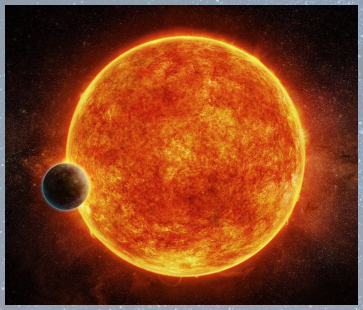
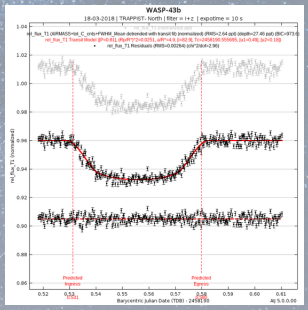
# ASTROIMAGEJ

## dedicated software to analyze astronomical observations






**Michaël Gillon:** michael.gillon@uliege.be
**Fran Pozuelos:** fjpozuelos@uliege.be
**Mathilde Timmermans:** mathilde.timmermans@uliege.be

**2021-2022**

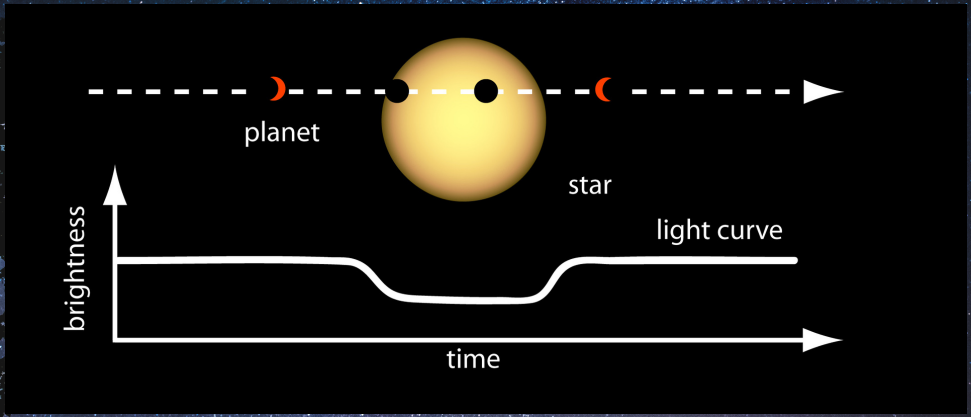
LIÈGE université
ASTROBIOLOGY

# ASTROIMAGEJ

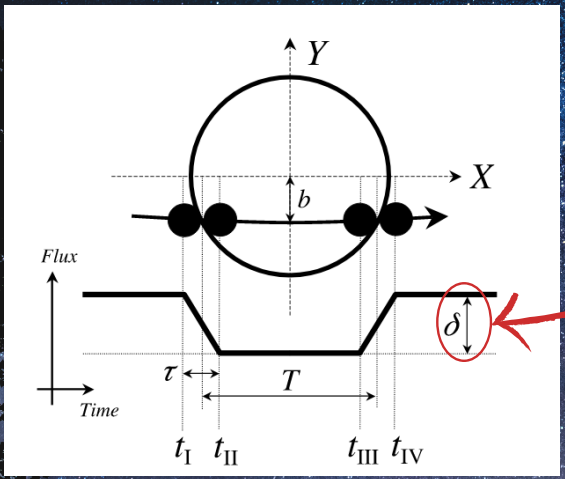
Download, Install (V5) and Read:

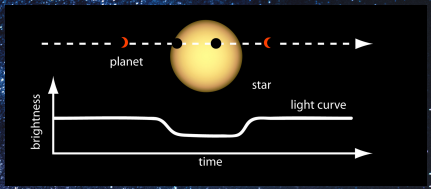
https://www.astro.louisville.edu/software/astroimagej/

