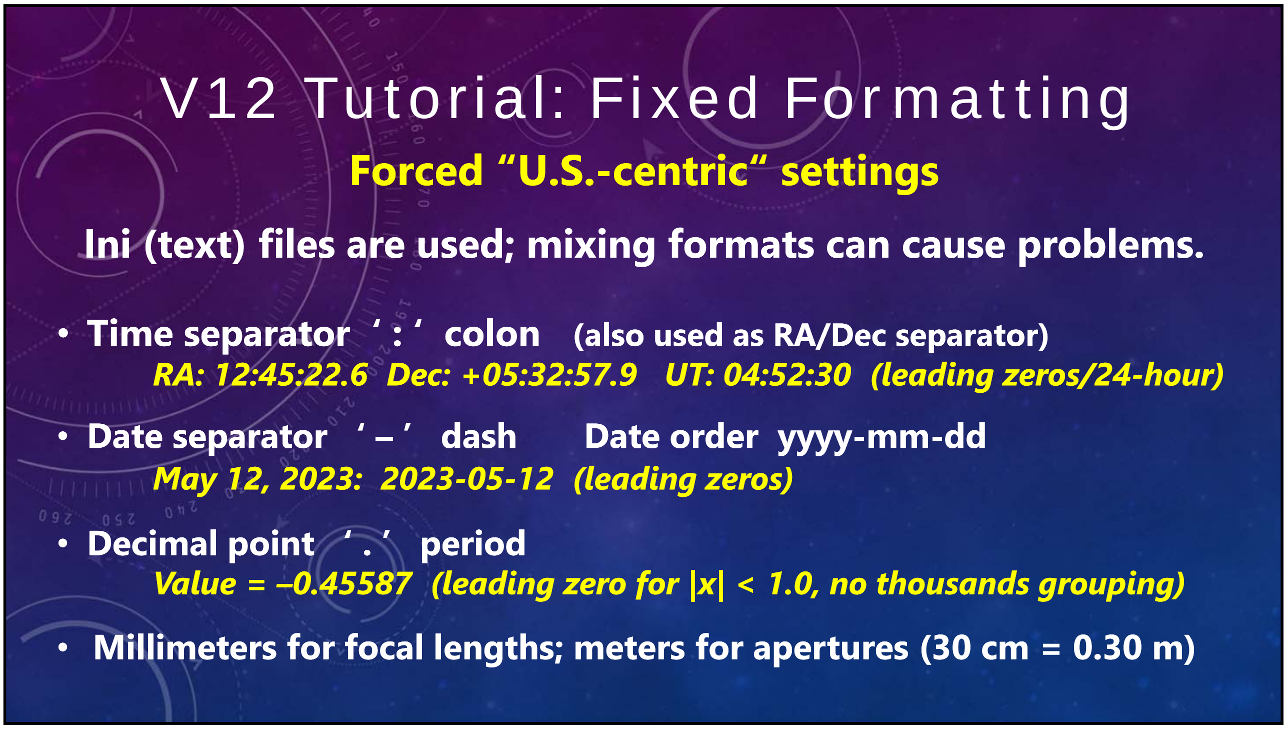
Before Getting Started…



V12 Tutorial: Fixed Formatting

Forced "U.S.-centric" settings

Ini (text) files are used; mixing formats can cause problems.

- **Time separator ' : ' colon** (also used as RA/Dec separator)
  RA: 12:45:22.6 Dec: +05:32:57.9 UT: 04:52:30 (leading zeros/24-hour)
- **Date separator ' – ' dash Date order yyyy-mm-dd**
  May 12, 2023: 2023-05-12 (leading zeros)
- **Decimal point ' . ' period**
  Value = –0.45587 (leading zero for |x| < 1.0, no thousands grouping)
- **Millimeters for focal lengths; meters for apertures (30 cm = 0.30 m)**

MPO v12 Tutorial

Multi-image Asteroid Photometry

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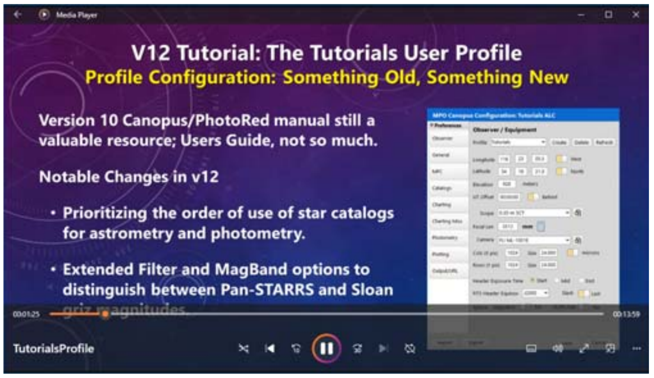
V12 Tutorial: Multi-image Asteroid Photometry

TutorialsProfile: View Me First!

TutorialsProfile.mp4

- How to create a user-profile that is ***required*** for many other tutorials.



V12 Tutorial: The Tutorials User Profile

Profile Configuration: Something Old, Something New

Version 10 Canopus/PhotoRed manual still a valuable resource; Users Guide, not so much.

Notable Changes in v12

- Prioritizing the order of use of star catalogs for astrometry and photometry.
- Extended Filter and MagBand options to distinguish between Pan-STARRS and Sloan griz magnitudes.

MPO YouTube channel *https://youtube.com/@8734Warner*

V12 Tutorial: Multi-image Asteroid Photometry

ImageForm: View Me Next!

ImageForm.mp4

- Used in all image measuring programs.
- “Sticky” image scaling and zoom.
- Set flat, dark, bias frames.
- Set aperture sizes and shapes.
- Automatch image.
- Supports only FITS images.

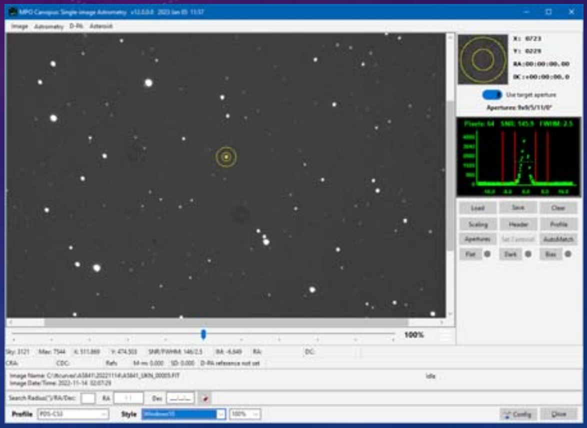
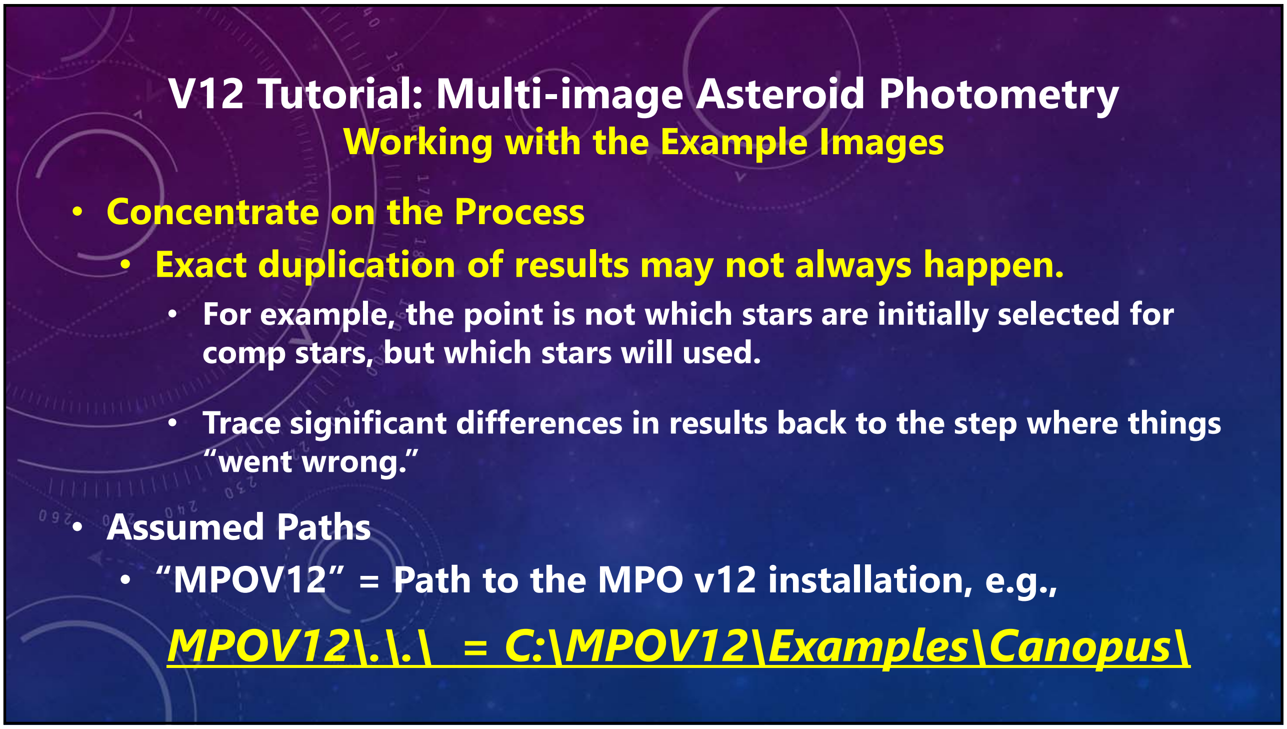


Image
Astrometry
D-PA
Asteroid
Load
Save
Clear
Scaling
Header
Profile
Apertures
Set Centroid
AutoMatch
Flat
Dark
Bias
100%
Profile
Style
Config
Close

