

Exoplanet Observing Using AstrolmageJ

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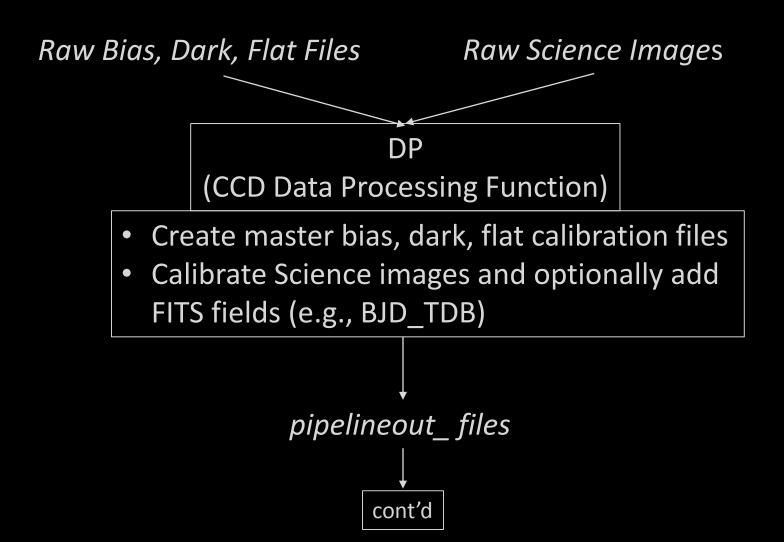
AstrolmageJ (AIJ)

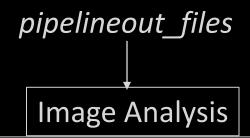
- All-in-one freeware developed and maintained by Dr. Karen Collins
- Can be used for image calibration, differential photometry, exoplanet transit modeling
- Latest version can be found at: http://www.astro.louisville.edu/software/astroimagej/
- A step-by-step guide to using AIJ for exoplanet observing can be found in "A Practical Guide to Exoplanet Observing" at: http://astrodennis.com

Worksheet

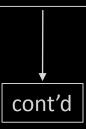
			WASP-12b	
		Observer:	Dennis Conti	
<u>tem</u>	Host Star/Exoplanet Information:	(click here)		
1	RA:	06:30:32.79		
2	Dec:	29:40:20.4		
3	Period (days):	1.0914		
4	R+:	1.63		
5	T _{eff} :	6300		
6	V mag:	11.7		
	Suggested range of comp stars:	11.26 to 12.45 mag		
7	Link to Reference Paper (optional):	https://arxiv.org/abs	<u>/1512.00464</u>	
8	Date of Observation (UT):	01/5-6/2016		
			BJD_TDB	
9	Predicted Ingress:		2457393.53948	
10	Predicted Egress:		2457393.66431	
-	Predicted midpoint:		2457393.60190	
11	Model fit midpoint (T _c) in BJD_TDB:		2457393.60123	
		proximate difference:		minutes
	Арі	proximate uniterence.	1.0	minutes
	Observing Location:			
12	Latitude:		38:55:48.51 N	
13				
	Longitude:		76:29:17.78 W	
14	Altitude (m):		0	
15	Aperture (mm):		280	
16	Focal length (mm):		3010	
17	Make/model of CCD Camera:		SX694M	
18	Gain (e-/ADU):		0.3	
19	Readout noise (e-):		5.0	
20	Dark current (e-/pixel/sec):		0.003	
21	Point of where CCD goes non-linear (ADU	s):	45,000	
		<u>x</u>	<u>Y</u>	
22	No. of pixels (unbinned):	2750	2200	
23	Pixel size (microns -unbinned):	4.54	4.54	
24	Binning used for this observation:	2	2	
25	Exposure time (secs):	45		
26	Filter used:	V		
	Limb darkening coefficients:	(click here)		
27	Quadratic LD u1:	0.39056081		
28	Quadratic LD u2:	0.3026992		
	Image scale (arcsec/pixel):	0.3020332	0.62	
	FOV (arcmin):	14.26		
29		2.68		
29	FWHM (arcseconds):			
	FWHM (pixels):	4		
	Initial Settings:			
30	FWHM pixel multiplier:	3		
	Aperture radius:	13		
31	Inner annulus radius:	14		
	Outer annulus radius:	29		
	Final Settings:			
32	Aperture radius:	13		
33	Inner annulus radius:	14		
34	Outer annulus radius:	29		
		# of Science Images:		
35	Original #:	336	Final #:	336
36	Images not used:			

AIJ Pipeline





- Determine FWHM and initial Aperture/
 Annulus radii using Alt-Left Click on target star
- Align images if necessary using Align Stack tool
- Eliminate "bad images"
- Select appropriate comp stars



Multi-Aperture Photometry

- Aperture settings:
 - ✓ Aperture/Annulus radii
 - ✓ CCD gain, readout noise, dark current
 - ✓ Saturation and linearity warning levels
- Place apertures
- When photometry completed, save
 Measurements table

cont'd

Important AIJ Terms

- T1: refers to target star
- Ci: refers to comparison star
- Source-Sky_xx: ADU counts in the aperture for star xx <u>after</u> the sky background is taken out (e.g., Source-Sky_C2)
- tot_C_cnts: the sum of the Source-Sky counts for all the comparison stars
- rel_flux_T1: the relative flux of target star T1= Source-Sky_T1/tot_C_cnts
- rel_flux_Ci: the relative flux of comp star Ci
 Source-Sky Ci/total cnts of all <u>other</u> C stars

AIJ Plotting

- Uses a plot configuration file with an extension of .plotcfg
- A sample plot configuration file,
 Measurements_Template.plotcfg,
 can be downloaded from http://astrodennis.com

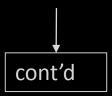
Multi-plot Main Screen

- Select BJD_TDB timebase in Default X-data
- Fill-in Title and Subtitle
- Fill-in Left and Right values for Fit and Normalize Regions (i.e., predicted ingress/egress times); copy them to
 V. Marker 1 and V. Marker 2
- Select Auto X Range and click on arrow
- If a meridian flip occurred during transit, click on Show and enter Flip Time

cont'd

Multi-plot Y Data Screen

- Plot AIRMASS vs. tot_C_cnts: will show changes in sky transparency
- Plot Source-Sky counts for target and comp stars: will show those with too much scatter
- Plot rel_flux of comp stars: will show those that might be variable; deselect those that are variable using the Multi-plot Reference Star Settings screen
- Plot rel_flux of target and its transit fit





- Enter predicted period
- Enter target star radius (R*)
- Enter predicted inclination (don't lock it)
- Enter limb darkening coefficients (u1 and u2) and lock them

cont'd

Data Set 2 Fit Screen

- If a meridian flip occurred during transit, select Meridian Flip as a detrend parameter
- Set detrend parameters (at most 3) that result in a reduction in BIC by more than 5 (start with AIRMASS)
- Sequentially deselect comp stars until a minimum RMS is obtained
- See "A Practical Guide to Exoplanet Observing" for further optimization guidelines and how to create a dataset for input to external programs