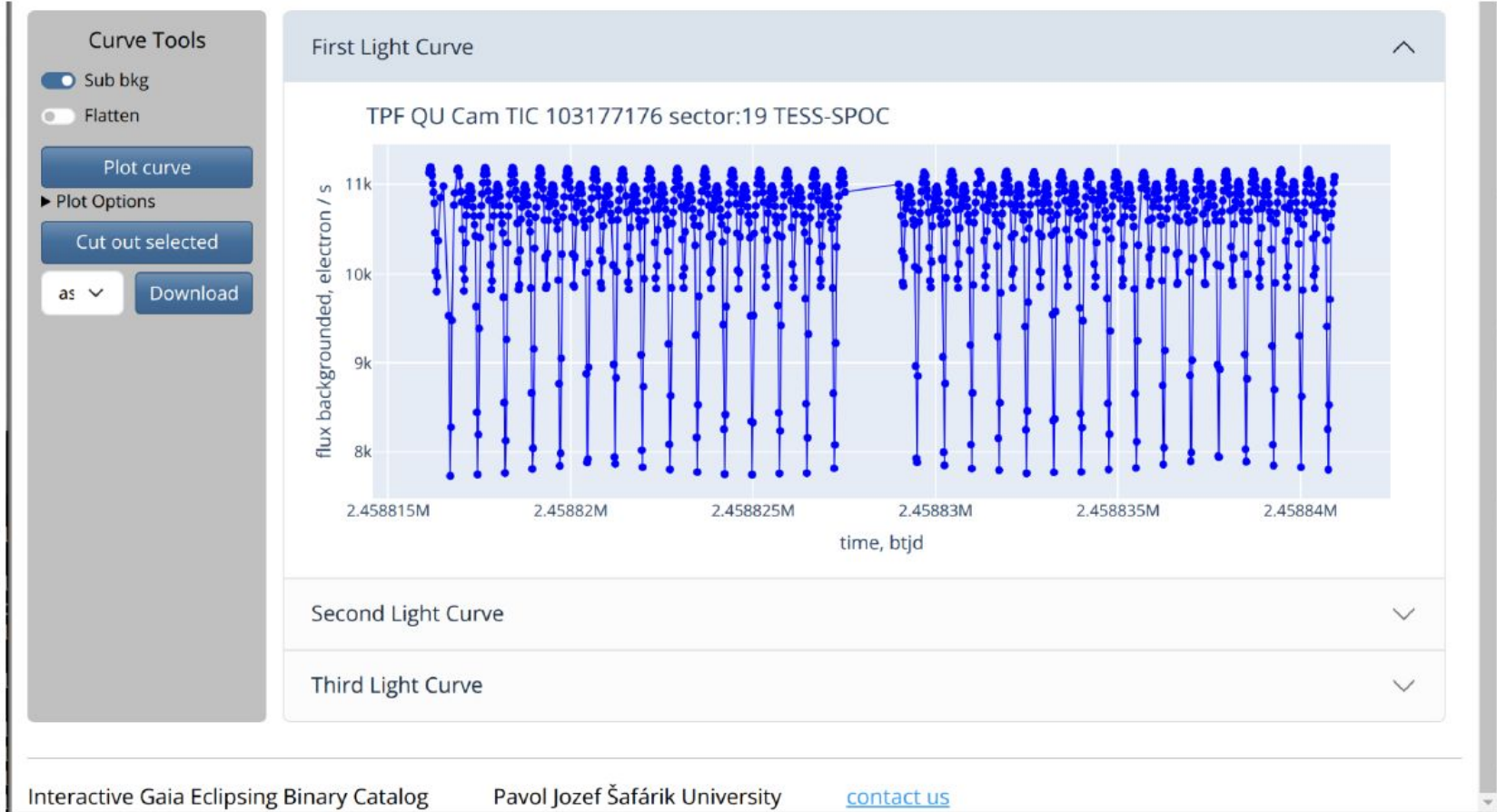
J2000