MPO YouTube channel ***https://youtube.com/@8734Warner***

Concentrate on the Process

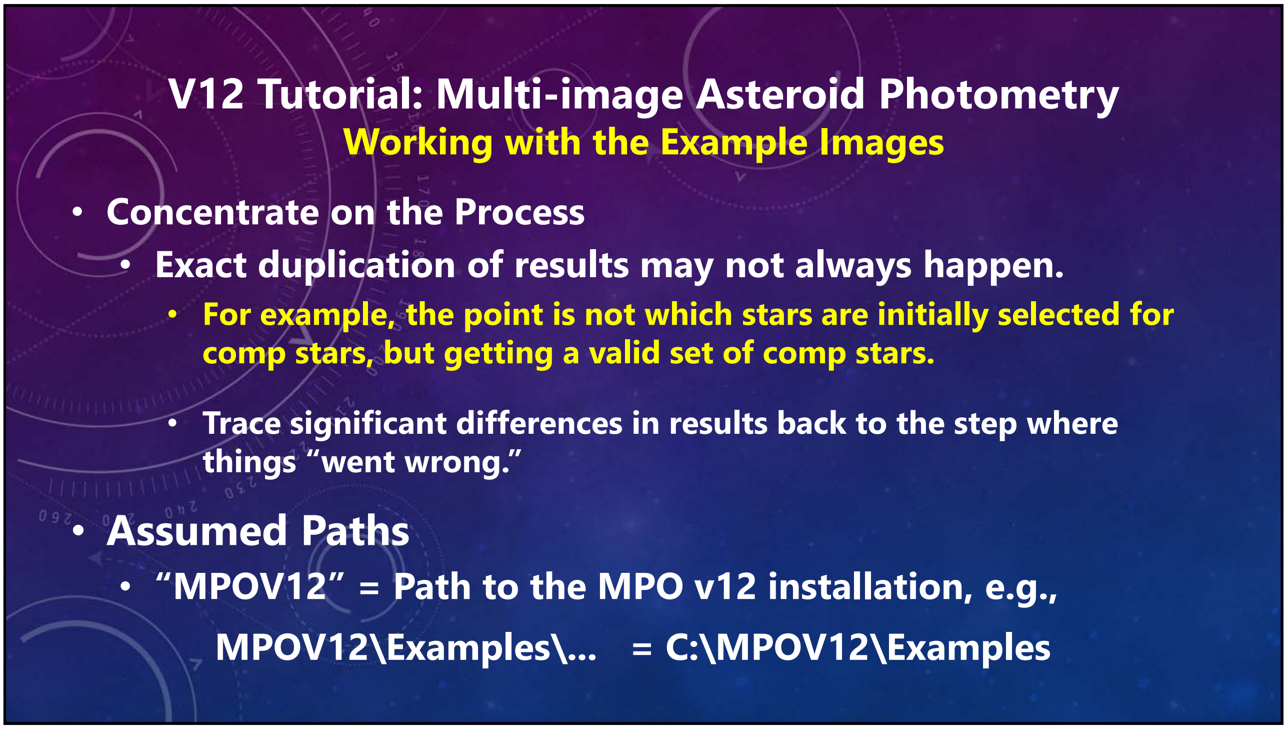


V12 Tutorial: Multi-image Asteroid Photometry

Working with the Example Images

- Concentrate on the Process
  - Exact duplication of results may not always happen.
    - For example, the point is not which stars are initially selected for comp stars, but which stars will used.
    - Trace significant differences in results back to the step where things “went wrong.”
- Assumed Paths
  - “MPOV12” = Path to the MPO v12 installation, e.g.,

MPOV12\.\.\ = C:\MPOV12\Examples\Canopus\



V12 Tutorial: Multi-image Asteroid Photometry

Working with the Example Images

- Concentrate on the Process
  - Exact duplication of results may not always happen.
    - For example, the point is not which stars are initially selected for comp stars, but getting a valid set of comp stars.
    - Trace significant differences in results back to the step where things “went wrong.”
- Assumed Paths
  - “MPOV12” = Path to the MPO v12 installation, e.g.,

MPOV12\Examples\...   = C:\MPOV12\Examples

V12 Tutorial: Multi-image Asteroid Photometry

Working with the Example Images

- Concentrate on the Process
  - Exact duplication of results may not always happen.
    - For example, the point is not which stars are initially selected for comp stars, but getting a valid set of comp stars.
    - Trace significant differences in results back to the step where things "went wrong."
- Assumed Paths
  - "MPOV12" = Path to the MPO v12 installation, e.g.,

MPOV12\Examples\... = C:\MPOV12\Examples

V12 Tutorial: Multi-image Asteroid Photometry

Working with the Example Images

- Concentrate on the Process
  - Exact duplication of results may not always happen.
    - For example, the point is not which stars are initially selected for comp stars, but getting a valid set of comp stars.
    - Trace significant differences in results back to the step where things "went wrong."
- Assumed Paths
  - "MPOV12" = Path to the MPO v12 installation, e.g.,

MPOV12\Examples\... = C:\MPOV12\Examples

Outlining the Steps

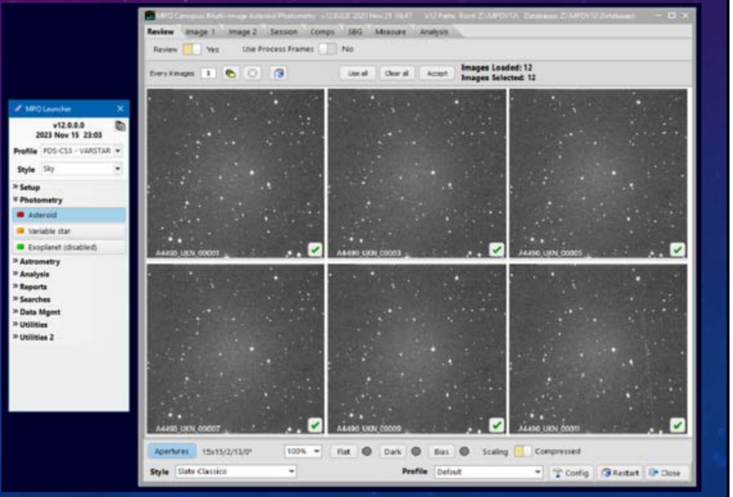
V12 Tutorial: Multi-image Asteroid Photometry

What's Covered

Measuring Images

- Set configuration profile
- Review Images (optional)
- Select asteroid on image 1
- Select asteroid on image 2
- Create session
- Select comp stars
- Select SBG stars (optional)
- Measure Images

Lightcurve analysis in separate tutorial



v12.0.0.0
2023 Nov 15 23:03
Profile: FOS-CS3 - VARSTAR
Style: Sky

Review: Yes
Use Process Frames: No
Every K images: 1
Images Loaded: 12
Images Selected: 12
Apertures: 15x15/2/13/0°
100%
Scaling: Compressed
Style: Slate Classico
Profile: Default

MPO Launcher
Setup
Photometry
Asteroid
Variable star
Exoplanet (disabled)
Astrometry
Analysis
Reports
Searches
Data Mgmt
Utilities
Utilities 2
Review
Image 1
Image 2
Session
Comps
SBG
Measure
Analysis
Use all
Clear all
Accept
A4490_UKN_00001
A4490_UKN_00003
A4490_UKN_00005
A4490_UKN_00007
A4490_UKN_00009
A4490_UKN_00011
Flat
Dark
Bias
Config
Restart
Close

Reviewing/Selecting Images

V12 Tutorial: Multi-image Asteroid Photometry

Reviewing and Selecting Images

Review: Yes

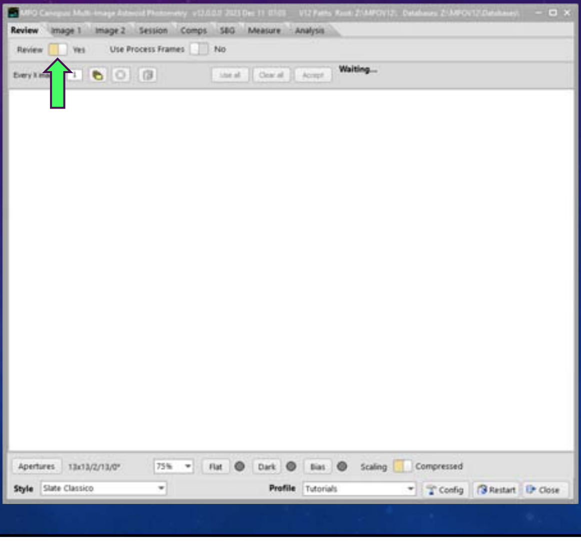
- **Yes**

  Create and display thumbnails of each selected image.

- **No**

  Load selected images without review.

Paths, not full images, are saved in memory.


Review
Image 1
Image 2
Session
Comps
SBG
Measure
Analysis
Every X ima
1
Use all
Clear all
Accept
Apertures
Flat
Dark
Bias
Config
Restart
Close

Review Yes

Use Process Frames No

Waiting...

13x13/2/13/0°

75%

Scaling Compressed

Style Slate Classico

Profile Tutorials

V12 Tutorial: Multi-image Asteroid Photometry

Reviewing and Selecting Images

Scaling: Compressed

- **Normal**

  Applies v10 "Normal" standard deviation display image scaling.

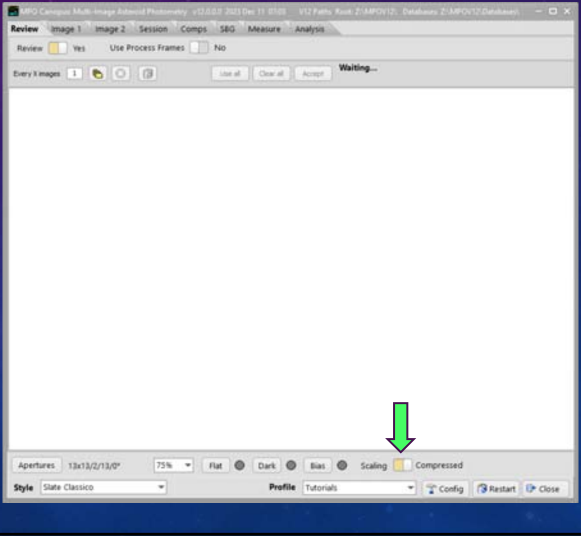
  Good if no bright object dominates

- **Compressed**

  Applies v10 "Compressed" standard deviation display image scaling.

  Better for showing faint stars and targets

Applies to all images from here on.



