

HOPS

HOlomon Photometric Software

v3.3.3

USER MANUAL



Prerequisites

To be able to run HOPS on your computer you need the below requirements:

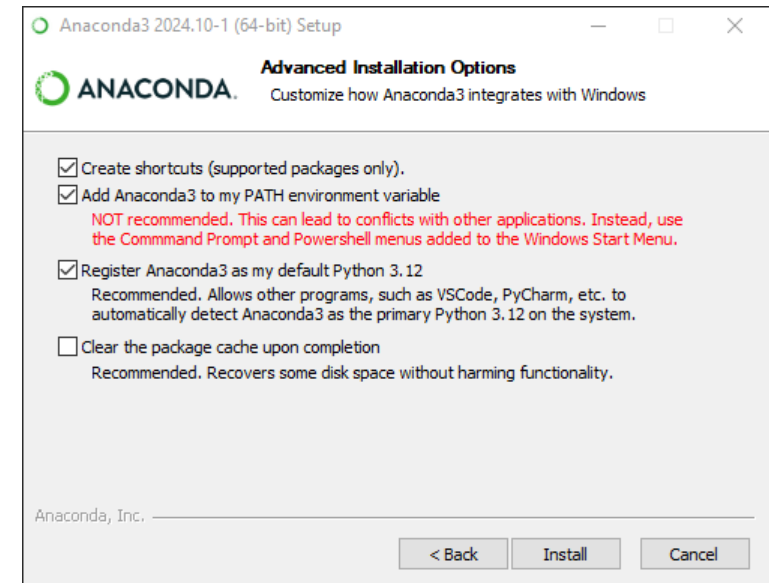
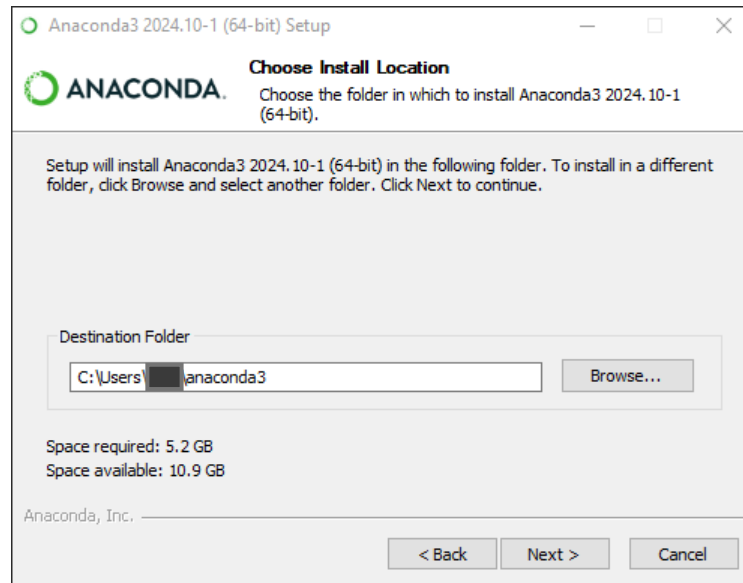
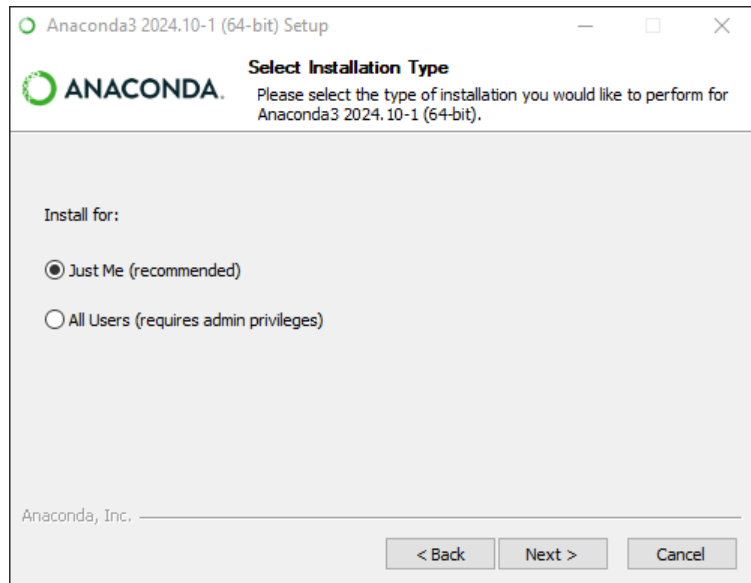
- Windows, MacOS or Linux
- 4 GB or more available RAM
- 4 GB or more free disk space
- Python version 3.7 or later (version 3.8 or later is recommended)

!!!If you have not installed in your computer Python, refer to the following slides.

If you have already installed Python, you may skip them.

Python Installation

- Download Python from www.anaconda.com/products/individual#download-section
- Choose the version you want to download depending on your operating system
- Follow the on-screen installation instructions
- **For Windows users:**
 - Install Python for you only (as recommended)
 - Use any destination you prefer (or the default)
 - Add python as a system variable



Python Installation Verification

➤ For Windows users!

- Open a Terminal (Command Prompt for Windows)
- Type **python**
- Check that the Terminal enters a python environment like this: **Python 3.8.5 (default, Sep 4 2020, 02:22:02) [Clang 10.0.0] :: Anaconda, Inc. on darwinType "help", "copyright", "credits" or "license" for more information. >>>**
- Or before this step run the commands
 - **python -version** (verifies the Python version)
 - **conda --version** (verifies the Anaconda itself)
 - **conda list** (verifies the packages installation)

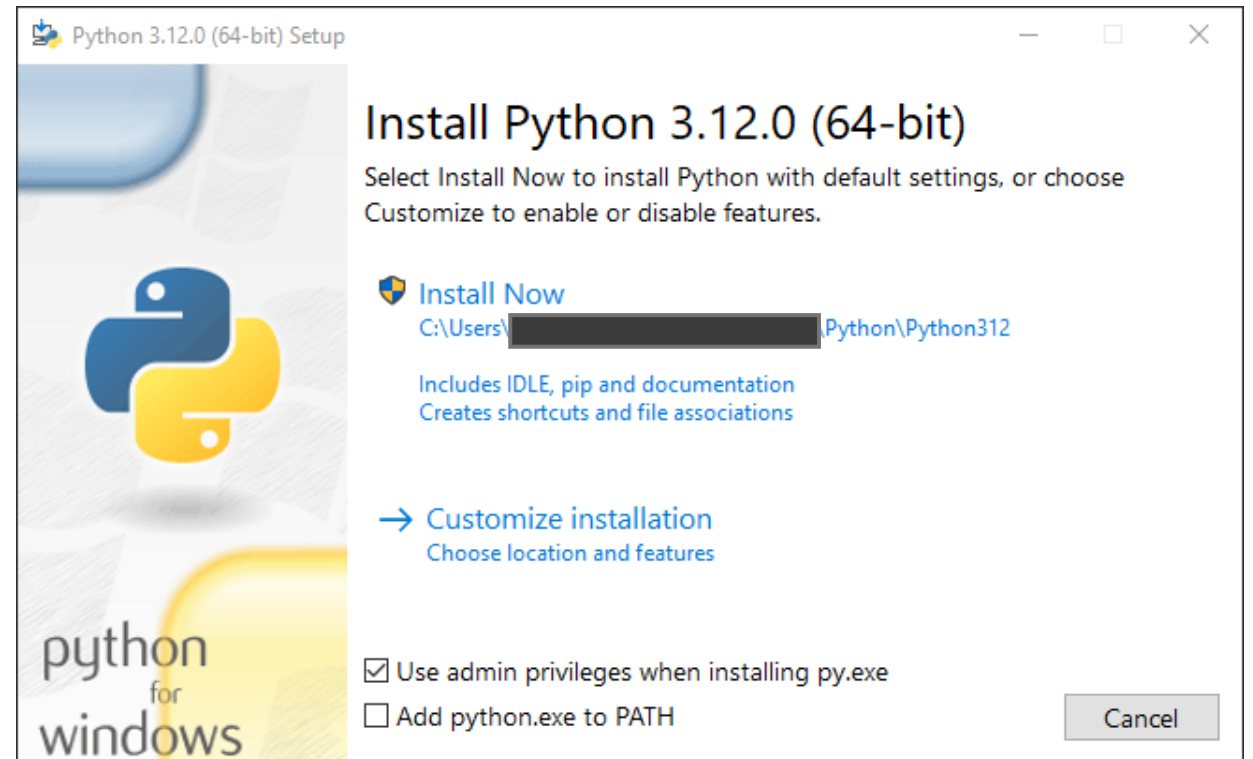
➤ If the command is not recognized:

- Close Command Prompt
- Add Python to the system variables manually (refer to this site: <https://geek-university.com/add-python-to-the-windows-path/>)
- Start the verification process again

Python Installation

- **Alternatively**, download Python from <https://www.python.org/downloads/>
- Choose the Release version you want with a maintenance status “**security**”
- Choose to download the file “Windows Installer (64-bit) if your operating system is Windows.

- You can press the “Install Now” to install Python using a predetermined path to your computer
- For customizing the path or some of its features’ press “Custom installation”



HOPS Installation

- Visit <https://www.exoworldsspies.com/en/software/>
- Click of the download button for the latest version
- Unzip the file “hops-master.zip”
- Double click on the “installer” files inside the extracted folder depending on your operating system
- A new file named “hops” will be created on your computer desktop
- Double click on it to start HOPS

➤ Known issues for **MacOS Mojave 10.14.6** users:

TkInter, the GUI backend used by HOPS, is not working properly on this MacOS version, causing a user log out. To solve this issue, you will need to either upgrade your MacOS to Catalina or downgrade your Python to 3.7.0

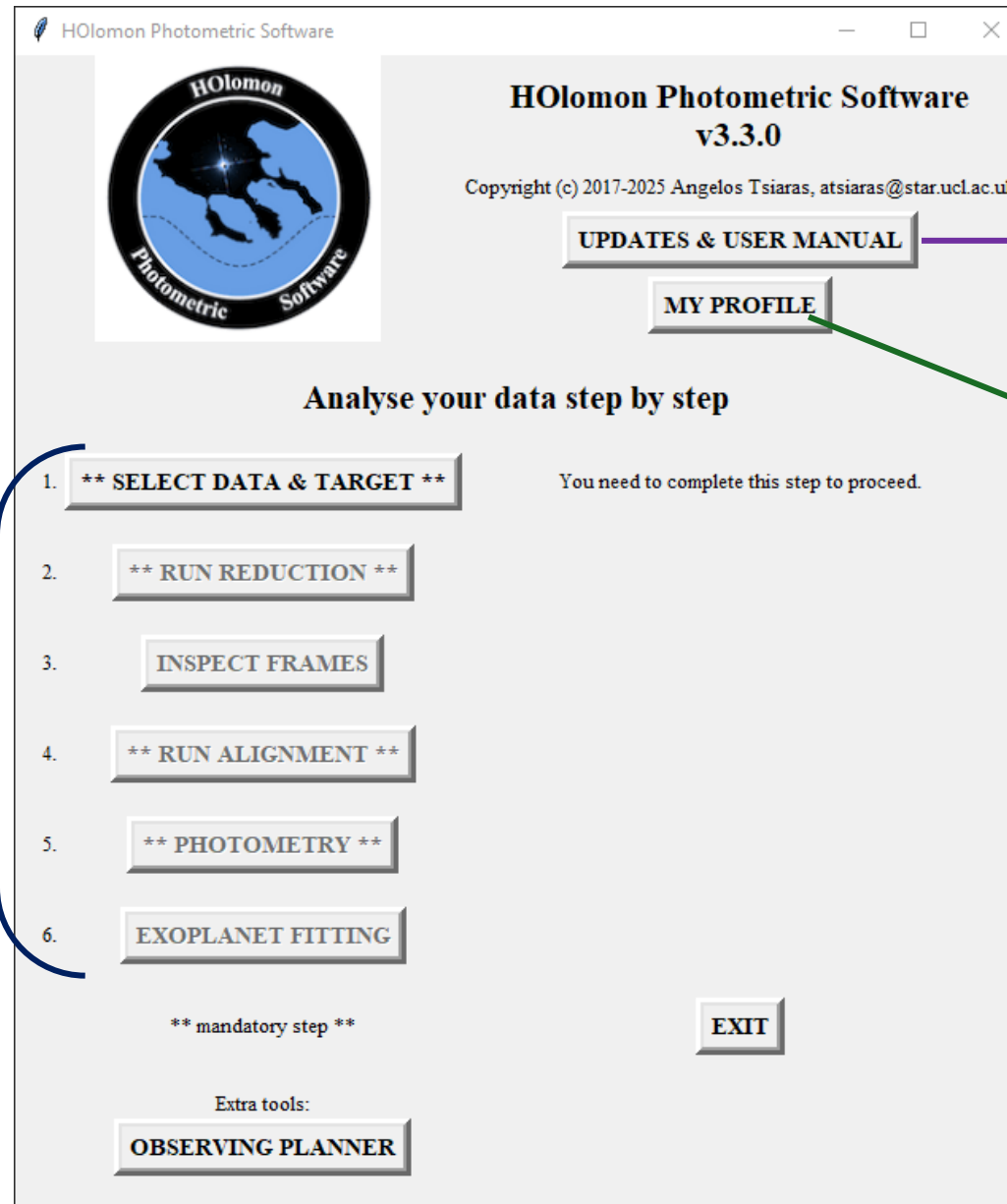
Before running HOPS

- Secure your Reduction frames!
 - Use the same **camera temperature, binning** and **subframe** as the science frames.
 - Obtain at least five bias frames (**zero exposure, using a cover**), and check that there is no external light contaminating them.
 - Obtain at least five dark frames (**same exposure time as the science frames, using a cover**), and check that there is no external light contaminating them.
 - Obtain at least five flat frames (**pointing to a uniformly illuminated surface, with the counts at 2/3 of the full well-depth of your camera**), if you are using the sky, check that stars are not visible in your frames.
 - **Do not apply any pre-processing** (for example do not create master frames) HOPS will create the master frames on the fly and use them appropriately.

Before running HOPS

- Organize your data for easy access!
 - Keep all scientific and reduction frames in one folder without subfolders.
 - Use a specific identifier for the scientific frames,
for example: “WASP-10b-001.fits”, “WASP-10b-002.fits”, etc...
 - Use a specific identifier for the bias frames,
for example: “bias-001.fits”, “bias-002.fits” etc...
 - Use a specific identifier for the dark frames,
for example: “dark-001.fits”, “dark-002.fits” etc...
 - Use a specific identifier for the flat frames,
for example: “flat-001.fits”, “flat-002.fits” etc...
- Make sure each category of frames have its own distinct, different name!
- For practice you can also use existing data: <https://www.exoworldsspies.com/en/observers/>

Running HOPS - Main control window



Easy access to the user manual

Personalize parameters for processing personal data

The 6 steps one can follow for analyzing the data.

The steps 1,2,4,5 are mandatory

Step 1: Select Data & Target

Begin by clicking on STEP 1: Select Data & Target

Directory: WASP 10b **Select/Change directory**

Name identifiers:

Observation files	Autosave	0 files found you cannot proceed
Bias files	bias	5 files - OK
Dark files	dark	5 files - OK
Dark-flat files	---	0 files - OK
Flat files	flat	5 files - OK

Show files

Header information:

Exposure time key	EXPTIME	Keyword not found you cannot proceed
Observation date key	DATE-OBS	Keyword not found you cannot proceed
Observation time key	TIME-OBS	Keyword not found you cannot proceed

Show header

Time-stamp: exposure start (dropdown) OK

Filter: No filter chosen (dropdown) Filter not valid
you cannot proceed

Select/Change location

Location: Not found Wrong coordinates
you cannot proceed

Select/Change target

Target: Coordinates not found Wrong coordinates
you cannot proceed

Name not resolved

Advanced settings

Observer's information (optional)

SAVE OPTIONS & RETURN TO MAIN MENU

SAVE OPTIONS & PROCEED

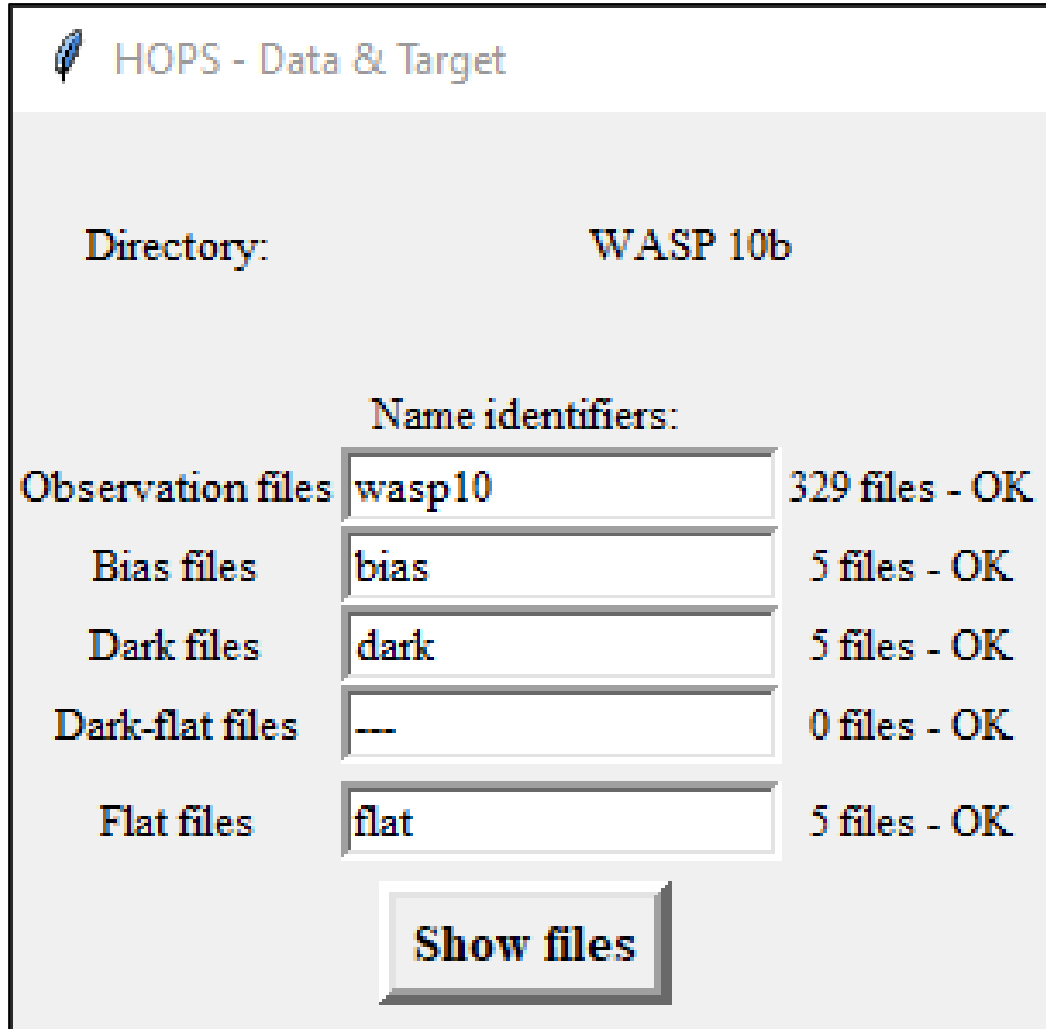
➤ **Select Directory:** select the file on your computer that contains all your frames.