# TRANSIT



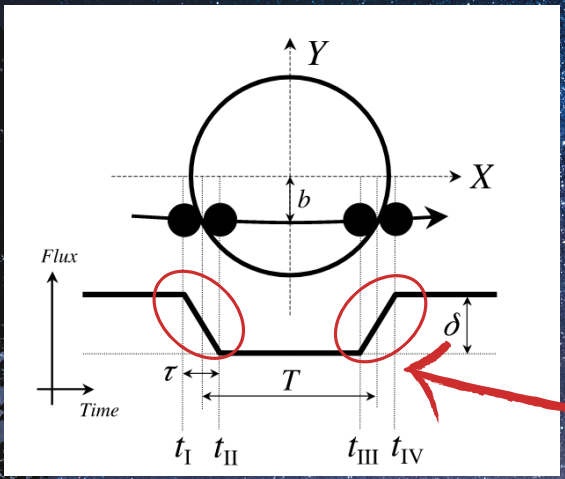
# TRANSIT

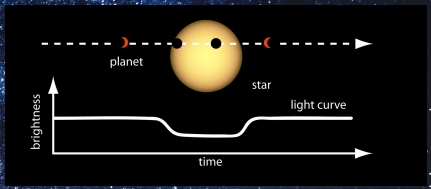



$$\text{Depth} = \left(\frac{R_p}{R_\star}\right)^2$$

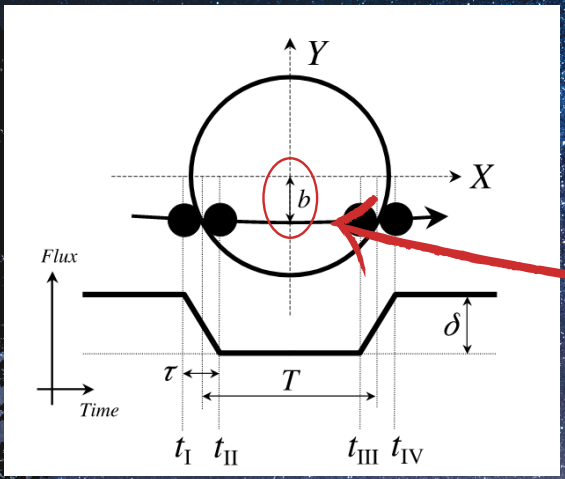
# TRANSIT

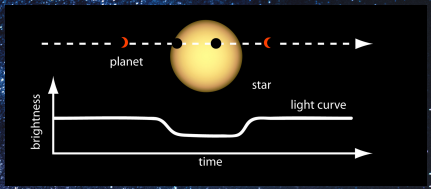



Ingress
Egress

# TRANSIT




Impact parameter

# AstroImageJ

1) What is the AIJ package?
2) What can we do with AIJ?
   - Data Reduction & Calibration
   - Differential photometry
   - Fitting model (exoplanets)
3) Practise yourself with WASP-12b !

# AstroImageJ

## 1) What is the AIJ package?

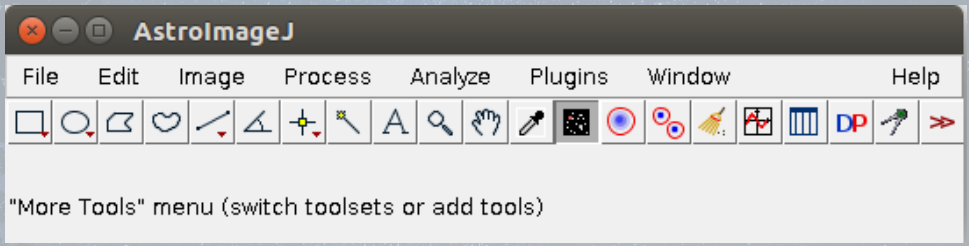
- Graphical User Interface (GUI) software
- Multi-platform (Windows, Mac, Linux) and is Java-based
- Performs time-series differential photometry: exoplanets, asteroids, var. stars
- Do you want more details? Have a look on:

https://www.astro.louisville.edu/software/astroimagej/

- This is your first contact with AIJ and is expected you practice more, and read the reference texts, papers, user guide, etc.