Review
Image 1
Image 2
Session
Comps
SBG
Measure
Analysis
Use all
Clear all
Accept
Flat
Dark
Bias
Config
Restart
Close

Review Yes

Use Process Frames No

Every X images 1

Waiting...

Apertures 13x13/2/13/0°

75%

Scaling Compressed

Style Slate Classico

Profile Tutorials

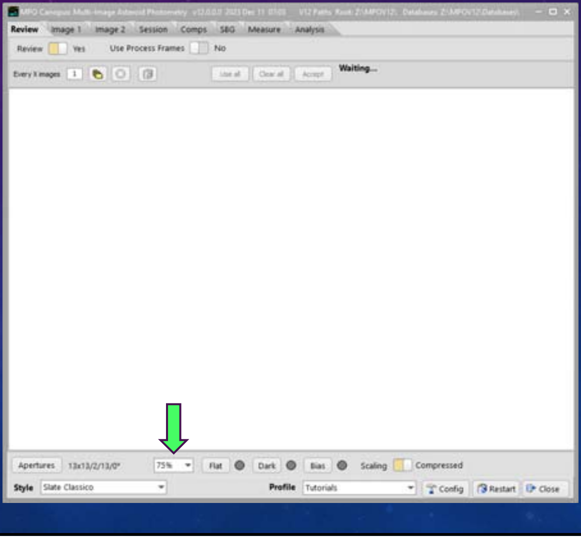
V12 Tutorial: Multi-image Asteroid Photometry

Reviewing and Selecting Images

Image Size Scaling: 75%

- Default value for all images from here on.
- Can be reset or overridden at any time.

Set the value based on row/column pixel counts of the image and display monitor resolution.



Review
Image 1
Image 2
Session
Comps
SBG
Measure
Analysis
Use all
Clear all
Accept
Flat
Dark
Bias
Config
Restart
Close

Review Yes

Use Process Frames No

Every X images 1

Waiting...

Apertures 13x13/2/13/0°

75%

Scaling Compressed

Style Slate Classico

Profile Tutorials

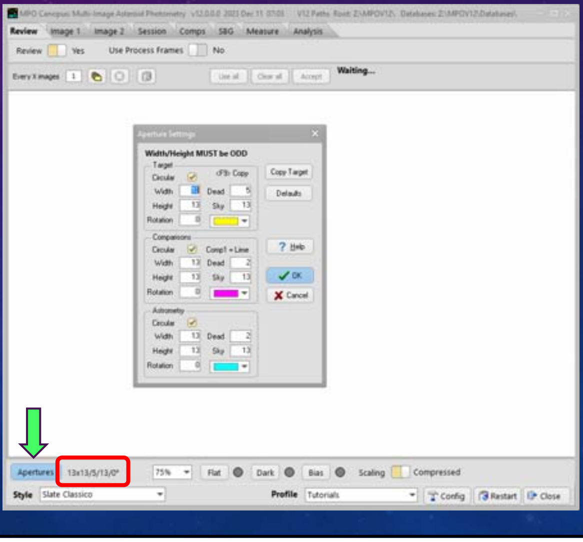
V12 Tutorial: Multi-image Asteroid Photometry

Reviewing and Selecting Images

Measuring Apertures

- Inner Width/Height
- Dead Zone
- Sky annulus width
- Rotation
- Color

- Target: 13/13/5/13/0 Yellow
- Comps: 13/13/2/13/0 Fuchsia
- Astrometry: 13/13/2/13/0 Aqua


MPO Canopus: Multi-Image Asteroid Photometry v12.0.0.0 2023 Dec 11 07:03 V12 Paths: Root: Z:\MPOV12\ Databases: Z:\MPOV12\Databases\
Review
Image 1
Image 2
Session
Comps
SBG
Measure
Analysis
Use all
Clear all
Accept
Aperture Settings
Copy Target
Defaults
? Help
OK
Cancel
Flat
Dark
Bias
Config
Restart
Close

Review Yes   Use Process Frames No

Every X images 1

Waiting...

Width/Height MUST be ODD

Target: Circular ☑ <F3> Copy; Width 13; Dead 5; Height 13; Sky 13; Rotation 0

Comparisons: Circular ☑ Comp1 = Line; Width 13; Dead 2; Height 13; Sky 13; Rotation 0

Astrometry: Circular ☑; Width 13; Dead 2; Height 13; Sky 13; Rotation 0

Apertures 13x13/5/13/0°   75%   Scaling Compressed

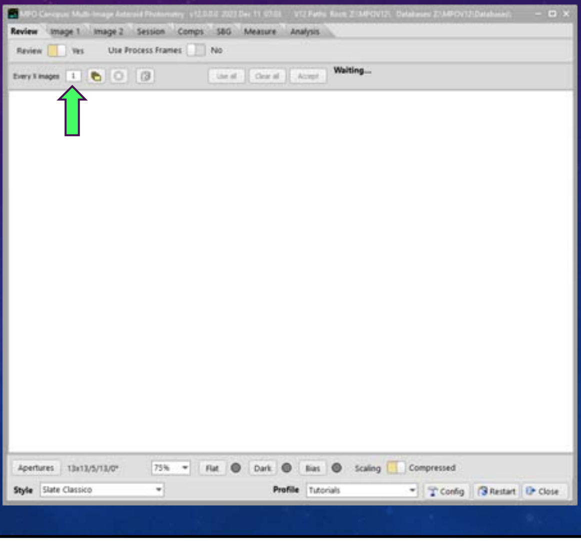
Style Slate Classico   Profile Tutorials

V12 Tutorial: Multi-image Asteroid Photometry

Reviewing and Selecting Images

Every X images: 1

- Must be > 0.
- If > 1, then a subset of images is loaded.
- X = 3, selecting images 1 – 99, Images 1, 4, 7, … 99 are selected.
- Use > 1 only if subset is useful.


MPO Canopus: Multi-Image Asteroid Photometry v12.0.0.0 2023 Dec 11 07:03 V12 Paths: Root: Z:\MPOV12\ Databases: Z:\MPOV12\Databases\
Review
Image 1
Image 2
Session
Comps
SBG
Measure
Analysis
Use all
Clear all
Accept
Flat
Dark
Bias
Config
Restart
Close

Review Yes   Use Process Frames No

Every X images 1

Waiting...

Apertures 13x13/5/13/0°   75%   Scaling Compressed

Style Slate Classico   Profile Tutorials

V12 Tutorial: Multi-image Asteroid Photometry

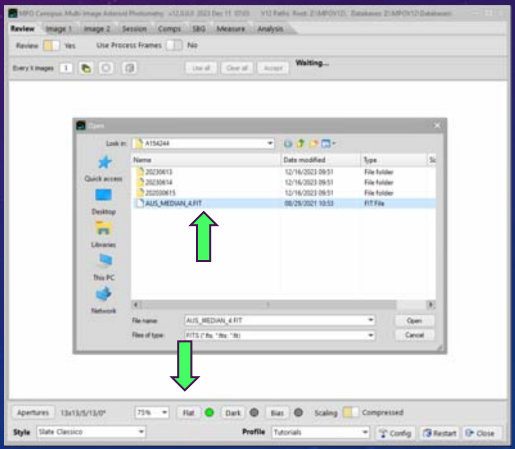
Reviewing and Selecting Images

Load Flat Frame

- Click <Flat>, select "Load"
- Navigate to

  MPOV12\.\.\Asteroid_LC\A154244\
- Select AUS_MEDIAN_4.FIT

- "LED" Colors (all frames)
  - Gray: No frame loaded.
  - Green: Frame loaded and used.
  - Red: Frame loaded, ***not*** used.


Review
Image 1
Image 2
Session
Comps
SBG
Measure
Analysis
Yes
Use Process Frames
No
Use all
Clear all
Accept
Waiting...
Look in: A154244
Quick access
Desktop
Libraries
This PC
Network
Open
Cancel
13x13/5/13/0°
75%
Flat
Dark
Bias
Scaling
Compressed
Style
Slate Classico
Profile
Tutorials
Config
Restart
Close

Name	Date modified	Type
20230613	12/16/2023 09:51	File folder
20230614	12/16/2023 09:51	File folder
202030615	12/16/2023 09:51	File folder
AUS_MEDIAN_4.FIT	08/29/2021 10:53	FIT File

File name: AUS_MEDIAN_4.FIT

Files of type: FITS (*.fts; *.fits; *.fit)

V12 Tutorial: Multi-image Asteroid Photometry

Reviewing and Selecting Images

Select Images

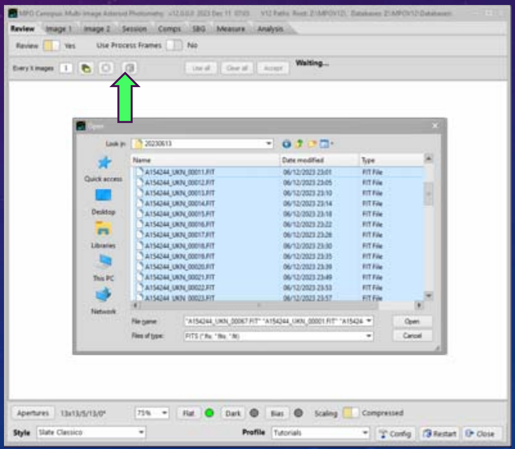
- Click <Files>
- Navigate to

MPOV12\.\.\Asteroid_LC\A154244\20230613\

- Select ***all*** images

- Generally, select the first and last image to be measured ***and all those in-between just as if assuming Every X = 1***.

- The program "does the math" to create the subset.