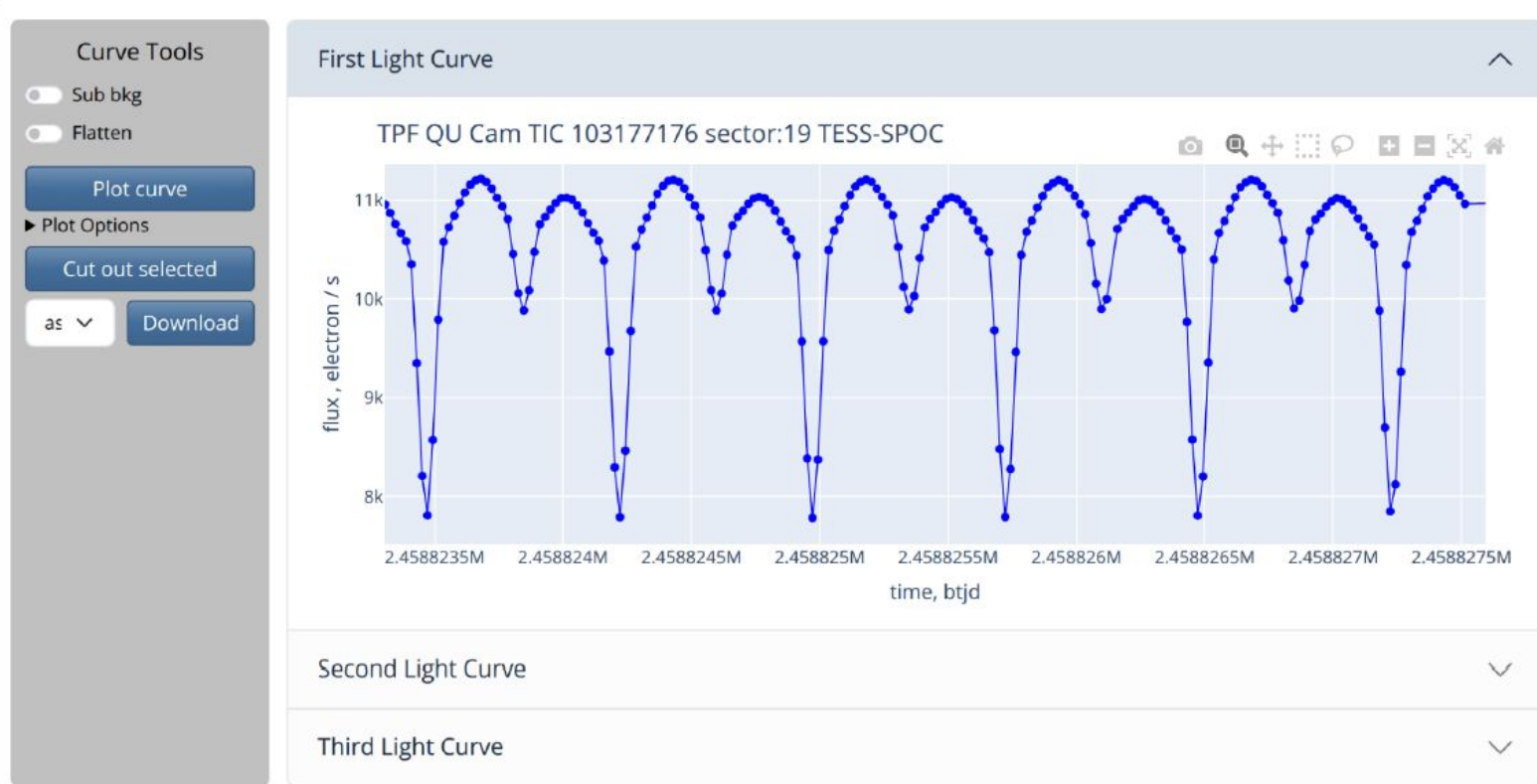


FoV: 19.93'