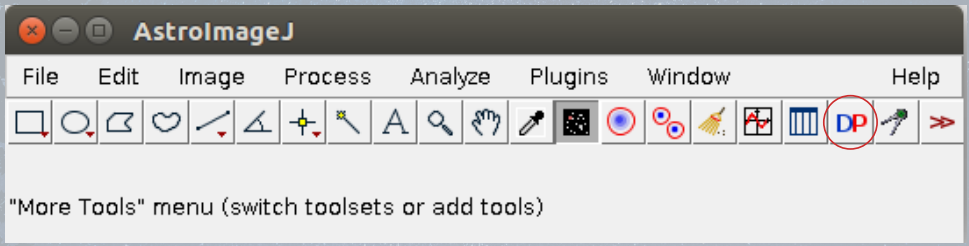
# AstroImageJ

2) What can we do with AIJ?



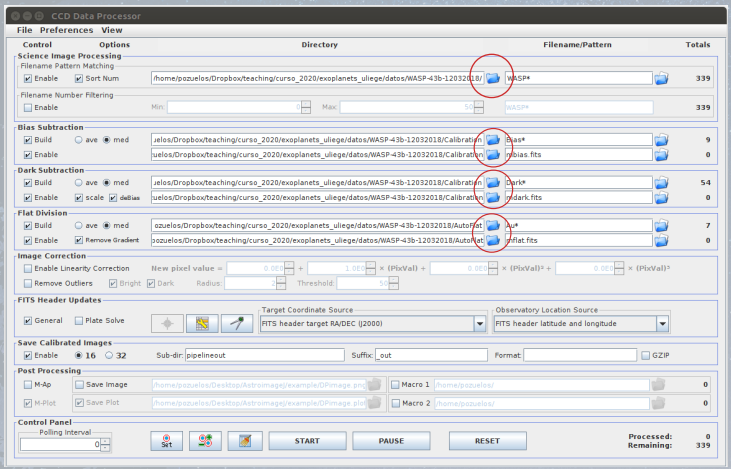
# AstroImageJ

## 2.1) Data Reduction & Calibration



# AstroImageJ

## 2.1) Data Reduction & Calibration



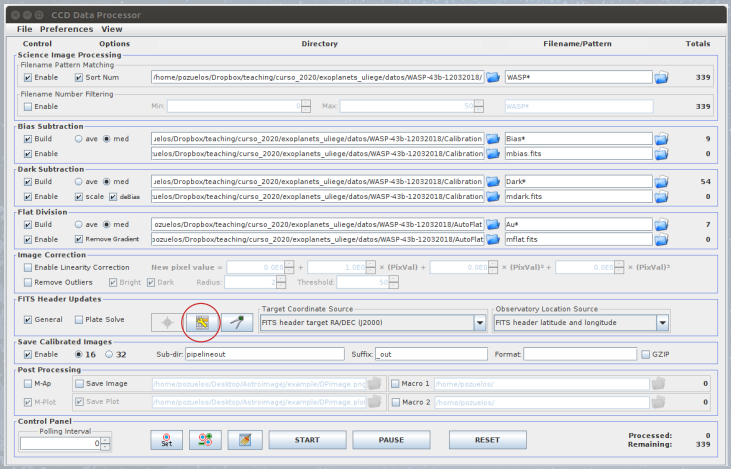

After an observation night you should have:
- Science Images
- Calibration Images (Flats,Darks and Bias)