Review
Image 1
Image 2
Session
Comps
SBG
Measure
Analysis
Yes
Use Process Frames
No
Use all
Clear all
Accept
Waiting...
Look in: 20230613
Quick access
Desktop
Libraries
This PC
Network
Open
Cancel
13x13/5/13/0°
75%
Flat
Dark
Bias
Scaling
Compressed
Style
Slate Classico
Profile
Tutorials
Config
Restart
Close

Name	Date modified	Type
A154244_UKN_00011.FIT	06/12/2023 23:01	FIT File
A154244_UKN_00012.FIT	06/12/2023 23:05	FIT File
A154244_UKN_00013.FIT	06/12/2023 23:10	FIT File
A154244_UKN_00014.FIT	06/12/2023 23:14	FIT File
A154244_UKN_00015.FIT	06/12/2023 23:18	FIT File
A154244_UKN_00016.FIT	06/12/2023 23:22	FIT File
A154244_UKN_00017.FIT	06/12/2023 23:26	FIT File
A154244_UKN_00018.FIT	06/12/2023 23:30	FIT File
A154244_UKN_00019.FIT	06/12/2023 23:35	FIT File
A154244_UKN_00020.FIT	06/12/2023 23:39	FIT File
A154244_UKN_00021.FIT	06/12/2023 23:49	FIT File
A154244_UKN_00022.FIT	06/12/2023 23:53	FIT File
A154244_UKN_00023.FIT	06/12/2023 23:57	FIT File

File name: "A154244_UKN_00067.FIT" "A154244_UKN_00001.FIT" "A15424

Files of type: FITS (*.fts; *.fits; *.fit)

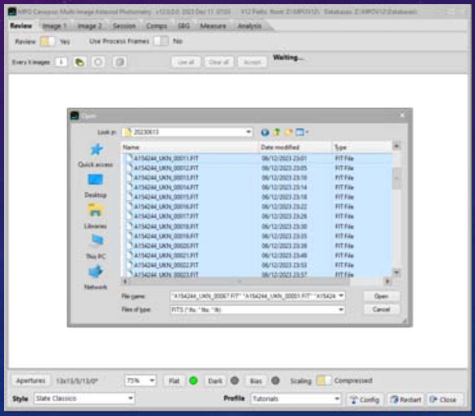
V12 Tutorial: Multi-image Asteroid Photometry

Reviewing and Selecting Images

Select Images

MPOV12\.\.\Asteroid_LC\A154244\20230613\

- Select *all* images
- Generally, select the first and last image to be measured ***and all those in-between just as if assuming Every X = 1***.
- The program "does the math" to create the subset.

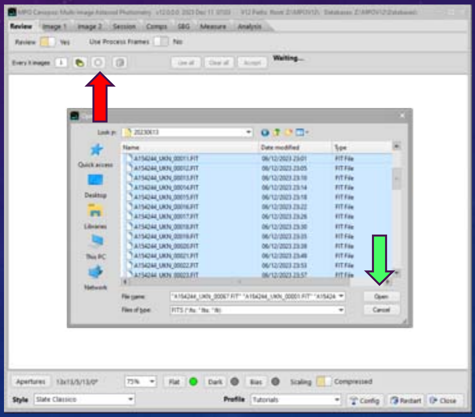

Review
Image 1
Image 2
Session
Comps
SBG
Measure
Analysis
Waiting...
Look in:
20230613
Name
Date modified
Type
Quick access
Desktop
Libraries
This PC
Network
File name:
Files of type:
Open
Cancel
Apertures
75%
Flat
Dark
Bias
Scaling
Compressed
Style
Slate Classico
Profile
Tutorials
Config
Restart
Close

V12 Tutorial: Multi-image Asteroid Photometry

Reviewing and Selecting Images

Load Selected Images

- Click <Open>.
- Message to right of <Accept> reports progress, e.g., "20 of 67."
- Click now highlighted <Abort> to stop loading. Images loaded to the point are displayed.

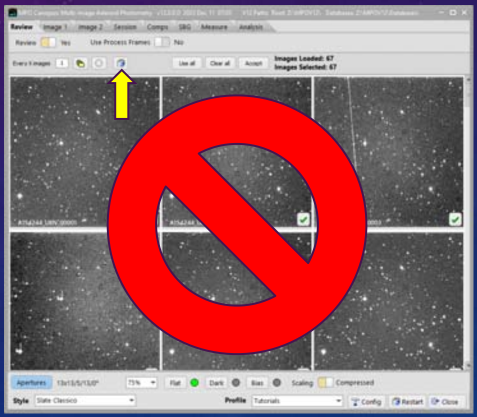

Review
Image 1
Image 2
Session
Comps
SBG
Measure
Analysis
Waiting...
Look in:
20230613
Name
Date modified
Type
Quick access
Desktop
Libraries
This PC
Network
File name:
Files of type:
Open
Cancel
Apertures
75%
Flat
Dark
Bias
Scaling
Compressed
Style
Slate Classico
Profile
Tutorials
Config
Restart
Close

V12 Tutorial: Multi-image Asteroid Photometry

Reviewing and Selecting Images

Don't Like Subset

- Click <Trash Can> to clear all images.
- Select new set of images by clicking <Files> again.

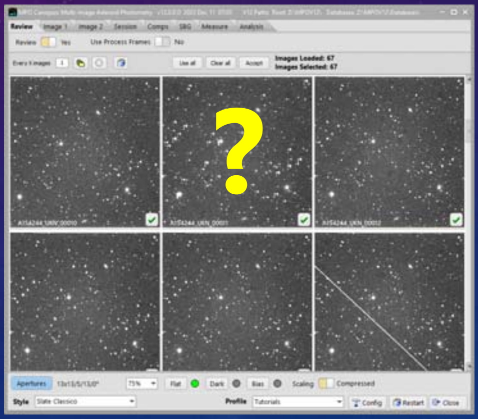


V12 Tutorial: Multi-image Asteroid Photometry

Reviewing and Selecting Images

Look for "Bad Images"

- Scroll down list to look for images that shouldn't be measured.
- Look for trailing, satellites/planes going through the field, clouds, etc.

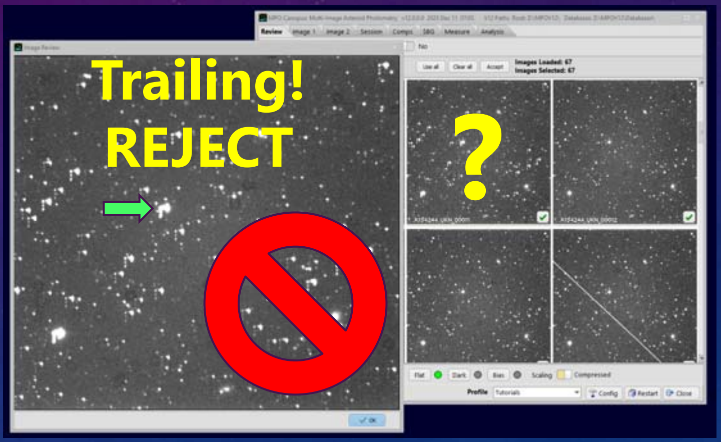


V12 Tutorial: Multi-image Asteroid Photometry

Reviewing and Selecting Images

Look for "Bad Images"

- Double-click on an image in the list to show a larger version.
- Image is trailed. Rejected!
- Click <Close>

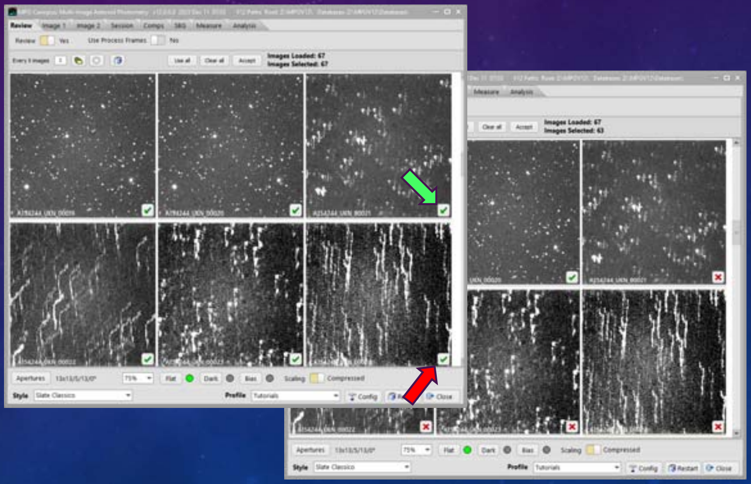


V12 Tutorial: Multi-image Asteroid Photometry

Reviewing and Selecting Images

Rejecting "Bad Images"

- Click on <Check> in first image to be excluded.
- Ctrl+Shift+Click on <Check> in last image to be excluded.

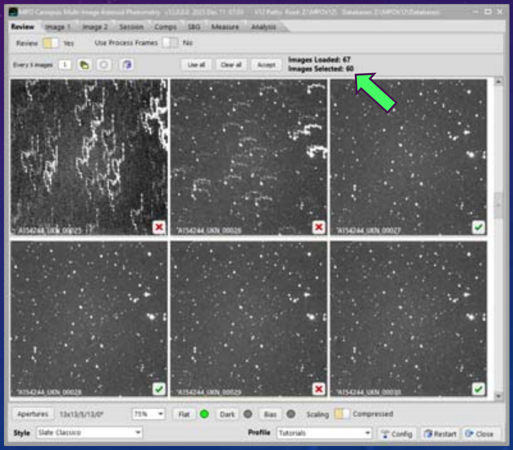


V12 Tutorial: Multi-image Asteroid Photometry

Reviewing and Selecting Images

Rejecting "Bad Images"

- To extend a ***contiguous*** range of images, Ctrl+Shift+Click on the "new last" image to be excluded.
- To exclude another image after the contiguous range, click on <Check>.
- Ctrl+Shift+Click on an image further down the list to create a new ***contiguous*** set that starts with image the image just selected.
- Note that the "Images Selected" numbers change as you select and deselect images.



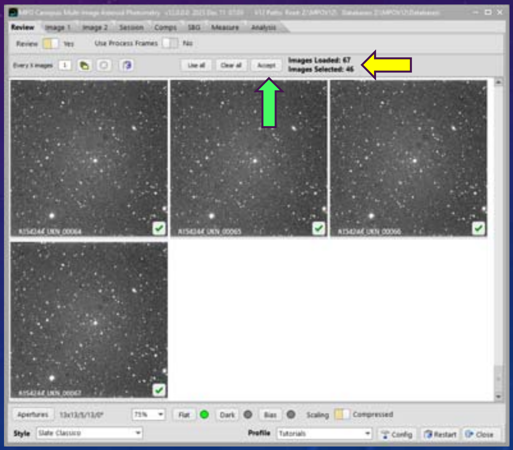
Review
Image 1
Image 2
Session
Comps
SBG
Measure
Analysis
Review Yes
Use Process Frames No
Every X images 1
Use all
Clear all
Accept
Images Loaded: 67
Images Selected: 60
Apertures
Flat
Dark
Bias
Scaling
Compressed
Style
Profile
Tutorials
Config
Restart
Close

V12 Tutorial: Multi-image Asteroid Photometry

Reviewing and Selecting Images

Accept the Selected Images

- A subset of 46 images has been selected.
- The number of images you select may be more or less but shouldn't be more than ±1-3.
- Click <Accept> to process the list and move to the Image 1 page.