As an example, WASP – 10b is used

➤ Next the “Name identifiers” and “Header information” must be checked.

Step 1: Select Data & Target

Name Identifiers



The screenshot shows a web interface titled "HOPS - Data & Target". It displays a directory path "WASP 10b" and a section for "Name identifiers". There are five rows of input fields, each with a label on the left and a count/status on the right. The labels are "Observation files", "Bias files", "Dark files", "Dark-flat files", and "Flat files". The input fields contain "wasp10", "bias", "dark", "---", and "flat" respectively. The counts/statuses are "329 files - OK", "5 files - OK", "5 files - OK", "0 files - OK", and "5 files - OK". A "Show files" button is located at the bottom of the form.

File Type	Name Identifier	Count/Status
Observation files	wasp10	329 files - OK
Bias files	bias	5 files - OK
Dark files	dark	5 files - OK
Dark-flat files	---	0 files - OK
Flat files	flat	5 files - OK

Show files

- The “Show files” button opens a second window showing all your files in your data directory.
- You cannot proceed with 0 observation files
- If you want to change the automatic name identifier, type your own name identifier.
- To show the message “OK” the name identifier for its of the files must be **the same** as in the file list.

Step 1: Select Data & Target

Name Identifiers

HOPS - Data & Target

Directory: WASP 10b

Name identifiers:

Observation files	<input type="text" value="Autosave"/>	0 files found you cannot proceed
Bias files	<input type="text" value="bias"/>	5 files - OK
Dark files	<input type="text" value="dark"/>	5 files - OK
Dark-flat files	<input type="text" value="--"/>	0 files - OK
Flat files	<input type="text" value="flat"/>	5 files - OK

Click on

```
Files list
List of files in your directory:
bias-001.fit
bias-002.fit
bias-003.fit
bias-004.fit
bias-005.fit
dark-001.fit
dark-002.fit
dark-003.fit
dark-004.fit
dark-005.fit
flat-001.fit
flat-002.fit
flat-003.fit
flat-004.fit
flat-005.fit
wasp10-001.fit
wasp10-002.fit
wasp10-003.fit
wasp10-004.fit
wasp10-005.fit
wasp10-006.fit
wasp10-007.fit
wasp10-008.fit
wasp10-009.fit
wasp10-010.fit
wasp10-011.fit
wasp10-012.fit
wasp10-013.fit
wasp10-014.fit
```

Change manually the name

HOPS - Data & Target

Directory: WASP 10b

Name identifiers:

Observation files	<input type="text" value="wasp10"/>	329 files - OK
Bias files	<input type="text" value="bias"/>	5 files - OK
Dark files	<input type="text" value="dark"/>	5 files - OK
Dark-flat files	<input type="text" value="--"/>	0 files - OK
Flat files	<input type="text" value="flat"/>	5 files - OK

Step 1: Select Data & Target

Tips for Reduction Frames

- It is suggested to not proceed without any reduction frames, but in some cases is unavoidable.
 - If your observatory provides fully reduced data, you can safely proceed without any bias, dark, or flat frames.
 - If your observatory provides bias-subtracted data, you can safely proceed without any bias frames.
 - If your observatory provides bias- and dark-subtracted data, you can safely proceed without any bias or dark frames.

- Do not proceed if:
 - you have raw data, dark and flat frames only. In absence of bias frames your reduced images will be distorted.
 - you have raw data and flat frames only. Flat frames not corrected for bias and dark will cause problems to your reduced frames.

Step 1: Select Data & Target

Header Information

- The “Show header” button opens a second window showing the header for your observational files.
- To proceed, the message “**OK**” must be shown everywhere.
- You can check and type the names for “*Exposure time key*”, “*Observation date key*”, “*Observation time key*” from the ‘Header keywords list’.
- Select the time-stamp of your data from the “*Time-stamp*” drop-down menu.

Usually, the time saved in the *fits* header represents the exposure start time, but this may not be the case for you. Be careful to choose the correct time stamp!
- Select the filter used for your data from the “*Filter*” drop-down menu.

Header information:		
Exposure time key	EXPTIME	OK
Observation date key	DATE-OBS	OK
Observation time key	TIME-OBS	OK
Time-stamp	exposure start	OK
Filter	Clear	OK

Show header

Step 1: Select Data & Target

Header Information

Select/Change directory

Header information:

Exposure time key Keyword **not found**
you cannot proceed

Observation date key Keyword **not found**
you cannot proceed

Observation time key Keyword **not found**
you cannot proceed

Time-stamp

Filter Filter **not valid**
you cannot proceed

Header keywords list

Keywords:	Values:
SIMPLE	True
BITPIX	16
NAXIS	2
NAXIS1	2003
NAXIS2	1335
BSCALE	1.0
BZERO	32768.0
DATE-OBS	2016-08-10
TIME-OBS	20:07:30
EXPTIME	40.0
EXPOSURE	40.0
SET-TEMP	-25.0
CCD-TEMP	0.3199999928474426
XPIXSZ	18.0
YPIXSZ	18.0
XBINNING	2
YBINNING	2
XORGSUBF	0
YORGSUBF	0
IMAGETYP	Light Frame
SITELAT	00 00 00
SITELONG	00 00 00
FOCALLEN	500.0
APTDIA	180.0
APTAREA	25446.901202201843
SWCREATE	MaxIm DL Version 5.07
SBSTDVER	SBFITSEXT Version 1.0
OBJECT	
TELESCOP	
INSTRUME	ArtemisHSC
OBSERVER	
NOTES	
FLIPSTAT	
SWOWNER	panos

Select/Change directory

Header information:

Exposure time key

Observation date key

Observation time key

Time-stamp

Filter

Step 1: Select Data & Target

Choose Target

- Click on the “Select/Change target” button to choose your target.
- There are 3 options, and you can select any of those.
 - Option 1: is available only if the RA/DEC are included in the header of your images
 - Option 2: is available only if you have an internet connection as it utilizes coordinates from the SIMBAD database. To access these coordinates, provide the name of your chosen target.
 - Option 3: is always available, but you have to provide the RA/DEC in the appropriate format (+hh:mm:ss +/- dd:mm:ss)

Step 1: Select Data & Target

Choose Target

- Click on the “Select/Change target” button to choose your target.
- There are 3 options, and you can select any of those.

HOPS - Data & Target

Directory: WASP 10b **Select/Change directory**

Name identifiers:		Header information:	
Observation files	wasp10 329 files - OK	Exposure time key	EXPTIME OK
Bias files	bias 5 files - OK	Observation date key	DATE-OBS OK
Dark files	dark 5 files - OK	Observation time key	TIME-OBS OK
Dark-flat files	--- 0 files - OK	Time-stamp	exposure start OK
Flat files	flat 5 files - OK	Filter	Clear OK

Show files **Show header**

Location: +00:00:00.0 00:00:00.0 OK **Select/Change location**

Advanced settings **Observer's information (optional)**

Target: 23:15:58.3005 +31:27:46.294 OK **Select/Change target**
WASP-10 / Host of: WASP-10b

SAVE OPTIONS & RETURN TO MAIN MENU **SAVE OPTIONS & PROCEED**

Select/Change target

How would you like to choose your target? Select one of the three options:

Use the RA/DEC found in the file's header: **Not found**

Provide the name of the target:

Provide the RA/DEC of the target (hh:mm:ss +/-dd:mm:ss):

Target RA/DEC: 23:15:58.3005 +31:27:46.294
Target Name: WASP-10 / Host of: WASP-10b

Cancel **Choose**

Step 1: Select Data & Target

Choose location

- Optional
- You can use the LAT/LONG provided in the file's header or choose differently

HOPS - Data & Target

Directory: WASP 10b_R Select/Change directory

Name identifiers:		Header information:	
Observation files	WASP 246 files - OK	Exposure time key	EXPTIME OK
Bias files	bias 10 files - OK	Observation date key	DATE-OBS OK
Dark files	dark 5 files - OK	Observation time key	DATE-OBS OK
Dark-flat files	--- 0 files - OK	Time-stamp	exposure start OK
Flat files	flat 10 files - OK	Filter	R OK

Show files Show header

Location: +40:25:33.0 23:30:10.0 OK Select/Change location

Target: 23:15:58.3005 +31:27:46.294 OK Select/Change target

WASP-107 Host of WASP-10b

Advanced settings Observer's information (optional)

SAVE OPTIONS & RETURN TO MAIN MENU SAVE OPTIONS & PROCEED

Select/Change location

How would you like to choose your location? Select one of the two options:

Use the LAT/LONG found in the file's header: +40:25:33.0 23:30:10.0

Use the LAT/LONG found in your profile: Not found

Provide the LAT/LONG of the location:
(+/-dd:mm:ss +/-dd:mm:ss)
positive LAT is NORTH
positive LONG is EAST

Cancel Choose

Step 1: Select Data & Target

Observer's information

➤ Optional

- You can enter your personal information: your name, your observatory, telescope and camera name. They are not necessary for the analysis; however, they will be printed on the image with the final results.

HOPS - Data & Target

Directory: WASP 10b

Name identifiers: 329 files - OK

Bias files: 5 files - OK

Dark files: 5 files - OK

Dark-flat files: 0 files - OK

Flat files: 5 files - OK

Header information:

Exposure time key: OK

Observation date key: OK

Observation time key: OK

Time-stamp: OK

Filter: OK

Location: +00:00:00.0 00:00:00.0 OK

Target: 23:15:58.3005 +31:27:46.294 OK

WASP-10 / Host of: WASP-10b

➤ **Now you can move on Step 2** by clicking “Save options & proceed”

➤ By clicking on “Save options & return to main menu”, you can save your progress and return later.

Observer information

Observer Name

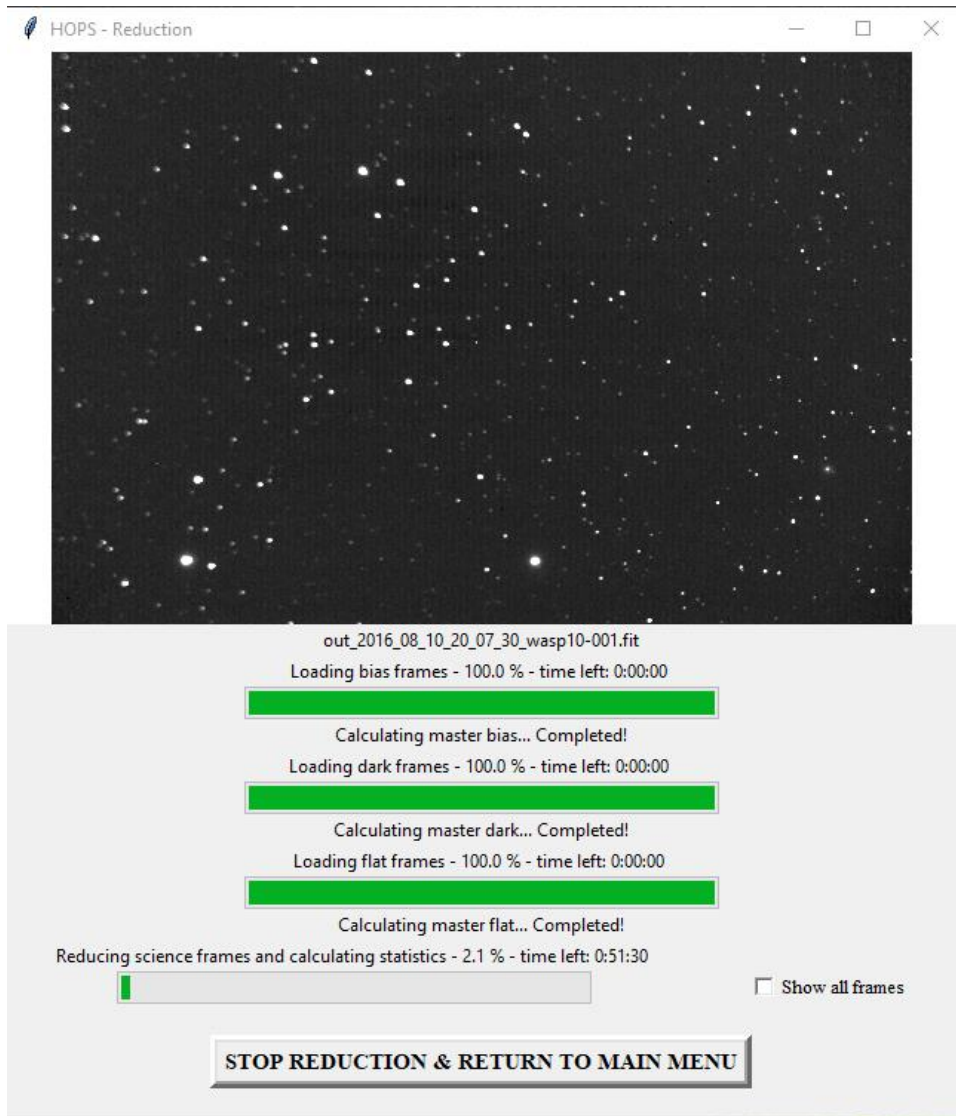
Observatory Name

Telescope Name

Camera Name

Step 2: Run Reduction

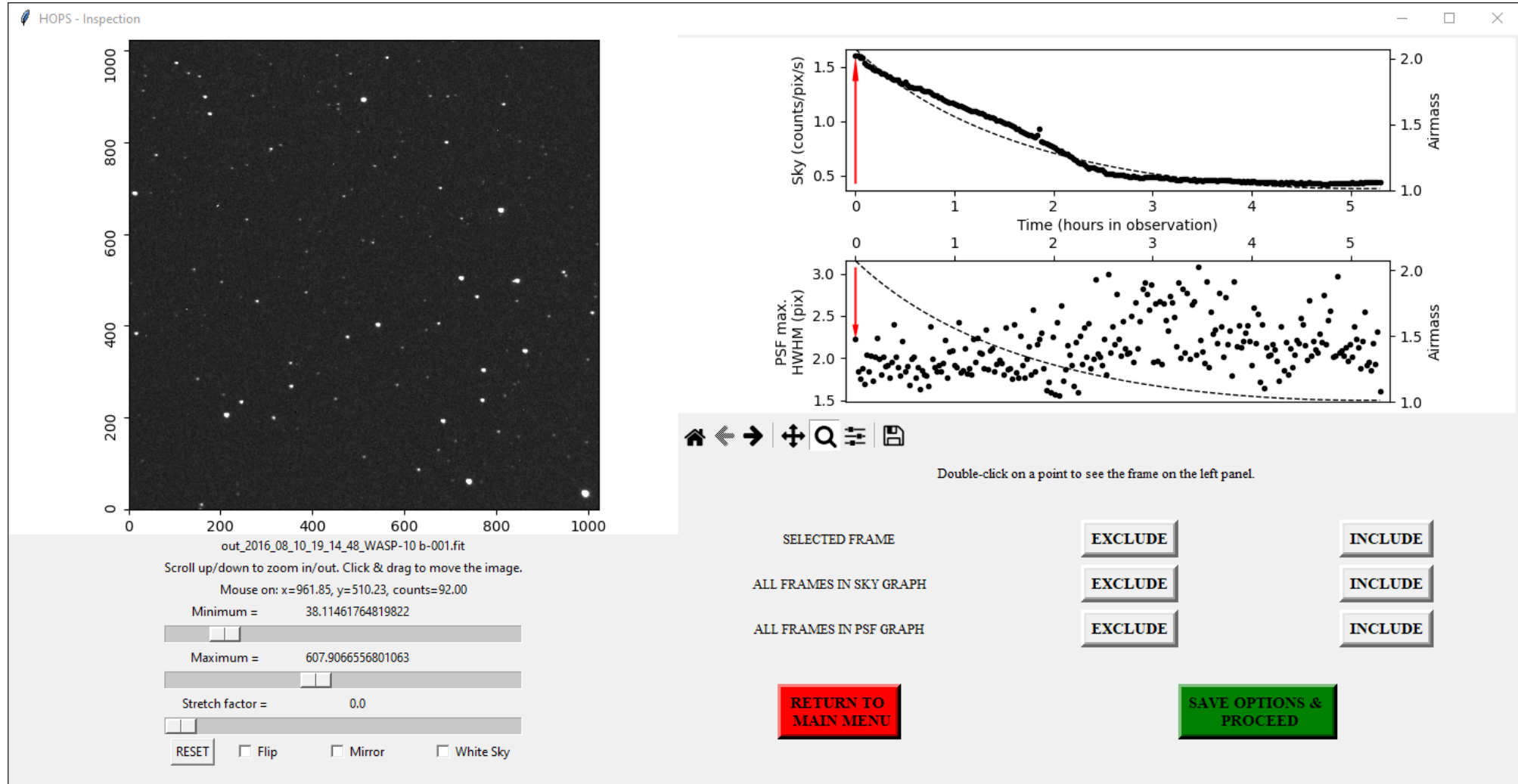
The process starts automatically after step 1



- For this step you just have to wait HOPS finish the reduction process.
 - *It might take some time!*
- Upon completion, automatically, you will advance on step 3.
- “Show all frames”, displays all the images, if you prefer to visually inspect them.
 - *However, it will slow down the process.*
- To interrupt and stop the process, press “Stop reduction & return to main menu”.

Step 3: Inspect Frames

This step is not mandatory however it operates as a filter for faulty images



HOPS - Inspection

out_2016_08_10_19_14_48_WASP-10 b-001.fit

Scroll up/down to zoom in/out. Click & drag to move the image.
Mouse on: x=961.85, y=510.23, counts=92.00

Minimum = 38.11461764819822

Maximum = 607.9066556801063

Stretch factor = 0.0

RESET Flip Mirror White Sky

Sky (counts/pix/s)

Time (hours in observation)

Airmass

PSF max. HWHM (pix)

Time (hours in observation)

Airmass

Double-click on a point to see the frame on the left panel.