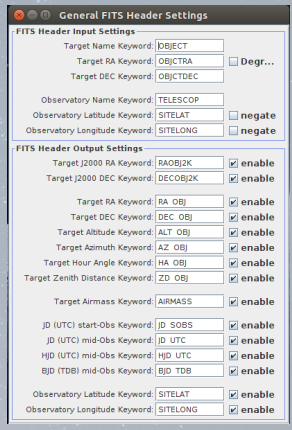
Pag. 17 to 21
Mathilde's presentation

# AstroImageJ

## 2.1) Data Reduction & Calibration

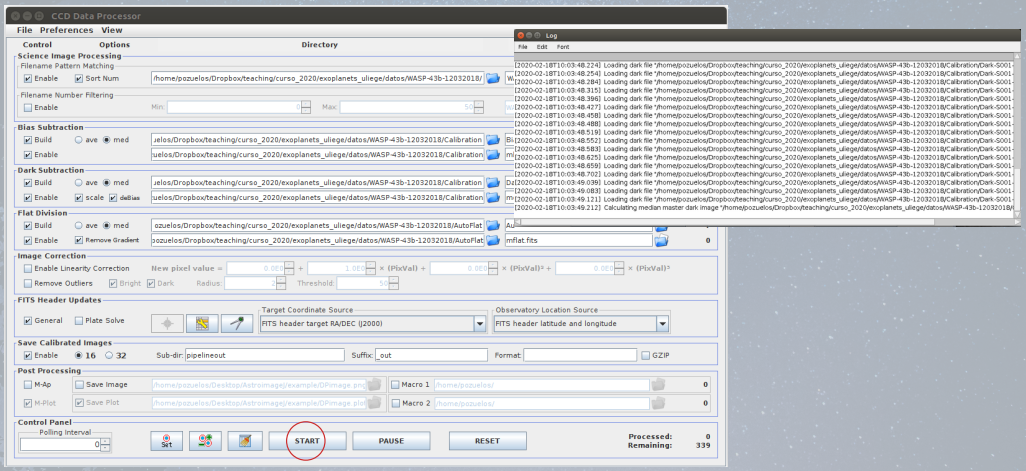
Pag. 17
Mathilde's presentation



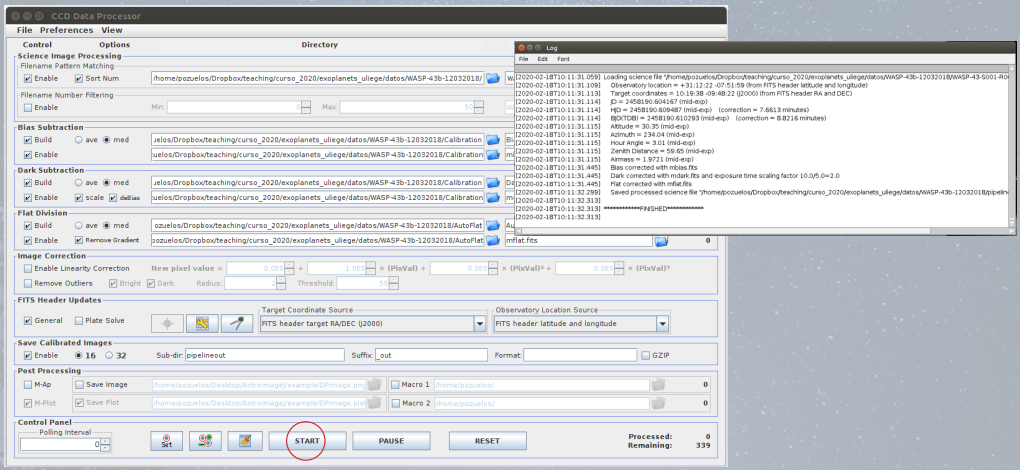
# AstroImageJ

## 2.1) Data Reduction & Calibration



# AstroImageJ

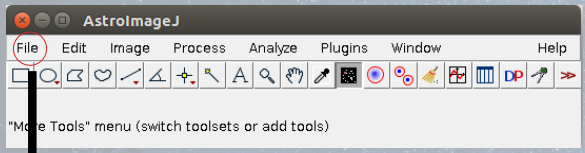
## 2.1) Data Reduction & Calibration



# AstroImageJ

## 2.2) Differential photometry

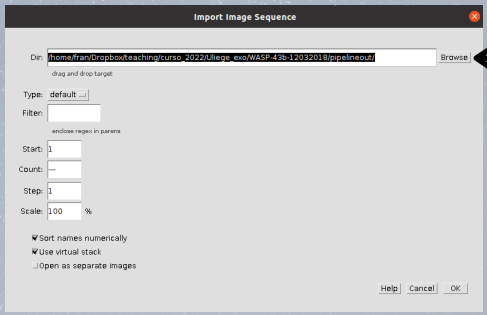
Pag. 22 to 23
Mathilde's presentation




Import

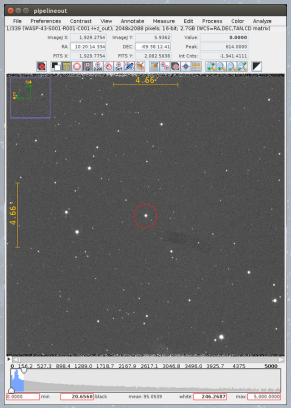
Image Sequence