Review
Image 1
Image 2
Session
Comps
SBG
Measure
Analysis
Review Yes
Use Process Frames No
Every X images 1
Use all
Clear all
Accept
Images Loaded: 67
Images Selected: 46
Apertures
Flat
Dark
Bias
Scaling
Compressed
Style
Profile
Tutorials
Config
Restart
Close

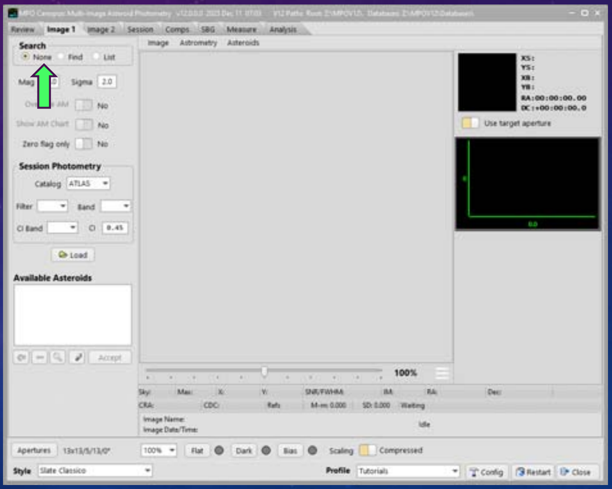
Image 1: Setting the Target

V12 Tutorial: Multi-image Asteroid Photometry

Image 1: Setting the Target

Search: None

- **None**
  Attempts to find only the asteroid derived from the FITS header.
- **Find (slow)**
  Attempts to find all asteroids in the field above a magnitude limit and sigmas above the sky value.
- **List**
  Attempts to find asteroids in a list of those known to be in the field.


Review
Image 1
Image 2
Session
Comps
SBG
Measure
Analysis
Search
None
Find
List
Image
Astrometry
Asteroids
Mag
Show AM Chart
Zero flag only
Session Photometry
Filter
Band
CI Band
Load
Available Asteroids
Accept
XS:
YS:
XB:
YB:
Use target aperture
Sky:
Max:
X:
Y:
SNR/FWHM:
IM:
RA:
Dec:
CRA:
CDC:
Refs
Image Name:
Image Date/Time:
Apertures
Flat
Dark
Bias
Scaling
Compressed
Config
Restart
Close

● None ○ Find ○ List

Sigma 2.0

Catalog ATLAS

CI 0.45

RA:00:00:00.00

DC:+00:00:00.0

100%

M-m 0.000

SD: 0.000

Waiting

Idle

Apertures 13x13/5/13/0°

Style Slate Classico

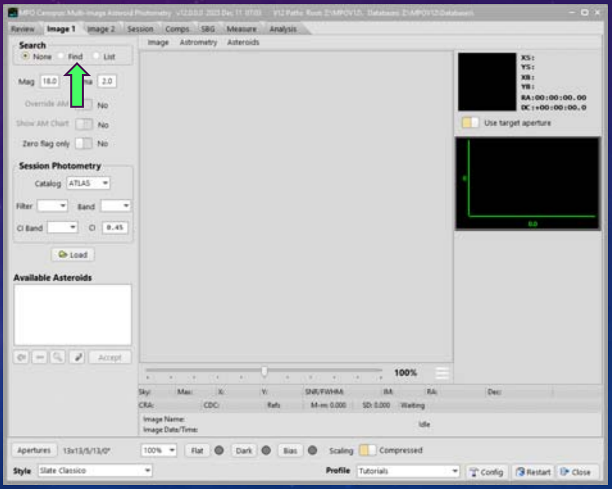
Profile Tutorials

V12 Tutorial: Multi-image Asteroid Photometry

Image 1: Setting the Target

Search: None

- None
  Attempts to find only the asteroid derived from the FITS header.
- Find (slow)
  Attempts to find all asteroids in the field above a magnitude limit and sigmas above the sky value.
- List
  Attempts to find asteroids in a list of those known to be in the field.


Review
Image 1
Image 2
Session
Comps
SBG
Measure
Analysis
Search
None
Find
List
Image
Astrometry
Asteroids
Override AM
Show AM Chart
Zero flag only
Session Photometry
Load
Available Asteroids
Accept
Use target aperture
Apertures
Flat
Dark
Bias
Scaling
Compressed
Config
Restart
Close

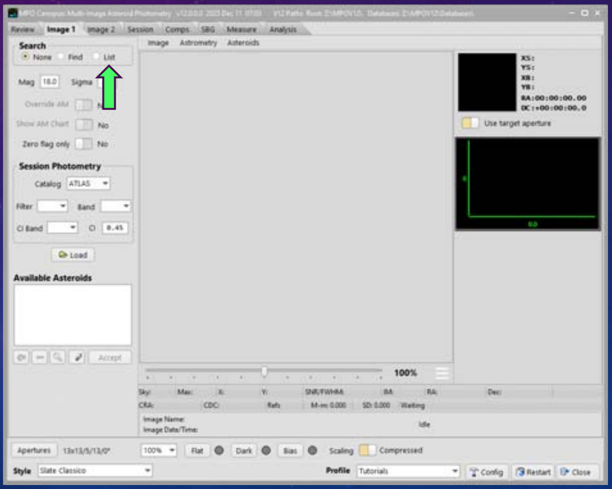
Mag 18.0 Sigma 2.0
Override AM No
Show AM Chart No
Zero flag only No
Catalog ATLAS
CI 0.45
XS:
YS:
XB:
YB:
RA:00:00:00.00
DC:+00:00:00.0
100%
Sky: Max: X: Y: SNR/FWHM: IM: RA: Dec:
CRA: CDC: Refs M-m 0.000 SD: 0.000 Waiting
Image Name:
Image Date/Time:
Idle
Apertures 13x13/5/13/0°
100%
Style Slate Classico
Profile Tutorials

V12 Tutorial: Multi-image Asteroid Photometry

Image 1: Setting the Target

Search: None

- None
  Attempts to find only the asteroid derived from the FITS header.
- Find (slow)
  Attempts to find all asteroids in the field above a magnitude limit and sigmas above the sky value.
- List
  Attempts to find asteroids in a list of those known to be in the field.


Review
Image 1
Image 2
Session
Comps
SBG
Measure
Analysis
Search
None
Find
List
Image
Astrometry
Asteroids
Override AM
Show AM Chart
Zero flag only
Session Photometry
Load
Available Asteroids
Accept
Use target aperture
Apertures
Flat
Dark
Bias
Scaling
Compressed
Config
Restart
Close

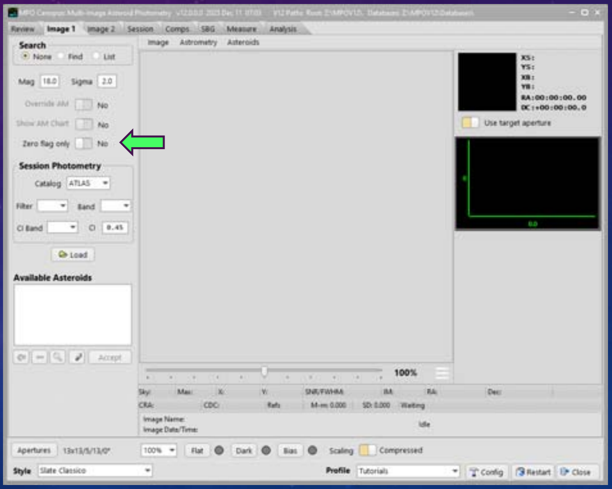
Mag 18.0 Sigma 2.0
Show AM Chart No
Zero flag only No
Catalog ATLAS
CI 0.45
XS:
YS:
XB:
YB:
RA:00:00:00.00
DC:+00:00:00.0
100%
Sky: Max: X: Y: SNR/FWHM: IM: RA: Dec:
CRA: CDC: Refs M-m 0.000 SD: 0.000 Waiting
Image Name:
Image Date/Time:
Idle
Apertures 13x13/5/13/0°
100%
Style Slate Classico
Profile Tutorials

V12 Tutorial: Multi-image Asteroid Photometry

Image 1: Setting the Target

Zero flag only: No

- **No**
  Includes all stars regardless of sextractor flag.
  e.g., involved with star, etc. Flag > 0.
- **Yes**
  Includes only stars with a sextractor flag = 0.


