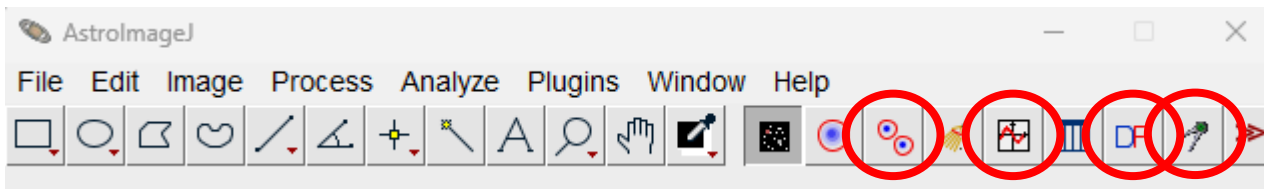


# AstrolImageJ

- General astronomical image and data analysis tool (based on ImageJ)
- Image calibration (bias, dark, and flat-fielding)
- Differential aperture photometry
- Lightcurve plotting (with automatic titling and legend capabilities)
- Lightcurve detrending and fitting
- Automatic comparison star selections
- Various aperture options (fixed, auto-fixed, variable size; circular, elliptical, arbitrary shape)
- Automated NEBcheck routine (written by AAVSO's Dennis Conti)
- Automatic optimization of comparison stars and detrend parameters
- Plate solving using astrometry.net (local solver capability on Microsoft Windows)
- Moving object tracking
- Image alignment (if needed)
- TESS image (e.g. TESScut) and SPOC lightcurve analysis

# AstroImageJ Toolbar

- Provides access to Astronomy Tools (and underlying ImageJ tools)
- Data Processor (DP; data calibration)
- Multi-Aperture (MA; differential photometry)
- Multi-Plot and lightcurve fitting (MP; plotting facility)
- Coordinate Converter (CC; time format and coordinate conversion)



# Data Processor (Image Calibration)

- Create master calibration files
- Bias subtract
- Dark Subtract
- Flat field
- Update FITS headers
- Plate Solve
- Save calibrated files
- Optional run photometry and plotting
- Run in realtime mode while observing to monitor live lightcurve