**Calibrated Images!**



# AstroImageJ

## 2.2) Differential photometry (Aperture selection)

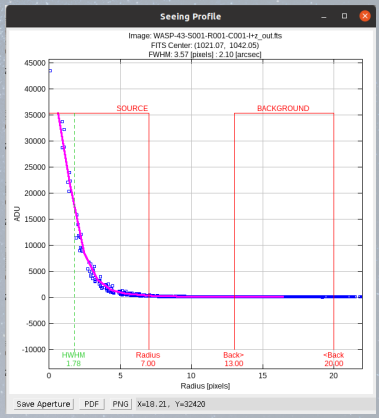


Field of View

(1) Click on T1
(2) Analyse tab
(3) Seeing profile

Optimum aperture

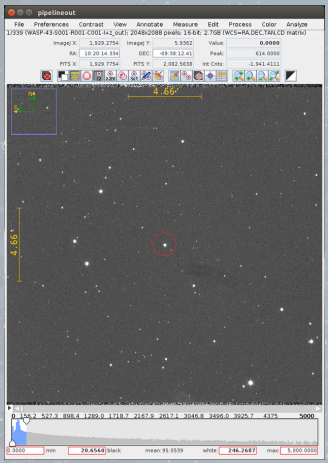
Pag. 22
Mathilde's presentation



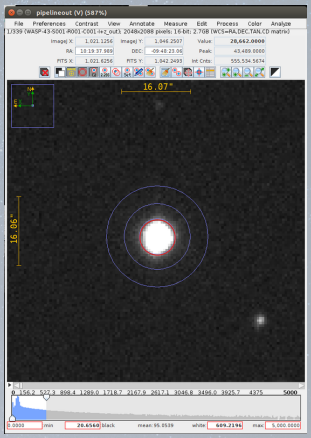

Seeing profile

# AstroImageJ

## 2.2) Differential photometry (Aperture selection)

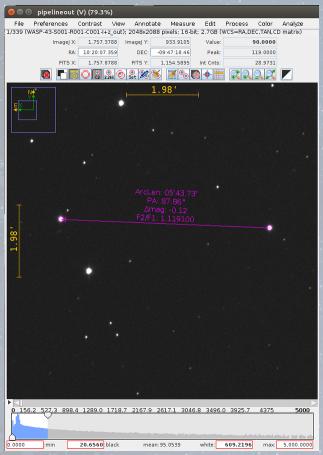



Pag. 22
Mathilde's presentation



# AstroImageJ

## 2.2) Differential photometry (comparison stars)



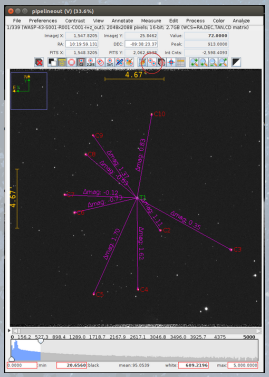

- Similar brightness (Delta Mag < |1.5|)
- As flat as possible (to be checked later)