Review
Image 1
Image 2
Session
Comps
SBG
Measure
Analysis
Image
Astrometry
Asteroids
Search
None
Find
List
Session Photometry
Load
Available Asteroids
Accept
100%
Use target aperture
Config
Restart
Close

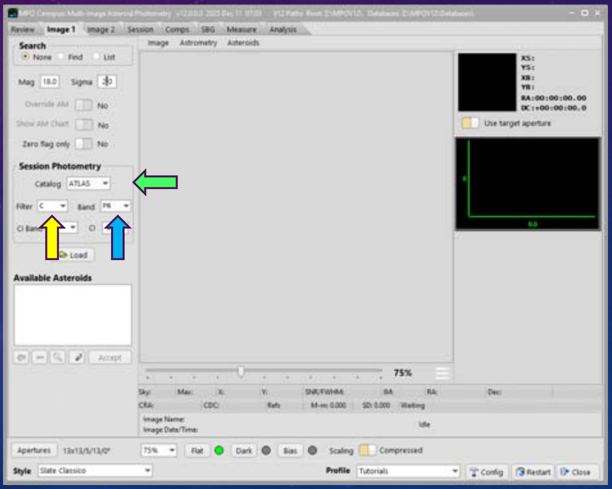
Mag 18.0 Sigma 2.0
Override AM No
Show AM Chart No
Zero flag only No
Catalog ATLAS
CI 0.45
Style Slate Classico
Profile Tutorials

V12 Tutorial: Multi-image Asteroid Photometry

Image 1: Setting the Target

Catalog: ATLAS
Filter: C
Band: PR

- **Recommended for all asteroid photometry and astrometry.**
- **Uses Gaia (DR2) astrometry and proper motions.**
- **Systematic errors in PanSTARRS griz magnitudes very low.**
- ***Do not change filter and/or band after Automatching Image 1.***


Review
Image 1
Image 2
Session
Comps
SBG
Measure
Analysis
Image
Astrometry
Asteroids
Search
None
Find
List
Session Photometry
Load
Available Asteroids
Accept
75%
Use target aperture
Config
Restart
Close

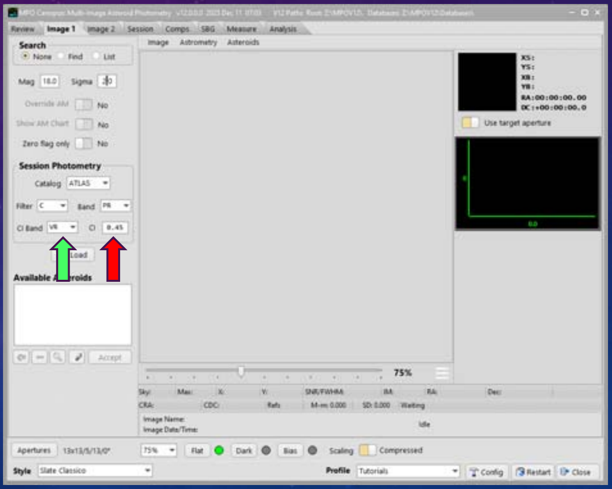
Mag 18.0 Sigma 2.0
Override AM No
Show AM Chart No
Zero flag only No
Catalog ATLAS
Filter C Band PR
Style Slate Classico
Profile Tutorials

V12 Tutorial: Multi-image Asteroid Photometry

Image 1: Setting the Target

CI Band: VR
CI: 0.45

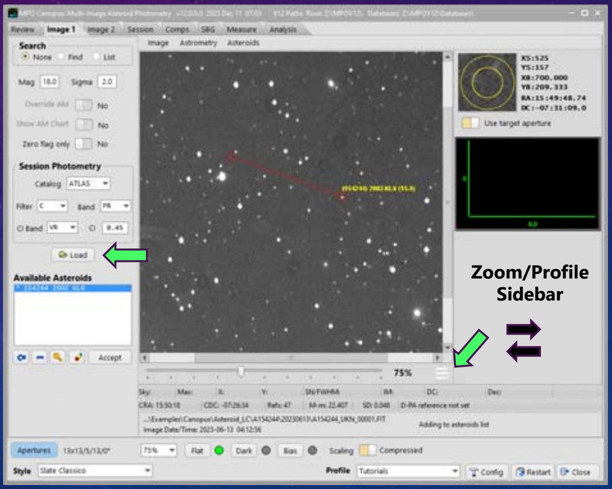
- If observing with filters, use a color index that includes two of the filters. “Clear” is *not* a valid color index filter.
- 0.45 is the value used in the LCDB if the actual value is not known. It is a compromise. For critical work, use the actual value if known.



V12 Tutorial: Multi-image Asteroid Photometry

Image 1: Setting the Target

- Click <Load>
- Wait for image to load *and* try to find asteroid.
  Wait time depends on computer, size of image, etc.
  - Use <menu> to expand or collapse zoom/profile sidebar.



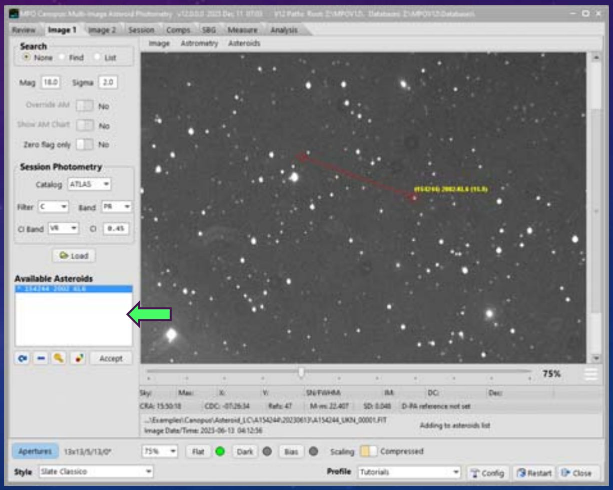
Zoom/Profile Sidebar

V12 Tutorial: Multi-image Asteroid Photometry

Image 1: Setting the Target

Available Asteroids List

- Shows all asteroids found in image.
- Object to measure is “key” target.


Available Asteroids
Image 1
Session Photometry
Load
Accept
75%

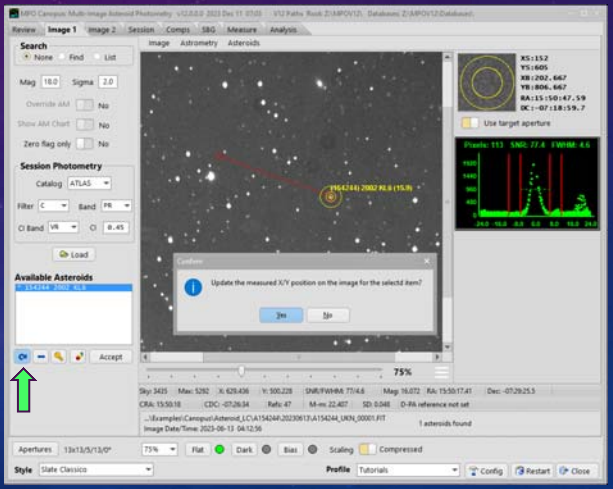
V12 Tutorial: Multi-image Asteroid Photometry

Image 1: Setting the Target

Available Asteroids List

- Shows all asteroids found in image.
- Object to measure is “key” target.
- To fix position, click on the target in image then click <Recycle>.

Expand Zoom/Profile panel and use zoom window to get the best update.


Update the measured X/Y position on the image for the selectd item?

Available Asteroids
Yes
No
Accept
75%

V12 Tutorial: Multi-image Asteroid Photometry

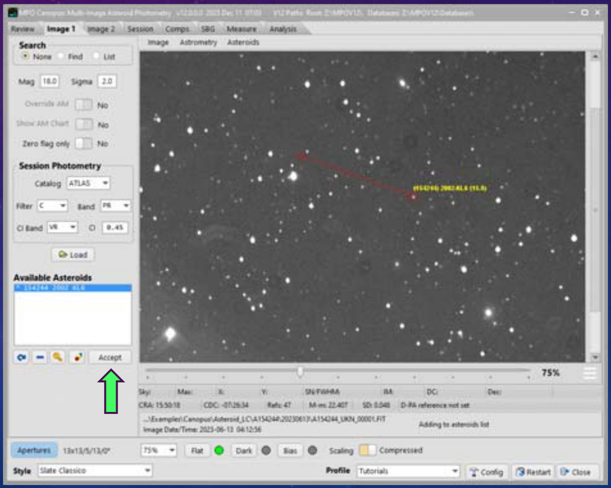
Image 1: Setting the Target

Available Asteroids List

- Shows all asteroids found in image.
- Object to measure is “key” target.
- To fix position, click on the target in image then click <Recycle>.

  Expand Zoom/Profile panel and watch zoom window to the best update.
- Click <Accept> to go to Image 2.

Do NOT Click <Load> on Image 2


Review
Image 1
Image 2
Session
Comps
SBG
Measure
Analysis
Image
Astrometry
Asteroids
Search
None
Find
List
Override AM
Show AM Chart
Zero flag only
Session Photometry
Load
Available Asteroids
Accept
Sky:
Max:
X:
Y:
SN/FWHM:
BA:
DC:
Dec:
Apertures
Flat
Dark
Bias
Scaling
Compressed
Config
Restart
Close

Mag 18.0 Sigma 2.0

Override AM No

Show AM Chart No

Zero flag only No

Catalog ATLAS

Filter C Band PR

CI Band VR CI 0.45

75%

CRA: 15:50:18 CDC: -07:26:34 Refs: 47 M-im: 22.407 SD: 0.048 D-PA reference not set

...\Examples\Canopus\Asteroid_LC\A154244\20230613\A154244_UKN_00001.FIT

Image Date/Time: 2023-06-13 04:12:56

Adding to asteroids list

Apertures 13x13/5/13/0° 75%

Style Slate Classico Profile Tutorials

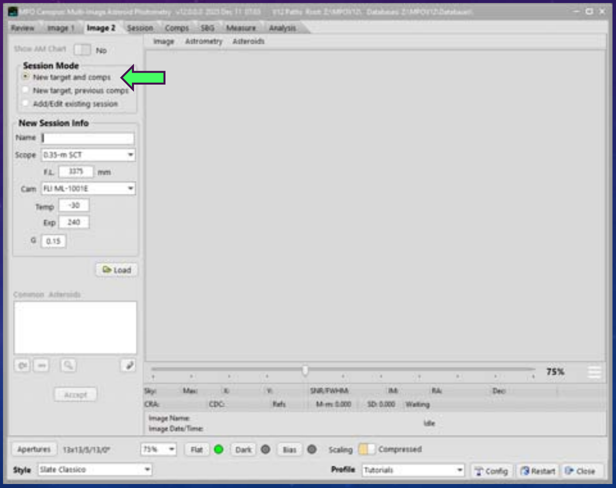
Image 2: Confirming the Target

V12 Tutorial: Multi-image Asteroid Photometry

Image 2: Confirming the Target

Session Mode: New Target/Comps

- **New Target and Comps**
  New session with undefined target and comps.
- **New Target, Previous Comps**
  New session with undefined target using comps from existing session.
- **Add/Edit Existing Session**
  Add to or edit (remeasure) observations for an existing session.