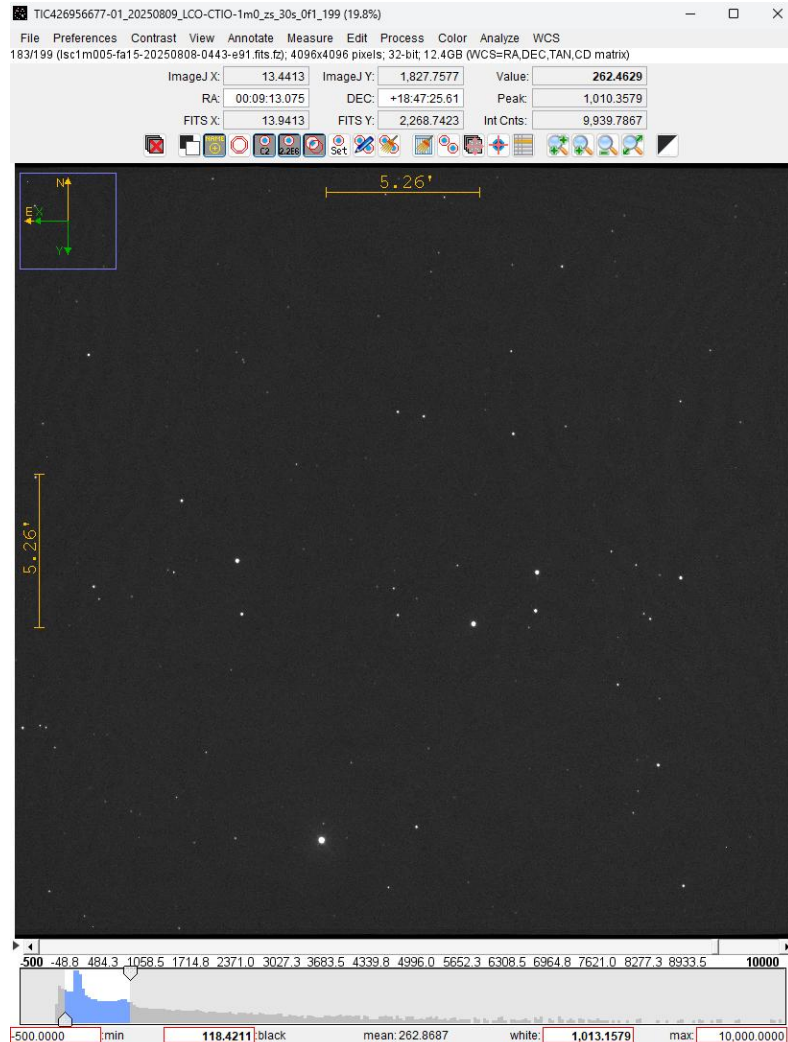
DP CCD Data Processor

File Preferences View

Control	Options	Directory	Filename/Pattern	Totals
<b>Science Image Processing</b>				
Filename Matching				
<input checked="" type="checkbox"/> Enable	<input checked="" type="checkbox"/> Sort Num	C:\Users\karen\Documents\Observations\WASP-12b_qty-19\20091127_WASP-12b_r-filter	WASP-12b_*.fits	134
Filename Number Filtering				
<input type="checkbox"/> Enable	Min: 0	Max: 1000000000	WASP-12b_*.fits	134
<b>Bias Subtraction</b>				
<input checked="" type="checkbox"/> Build	<input type="radio"/> ave <input checked="" type="radio"/> med	:\Users\karen\Documents\Observations\WASP-12b_qty-19\20091127_WASP-12b_r-filter\Bias	BIAS_*.fits	6
<input checked="" type="checkbox"/> Enable		:\Users\karen\Documents\Observations\WASP-12b_qty-19\20091127_WASP-12b_r-filter\Bias	mbias.fits	1
<b>Dark Subtraction</b>				
<input checked="" type="checkbox"/> Build	<input type="radio"/> ave <input checked="" type="radio"/> med	:\Users\karen\Documents\Observations\WASP-12b_qty-19\20091127_WASP-12b_r-filter\Dark	Dark_100s_*.fits	10
<input checked="" type="checkbox"/> Enable	<input checked="" type="checkbox"/> scale <input checked="" type="checkbox"/> deBias	:\Users\karen\Documents\Observations\WASP-12b_qty-19\20091127_WASP-12b_r-filter\Dark	mdark.fits	1
<b>Flat Division</b>				
<input type="checkbox"/> Build	<input type="radio"/> ave <input checked="" type="radio"/> med	C:\Users\Karen\Documents\_Awaiting Reduction - TESS\Wingham\Calibration_Images\Flats 1x	*FLAT.FIT	0
<input checked="" type="checkbox"/> Enable	<input type="checkbox"/> Remove Gradient	C:\Users\karen\Documents\Observations\WASP-12b_qty-19\20091127_WASP-12b_r-filter	mflat.fits	1
<b>Image Correction</b>				
<input type="checkbox"/> Enable Linearity Correction	New pixel value = 0.0E0 + 1.0E0 * (PixVal) + 0.0E0 * (PixVal)^2 + 0.0E0 * (PixVal)^3			
<input type="checkbox"/> Remove Outliers	<input checked="" type="checkbox"/> Bright <input checked="" type="checkbox"/> Dark	Radius: 2	Threshold: 50	
<b>FITS Header Updates</b>				
<input checked="" type="checkbox"/> General	<input type="checkbox"/> Plate Solve	Target Coordinate Source: FITS header target RA/DEC (J2000)		Observatory Location Source: FITS header latitude and longitude
<b>Save Calibrated Images</b>				
<input checked="" type="checkbox"/> Enable	<input type="radio"/> 16 <input checked="" type="radio"/> 32	Sub-dir: .\pipelineout	Suffix: _out	Format: <input type="checkbox"/> FPACK <input type="checkbox"/> GZIP
<b>Post Processing</b>				
<input checked="" type="checkbox"/> M-Ap	<input type="checkbox"/> Save Image		<input type="checkbox"/> Macro 1: C:\Users\Karen\	0
<input checked="" type="checkbox"/> M-Plot	<input type="checkbox"/> Save Plot		<input type="checkbox"/> Macro 2: C:\Users\Karen\	0
<b>Control Panel</b>				
Polling Interval: 3		START PAUSE RESET		Processed: 0 Remaining: 134

# Image Stack Display

- Zoom and pan image with mouse
- Adjust contrast
- Scroll through stack
- Photometer at mouse pointer
- X, Y, East, North, indicators
- Access to all AIJ settings and tools
  - Icons for common settings and tools
  - Menus for all others



# Multi-Aperture

- Select aperture shape
- Select aperture size and size mode
- Select new or saved aperture mode
- Select aperture tracking modes
- Set up auto comp star mode
- Select runtime display options
- Select “Place Apertures” to interactively add, remove, or move apertures in image stack

Multi-Aperture Measurements

Aperture Shape: Circular

First slice: 1

Last slice: 199

Fixed/Base radius of photometric aperture: 15

Fixed/Base radius of inner background annulus: 30

Fixed/Base radius of outer background annulus: 45

☐ Fixed Apertures as selected above

☐ Auto Fixed Apertures from first image T1 radial profile

☒ Auto Fixed Apertures from multi-image T1 radial profiles

☐ Auto Variable Apertures from each image T1 radial profile

☐ Auto Variable Apertures from each image T1 FWHM

Normalized flux cutoff threshold: 0.005 (0 < cutoff < 1; default = 0.010)

Normalized flux cutoff threshold: 0.005 (0 < cutoff < 1; default = 0.010)

Normalized flux cutoff threshold: 0.005 (0 < cutoff < 1; default = 0.010)

FWHM factor: 1.4

☐ Place all new apertures

☐ Place first previously used aperture

☐ Place 31 previously used apertures

☒ Place 1 imported apertures

☐ Use RA/Dec to locate aperture positions

☐ T1 is moving object

☐ Use single step mode (1-click to set first aperture location in each image)

☐ Allow aperture changes between slices in single step mode (right click to advance image)