SELECTED FRAME EXCLUDE INCLUDE

ALL FRAMES IN SKY GRAPH EXCLUDE INCLUDE

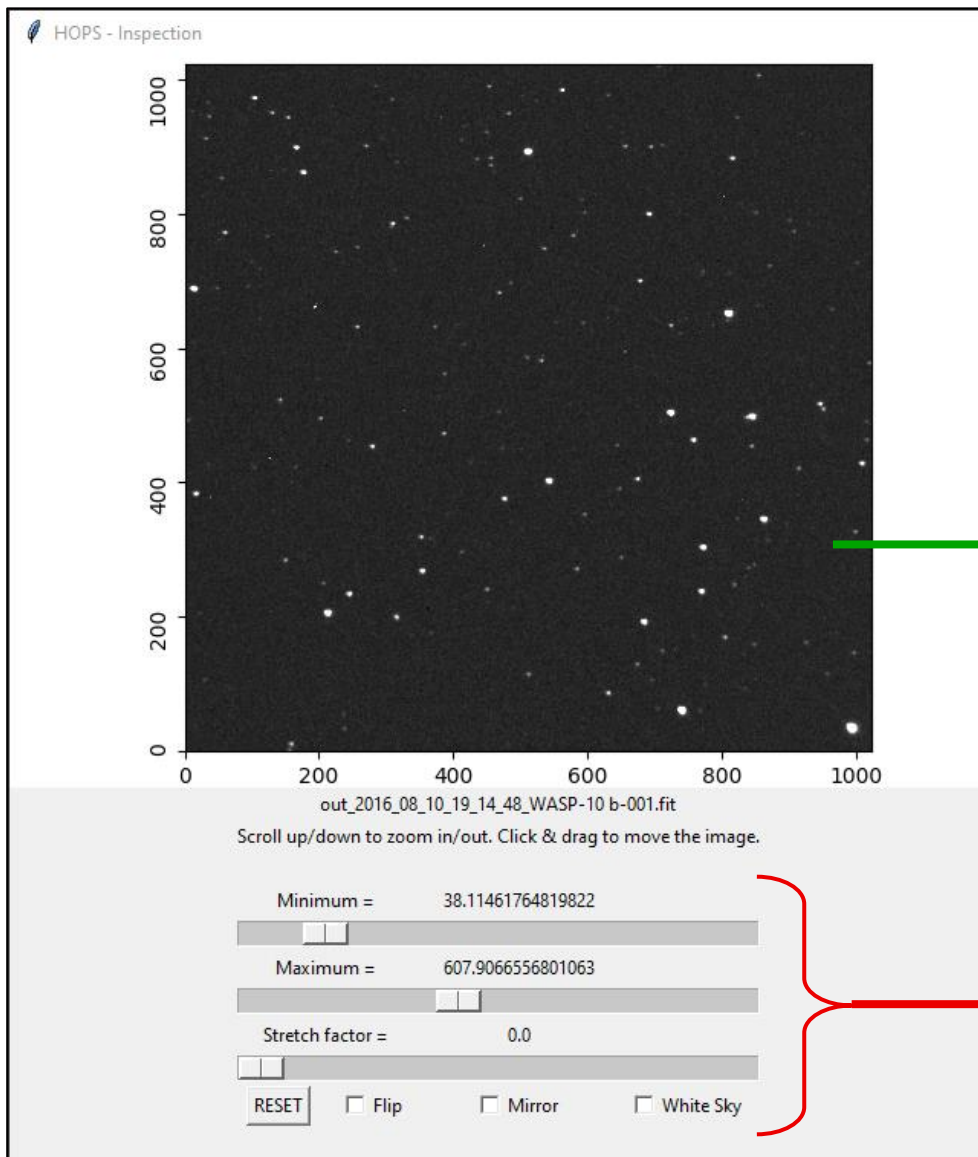
ALL FRAMES IN PSF GRAPH EXCLUDE INCLUDE

RETURN TO MAIN MENU

SAVE OPTIONS & PROCEED

Step 3: Inspect Frames

A filter for faulty images



➤ Why filter out faulty images?

Purpose of this inspection is to help you identify frames that have been affected by:

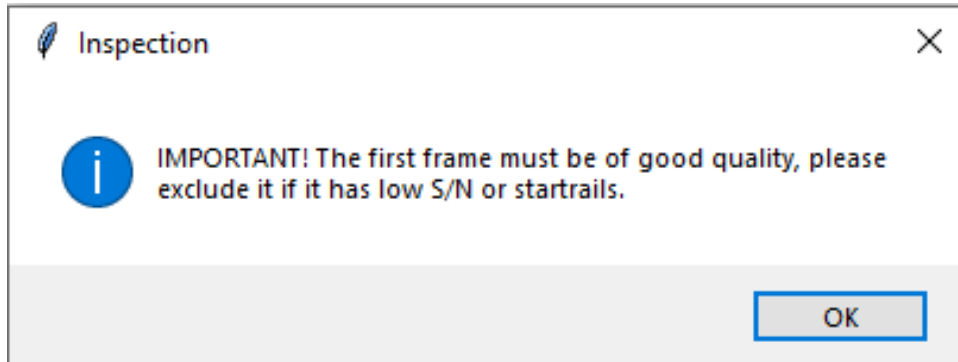
- Clouds or twilight (high SKY values)
- Pointing issues (high PSF values)

Visualization of an image. To pick an image double click on any point in the SKY or PSF graph. The selected image is shown with a red arrow.

You can adjust the contrast, zoom, move, flip, mirror, use a negative filter or reset your image

Step 3: Inspect Frames

A filter for faulty images

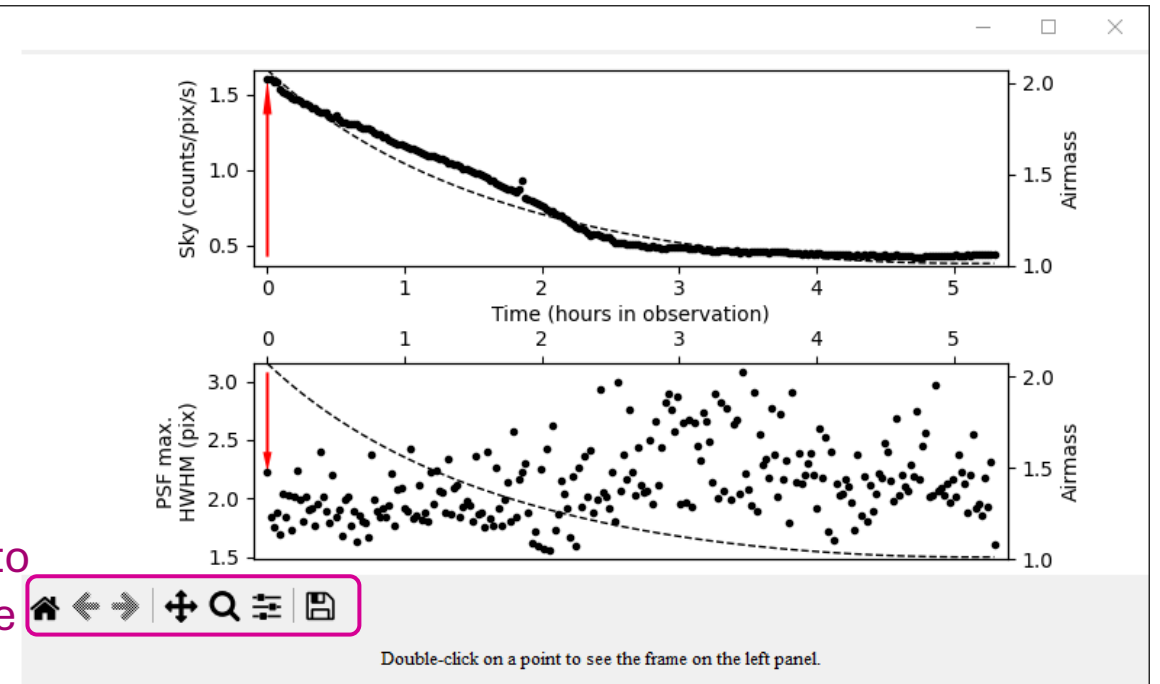


- The next steps heavily relies on the first image. For this reason, the first image must be checked for overexposing and for the tracking be representative of your observation in total.

➤ How to filter out faulty images?

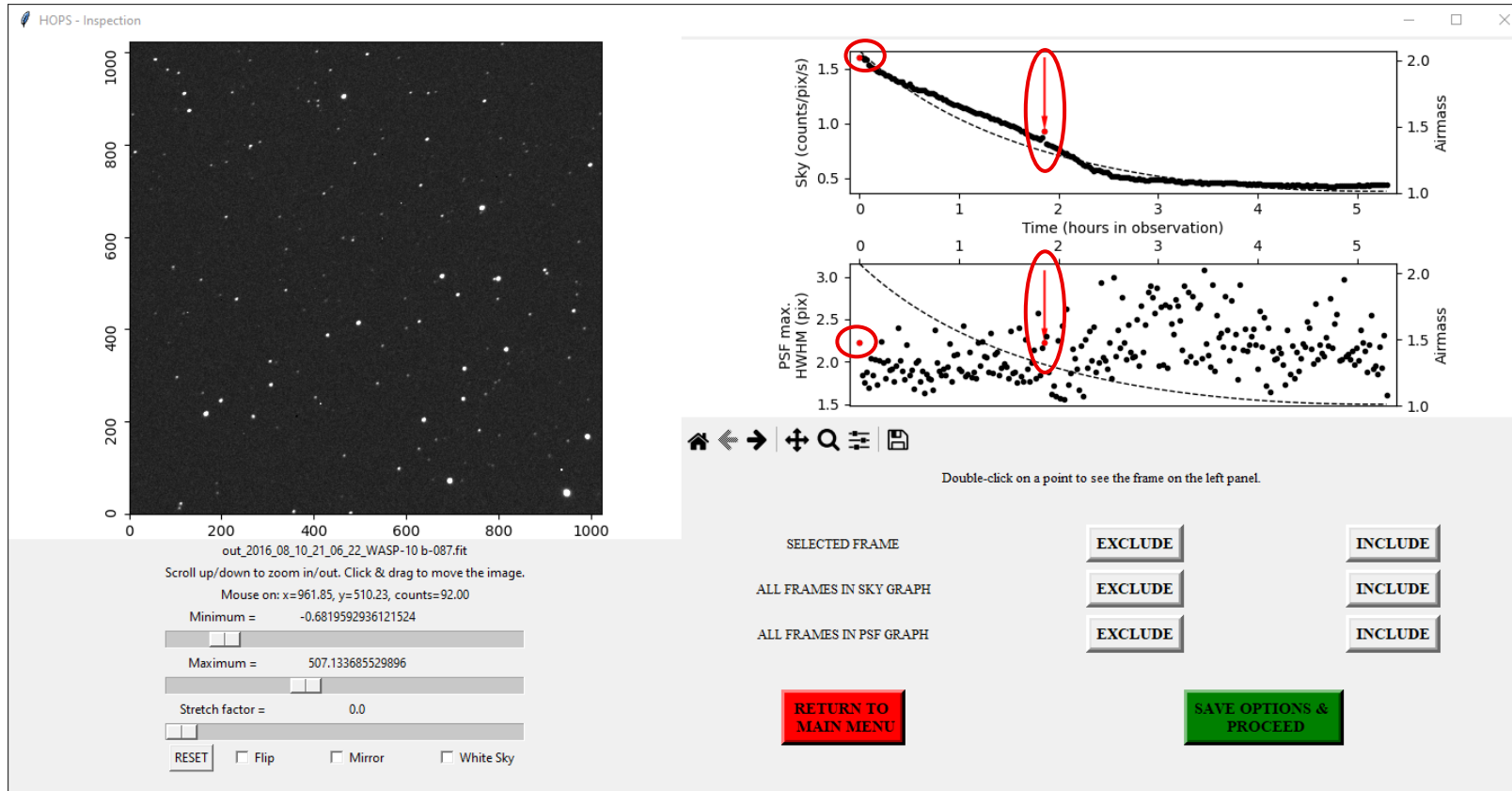
From the 2 graphs (SKY graph and PSF graph) you can select which images to be excluded for the process.

You can (from left to right): reset to original, back to previous, forward to next, move, zoom, change the dimensions, save the plot



Step 3: Inspect Frames

Using the SKY graph to filter out images

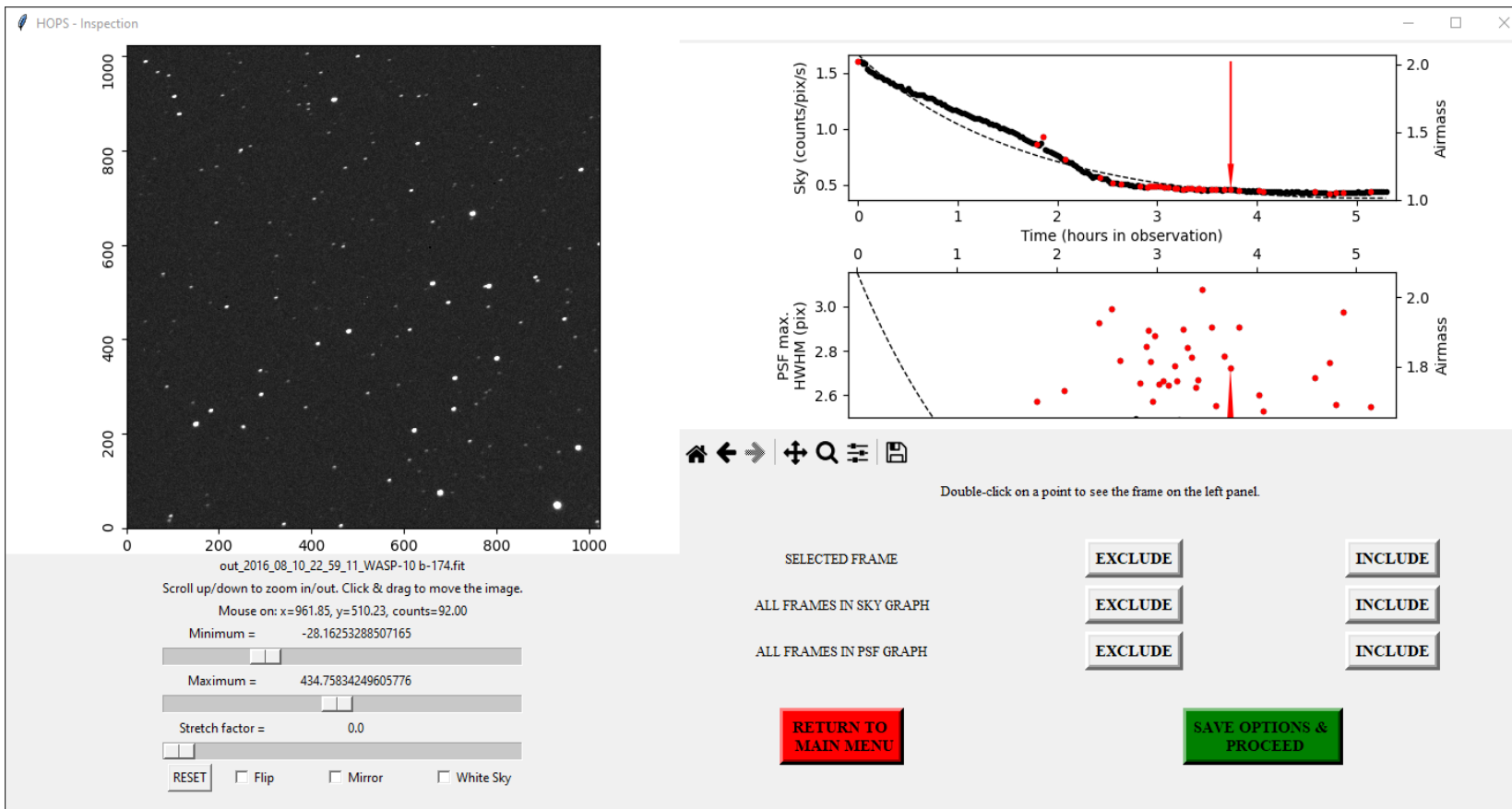


- In the SKY plot an indication for image, faulty image is a point's values and airmass in correlation to other points.
- Double click on a point to view the image.
- To exclude an image, press the button "EXCLUDE" next to the "SELECTED FRAME".
- To include an image back, press "INCLUDE".

- To exclude or include many images at the same time, zoom your plot in the area they are located, and press "EXCLUDE" for the "ALL FRAMES IN SKY GRAPH"

Step 3: Inspect Frames

Using the PSF graph to filter out images



➤ You can choose a PSF value as an upper limit that will define with frames to include or exclude. A value of 2.5 is appropriate.

➤ To exclude or include many images at the same time, zoom your plot in the area they are located, and press “EXCLUDE” for the “ALL FRAMES IN PSF GRAPH”

Step 3: Inspect Frames

HOPS - Inspection

out_2016_08_10_19_16_06_WASP-10 b-002.fit

Scroll up/down to zoom in/out. Click & drag to move the image.

Mouse on: x=961.85, y=510.23, counts=92.00

Minimum = 39.025122226650254

Maximum = 599.1289211268979

Stretch factor = 0.0

RESET Flip Mirror White Sky

sky (counts/pix/s)

Time (hours in observation)

Airmass

PSF max. HWHM (pix)

(x, y) = (0.12, 1.026) | (0.12, 1.52)

Double-click on a point to see the frame on the left panel.

SELECTED FRAME EXCLUDE INCLUDE

ALL FRAMES IN SKY GRAPH EXCLUDE INCLUDE

ALL FRAMES IN PSF GRAPH EXCLUDE INCLUDE

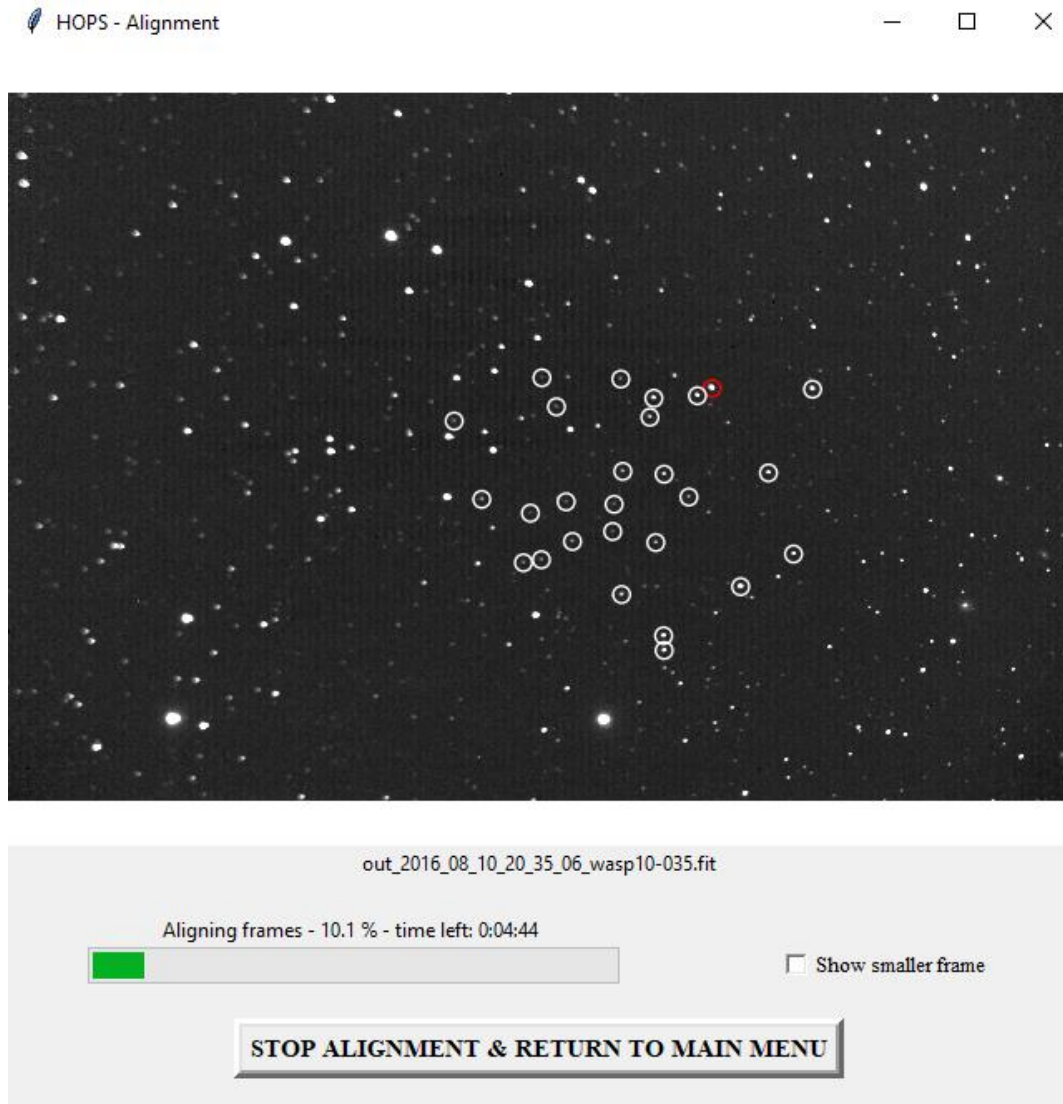
RETURN TO MAIN MENU

SAVE OPTIONS & PROCEED

- **“RETURN TO MAIN MENU”**: all your progress will not be saved.
- **“SAVE OPTIONS & PROCEED”**: your progress is saved, and you can proceed to step 4. 26

Step 4: Run Alignment

The process starts automatically after step 3



- To interrupt the process press “STOP ALIGNMENT & RETURN TO MAIN MENU”
- If in the image the stars cannot be detected this message will be shown:



- Press “YES” if the image is faulty
- Press “NO” if the image is shifted or flipped

Step 5: Photometry

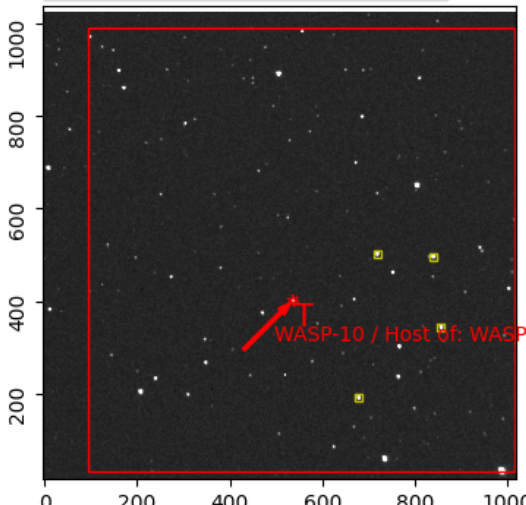
Select your target

HOPS - Photometry

Show stars with flux similar to the target (+/- %):

Remember, the best comparison stars need to be:
a) close to your target, b) of similar magnitude to the target,
c) of similar colour to the target, d) photometrically stable, i.e. not variables!