Review
Image 1
Image 2
Session
Comps
SBG
Measure
Analysis
Image
Astrometry
Asteroids
Load
Accept
Flat
Dark
Bias
Config
Restart
Close

Show AM Chart: No

Session Mode
● New target and comps
○ New target, previous comps
○ Add/Edit existing session

New Session Info
Name:
Scope: 0.35-m SCT
F.L. 3375 mm
Cam: FLI ML-1001E
Temp: -30
Exp: 240
G: 0.15

75%
Sky: Max: X: Y: SNR/FWHM: IM: RA: Dec:
CRA: CDC: Refs: M-m: 0.000 SD: 0.000 Waiting
Image Name:
Image Date/Time:
Idle

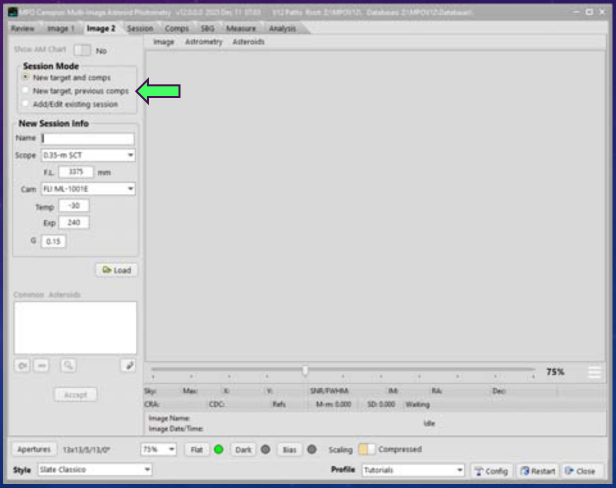
Apertures: 13x13/5/13/0"
75%
Scaling: Compressed
Style: Slate Classico
Profile: Tutorials

V12 Tutorial: Multi-image Asteroid Photometry

Image 2: Confirming the Target

Session Mode: New Target/Comps

- **New Target and Comps**
  New session with undefined target and comps.
- **New Target, Previous Comps**
  New session with undefined target using comps from existing session.
- **Add/Edit Existing Session**
  Add to or edit (remeasure) observations for an existing session.


Review
Image 1
Image 2
Session
Comps
SBG
Measure
Analysis
Image
Astrometry
Asteroids
Load
Accept
Flat
Dark
Bias
Config
Restart
Close

Show AM Chart: No

Session Mode
● New target and comps
○ New target, previous comps
○ Add/Edit existing session

New Session Info
Name:
Scope: 0.35-m SCT
F.L. 3375 mm
Cam: FLI ML-1001E
Temp: -30
Exp: 240
G: 0.15

75%
Sky: Max: X: Y: SNR/FWHM: IM: RA: Dec:
CRA: CDC: Refs: M-m: 0.000 SD: 0.000 Waiting
Image Name:
Image Date/Time:
Idle

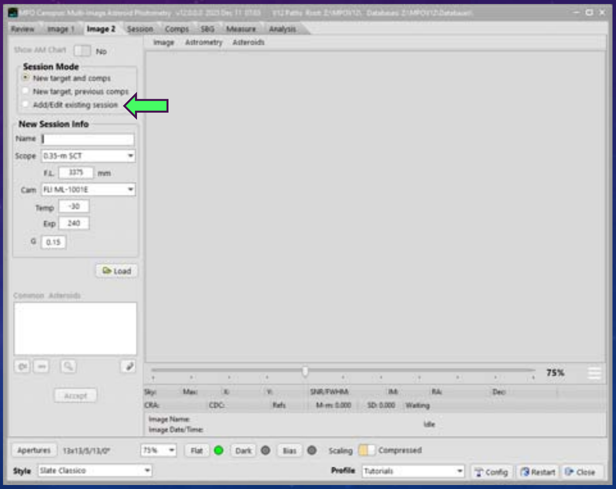
Apertures: 13x13/5/13/0"
75%
Scaling: Compressed
Style: Slate Classico
Profile: Tutorials

V12 Tutorial: Multi-image Asteroid Photometry

Image 2: Confirming the Target

Session Mode: New Target/Comps

- **New Target and Comps**
  New session with undefined target and comps.
- **New Target, Previous Comps**
  New session with undefined target using comps from existing session.
- **Add/Edit Existing Session**
  Add to or edit (remeasure) observations for an existing session.


Review
Image 1
Image 2
Session
Comps
SBG
Measure
Analysis
Image
Astrometry
Asteroids
Load
Accept
Apertures
Flat
Dark
Bias
Config
Restart
Close

Show AM Chart: No

Session Mode
● New target and comps
○ New target, previous comps
○ Add/Edit existing session

New Session Info
Name:
Scope: 0.35-m SCT
F.L.: 3375 mm
Cam: FLI ML-1001E
Temp: -30
Exp: 240
G: 0.15

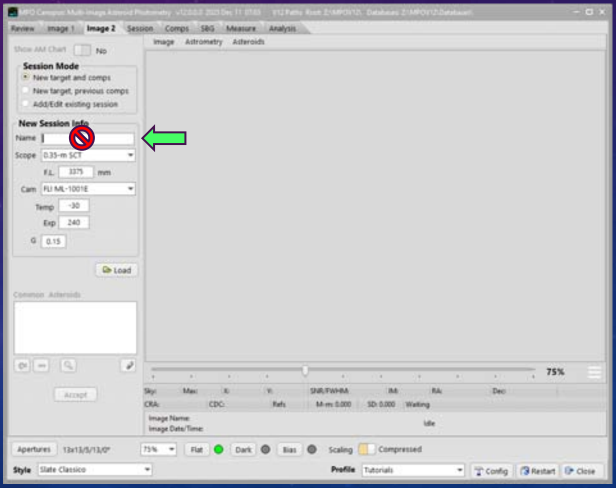
Apertures: 13x13/5/13/0°
75%
Style: Slate Classico
Profile: Tutorials

V12 Tutorial: Multi-image Asteroid Photometry

Image 2: Confirming the Target

Session Info: Name: [empty]

- Used only if target name different from the one derived from FITS header or the selected "key" target if multiple targets in image.


Review
Image 1
Image 2
Session
Comps
SBG
Measure
Analysis
Image
Astrometry
Asteroids
Load
Accept
Apertures
Flat
Dark
Bias
Config
Restart
Close

Show AM Chart: No

Session Mode
● New target and comps
○ New target, previous comps
○ Add/Edit existing session

New Session Info
Name:
Scope: 0.35-m SCT
F.L.: 3375 mm
Cam: FLI ML-1001E
Temp: -30
Exp: 240
G: 0.15

Apertures: 13x13/5/13/0°
75%
Style: Slate Classico
Profile: Tutorials

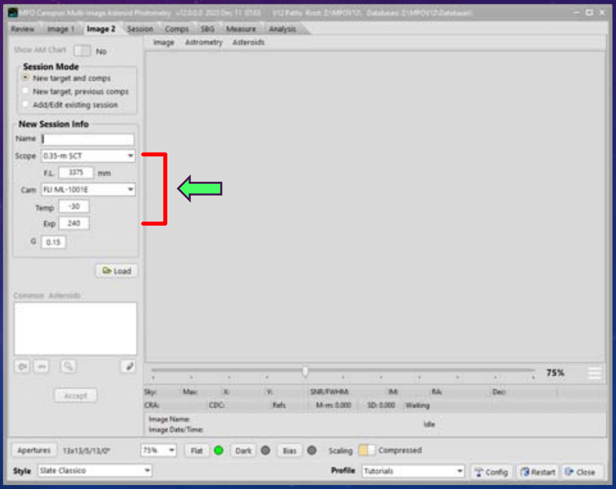
V12 Tutorial: Multi-image Asteroid Photometry

Image 2: Confirming the Target

Session Info: Confirm Equipment

- Change Telescope info if default values are incorrect.
- Change Camera info if default values are incorrect.
- Exposure (in seconds) is taken from FITS header; edit *__only__* if exposures are *__known__* to be different.

  The exposures for __all__ images in the session __must__ be the same as the new value.


Review
Image 1
Image 2
Session
Comps
SBG
Measure
Analysis
Image
Astrometry
Asteroids
Show AM Chart
No
Load
Common Asteroids
Accept
75%
Sky:
Max:
X:
Y:
SNR/FWHM:
IM:
RA:
Dec:
CRA:
CDC:
Refs:
M-m: 0.000
SD: 0.000
Waiting
Image Name:
Image Date/Time:
Idle
Apertures
13x13/5/13/0°
Flat
Dark
Bias
Scaling
Compressed
Config
Restart
Close

Session Mode
- ● New target and comps
- ○ New target, previous comps
- ○ Add/Edit existing session

New Session Info

Name:
Scope: 0.35-m SCT
F.L.: 3375 mm
Cam: FLI ML-1001E
Temp: -30
Exp: 240
G: 0.15

75%
Style: Slate Classico
Profile: Tutorials

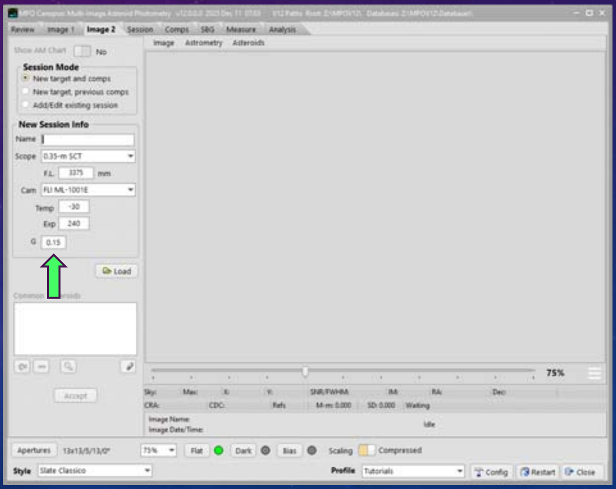
V12 Tutorial: Multi-image Asteroid Photometry

Image 2: Confirming the Target

Session Info: G: 0.15

- Use MPC default unless using a known different value.
- Changing *G* changes corrections for phase angle; this changes derived magnitudes during period analysis.
- Can be overridden during analysis.

All sessions used during period analysis for the target __must__ use the same value of G. If that value is different from the value in session records, update the session records using SessionManger.