☒ Auto comparison stars ☐ Enable log ☐ Show peaks

Smoothing Filter Radius: 3.5 pixels

☒ Auto Thresholds

Max. Peak Value: 145,370.01

Min. Peak Value: 470.56

Base Aperture: 1

Max. Comp. Brightness %: 300.0

Min. Comp. Brightness %: 10.0

Weight of Distance: 50 vs Brightness

Max. Comp. Stars: 30

☒ Centroid apertures (initial setting)

☐ Halt processing on WCS or centroid error

☒ Remove stars from background

☐ Assume background is a plane

☐ Prompt to enter ref star apparent magnitude (required if target star apparent mag is desired)

☐ Update plot while running

☐ Show help panel during aperture selection

☐ Update image display while running

CLICK 'PLACE APERTURES' AND SELECT APERTURE LOCATIONS WITH LEFT CLICKS.  
THEN RIGHT CLICK or <ENTER> TO BEGIN PROCESSING.  
(to abort aperture selection or processing, press <ESC>)

Place Apertures Aperture Settings Cancel

# Measurements Table Display

- Contains all data from multi-aperture run
- Interactive with plotted data
- Searchable
- Sortable
- Editable

Measurements in TIC393818343-01_20240702_LCO-CTIO-0m4p_5px_KC_measurements.tbl									
File Edit Font Results Filter									
	Label	slice	Saturated	J.D.-2400000	JD_UTC	BJD_TDB	ATDMACC	MMCHUMID	CCDATEMD
1	lsc0m476-sq34-20240701-0141-e91.fits.fz	1	0.0	60493.60185756395	2460493.601857564	2460493.601857564			
2	lsc0m476-sq34-20240701-0143-e91.fits.fz	2	0.0	60493.60233846679	2460493.602338467	2460493.602338467			
3	lsc0m476-sq34-20240701-0145-e91.fits.fz	3	0.0	60493.60281584505	2460493.602815845	2460493.602815845			
4	lsc0m476-sq34-20240701-0147-e91.fits.fz	4	0.0	60493.603305567056	2460493.603305567	2460493.603305567			
5	lsc0m476-sq34-20240701-0149-e91.fits.fz	5	0.0	60493.603779363446	2460493.603779363	2460493.603779363			
6	lsc0m476-sq34-20240701-0151-e91.fits.fz	6	0.0	60493.60424845526	2460493.604248455	2460493.604248455			
7	lsc0m476-sq34-20240701-0159-e91.fits.fz	10	0.0	60493.6061387267	2460493.606138726	2460493.606138726			
8	lsc0m476-sq34-20240701-0163-e91.fits.fz	12	0.0	60493.6070901854	2460493.607090185	2460493.607090185			
9	lsc0m476-sq34-20240701-0165-e91.fits.fz	13	0.0	60493.60756527772	2460493.607565277	2460493.607565277			
10	lsc0m476-sq34-20240701-0167-e91.fits.fz	14	0.0	60493.60803953698	2460493.608039537	2460493.608039537			
11	lsc0m476-sq34-20240701-0169-e91.fits.fz	15	0.0	60493.60851792246	2460493.608517922	2460493.608517922			
12	lsc0m476-sq34-20240701-0171-e91.fits.fz	16	0.0	60493.608991921414	2460493.608991921	2460493.608991921			
13	lsc0m476-sq34-20240701-0173-e91.fits.fz	17	0.0	60493.60946921911	2460493.609469219	2460493.609469219			
14	lsc0m476-sq34-20240701-0175-e91.fits.fz	18	0.0	60493.60994497128	2460493.609944971	2460493.609944971			
15	lsc0m476-sq34-20240701-0177-e91.fits.fz	19	0.0	60493.610423472244	2460493.610423472	2460493.610423472			
16	lsc0m476-sq34-20240701-0179-e91.fits.fz	20	0.0	60493.61090125609	2460493.610901256	2460493.610901256			
17	lsc0m476-sq34-20240701-0181-e91.fits.fz	21	0.0	60493.61137435166	2460493.611374351	2460493.611374351			
18	lsc0m476-sq34-20240701-0183-e91.fits.fz	22	0.0	60493.61184606468	2460493.611846064	2460493.611846064			
19	lsc0m476-sq34-20240701-0185-e91.fits.fz	23	0.0	60493.61237861728	2460493.612378617	2460493.612378617			
20	lsc0m476-sq34-20240701-0187-e91.fits.fz	24	0.0	60493.61285255244	2460493.612852552	2460493.612852552			
21	lsc0m476-sq34-20240701-0191-e91.fits.fz	26	0.0	60493.61385250604	2460493.613852506	2460493.613852506			
22	lsc0m476-sq34-20240701-0193-e91.fits.fz	27	0.0	60493.61432887195	2460493.614328872	2460493.614328872			
23	lsc0m476-sq34-20240701-0195-e91.fits.fz	28	0.0	60493.61480316566	2460493.614803165	2460493.614803165			
24	lsc0m476-sq34-20240701-0197-e91.fits.fz	29	0.0	60493.61527910316	2460493.615279103	2460493.615279103			
25	lsc0m476-sq34-20240701-0201-e91.fits.fz	31	0.0	60493.6162245255	2460493.616224525	2460493.616224525			
26	lsc0m476-sq34-20240701-0203-e91.fits.fz	32	0.0	60493.61669783015	2460493.616697830	2460493.616697830			
27	lsc0m476-sq34-20240701-0205-e91.fits.fz	33	0.0	60493.61716912035	2460493.617169120	2460493.617169120			
28	lsc0m476-sq34-20240701-0207-e91.fits.fz	34	0.0	60493.61764584482	2460493.617645844	2460493.617645844			
29	lsc0m476-sq34-20240701-0209-e91.fits.fz	35	0.0	60493.61812527198	2460493.618125272	2460493.618125272			
30	lsc0m476-sq34-20240701-0211-e91.fits.fz	36	0.0	60493.61860082764	2460493.618600827	2460493.618600827			
31	lsc0m476-sq34-20240701-0213-e91.fits.fz	37	0.0	60493.61907348968	2460493.619073489	2460493.619073489			
32	lsc0m476-sq34-20240701-0215-e91.fits.fz	38	0.0	60493.61954888329	2460493.619548883	2460493.619548883			
33	lsc0m476-sq34-20240701-0217-e91.fits.fz	39	0.0	60493.6200197977	2460493.620019797	2460493.620019797			
34	lsc0m476-sq34-20240701-0221-e91.fits.fz	41	0.0	60493.62096436927	2460493.620964369	2460493.620964369			
35	lsc0m476-sq34-20240701-0223-e91.fits.fz	42	0.0	60493.6214413424	2460493.621441342	2460493.621441342			
36	lsc0m476-sq34-20240701-0225-e91.fits.fz	43	0.0	60493.621919664554	2460493.621919664	2460493.621919664			
37	lsc0m476-sq34-20240701-0227-e91.fits.fz	44	0.0	60493.622391458135	2460493.622391458	2460493.622391458			
38	lsc0m476-sq34-20240701-0229-e91.fits.fz	45	0.0	60493.62286680564	2460493.622866805	2460493.622866805			
39	lsc0m476-sq34-20240701-0231-e91.fits.fz	46	0.0	60493.62334713573	2460493.623347135	2460493.623347135			
40	lsc0m476-sq34-20240701-0233-e91.fits.fz	47	0.0	60493.623822575435	2460493.623822574	2460493.623822574			
41	lsc0m476-sq34-20240701-0235-e91.fits.fz	48	0.0	60493.62430097815	2460493.624300978	2460493.624300978			
42	lsc0m476-sq34-20240701-0237-e91.fits.fz	49	0.0	60493.624772505835	2460493.624772506	2460493.624772506			