Available FOV
 Stars of similar flux to the target



out_2016_08_10_19_16_06_WASP-10 b-002.fit

Scroll up/down to zoom in/out. Click & drag to move the image.
Mouse on: x=955.40, y=243.42, counts=88.00

Minimum = 39.025122226650254

Maximum = 599.128921126898

Stretch factor = 0

Flip Mirror White Sky

	Aperture radius (>1.5)		Gbp-Grp	Total counts	Max counts	Max HWHM
<input checked="" type="radio"/> Target	<input type="text" value="4.7"/>		1.28	94589.7	8841.0	1.8
<input type="radio"/> Comparison 1	<input type="text" value="0"/>	<input type="button" value="CLEAR"/>	-	0	0	0
<input type="radio"/> Comparison 2	<input type="text" value="0"/>	<input type="button" value="CLEAR"/>	-	0	0	0
<input type="radio"/> Comparison 3	<input type="text" value="0"/>	<input type="button" value="CLEAR"/>	-	0	0	0
<input type="radio"/> Comparison 4	<input type="text" value="0"/>	<input type="button" value="CLEAR"/>	-	0	0	0
<input type="radio"/> Comparison 5	<input type="text" value="0"/>	<input type="button" value="CLEAR"/>	-	0	0	0
<input type="radio"/> Comparison 6	<input type="text" value="0"/>	<input type="button" value="CLEAR"/>	-	0	0	0
<input type="radio"/> Comparison 7	<input type="text" value="0"/>	<input type="button" value="CLEAR"/>	-	0	0	0
<input type="radio"/> Comparison 8	<input type="text" value="0"/>	<input type="button" value="CLEAR"/>	-	0	0	0
<input type="radio"/> Comparison 9	<input type="text" value="0"/>	<input type="button" value="CLEAR"/>	-	0	0	0
<input type="radio"/> Comparison 10	<input type="text" value="0"/>	<input type="button" value="CLEAR"/>	-	0	0	0

Load options from previous run

You need to select the target and at least one comparison star to proceed.

Use this button to automatically resolve your target. Alternatively press “Check SIMBAD” to find the target manually using its coordinates from SIMBAD.

Step 5: Photometry

Select your target

HOPS - Photometry

Show stars with flux similar to the target (+/- %):

Remember, the best comparison stars need to be:
a) close to your target, b) of similar magnitude to the target,
c) of similar colour to the target, d) photometrically stable, i.e. not variables!

	Aperture radius (>1.5)	Obj-Grp	Total counts	Max counts	Max HWHM	
<input checked="" type="radio"/> Target	<input type="text" value="4.7"/>		1.28	94589.7	8841.0	1.8
<input type="radio"/> Comparison 1	<input type="text" value="0"/>	<input type="button" value="CLEAR"/>	-	0	0	0
<input type="radio"/> Comparison 2	<input type="text" value="0"/>	<input type="button" value="CLEAR"/>	-	0	0	0
<input type="radio"/> Comparison 3	<input type="text" value="0"/>	<input type="button" value="CLEAR"/>	-	0	0	0
<input type="radio"/> Comparison 4	<input type="text" value="0"/>	<input type="button" value="CLEAR"/>	-	0	0	0
<input type="radio"/> Comparison 5	<input type="text" value="0"/>	<input type="button" value="CLEAR"/>	-	0	0	0
<input type="radio"/> Comparison 6	<input type="text" value="0"/>	<input type="button" value="CLEAR"/>	-	0	0	0
<input type="radio"/> Comparison 7	<input type="text" value="0"/>	<input type="button" value="CLEAR"/>	-	0	0	0
<input type="radio"/> Comparison 8	<input type="text" value="0"/>	<input type="button" value="CLEAR"/>	-	0	0	0
<input type="radio"/> Comparison 9	<input type="text" value="0"/>	<input type="button" value="CLEAR"/>	-	0	0	0
<input type="radio"/> Comparison 10	<input type="text" value="0"/>	<input type="button" value="CLEAR"/>	-	0	0	0

You need to select the target and at least one comparison star to proceed.

Use these to configurations to adjust the contrast, flip or mirror the image. They will be helpful when you will have to choose the comparison stars for your target.

Available FOV
Stars of similar flux to the target

WASP-10 / Host of WASP-10b

out_2016_08_10_19_16_06_WASP-10 b-002.fit

Scroll up/down to zoom in/out. Click & drag to move the image.

Mouse on: x=955.40, y=243.42, counts=88.08

Minimum = 39.025122226650254

Maximum = 599.128921126898

Stretch factor = 0

Flip Mirror White Sky

Step 5: Photometry

Select your target

In the table (on the right), the option “Target” is selected. This means that the photometric data of identified target are configured.

!!! To identify these data for the stars double click on them on the image

HOPS - Photometry

Show stars with flux similar to the target (+/- %):

Remember, the best comparison stars need to be:
a) close to your target, b) of similar magnitude to the target,
c) of similar colour to the target, d) photometrically stable, i.e. not variables!

	Aperture radius (>1.3)	Gbp.Grp	Total counts	Max counts	Max HWHM
<input checked="" type="radio"/> Target	<input type="text" value="4.7"/>	1.28	94589.7	8841.0	1.8
<input type="radio"/> Comparison 1	<input type="text" value="0"/>	<input type="button" value="CLEAR"/>	-	0	0
<input type="radio"/> Comparison 2	<input type="text" value="0"/>	<input type="button" value="CLEAR"/>	-	0	0
<input type="radio"/> Comparison 3	<input type="text" value="0"/>	<input type="button" value="CLEAR"/>	-	0	0
<input type="radio"/> Comparison 4	<input type="text" value="0"/>	<input type="button" value="CLEAR"/>	-	0	0
<input type="radio"/> Comparison 5	<input type="text" value="0"/>	<input type="button" value="CLEAR"/>	-	0	0
<input type="radio"/> Comparison 6	<input type="text" value="0"/>	<input type="button" value="CLEAR"/>	-	0	0
<input type="radio"/> Comparison 7	<input type="text" value="0"/>	<input type="button" value="CLEAR"/>	-	0	0
<input type="radio"/> Comparison 8	<input type="text" value="0"/>	<input type="button" value="CLEAR"/>	-	0	0
<input type="radio"/> Comparison 9	<input type="text" value="0"/>	<input type="button" value="CLEAR"/>	-	0	0
<input type="radio"/> Comparison 10	<input type="text" value="0"/>	<input type="button" value="CLEAR"/>	-	0	0

Load options from previous run

You need to select the target and at least one comparison star to proceed.

Step 5: Photometry

Select your companion stars

s with flux similar to target (+/- %):

Remember, the best comparison stars need to be:
a) close to your target, b) of similar magnitude to the target,
c) of similar colour to the target, d) photometrically stable, i.e. not variables!

	Aperture radius (>1.5)	Clear	Gbp-Grp	Total counts	Max counts	Max HWHM
<input checked="" type="radio"/> Target	<input type="text" value="4.7"/>		1.28	94589.7	8841.0	1.8
<input type="radio"/> Comparison 1	<input type="text" value="0"/>	<input type="button" value="CLEAR"/>	-	0	0	0
<input type="radio"/> Comparison 2	<input type="text" value="0"/>	<input type="button" value="CLEAR"/>	-	0	0	0
<input type="radio"/> Comparison 3	<input type="text" value="0"/>	<input type="button" value="CLEAR"/>	-	0	0	0
<input type="radio"/> Comparison 4	<input type="text" value="0"/>	<input type="button" value="CLEAR"/>	-	0	0	0
<input type="radio"/> Comparison 5	<input type="text" value="0"/>	<input type="button" value="CLEAR"/>	-	0	0	0
<input type="radio"/> Comparison 6	<input type="text" value="0"/>	<input type="button" value="CLEAR"/>	-	0	0	0
<input type="radio"/> Comparison 7	<input type="text" value="0"/>	<input type="button" value="CLEAR"/>	-	0	0	0
<input type="radio"/> Comparison 8	<input type="text" value="0"/>	<input type="button" value="CLEAR"/>	-	0	0	0
<input type="radio"/> Comparison 9	<input type="text" value="0"/>	<input type="button" value="CLEAR"/>	-	0	0	0
<input type="radio"/> Comparison 10	<input type="text" value="0"/>	<input type="button" value="CLEAR"/>	-	0	0	0

- Choose stars that are within the red square (it contains all the stars constantly inside your FOV)
- With yellow, stars of similar flux are shown
- To proceed you need **at least 2** companion stars.

- When you have selected a star for “Companion 1”, you can proceed selecting a star for “Companion 2” etc.

Step 5: Photometry

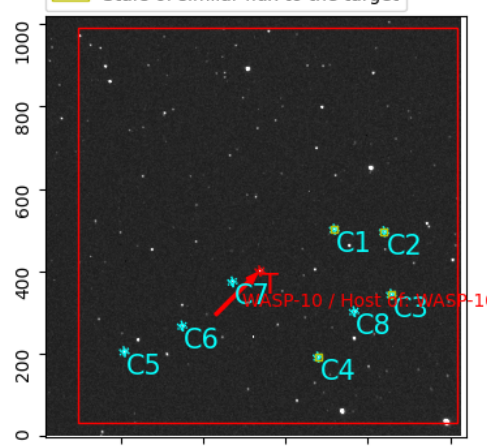
Step 1: select possible candidates for your comparison stars

- Some eligibility criteria the selected comparison stars should cover are: similar (i) aperture, (ii) Gbp-Grp, (iii) HWHM.

Show stars with flux similar to the target (+/- %):

PLATE SOLVE IMAGE (if connected to the internet)

Available FOV
Stars of similar flux to the target



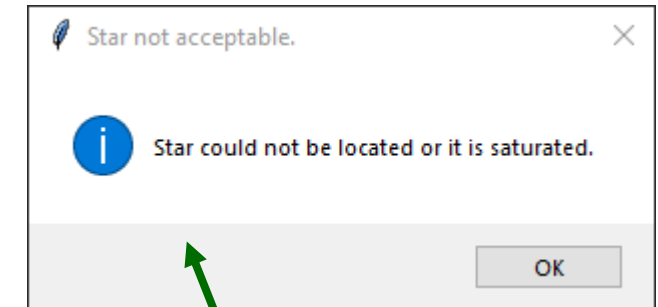
out_2016_08_10_19_16_06_WASP-10 b-002.fit

Scroll up/down to zoom in/out. Click & drag to move the image.
Mouse on: x=1026.66, y=108.29, counts=-
Minimum = 39.025122226650254
Maximum = 599.128921126898
Stretch factor = 0
 Flip Mirror White Sky

Remember, the best comparison stars need to be:
a) close to your target, b) of similar magnitude to the target,
c) of similar colour to the target, d) photometrically stable, i.e. not variables!

	Aperture radius (>1.5)	Gbp-Grp	Total counts	Max counts	Max HWHM	
<input checked="" type="radio"/> Target	4.7	1.28	94589.7	8841.0	1.8	
<input type="radio"/> Comparison 1	4.7	0.72	117345.7	11289.0	1.8	
<input type="radio"/> Comparison 2	4.7	0.8	124304.0	10960.0	1.8	
<input type="radio"/> Comparison 3	4.7	0.81	85831.5	6234.0	2.0	
<input type="radio"/> Comparison 4	4.7	0.72	65128.4	4841.0	2.1	
<input type="radio"/> Comparison 5	4.7	0.81	145523.1	11683.0	2.0	
<input type="radio"/> Comparison 6	4.7	1.2	27993.7	2406.0	1.9	Comp. too faint
<input type="radio"/> Comparison 7	4.7	1.34	21530.9	1960.0	1.9	Comp. too faint
<input type="radio"/> Comparison 8	4.7	0.8	54132.3	4465.0	2.0	
<input type="radio"/> Comparison 9	0	-	0	0	0	
<input type="radio"/> Comparison 10	0	-	0	0	0	

Load options from previous run



If this error message is shown, zoom in the image and try again selecting a star.

Step 5: Photometry

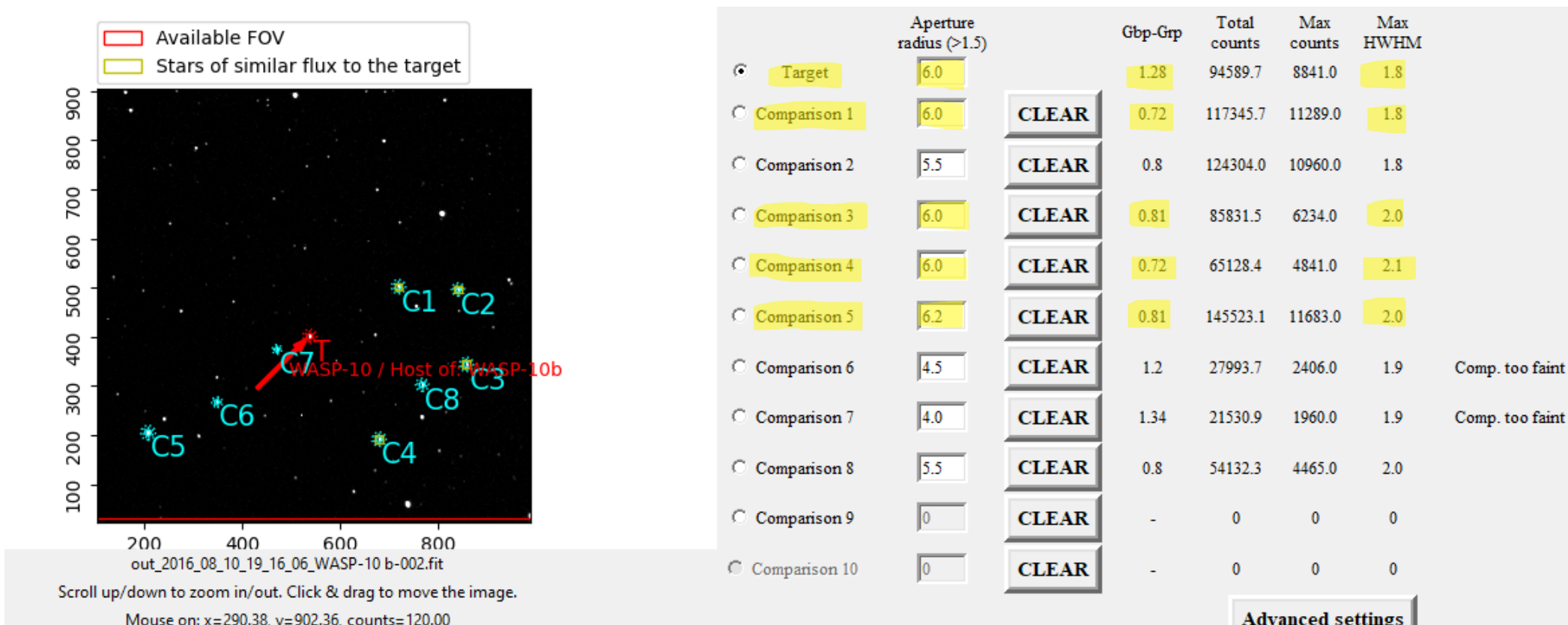
How to select the most compatible stars?

- Choose your comparison stars carefully, as they affect significantly the quality of the final result. The general rules are that the comparison stars need to be:
 1. close to the target star;
 2. of similar magnitude to the star;
 3. of similar color to the target star, Gbp-Grp (check with SIMBAD or GAIA);
 4. stable, i.e. not variables (check with SIMBAD or AAVSO or from the comparison light curves on a few pages later).
- There is always the possibility that no good comparison stars exist. In this case you have to proceed with on-ideal comparison stars (very faint or very bright).

Step 5: Photometry

Step 2: correct the aperture radius

- From the 8 stars we tried out, let's select the 4 with the characteristics most similar to our target. Those stars can form a first checkpoint for our photometry analysis



- If you want to select another star, select an “Comparison X” and double click to a new star. All the photometric data of the previous option will be replaced.

Step 5: Photometry

Advanced settings

Advanced settings

Inner sky-ring radius, relatively to the aperture (default = 1.7)

Outer sky-ring radius, relatively to the aperture (default = 2.4)

Note: the bright pixels inside the sky-ring are NOT taken into account for the sky background estimation.

Saturation warning limit, relatively to the full-well depth (default = 0.95)

Star FWHM in arcseconds (approximate) (default = 4.0)

Camera gain in e-/ADU (default = 1.0)

Vary the aperture size proportionally to the variations of the PSF size.

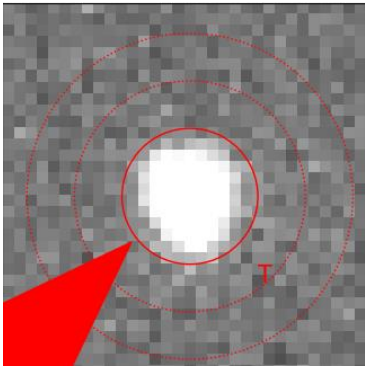
Align the aperture with the geometric center instead of the PSF peak.

- If you believe that the PSF size is changing considerably during the observation you may wish to select the option to vary the aperture size proportionally to the variations of the PSF size. As this option is currently selected you can change the parameters to accommodate the PSF size.
- If your PSF suffers from strong asymmetries, you can select the option to align the aperture with the geometric center of the star instead of the PSF peak by clicking on this option.