4. Generate and plot light curve



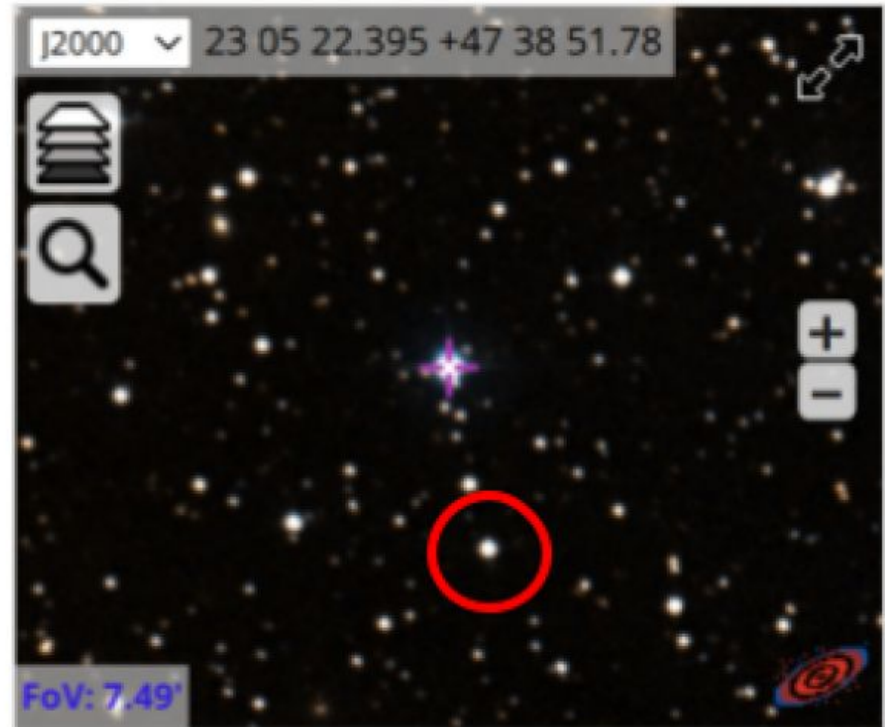
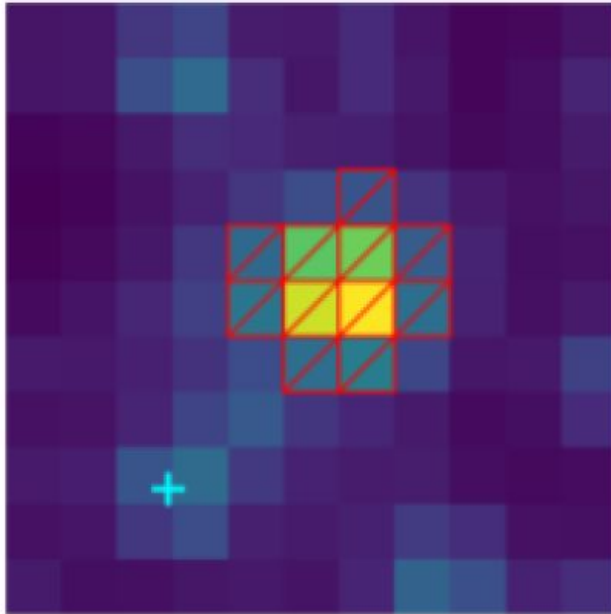
5. Select, zoom, or cut specific parts of the light curve → **download it**