# Multi-plot Main

- Controls related to overall plot
- Titling
- Axis labeling
- Axis Scaling
- Legend
- Plot size

Multi-plot Main

File Preferences Table X-axis Y-axis Style Help

Data (TIC393818343-01\_20240702\_LCO-CTIO-0m4p\_ip\_5px\_KC\_measurements.tbl)

Default X-data: BJD\_TDB Y-datasets: 15 sets Detrend Vars: 10 Rel. Mag. Reference: 10 samples V. Marker 1: 0.6207 V. Marker 2: 0.7936

**Title**  
☐ None ☒ Text ☐ Programmable  
 TIC 393818343.01 (TOI 6883.01) on UT 2024-07-02

**Subtitle**  
☐ None ☒ Text ☐ Programmable  
 LCO-CTIO-0m4p Telescope (ip-band, exp=14s, C-FA: 5-30--

**Legend**  
 Align: ☐ Left ☒ Center ☐ Right  
 Position: Top Middle Bottom

**X-Axis Label**  
☐ None ☒ Column Label ☐ Custom Label  
 X-axis custom label

**Y-Axis Label**  
☐ None ☐ Column Label ☒ Custom Label  
 Relative Flux

**Trim Data Samples**  
 Head: 0 Tail: 0

**X-Axis Scaling**  
☒ Auto X-range ☐ First X-value as min ☐ Custom X-range  
 X-width: 0.251088 X-max: 2458823.803 X-min: 2458823.453912

**Y-Axis Scaling**  
☐ Auto Y-range ☒ Custom Y-range  
 Y-max: 1.016573 Y-min: 0.943377

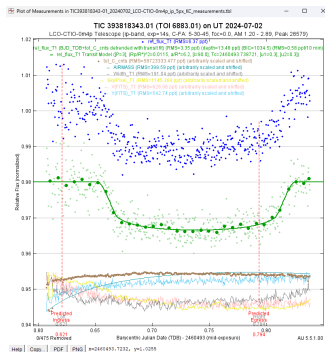
**Plot Size**  
 Height: 800 Width: 800

**Phase Folding**  
☒ Unphased ☐ Days Since Tc ☐ Hours Since Tc ☐ Phase  
 T0 (Days): 2455873.679 Period (Days): 3.0196 Duration (Hours): 3 ☐ 2xP ☐ odd/even