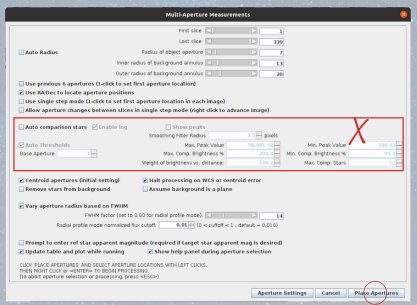
Hold click right and drop over a comparison star

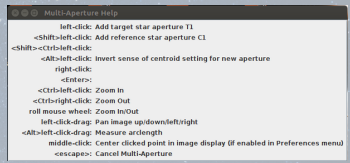
Pag. 23
Mathilde's presentation

# AstroImageJ

## 2.2) Differential photometry (comparison stars)



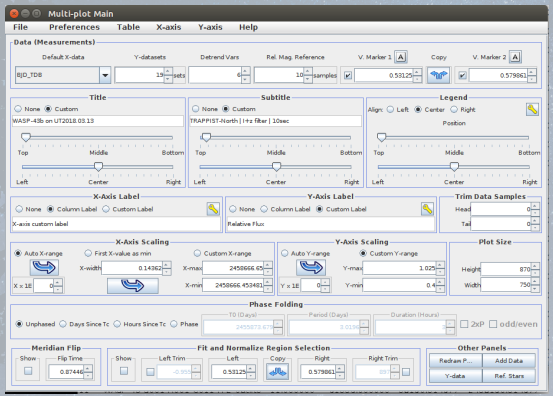


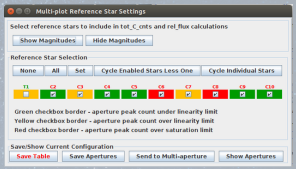



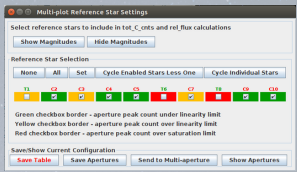

Press Enter

# AstroImageJ

## 2.2) Differential photometry (plotting results)

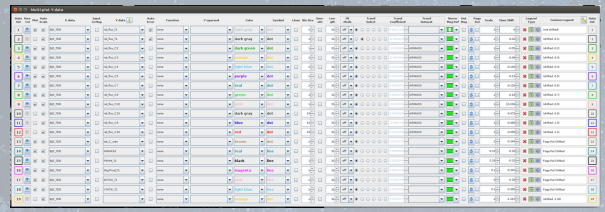


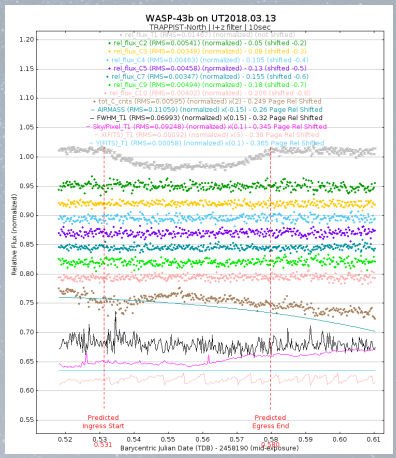
# AstroImageJ

## 2.2) Differential photometry (plotting results)



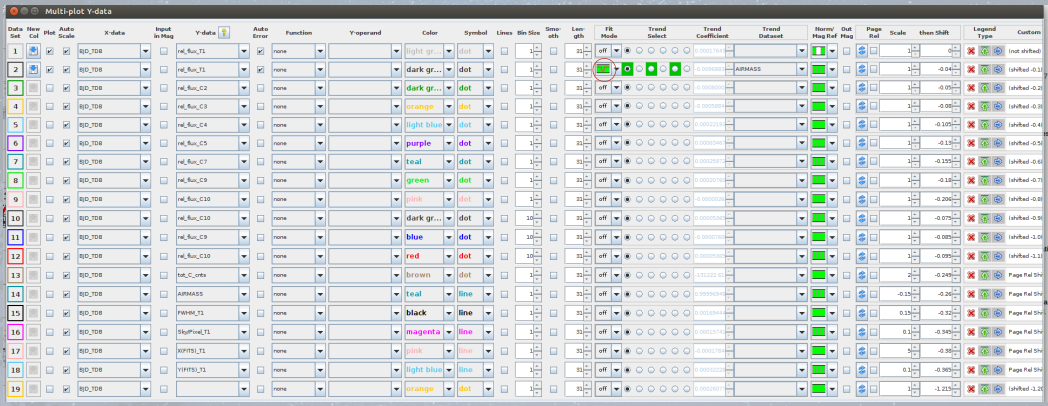
Plot:

- T1 flux
- expected ingress and egrees times