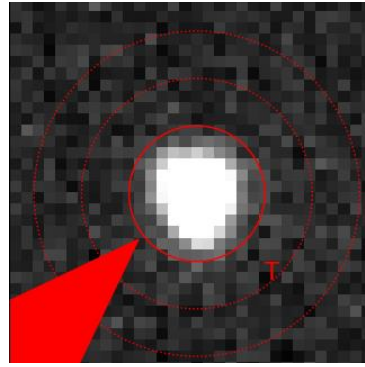
Step 5: Photometry

How to select the aperture radius?

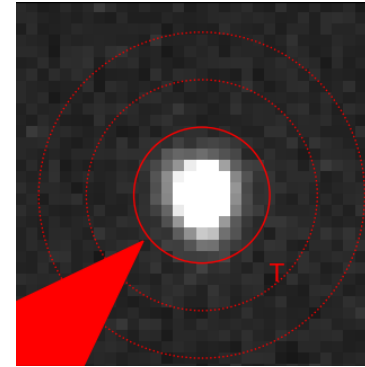
- The aperture should close completely the star and avoid nearby stars.
- Adjust the contrast in a way the star become more apparent.



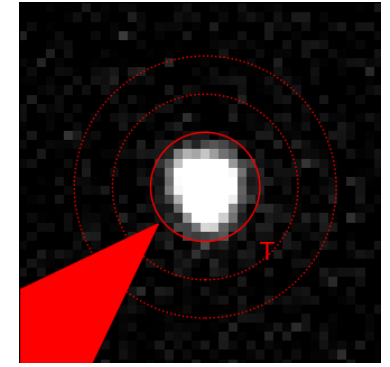
Too low contrast



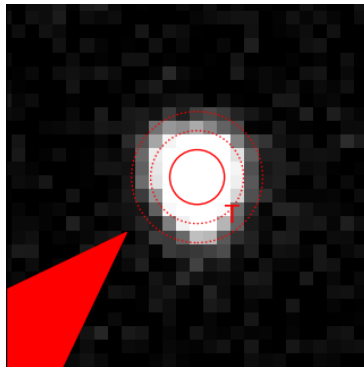
Original contrast



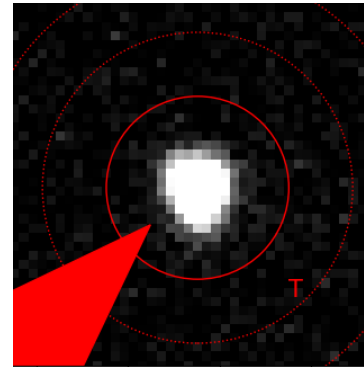
High contrast



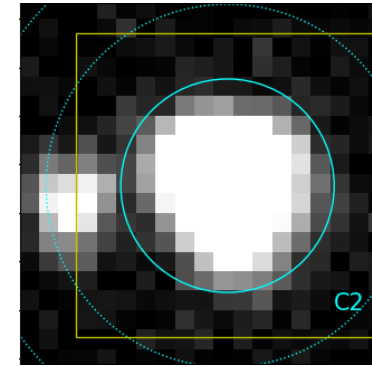
Too high contrast



Too small aperture



Too big aperture



Aperture with nearby star

Step 5: Photometry

Step 3: the final selection

☑ Show stars with flux similar to the target (+/- %):

Remember, the best comparison stars need to be:
a) close to your target, b) of similar magnitude to the target,
c) of similar colour to the target, d) photometrically stable, i.e. not variables!

	Aperture radius (>1.5)	Gbp-Grp	Total counts	Max counts	Max HWHM
<input checked="" type="radio"/> Target	<input type="text" value="6.0"/>	1.28	94589.7	8841.0	1.8
<input type="radio"/> Comparison 1	<input type="text" value="6.0"/> <input type="button" value="CLEAR"/>	0.72	117345.7	11289.0	1.8
<input type="radio"/> Comparison 2	<input type="text" value="6.0"/> <input type="button" value="CLEAR"/>	0.81	85831.5	6234.0	2.0
<input type="radio"/> Comparison 3	<input type="text" value="6.0"/> <input type="button" value="CLEAR"/>	0.72	65128.4	4841.0	2.1
<input type="radio"/> Comparison 4	<input type="text" value="6.2"/> <input type="button" value="CLEAR"/>	0.81	145523.1	11683.0	2.0
<input type="radio"/> Comparison 5	<input type="text" value="0"/> <input type="button" value="CLEAR"/>	-	0	0	0
<input type="radio"/> Comparison 6	<input type="text" value="0"/> <input type="button" value="CLEAR"/>	-	0	0	0
<input type="radio"/> Comparison 7	<input type="text" value="0"/> <input type="button" value="CLEAR"/>	-	0	0	0
<input type="radio"/> Comparison 8	<input type="text" value="0"/> <input type="button" value="CLEAR"/>	-	0	0	0
<input type="radio"/> Comparison 9	<input type="text" value="0"/> <input type="button" value="CLEAR"/>	-	0	0	0
<input type="radio"/> Comparison 10	<input type="text" value="0"/> <input type="button" value="CLEAR"/>	-	0	0	0

Load options from previous run

Available FOV
Stars of similar flux to the target

WASP-10 / Host of WASP-10b

C1, C2, C3, C4

out_2016_08_10_19_16_06_WASP-10 b-002.fit

Scroll up/down to zoom in/out. Click & drag to move the image.

Mouse on: x=962.33, y=446.98, counts=118.00

Minimum = 112.08313034208155

Maximum = 599.2945506904388

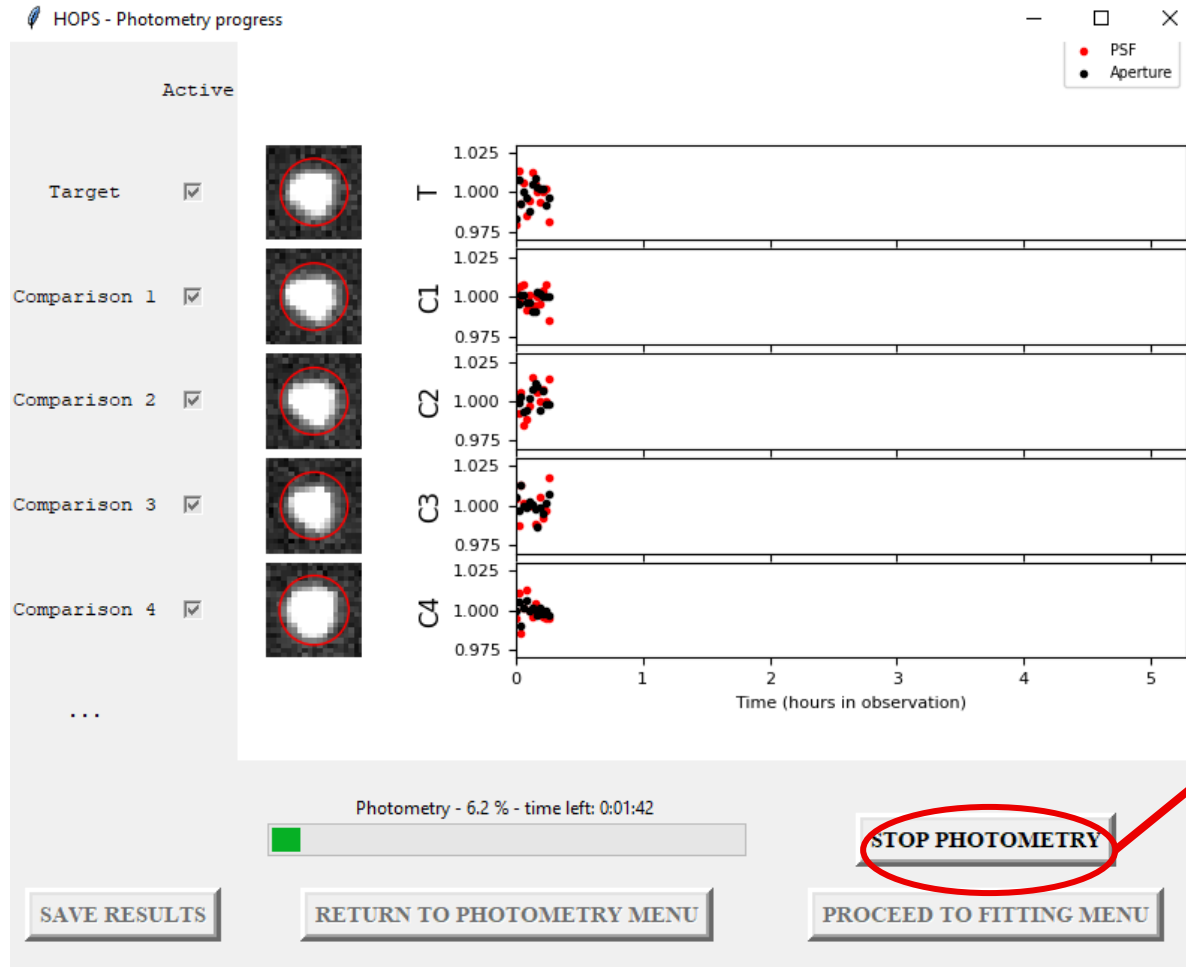
Stretch factor = 0.0

RESET Flip Mirror White Sky

- Keep only the most compatible comparison stars.
- To delete all the other stars, press “*CLEAR*”
- To save your work but not proceed to the next level press “*SAVE OPTIONS & RETURN TO MAIN MENU*”
- To discard your work press “*RETURN TO MAIN MENU*”
- To proceed press “*RUN PHOTOMETRY*”

Step 5: Run Photometry

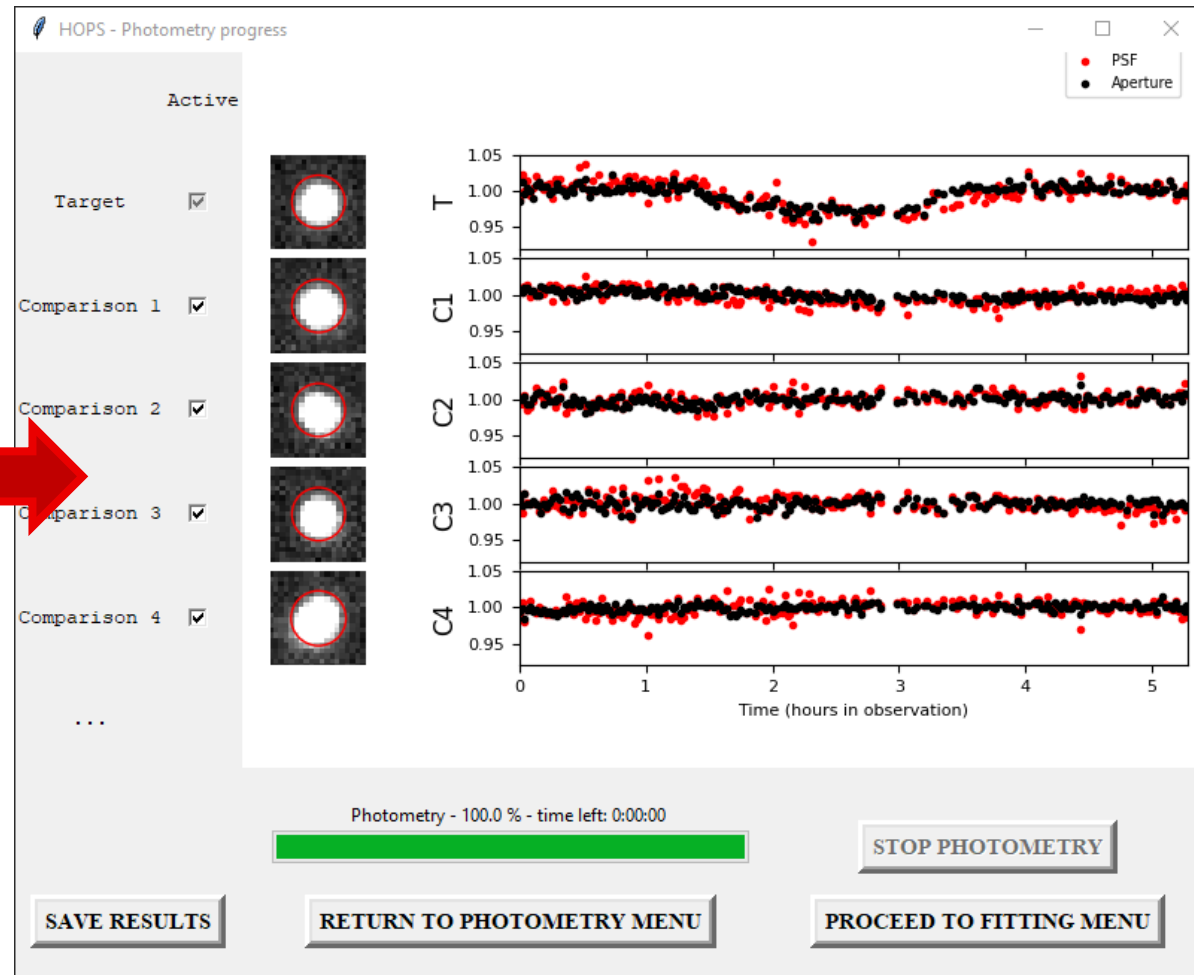
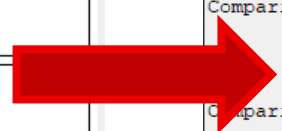
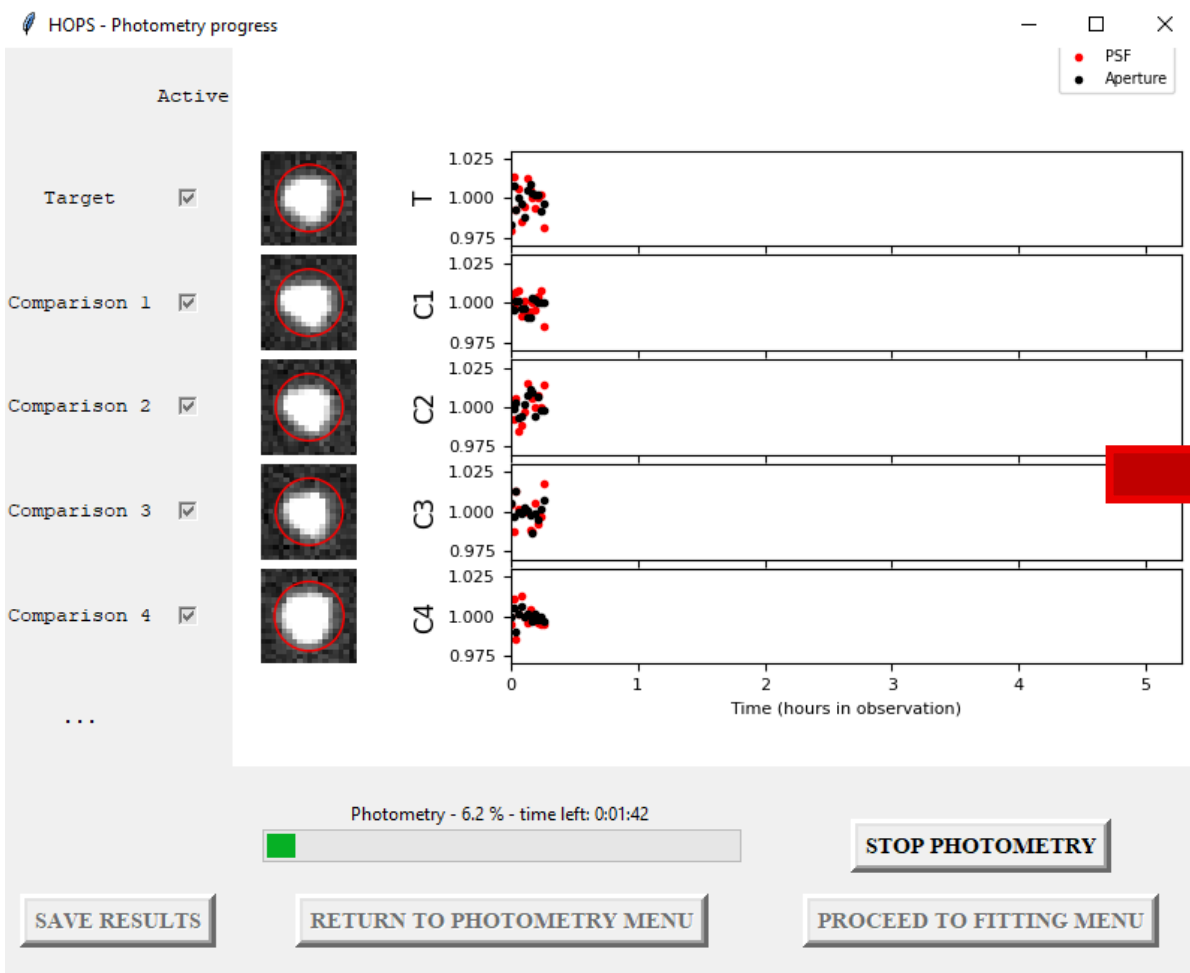
Starts automatically to process the photometric data of the selected target and comparison stars.



To stop the process and return to the main menu of photometry for selecting the target and comparison stars.

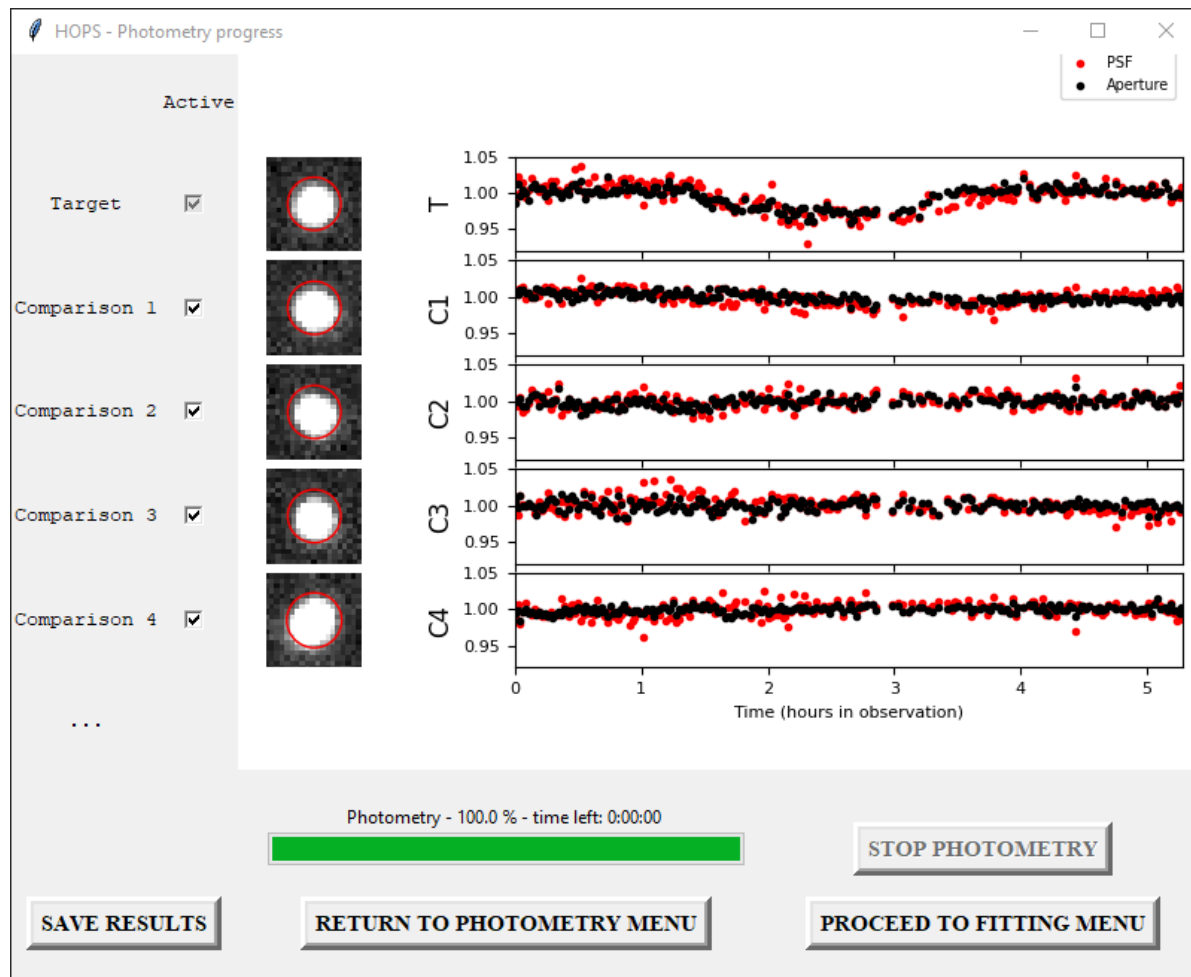
Step 5: Run Photometry

Starts automatically to process the photometric data of the selected target and comparison stars.