**Meridian Flip**  
☐ Show Flip Time: 0.6

**Fit and Normalize Region Selection**  
☒ Show Left Trim: -0.01 Left: 0.6207 Right: 0.7936 Right Trim: 6.649275

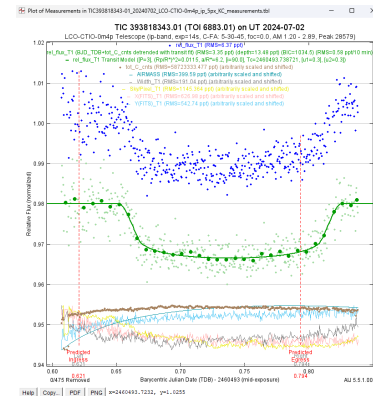
**Other Panels**





# Multi-plot Y-data

- Controls related to individual plotted datasets
- Color, symbol shape
- Fitting mode
- Data averaging and binning



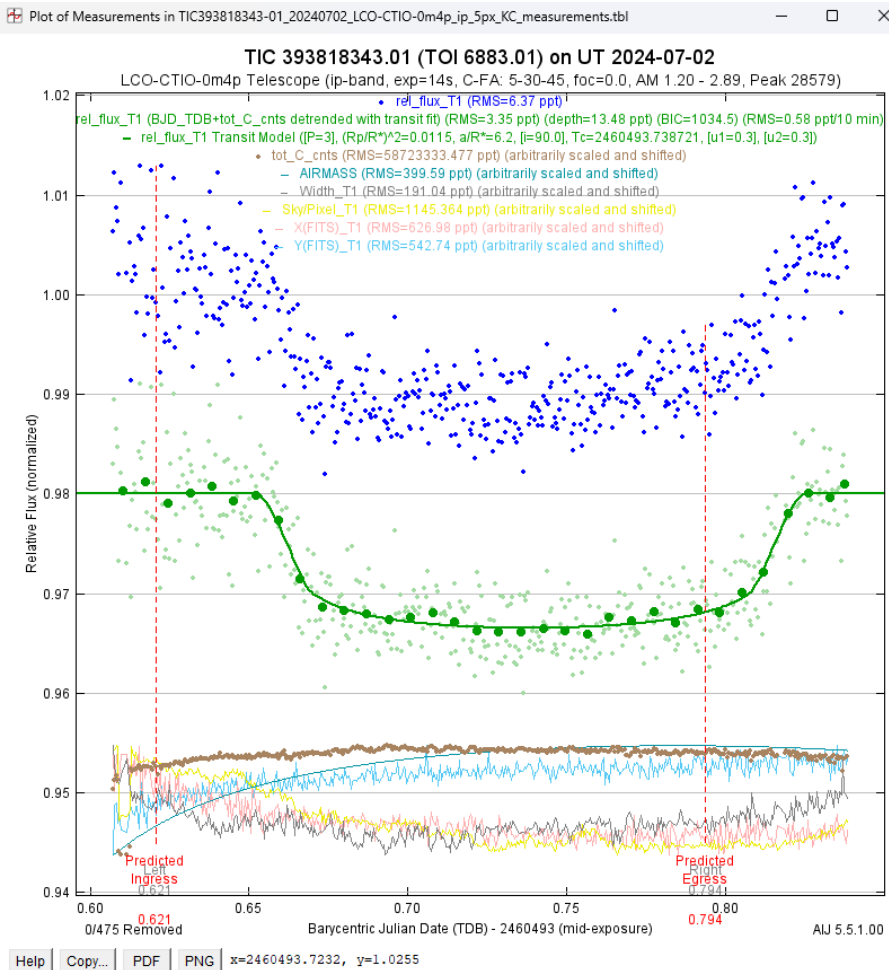
Multi-plot Y-data

Data Set	New Col	Plot	Auto Scale	X-data	Input in Mag	Y-data	Function	Y-operand	Show Error	Color	Symbol	Lines	Input Average	Spline Smooth	Fit Mode	Trend Select	Trend Coefficient	Trend Dataset	Norm/ Mag Ref	Out Mag	Page Rel	Scale	then Shift	Out Bin	BinSize (min)
1			<input checked="" type="checkbox"/>	default	<input type="checkbox"/>	rel_flux_T1	<input type="checkbox"/>		<input type="checkbox"/>	blue	dot	<input type="checkbox"/>	1			<input type="checkbox"/>	0.0000023			<input type="checkbox"/>		1	0	<input type="checkbox"/>	5
2			<input type="checkbox"/>	default	<input type="checkbox"/>	rel_flux_T1	<input type="checkbox"/>		<input type="checkbox"/>	red	box	<input type="checkbox"/>	5			<input checked="" type="checkbox"/>	0			<input type="checkbox"/>		1	-0.008	<input type="checkbox"/>	5
3			<input checked="" type="checkbox"/>	default	<input type="checkbox"/>	rel_flux_T1	<input type="checkbox"/>		<input type="checkbox"/>	dark green	dot	<input type="checkbox"/>	1			<input type="checkbox"/>	-0.0000000	tot_C_ents		<input type="checkbox"/>		1	-0.02	<input checked="" type="checkbox"/>	10
4			<input type="checkbox"/>	default	<input type="checkbox"/>	rel_flux_C2	<input type="checkbox"/>		<input type="checkbox"/>	magenta	X	<input type="checkbox"/>	1		off	<input checked="" type="checkbox"/>	-0.0001225			<input type="checkbox"/>		1	-0.04	<input type="checkbox"/>	5
5			<input checked="" type="checkbox"/>	default	<input type="checkbox"/>	rel_flux_C3	<input type="checkbox"/>		<input type="checkbox"/>	black	X	<input type="checkbox"/>	1		off	<input type="checkbox"/>	0.0000094			<input type="checkbox"/>		1	-0.045	<input type="checkbox"/>	5
6			<input checked="" type="checkbox"/>	default	<input type="checkbox"/>	rel_flux_C4	<input type="checkbox"/>		<input type="checkbox"/>	red	X	<input type="checkbox"/>	1		off	<input type="checkbox"/>	-0.000051			<input type="checkbox"/>		1	-0.05	<input type="checkbox"/>	5
7			<input checked="" type="checkbox"/>	default	<input type="checkbox"/>	rel_flux_C5	<input type="checkbox"/>		<input type="checkbox"/>	purple	X	<input type="checkbox"/>	1		off	<input checked="" type="checkbox"/>	-0.001511			<input type="checkbox"/>		1	-0.055	<input type="checkbox"/>	5