- Comparison stars fluxes
- Typical systematics (airmass, sky/pixel, FWHM, X-Y, BJD_TDB, total_C_cnts)



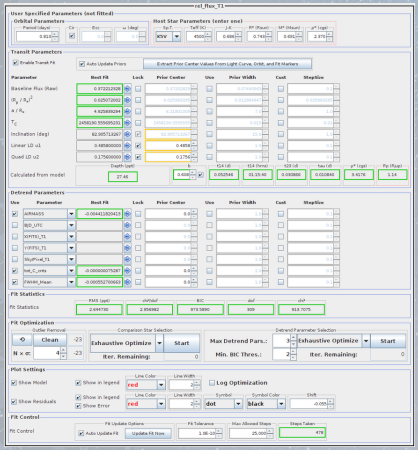
# AstroImageJ

## 2.3) Fitting model



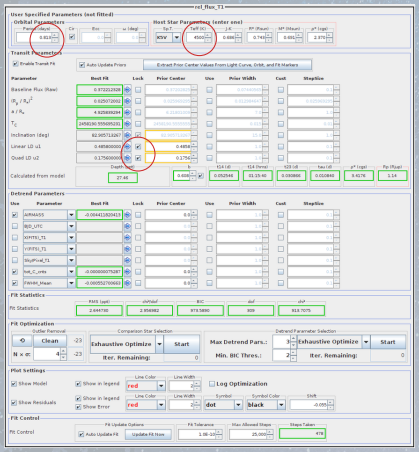
# AstroImageJ

## 2.3) Fitting model



# AstroImageJ

## 2.3) Fitting model



Use the available values of:

- Period
- Teff
- Compute the LD (Limb Darkening coefficients)

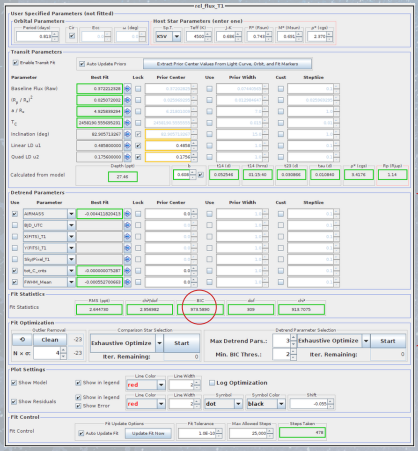
https://exoctk.stsci.edu/limb_darkening

- Temp (K)
- Metalicity [Fe/H]
- log(g)
- Filter

} ExoFOP

# AstroImageJ

## 2.3) Fitting model



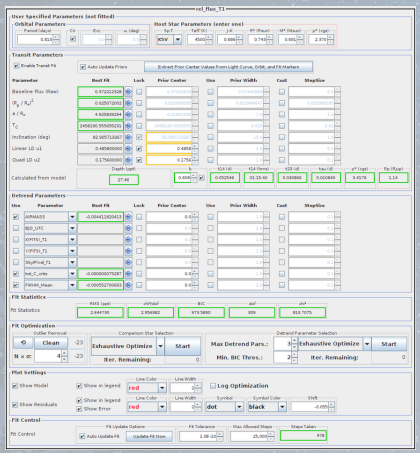
Apply some detrends to improve your model