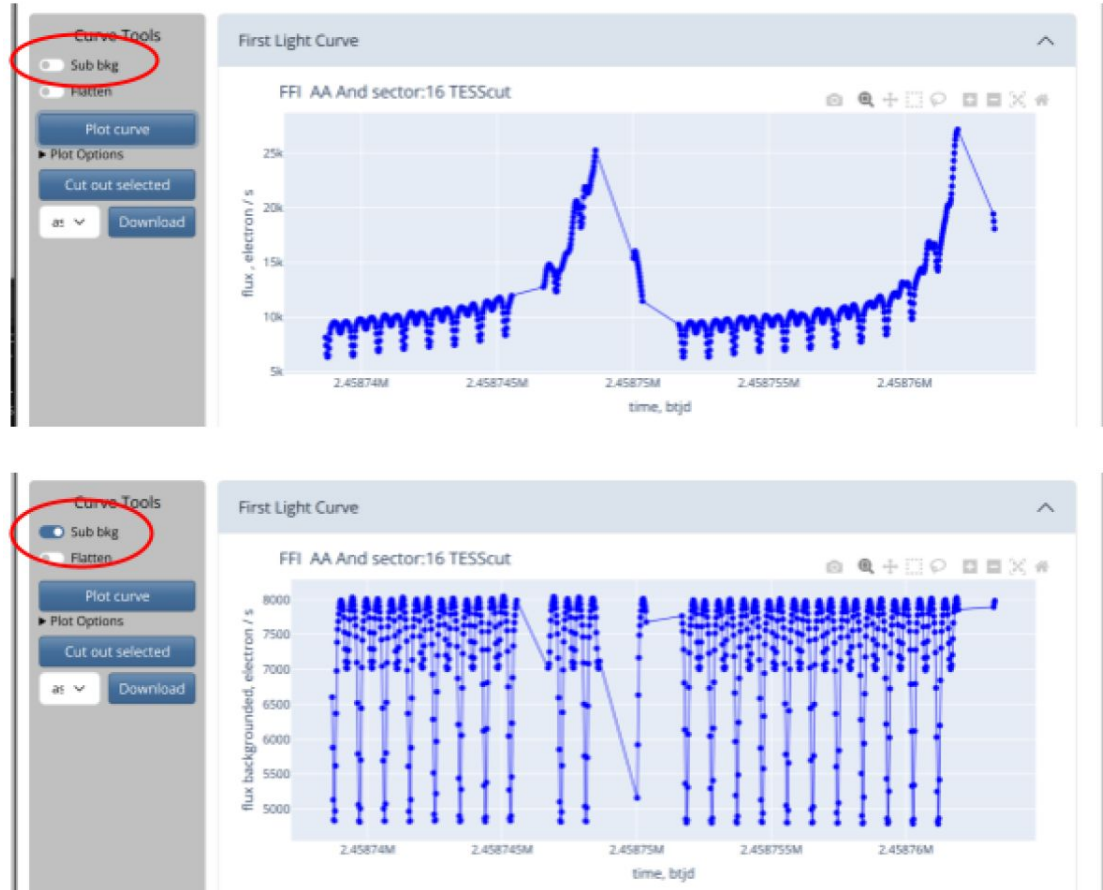
Additional features

Aladin applet

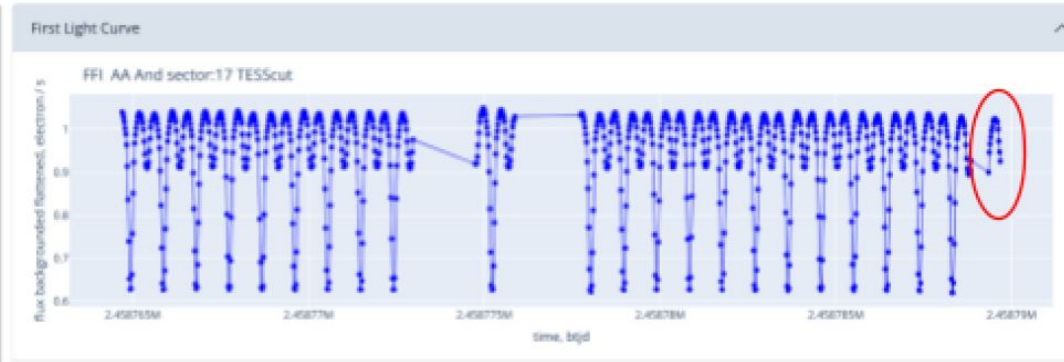
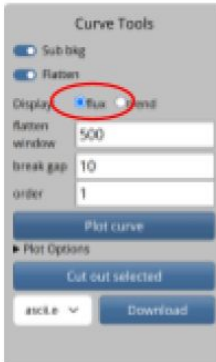
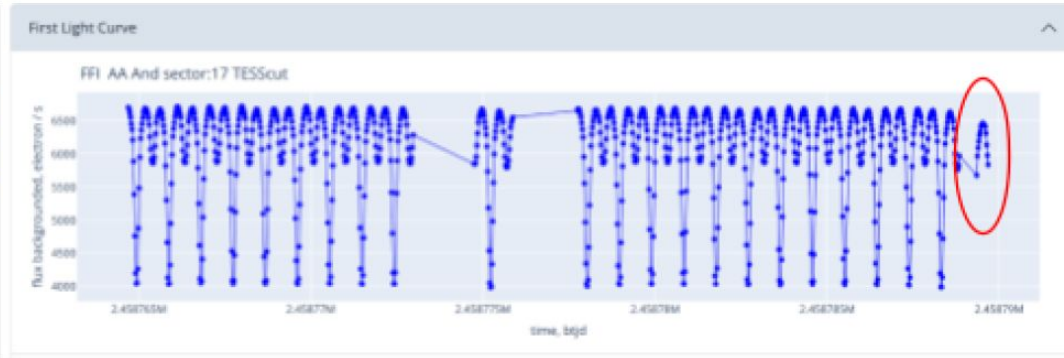
AA And TESScut



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]