8			<input checked="" type="checkbox"/>	default	<input type="checkbox"/>	rel_flux_C6	<input type="checkbox"/>		<input type="checkbox"/>	light blue	X	<input type="checkbox"/>	1		off	<input type="checkbox"/>	0.0000020			<input type="checkbox"/>		1	-0.06	<input type="checkbox"/>	5
9			<input type="checkbox"/>	default	<input type="checkbox"/>	rel_flux_C7	<input type="checkbox"/>		<input type="checkbox"/>	dark green	X	<input type="checkbox"/>	1		off	<input checked="" type="checkbox"/>	0.0000997			<input type="checkbox"/>		1	-0.065	<input type="checkbox"/>	5
10			<input checked="" type="checkbox"/>	default	<input type="checkbox"/>	tot_C_ents	<input type="checkbox"/>		<input type="checkbox"/>	brown	dot	<input type="checkbox"/>	1		off	<input type="checkbox"/>	0		off	<input type="checkbox"/>		15	-42	<input type="checkbox"/>	5
11			<input checked="" type="checkbox"/>	default	<input type="checkbox"/>	AIRMASS	<input type="checkbox"/>		<input type="checkbox"/>	teal	line	<input type="checkbox"/>	1		off	<input type="checkbox"/>	0		off	<input type="checkbox"/>		-15	-42	<input type="checkbox"/>	5
12			<input checked="" type="checkbox"/>	default	<input type="checkbox"/>	Width_T1	<input type="checkbox"/>		<input type="checkbox"/>	gray	line	<input type="checkbox"/>	1		off	<input type="checkbox"/>	0		off	<input type="checkbox"/>		15	-42	<input type="checkbox"/>	5
13			<input checked="" type="checkbox"/>	default	<input type="checkbox"/>	Sky/Pixel_T1	<input type="checkbox"/>		<input type="checkbox"/>	yellow	line	<input type="checkbox"/>	1		off	<input type="checkbox"/>	0		off	<input type="checkbox"/>		15	-42	<input type="checkbox"/>	5
14			<input checked="" type="checkbox"/>	default	<input type="checkbox"/>	X(FITS)_T1	<input type="checkbox"/>		<input type="checkbox"/>	pink	line	<input type="checkbox"/>	1		off	<input type="checkbox"/>	0		off	<input type="checkbox"/>		15	-42	<input type="checkbox"/>	5
15			<input checked="" type="checkbox"/>	default	<input type="checkbox"/>	Y(FITS)_T1	<input type="checkbox"/>		<input type="checkbox"/>	light blue	line	<input type="checkbox"/>	1		off	<input type="checkbox"/>	0		off	<input type="checkbox"/>		15	-42	<input type="checkbox"/>	5



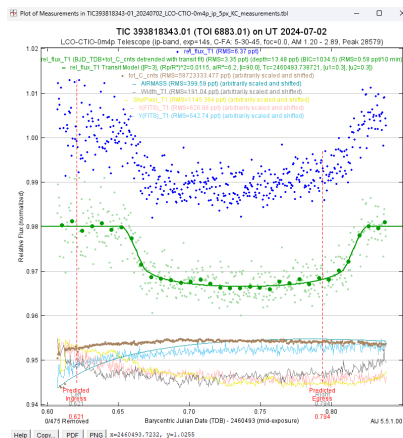
# Plot Window

- Displays plotted dataset(s)
- Is interactive with mouse and data table
- Zoom and pan with mouse



# Lightcurve Fitting Panel

- Set up initial fitting parameters
- View fitted values
- Manually select detrending
- Auto remove bad data points (“clean”)
- Auto optimize comparison stars
- Auto optimize detrending



File Auto Priors

rel\_flux\_T1

User Specified Parameters (not fitted)

Orbital Parameters

Period (days)  Cr ☒ Ecc   $\omega$  (deg)

Host Star Parameters (enter one)

Sp.T.  Teff (K)  J-K   $R^*$  ( $R_{sun}$ )   $M^*$  ( $M_{sun}$ )   $\rho^*$  (cgs)