Step 5: Run Photometry

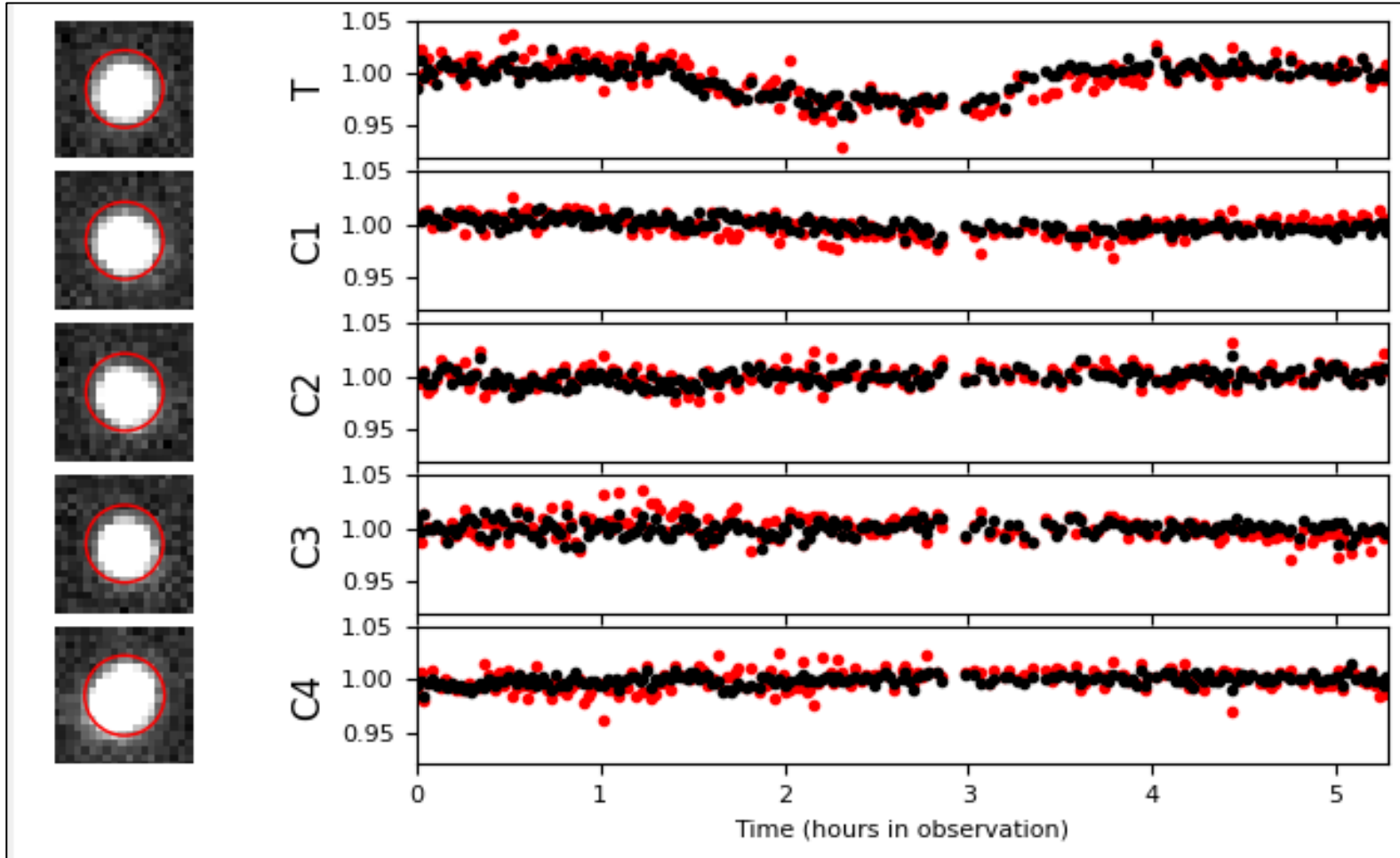
Inspection of the light curves



- By inspecting the light curves, we can determine if one or more stars have a negative impact to our target's light curve.
- Those light curves can be removed by clicking in the boxes next to the stars' names to deactivate them (or activate them back).
- You need at least 2 comparison stars because these curves are produced in relation to all the others.

Step 5: Run Photometry

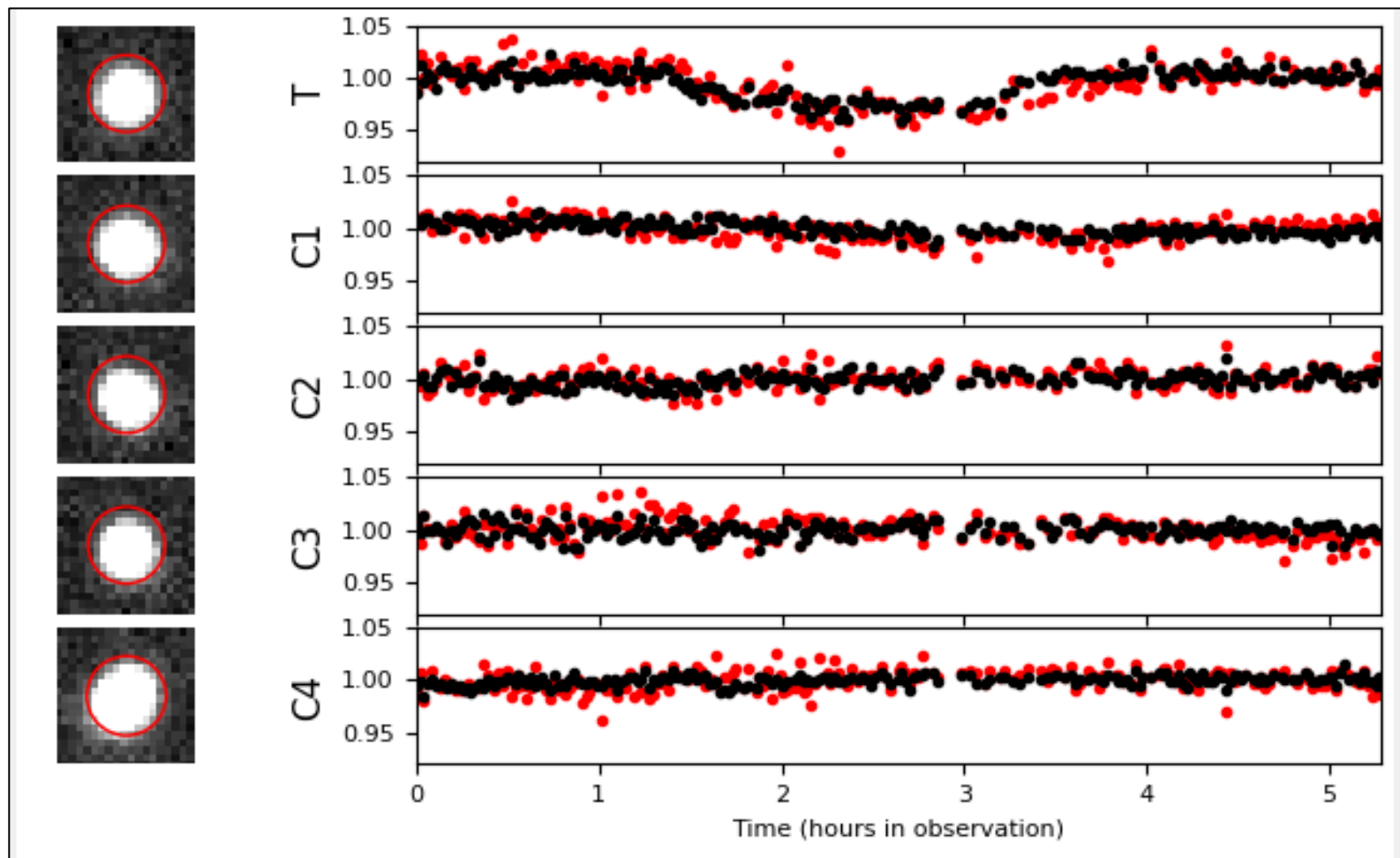
Inspection of the light curves



- The light curve of the target is divided by the sum of all the comparison stars.
- The light curve of its comparison star is divided by the sum of all the other comparison stars.

Step 5: Run Photometry

Inspection of the light curves



Target

Comp1 + Comp2 + Comp3 + Comp4

Comp1

Comp2 + Comp3 + Comp4

Comp2

Comp1 + Comp3 + Comp4

Comp3

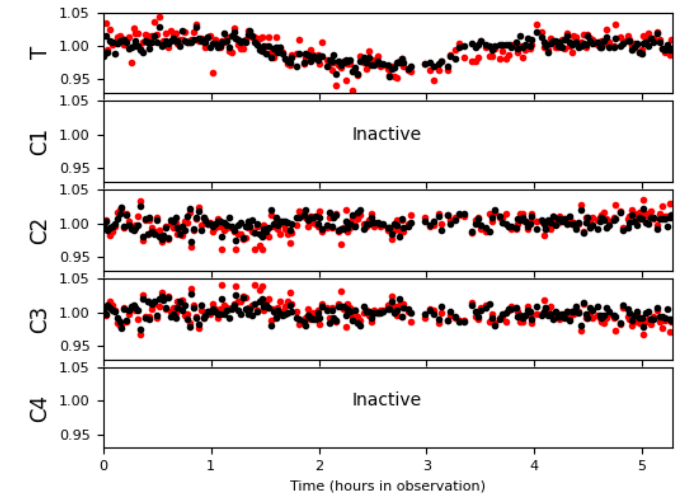
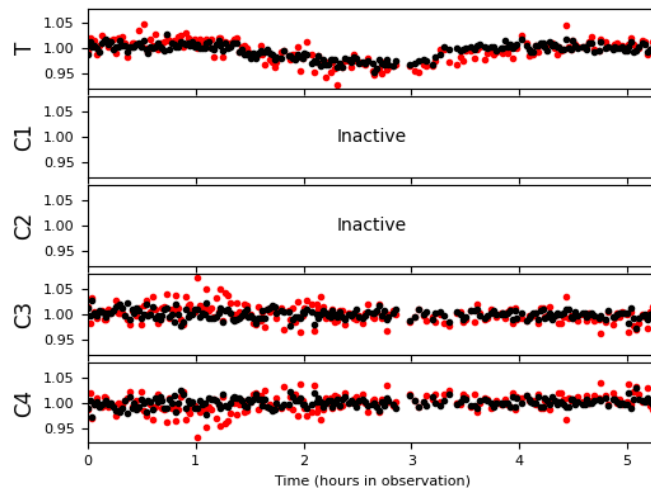
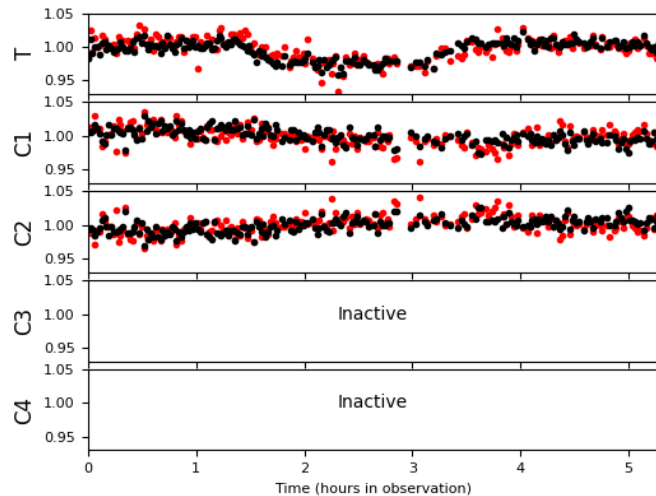
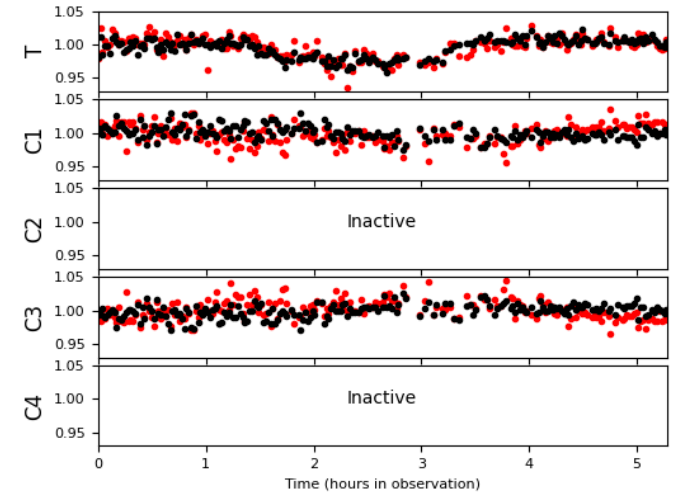
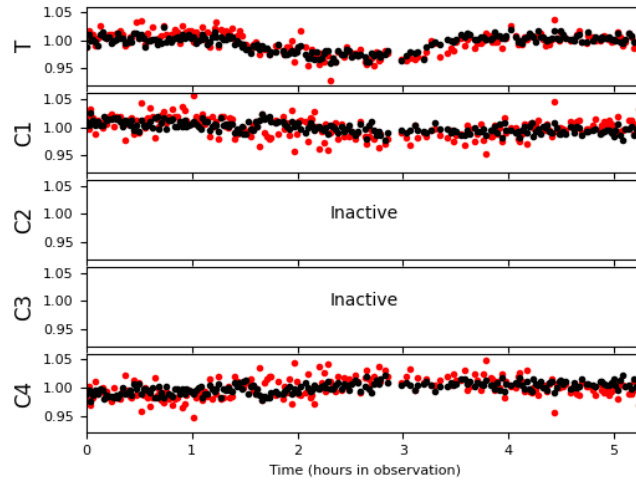
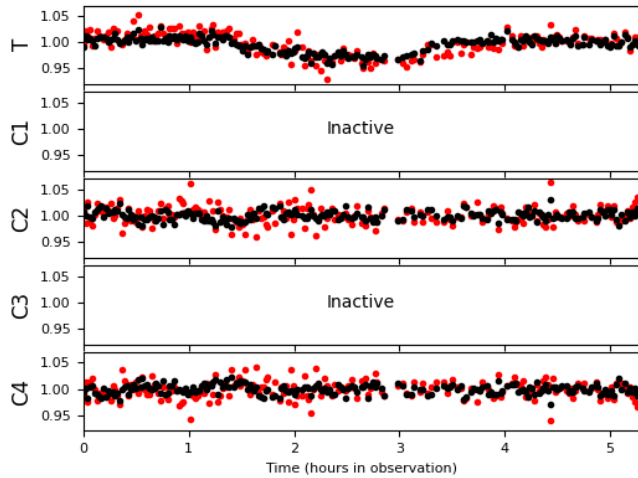
Comp1 + Comp2 + Comp4

Comp4

Comp1 + Comp2 + Comp3

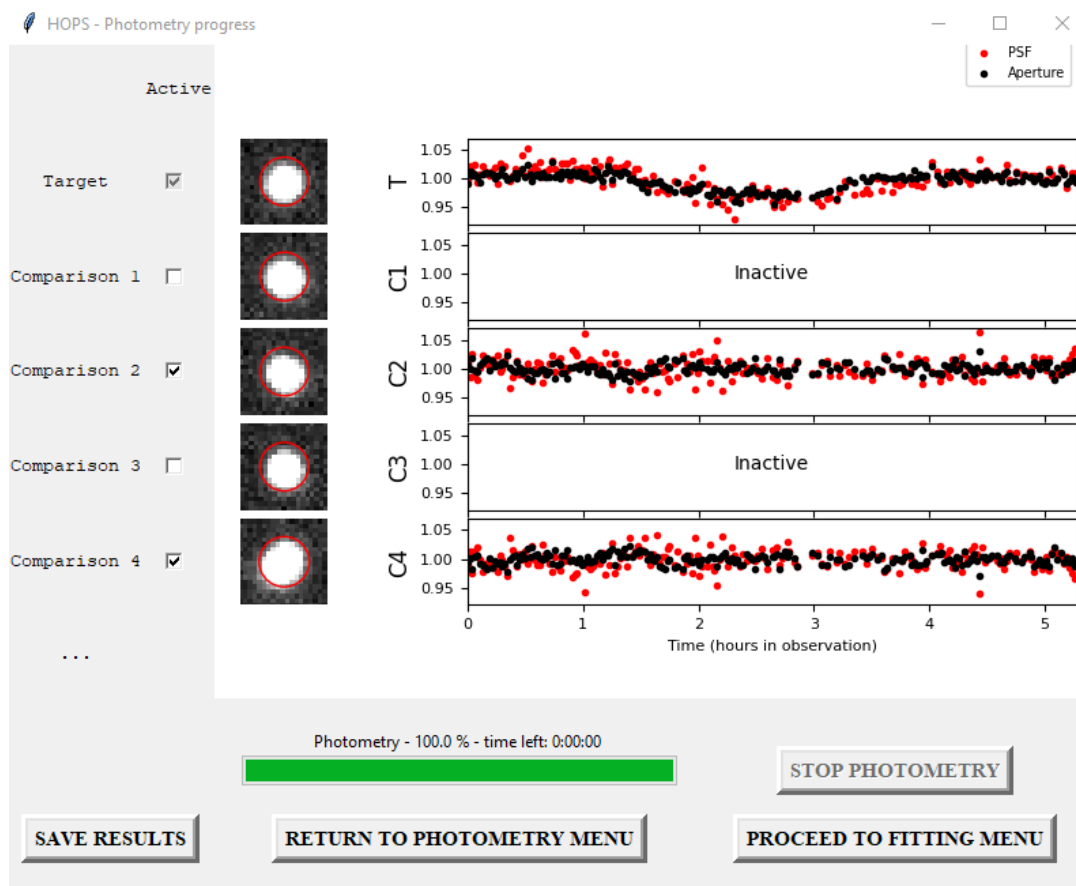
Step 5: Run Photometry

- Let's examine the scenario that we want only two comparison stars for our final fitting.
How can we pick which two comparison stars to keep?