- airmass
- sky/pixel
- FWHM
- X & Y
- BJD_TDB
- total_C_cnts

The lower the BIC the better
BIC (Bayesian Information Criterion)

# AstroImageJ

## 2.3) Fitting model

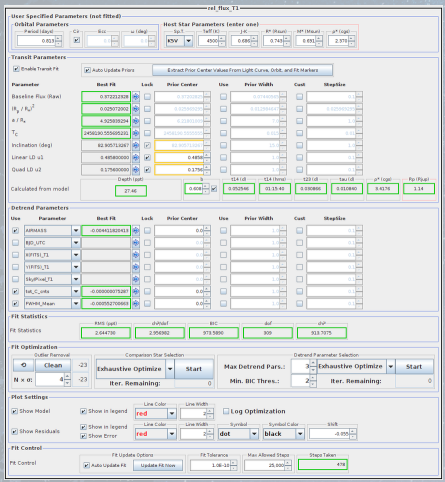


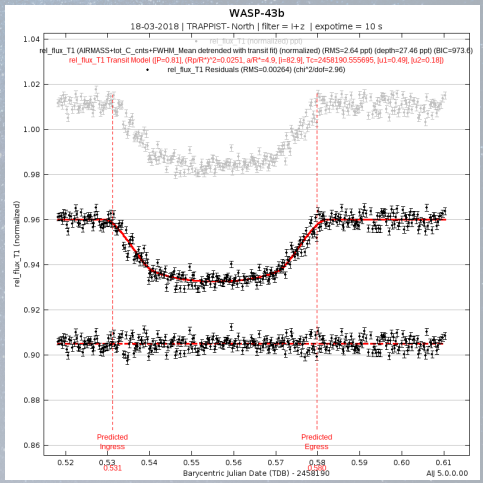
These are the results of your model:

- Depth: (Rp/R*) ^2
- The scale parameter: a/R*
- Orbital Inclination: i
- Impact parameter: b
- Full transit duration: T14
- Planetary radius: Rp
- Check carefully that the model is realistic and compare them with the expected values !!

# AstroImageJ

## 2.3) Fitting model



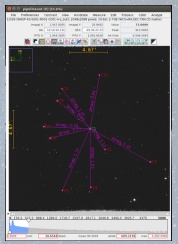



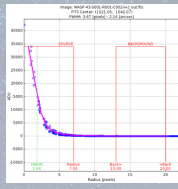
# AstroImageJ

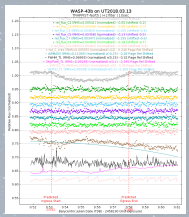
## 2.3) Fitting model

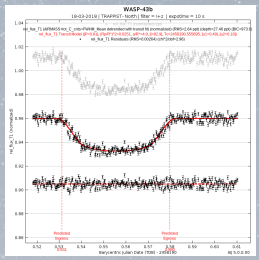
In your final report :

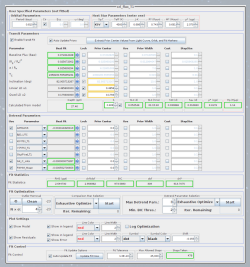
- Depth: (Rp/R*) ^2
- The scale parameter: a/R*
- Orbital Inclination: i
- Impact parameter: b
- Full transit duration: T14
- Planetary radius: Rp
- Check carefully that the model is realistic and compare them with the predictions









# Tess Object of Interest Candidates

https://docs.google.com/spreadsheets/d/1WbUW_LZcgKqk9yV3_dEtJ4radUi5o-QfFV3wag1KWP0/edit#gid=0