Transit Parameters

☒ Enable Transit Fit

☒ Auto Update Priors

Extract Prior Center Values From Light Curve, Orbit, and Fit Markers

Parameter	Best Fit	Lock	Prior Center	Use	Prior Width	Cust	StepSize	
Baseline Flux (Raw)	0.177981439	<input type="checkbox"/>	0.177516248	<input type="checkbox"/>	0.03550325	<input type="checkbox"/>	0.1	
$(R_p / R_*)^2$	0.011466227	<input type="checkbox"/>	0.010690118	<input type="checkbox"/>	0.005345059	<input type="checkbox"/>	0.010690118	
$a / R_*$	6.152852370	<input type="checkbox"/>	6.127483167	<input type="checkbox"/>	0.8	<input type="checkbox"/>	1.0	
$T_c$	2460493.738720952	<input type="checkbox"/>	2460493.70715	<input type="checkbox"/>	0.015	<input type="checkbox"/>	0.04	
Inclination (deg)	90.00000000	<input checked="" type="checkbox"/>	90.0	<input type="checkbox"/>	15.0	<input type="checkbox"/>	30.0	
Linear LD u1	0.300000000	<input checked="" type="checkbox"/>	0.3	<input type="checkbox"/>	1.0	<input type="checkbox"/>	0.1	
Quad LD u2	0.300000000	<input checked="" type="checkbox"/>	0.3	<input type="checkbox"/>	0.2	<input type="checkbox"/>	0.1	
Calculated from model	13.48	<input type="checkbox"/>	0.000	<input type="checkbox"/>	0.000	<input type="checkbox"/>	0.000	
Depth (ppt)	b	<input type="checkbox"/>	t14 (d)	t14 (hrs)	t23 (d)	tau (d)	$\rho^*$ (cgs)	Rp (Rjup)
		<input type="checkbox"/>	0.172761	04:08:47	0.139073	0.016844	0.4892	1.05

Detrend Parameters

Use	Parameter	Best Fit	Lock	Prior Center	Use	Prior Width	Cust	StepSize
<input type="checkbox"/>	AIRMASS		<input type="checkbox"/>	0.0	<input type="checkbox"/>	1.0	<input type="checkbox"/>	0.1
<input checked="" type="checkbox"/>	BJD_TDB	0.003308716042	<input type="checkbox"/>	0.0	<input type="checkbox"/>	1.0	<input type="checkbox"/>	0.1
<input type="checkbox"/>	Width_T1		<input type="checkbox"/>	0.0	<input type="checkbox"/>	1.0	<input type="checkbox"/>	0.1
<input type="checkbox"/>	Sky/Pixel_T1		<input type="checkbox"/>	0.0	<input type="checkbox"/>	1.0	<input type="checkbox"/>	0.1
<input checked="" type="checkbox"/>	tot_cnts	-0.000000002762	<input type="checkbox"/>	0.0	<input type="checkbox"/>	1.0	<input type="checkbox"/>	0.1
<input type="checkbox"/>	Y(FITS)_T1		<input type="checkbox"/>	0.0	<input type="checkbox"/>	1.0	<input type="checkbox"/>	0.1
<input type="checkbox"/>	X(FITS)_T1		<input type="checkbox"/>	0.0	<input type="checkbox"/>	1.0	<input type="checkbox"/>	0.1
<input type="checkbox"/>			<input type="checkbox"/>	0.0	<input type="checkbox"/>	1.0	<input type="checkbox"/>	0.1
<input type="checkbox"/>			<input type="checkbox"/>	0.0	<input type="checkbox"/>	1.0	<input type="checkbox"/>	0.1
<input type="checkbox"/>			<input type="checkbox"/>	0.0	<input type="checkbox"/>	1.0	<input type="checkbox"/>	0.1
<input type="checkbox"/>			<input type="checkbox"/>	0.0	<input type="checkbox"/>	1.0	<input type="checkbox"/>	0.1

Fit Statistics

RMS (ppt)   $\chi^2/\text{dof}$   BIC  dof   $\chi^2$

Fit Optimization

Outlier Removal:  Clean

Comparison Star Selection: Quick  Start  Iter. Remaining:

Detrend Parameter Selection: Max Pars:  Exhaustive  BIC Thres:  Iter. Remaining:

Plot Settings

☒ Show Model ☒ Show in legend ☐ Show Residuals ☐ Show Error

Line Color:  Line Width:  ☐ Log Optimization

Symbol:  Symbol Color:  Shift:

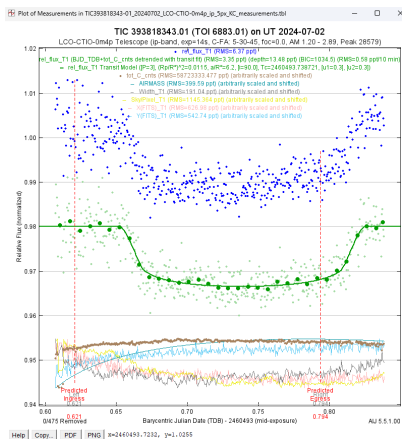
Fit Control

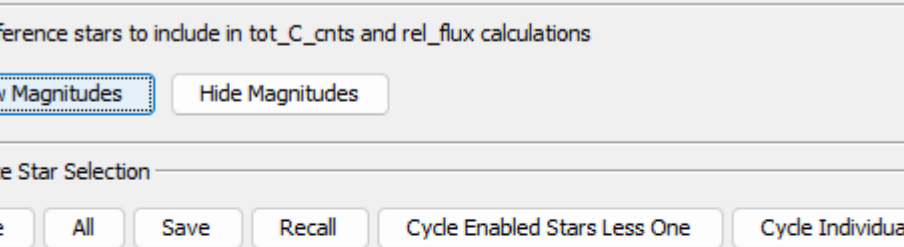
Fit Update Options: ☒ Auto Update Fit

Fit Tolerance:  Max Allowed Steps:  Steps Taken:

# Reference Star Panel

- Interactively change comparison stars
- Add comp star magnitude data (optional)





Multi-plot Reference Star Settings

Select reference stars to include in tot\_C\_cnts and rel\_flux calculations

Show Magnitudes Hide Magnitudes

Reference Star Selection

None All Save Recall Cycle Enabled Stars Less One Cycle Individual Stars

T1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

Green checkbox border - aperture peak count under linearity limit  
 Yellow checkbox border - aperture peak count over linearity limit  
 Red checkbox border - aperture peak count over saturation limit

Save/Show Current Configuration

Save Table Save Apertures Send to Multi-aperture Show Apertures

# Add Astronomical Data Panel

- Add calculated data to measurements table
- Examples are BJD\_TDB, airmass, etc.
- Optionally runs automatically at end of each Multi-Aperture run

The screenshot shows a software dialog box titled "Add astronomical data to table". It contains several configuration options for adding astronomical data to a table.

**Input Time Format:** Three radio buttons are present: ☒ JD (UTC), ☐ HJD (UTC), and ☐ BJD (TDB).

**Date/Time Column From Active Table:** A dropdown menu is set to "JD.UTC".

**RA/Dec Source (J2000):** Two radio buttons are present: ☐ Manual and ☒ Table.

**RA Column (hrs):** A dropdown menu is set to "RA\_T1".

**DEC Column (deg):** A dropdown menu is set to "DEC\_T1".

**Select data to add:** A list of checkboxes on the left side. ☒ Airmass is selected. Other options include Altitude, Azimuth, Hour Angle, Zenith Distance, JD.UTC, HJD.UTC, HJD Correction, BJD.TDB (selected), BJD Correction, RA Now, Declination Now, RA J2000, and Declination J2000.

**Enter table column name to add:** A list of text boxes on the right side, each containing a column name: AIRMASS2, ALTITUDE, AZIMUTH, HOUR\_ANGLE, ZENITH\_DIST, JD.UTC\_MOBS, HJD.UTC\_MOBS, HJD\_CORR, BJD.TDB, BJD\_CORR, RA\_EOD, DEC\_EOD, RA\_J2000, and DEC\_J2000.

**Setup target and/or observatory parameters:** A note at the bottom states: "Setup target and/or observatory parameters in 'MP Coordinate Converter' window, then press the 'Update Table' button."

**Buttons:** At the bottom right, there are three buttons: "Auto" (with a checked checkbox), "Update Table", and "Close".

# Coordinate Converter Panel

- Convert between time formats
- Convert between coordinate formats
- Calculates observability parameters
- Includes leap second calculations
- Manual control or automatic control from:
  - Data Processor
  - Add Data panel

Coordinate Converter

File Preferences Network Help

**Current UTC-based Time**

UTC: 2025-09-05 11:07:57 Local: 2025-09-05 07:07:57 JD: 2460923.963858 LST: 05:23:57

**SIMBAD Object ID (or SS Object)**

Time Zone: UTC offset: -4

**Observatory ID**

LCO CTIO (IsC)

**Target Proper Motion (mas/yr)**

pmRA: 0 pmDec: 0

**Geographic Location of Observatory**

Lon: -70.815000 Lat: -30.165000 Alt: 2215

**Standard Coordinates**

J2000 Equatorial

SIMBAD RA: 15.245316 Dec: -72.684825

J2000 Ecliptic

Lon: 251.426781 Lat: -51.905055

B1950 Equatorial

Sky-Map RA: 15.158580 Dec: -72.498568

Galactic

Lon: 313.219085 Lat: -12.740492

**Epoch of Interest**

UTC-based Time

Now UTC: 2020-01-10 08:21:24 UT 19:49 JD: 2458858.848194 LST: 10:55:28

Lock Local: 2020-01-10 03:21:24 03:52 HJD: 2458858.845428 dT: -00:03:59

**Dynamical Time**

Update Auto Leap-secs: 37.0 OSU/internal BJD: 2458858.846208 dT: -00:02:52

**Equatorial**

RA: 15.279270 Dec: -72.752073

**Ecliptic**

Lon: 251.694040 Lat: -51.904368

**Horizontal**

Alt: 35.961394 Az: 160.562732

**Direction - Hour Angle - Zenith Distance - Airmass**

Dir: S HA: -4.354841 ZD: 54.038606 AM: 1.6989

**Phase - Altitude - Proximity**

Moon 11.25 122.83

Mercury Down 59.05

Venus Down 78.94

Mars 19.53 52.50

Jupiter Down 56.77

Saturn Down 62.25

Uranus Down 118.28

Neptune Down 92.14

Pluto Down 61.50