Step 5: Run Photometry

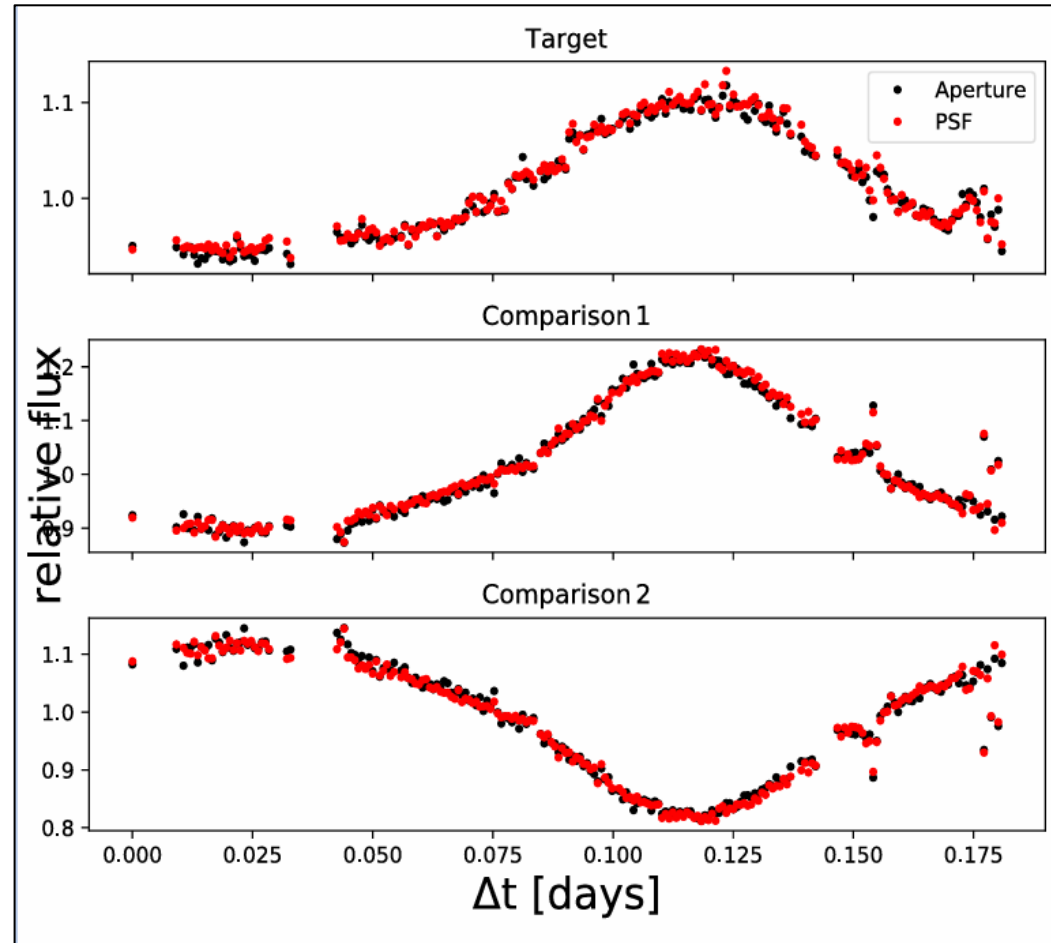
- The scenario we have picked is with the Comparison 2 and 4 because we can approximately evaluate it as the most symmetrical.



- Do not forget to save your work by pressing “**SAVE RESULTS**”. You can utilize this as many times as you want if you want to export results for different scenarios.

Step 5: Run Photometry

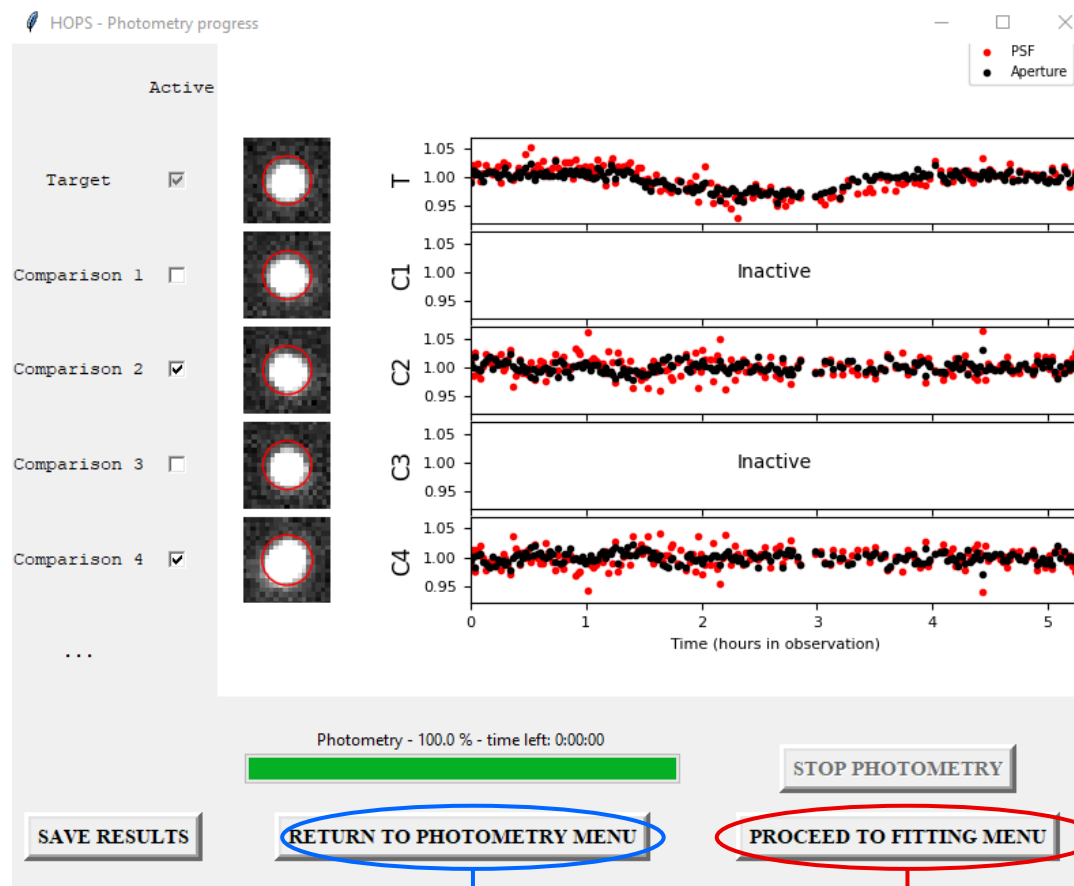
Variable stars as comparison stars.



- If one comparison star is variable, you will see its light curve is **anti-correlated to all the other light curves**, including the target's light curve.

Step 5: Run Photometry

➤ When you are ready you can proceed to the next step: the *EXOPLANET FITTING*




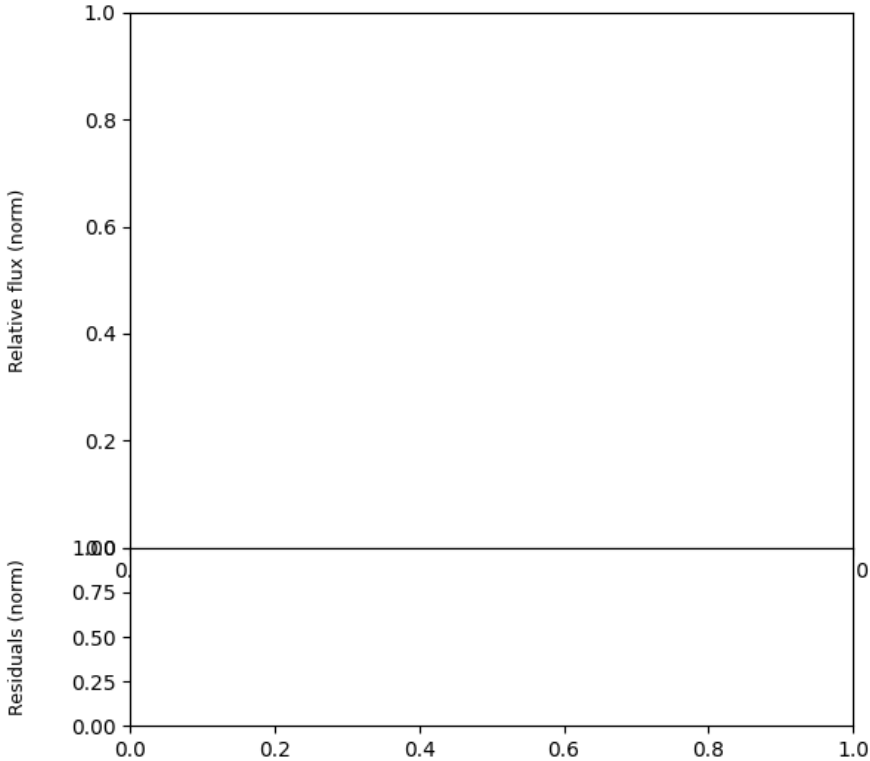
Return to the main photometry result. **If you have saved your results**, you can see that previous work by clicking in the **“Load options from previous runs”** drop-down menu.

Proceed automatically to the next step.

Step 6: Exoplanet Fitting

HOPS - Fitting

 **None**



Relative flux (norm)

Residuals (norm)

Light-curve file

Choose Light-curve file

EXPORT FOR DATABASES (ExoClock / ETD)

	Catalogue param.	<input type="checkbox"/> Enter param. manually
Planet	None	WASP-10b
Planet RA DEC (hh:mm:ss +/-dd:mm:ss)	None	23:15:58.3005 +31:27:46
Period [days]	0	3.09272813
Mid-time [BJD_TDB]	0	2456253.700518
Rp/Rs	0	0.1592
a/Rs	0	11.65
Inclination [deg]	0	88.49
Eccentricity	0	0.0
Periastron [deg]	0	0.0
M* [Fe/H, dex]	0	0.03
T* [K]	0	4675.0
log(g*) [cm/s^2]	0	4.4

MCMC options:

Iterations (def=5000) 5000

Burn-in (def=1000) 1000

De-trending: Airmass

Fit for a/Rs, i.

RETURN TO MAIN MENU **SAVE OPTIONS & RETURN TO MAIN MENU** **RETURN TO PHOTOMETRY**

RUN TEST **RUN FITTING**

Navigation icons: Home, Back, Forward, Zoom, Pan, Save

Step 6: Exoplanet Fitting

Select a file

HOPS - Fitting

None

Relative flux (norm)

Residuals (norm)

Light-curve file

Choose Light-curve file

PHOTOMETRY_3\PHOTOMETRY_APERTURE.tx
PHOTOMETRY_3\PHOTOMETRY_GAUSS.txt
PHOTOMETRY_4\PHOTOMETRY_APERTURE.tx
PHOTOMETRY_4\PHOTOMETRY_GAUSS.txt
PHOTOMETRY_5\PHOTOMETRY_APERTURE.tx
PHOTOMETRY_5\PHOTOMETRY_GAUSS.txt
PHOTOMETRY_6\PHOTOMETRY_APERTURE.tx
PHOTOMETRY_6\PHOTOMETRY_GAUSS.txt
PHOTOMETRY_7\PHOTOMETRY_APERTURE.tx
PHOTOMETRY_7\PHOTOMETRY_GAUSS.txt

Planet

Planet R.A. DEC
(hh:mm:ss +/-dd:mm)

Period [days] 0 3.09272813

Mid-time [BJD_TDB] 0 2456253.700518

Rp/Rs 0 0.1592

a/Rs 0 11.65

Inclination [deg] 0 88.49

Eccentricity 0 0.0

Periastron [deg] 0 0.0

M* [Fe/H, dex] 0 0.03

T* [K] 0 4675.0

log(g*) [cm/s²] 0 4.4

MCMC options:

Iterations (def=5000) 5000

Burn-in (def=1000) 1000

De-trending:

Airmass

Fit for a/Rs, i.

RETURN TO MAIN MENU

SAVE OPTIONS & RETURN TO MAIN MENU

RETURN TO PHOTOMETRY

RUN TEST

RUN FITTING

(x, y) = (0.973, 0.177)

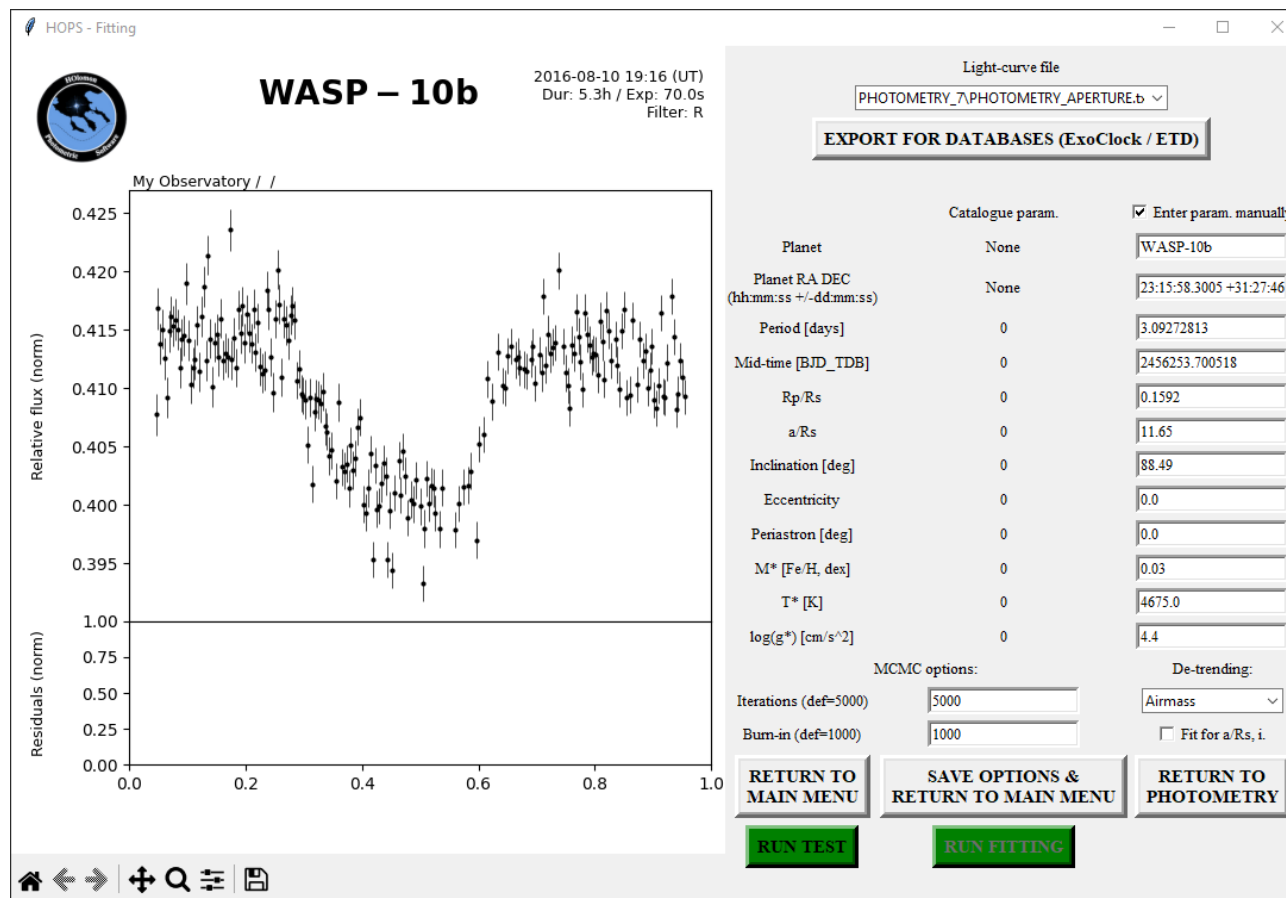
➤ Utilize the drop-down menu to pick which file you want.

➤ You have 2 options for its of your photometry attempts: APERTURE or GAUSS (PSF) fitting.

Step 6: Exoplanet Fitting

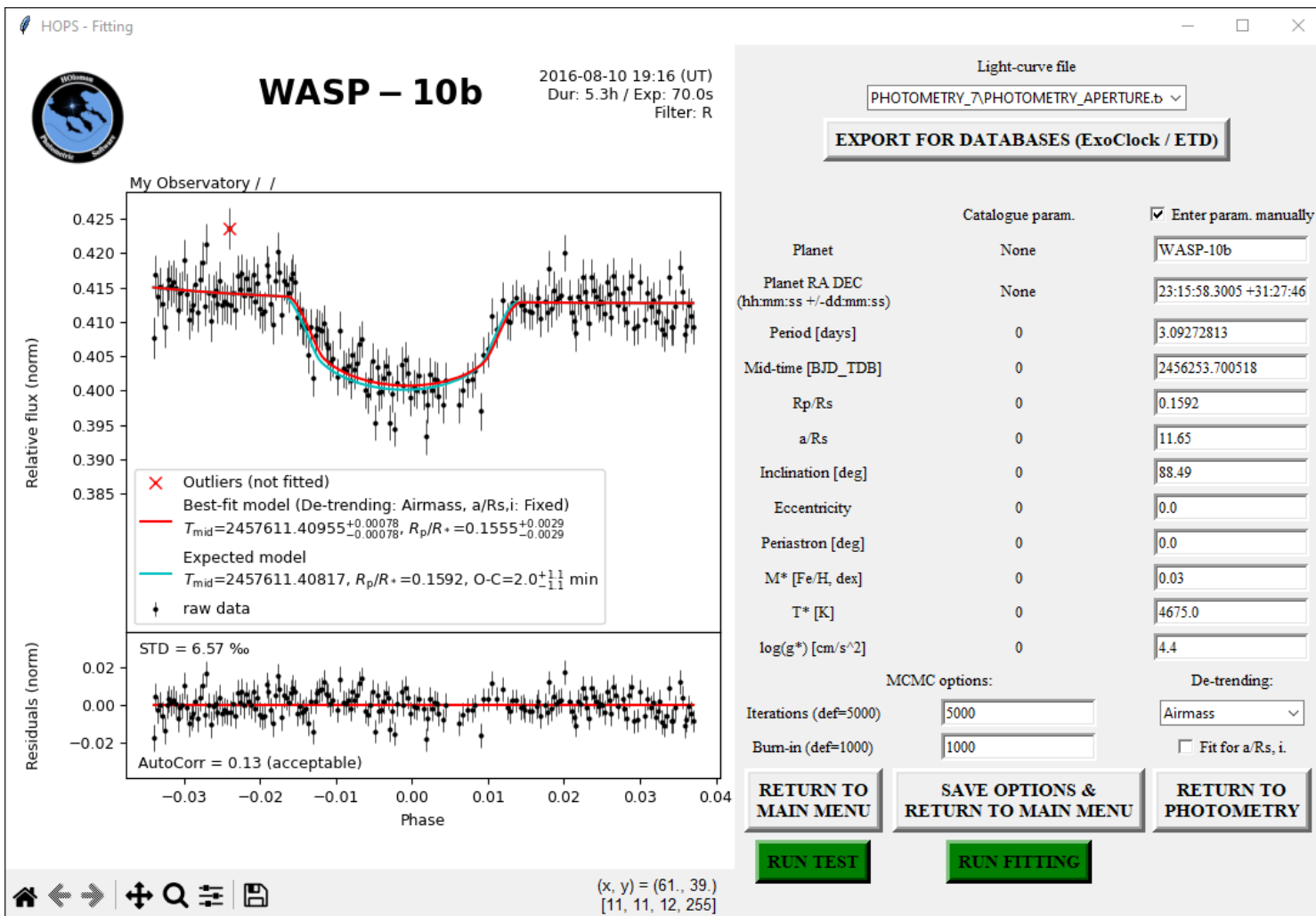
Enter the planets parameters

- The parameters of the exoplanet that is the closest to your coordinates will be chosen from a built-in catalogue. This catalogue contains about 400 exoplanets but not all of them.
- If this is not your target, or if you want to change the default values, select the “*Enter param. Manually*” option to activate the manual entries.
- When it is ready press “**RUN TEST**”



Step 6: Exoplanet Fitting

Run test

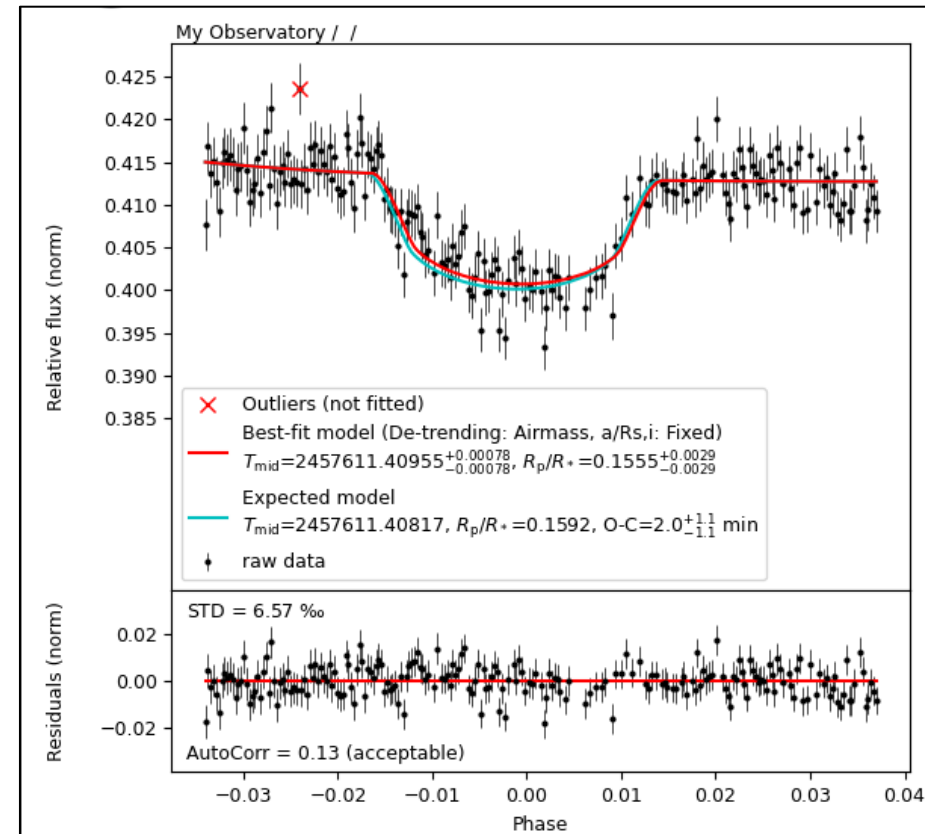


- This is a fitting preview. In this graph, the data have been corrected for a quadratic term (de-trended).
- The model plotted with red represent the best-fit model on the data (not MCMC).
- the expected model based on the parameters you have provided with cyan.
- This graph also shows the fitting residuals and some diagnostics on them (STD and autocorrelation).

Step 6: Exoplanet Fitting

Evaluation of test run

- Evaluate the fitting preview before hitting the “**RUN FITTING**” button. This is an important part of the process. It will tell you if your data are good to a level that results can be extracted.
- First check the compatibility with the expected model, especially the **transit depth**. If you find large inconsistencies you may need to go back to photometry and pick different comparisons or go back to reduction and check your flat frames.
- You will realize that changing comparisons can affect your final results a lot! This is usually due to airmass effects caused by comparison stars of different spectral types. A way to be safe is to:
 - get good flat fields
 - observe long before and after the transit
 - keep your stars within the linear response range of your camera.
- The residuals are the difference between your data and the best model. *STD* and *AutoCorr* are the standard deviation and autocorrelation of the residuals, respectively. The smaller these numbers, the better the fitting.



Step 6: Exoplanet Fitting

Adjust the MCMC parameters

- HOPS uses MCMC fitting, which is a process that tries to obtain the best result by approaching it in small steps.
- The number of steps is indicated by the MCMC iterations. The default value of 5000 should be sufficient but if the result is not good (very noisy light curve) you may need to increase it to 10000.
- The MCMC burn-in parameter states how many of the initial steps should be ignored and the default value is 1000. This is because in the beginning the algorithm is trying to “find its way towards the best solution” and the results are still unstable.
- If you increase MCMC iterations, increase MCMC burn-in accordingly, but do not exceed The MCMC iterations value!
- If the fitting preview is approved press “**RUN FITTING**”

Light-curve file

PHOTOMETRY_7\PHOTOMETRY_APERTURE.b

EXPORT FOR DATABASES (ExoClock / ETD)

	Catalogue param.	<input checked="" type="checkbox"/> Enter param. manually
Planet	None	WASP-10b
Planet RA DEC (hh:mm:ss +/-dd:mm:ss)	None	23:15:58.3005 +31:27:46
Period [days]	0	3.09272813
Mid-time [BJD_TDB]	0	2456253.700518
Rp/Rs	0	0.1592
a/Rs	0	11.65
Inclination [deg]	0	88.49
Eccentricity	0	0.0
Periastron [deg]	0	0.0
M* [Fe/H, dex]	0	0.03
T* [K]	0	4675.0
log(g*) [cm/s ²]	0	4.4

MCMC options:

Iterations (def=5000) 5000

Burn-in (def=1000) 1000

De-trending: Airmass

Fit for a/Rs, i

RETURN TO MAIN MENU SAVE OPTIONS & RETURN TO MAIN MENU RETURN TO PHOTOMETRY

RUN TEST RUN FITTING

Step 6: Exoplanet Fitting

HOPS - Fitting

WASP - 10b

2016-08-10 19:16 (UT)
Dur: 5.3h / Exp: 70.0s
Filter: R

My Observatory / /

Relative flux (norm)

Residuals (norm)

Phase

STD = 6.57 ‰
AutoCorr = 0.13 (acceptable)

Legend:
x Outliers (not fitted)
— Best-fit model (De-trending: Airmass, a/R_s, i: Fixed)
T_{mid}=2457611.40955^{+0.00078}_{-0.00078}, R_p/R_{*}=0.1555^{+0.0029}_{-0.0029}
— Expected model
T_{mid}=2457611.40817, R_p/R_{*}=0.1592, O-C=2.0^{+1.1}_{-1.1} min
+ raw data

Planet	Catalogue param.	Enter param. manually
Planet	None	WASP-10b
Planet RA DEC (hh:mm:ss +/-dd:mm:ss)	None	23:15:58.3005 +31:27:46
Period [days]	0	3.09272813
Mid-time [BJD_TDB]	0	2456253.700518
R _p /R _s	0	0.1592
a/R _s	0	11.65
Inclination [deg]	0	88.49
Eccentricity	0	0.0
Periastron [deg]	0	0.0
M* [Fe/H, dex]	0	0.03
T* [K]	0	4675.0
log(g*) [cm/s ²]	0	4.4

MCMC options:
Iterations (def=5000) 5000
Burn-in (def=1000) 1000

De-trending:
Airmass
 fit for a/R_s, i

Buttons:
RETURN TO MAIN MENU
SAVE OPTIONS & RETURN TO MAIN MENU
RETURN TO PHOTOMETRY
RUN TEST
RUN FITTING

Return to the main menu without saving your work

Run a fitting preview

Run a fitting

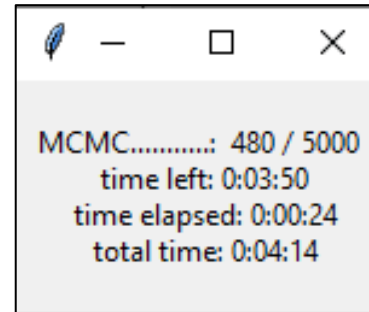
Save the current work and return to the main menu

Save the current work and return to the photometry menu

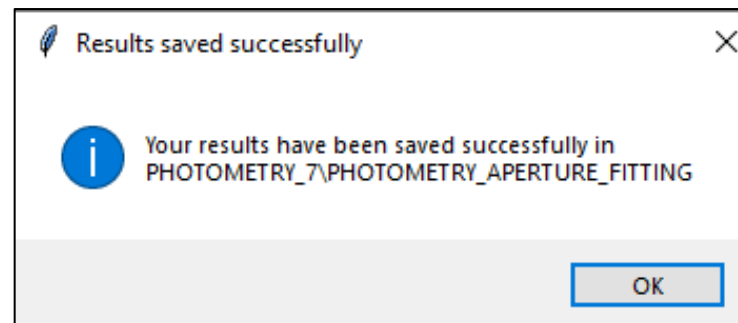
Step 6: Exoplanet Fitting

Run fitting

- During the process, the window below opens:



- When the process is finished a message is shown, that informs you about the name of the folder your files have been saved:



Step 6: Exoplanet Fitting

Output

- HOPS will create 3 new files and at least 2 new folders inside your initial data directory:
- *log.yaml*, *all_frames.pickle*, *all_stars.pickle*: supporting files (**DO NOT DELETE THEM!**)
- **REDUCED_DATA**: folder that contains the reduced data (**DO NOT DELETE OR ANOTATE DATA** in this folder, if you want to do so, work with the raw data and perform reduction again)
- **PHOTOMETRY**: folder that contains the photometry results, one for each time you run photometry or saved the photometry results.
- **PHOTOMETRY_APERTURE_FITTING** or **PHOTOMETRY_GAUSS_FITTING** (included in the photometry folder): folders that contains the fitting results on the aperture or gauss light curves, respectively, one for each time you run fitting on this specific light curve.
- Included in the **PHOTOMETRY** and the **FITTING** folders you will find .txt files with more detailed descriptions of the output. files of your final fitting.

Step 6: Exoplanet Fitting

Output

- In the folder in which your data are stored, new folders containing the results of its of your attempts are created. There you can find the files of your final fitting.

The screenshot displays a file explorer window with a list of folders and files. The main window shows a directory with folders named PHOTOMETRY_1 through PHOTOMETRY_7, and files like all_frames.pickle and all_stars.pickle. A red circle highlights the PHOTOMETRY_7 folder. A red arrow points from this folder to a sub-window that shows the contents of PHOTOMETRY_7. This sub-window contains a folder named PHOTOMETRY_APERTURE_FITTING (circled in red) and several files: ExoClock_info, FOV, log, PHOTOMETRY_a, PHOTOMETRY_APERTURE, PHOTOMETRY_g, PHOTOMETRY_GAUSS, photometry_output_description, and RESULTS. Another red arrow points from the PHOTOMETRY_APERTURE_FITTING folder to a second sub-window showing the contents of that folder. This window lists files: corner, detrended_model, detrended_model, fitting_output_description, log, model, results, and traces, along with their respective sizes and types.

Όνομα	Ημερομηνία τροποποι...	Τύπος	Μέγεθος
PHOTOMETRY_1	19/2/2025 6:27 μμ	Φάκελος αρχείων	
PHOTOMETRY_2	19/2/2025 6:55 μμ	Φάκελος αρχείων	
PHOTOMETRY_3	19/2/2025 6:58 μμ	Φάκελος αρχείων	
PHOTOMETRY_4	19/2/2025 7:00 μμ	Φάκελος αρχείων	
PHOTOMETRY_5	27/2/2025 5:23 μμ	Φάκελο	
PHOTOMETRY_6	27/2/2025 6:04 μμ	Φάκελο	
PHOTOMETRY_7	27/2/2025 7:11 μμ	Φάκελο	
REDUCED_DATA	19/2/2025 5:52 μμ	Φάκελο	
all_frames.pickle	27/2/2025 6:36 μμ	Αρχείο	
all_stars.pickle	19/2/2025 5:56 μμ	Αρχείο	
bias-001bias	24/10/2018 5:04 μμ	Αρχείο	
bias-002bias	24/10/2018 5:04 μμ	Αρχείο	
bias-003bias	24/10/2018 5:04 μμ	Αρχείο	
bias-004bias	24/10/2018 5:04 μμ	Αρχείο	
bias-005bias	24/10/2018 5:04 μμ	Αρχείο	
bias-006bias	24/10/2018 5:04 μμ	Αρχείο	
bias-007bias	24/10/2018 5:04 μμ	Αρχείο	
bias-008bias	24/10/2018 5:04 μμ	Αρχείο	
bias-009bias	24/10/2018 5:04 μμ	Αρχείο	
bias-010bias	24/10/2018 5:04 μμ	Αρχείο	
dark-001dark	24/10/2018 5:05 μμ	Αρχείο	
dark-002dark	24/10/2018 5:04 μμ	Αρχείο	
dark-003dark	24/10/2018 5:05 μμ	Αρχείο	
dark-004dark	24/10/2018 5:05 μμ	Αρχείο FIT	2.048 KB
dark-005dark	24/10/2018 5:04 μμ	Αρχείο FIT	2.048 KB
flat-001flat	24/10/2018 5:04 μμ	Αρχείο FIT	2.048 KB
flat-002flat	24/10/2018 5:04 μμ	Αρχείο FIT	2.048 KB
flat-003flat	24/10/2018 5:04 μμ	Αρχείο FIT	2.048 KB
flat-004flat	24/10/2018 5:04 μμ	Αρχείο FIT	2.048 KB

Όνομα	Ημερομηνία τροποποι...	Τύπος	Μέγεθος
PHOTOMETRY_APERTURE_FITTING	27/2/2025 7:11 μμ	Φάκελος αρχείων	
ExoClock_info	27/2/2025 6:05 μμ	Έγγραφο κειμένου	1 KB
FOV	27/2/2025 6:05 μμ	Microsoft Edge P...	438 KB
log	27/2/2025 6:05 μμ	Yaml Source File	5 KB
PHOTOMETRY_a	27/2/2025 6:05 μμ	Έγγραφο κειμένου	126 KB
PHOTOMETRY_APERTURE	27/2/2025 6:05 μμ		
PHOTOMETRY_g	27/2/2025 6:05 μμ		
PHOTOMETRY_GAUSS	27/2/2025 6:05 μμ		
photometry_output_description	27/2/2025 6:05 μμ		
RESULTS	27/2/2025 6:05 μμ		

Όνομα	Ημερομηνία τροποποι...	Τύπος	Μέγεθος
corner	27/2/2025 7:11 μμ	Microsoft Edge P...	92 KB
detrended_model	27/2/2025 7:11 μμ	Αρχείο JPG	1.691 KB
detrended_model	27/2/2025 7:11 μμ	Έγγραφο κειμένου	32 KB
fitting_output_description	27/2/2025 7:11 μμ	Έγγραφο κειμένου	5 KB
log	27/2/2025 7:11 μμ	Yaml Source File	5 KB
model	27/2/2025 7:11 μμ	Έγγραφο κειμένου	32 KB
results	27/2/2025 7:11 μμ	Έγγραφο κειμένου	3 KB
traces	27/2/2025 7:11 μμ	Microsoft Edge P...	355 KB

Step 6: Exoplanet Fitting

Export for databases

- Produce a .txt file which contains information of your observation and indicates which file to upload to keep the ExoClock's project database up to date.

HOPS - Fitting

WASP - 10b 2016-08-10 19:16 (UT)
Dur: 5.3h / Exp: 70.0s
Filter: R

My Observatory: / /

Relative flux (norm)

Residuals (norm)

STD = 6.57 %
AutoCorr = 0.13 (acceptable)

(x, y) = (61., 39.)
[11, 11, 12, 255]

Light-curve file

PHOTOMETRY_7_PHOTOMETRY_APERTURE.t

EXPORT FOR DATABASES (ExoClock / ETD)

Catalogue param. Enter param. manually

Planet	None	WASP-10b
Planet RA DEC (hh:mm:ss +/-dd:mm:ss)	None	23:15:58.3005 +31:27:46
Period [days]	0	3.09272813
Mid-time [BJD_TDB]	0	2456237.700518
Rp/Rs	0	0.1592
a/Rs	0	11.65
Inclination [deg]	0	88.49
Eccentricity	0	0.0
Periastron [deg]	0	0.0
M* [Fe/H, dex]	0	0.03
T* [K]	0	4675.0
log(g*) [cm/s ²]	0	4.4

MCMC options:

Iterations (def=5000) 5000 De-trending: Airmass

Burn-in (def=1000) 1000 Fit for a/Rs, i

EXPORT

Export Results

Database: ExoClock

Camera gain: 1.0

No transformation is needed to upload your results to ExoClock (www.exoclock.space).

When uploading you will need to use the following details:

Planet: None
Time format: JD.UTC
Time stamp: Exposure start
Flux format: Flux
Filter: R
Exposure time in seconds: 70.0

EXPORT

Export

File saved at:
HOPS_PHOTOMETRY_7_PHOTOMETRY_APERTURE_2016-08-10_None_R_70.0s_for_ExoClock.txt

OK

My profile

set default values for some parameters to save time for future use of HOPS

HOPS - My Profile

Header Keywords for useful information, if included in the FITS header:

target_ra_key	OBJCTRA,RA
target_dec_key	OBJCTDEC,DEC
observation_date_key	DATE-OBS
observation_time_key	TIME-OBS
exposure_time_key	EXPTIME
filter_key	FILTER
observatory_latitude_key	SITELAT,LAT-OBS,L
observatory_longitude_key	SITELONG,LONG-OBS
observatory_altitude_key	SITEALT,ALT-OBS,A
observatory_key	OBSERVAT
observer_key	OBSERVER
telescope_key	TELESCOP
focal_length_key	FOCALLEN
aperture_key	APTIDIA
camera_key	INSTRUME
pixel_width_key	XPIXSZ
pixel_height_key	YPIXSZ

Default values for useful information, if not included in the FITS header:

Not Applicable	
Not Applicable	
Not Applicable	
Not Applicable	
Not Applicable	
Not Applicable	
observatory_lat	
observatory_long	
observatory_alt	
observatory	My Observatory
observer	
telescope	
focal_length	
aperture	
camera	
pixel_width	
pixel_height	

Default values:

observation_files	Autosave
bias_files	bias
dark_files	dark
dark_flat_files	---
flat_files	flat
crop_edge_pixels	0

Information used only by the scheduler:

observatory_time_zone	0
observatory_horizon_s	0
observatory_horizon_sw	0
observatory_horizon_w	0
observatory_horizon_nw	0
observatory_horizon_n	0
observatory_horizon_ne	0
observatory_horizon_e	0
observatory_horizon_se	0

SAVE CHANGES & CLOSE WINDOW