Review
Image 1
Image 2
Session
Comps
SBG
Measure
Analysis
Image
Astrometry
Asteroids
Show AM Chart
No
Load
Common Asteroids
Accept
75%
Sky:
Max:
X:
Y:
SNR/FWHM:
IM:
RA:
Dec:
CRA:
CDC:
Refs:
M-m: 0.000
SD: 0.000
Waiting
Image Name:
Image Date/Time:
Idle
Apertures
13x13/5/13/0°
Flat
Dark
Bias
Scaling
Compressed
Config
Restart
Close

Session Mode
- ● New target and comps
- ○ New target, previous comps
- ○ Add/Edit existing session

New Session Info

Name:
Scope: 0.35-m SCT
F.L.: 3375 mm
Cam: FLI ML-1001E
Temp: -30
Exp: 240
G: 0.15

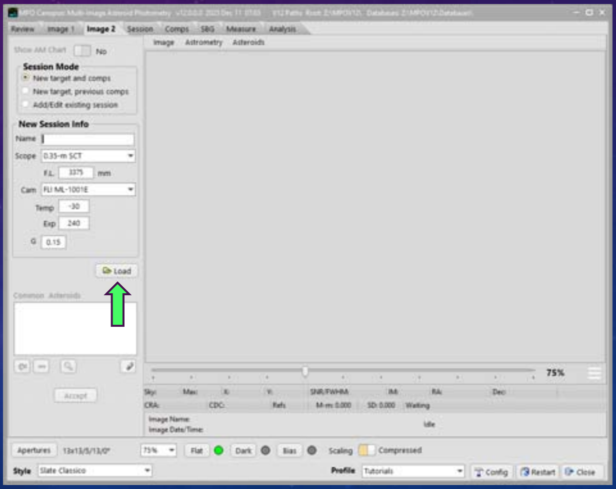
75%
Style: Slate Classico
Profile: Tutorials

V12 Tutorial: Multi-image Asteroid Photometry

Image 2: Confirming the Target

- Click <Load>
- Wait for image to load *and* try to find asteroid.

  Wait time depends on computer, size of image, etc.


MPO Canopus: Multi-image Asteroid Photometry v12.0.0.0 2023 Dec 11 07:03 V12 Paths: Root: Z:\MPOV12\ Databases: Z:\MPOV12\Databases\

Show AM Chart: No

Session Mode
○ New target and comps
○ New target, previous comps
○ Add/Edit existing session

New Session Info
Name
Scope: 0.35-m SCT
F.L.: 3375 mm
Cam: FLI ML-1001E
Temp: -30
Exp: 240
G: 0.15

Apertures: 13x13/5/13/0°
Style: Slate Classico
Profile: Tutorials
Review
Image 1
Image 2
Session
Comps
SBG
Measure
Analysis
Image
Astrometry
Asteroids
Load
Common Asteroids
Accept
75%
Sky:
Max:
X:
Y:
SNR/FWHM:
IM:
RA:
Dec:
CRA:
CDC:
Refs:
M-m: 0.000
SD: 0.000
Waiting
Image Name:
Image Date/Time:
Idle
Flat
Dark
Bias
Scaling
Compressed
Config
Restart
Close

V12 Tutorial: Multi-image Asteroid Photometry

Image 2: Confirming the Target

Common Targets Form

- Confirm highlighted object is the same as on Image 1.
- Click <Accept> on Common Targets form.
- To fix position, click on the target in image then click <Recycle>.

  Expand Zoom/Profile panel and use zoom window to get the best update.

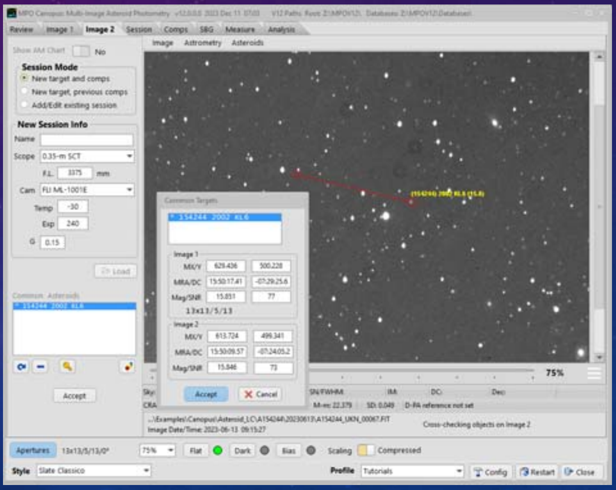

Common Targets
* 154244 2002 KL6

Image 1
MX/Y: 629.436 500.228
MRA/DC: 15:50:17.41 -07:29:25.6
Mag/SNR: 15.851 77
13x13/5/13

Image 2
MX/Y: 613.724 499.341
MRA/DC: 15:50:09.57 -07:24:05.2
Mag/SNR: 15.846 73

...\Examples\Canopus\Asteroid_LC\A154244\20230613\A154244_UKN_00067.FIT
Image Date/Time: 2023-06-13 09:15:27
Cross-checking objects on Image 2

M-m: 22.379 SD: 0.049 D-FA reference not set

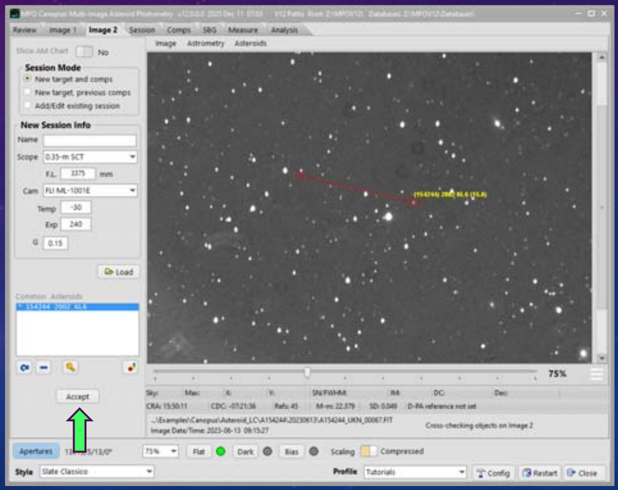
Scope: 0.35-m SCT
F.L.: 3375 mm
Cam: FLI ML-1001E
Temp: -30
Exp: 240
G: 0.15
Apertures: 13x13/5/13/0°
Style: Slate Classico
Profile: Tutorials
(154244) 2002 KL6 (15.8)
Common Asteroids
* 154244 2002 KL6
Load
Accept
Cancel
75%
Flat
Dark
Bias
Scaling
Compressed
Config
Restart
Close

V12 Tutorial: Multi-image Asteroid Photometry

Image 2: Confirming the Target

Create Session

- **Click <Accept> on Main form.**
- **Wait for form to go to the Sessions page.**
  This may take a few seconds and the form may disappear or go black. PATIENCE!


Review
Image 1
Image 2
Session
Comps
SBG
Measure
Analysis
Image
Astrometry
Asteroids
(154244) 2002 KL6 (15.8)
Load
Accept
75%
Apertures
Flat
Dark
Bias
Scaling
Compressed
Config
Restart
Close

Show AM Chart No

Session Mode
● New target and comps
○ New target, previous comps
○ Add/Edit existing session

New Session Info
Name
Scope 0.35-m SCT
F.L. 3375 mm
Cam FLI ML-1001E
Temp -30
Exp 240
G 0.15

Common Asteroids
* 154244 2002 KL6

Sky: Max: X: Y: SN/FWHM IM: DC: Dec:
CRA: 15:50:11 CDC: -07:21:36 Refs: 45 M-m: 22.379 SD: 0.049 D-PA reference not set
..\Examples\Canopus\Asteroid_LC\A154244\20230613\A154244_UKN_00067.FIT
Image Date/Time: 2023-06-13 09:15:27
Cross-checking objects on Image 2
Apertures 13x13/5/13/0° 75%
Style Slate Classico
Profile Tutorials

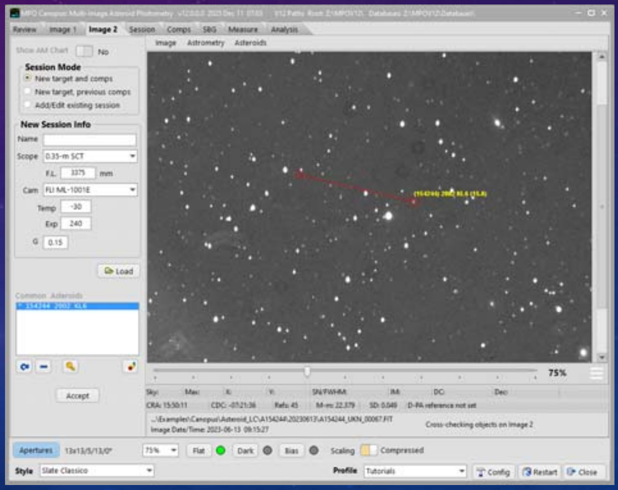
V12 Tutorial: Multi-image Asteroid Photometry

Image 2: Confirming the Target

Create Session

- Click <Accept> on Main form.
- **Wait for form to go to the Sessions page.**
  This may take a few seconds and the form may disappear and/or go black. This depends on the CPU load and hard drive speed.

BE PATIENT!


Review
Image 1
Image 2
Session
Comps
SBG
Measure
Analysis
Image
Astrometry
Asteroids
(154244) 2002 KL6 (15.8)
Load
Accept
75%
Apertures
Flat
Dark
Bias
Scaling
Compressed
Config
Restart
Close

Show AM Chart No

Session Mode
● New target and comps
○ New target, previous comps
○ Add/Edit existing session

New Session Info
Name
Scope 0.35-m SCT
F.L. 3375 mm
Cam FLI ML-1001E
Temp -30
Exp 240
G 0.15

Common Asteroids
* 154244 2002 KL6

Sky: Max: X: Y: SN/FWHM IM: DC: Dec:
CRA: 15:50:11 CDC: -07:21:36 Refs: 45 M-m: 22.379 SD: 0.049 D-PA reference not set
..\Examples\Canopus\Asteroid_LC\A154244\20230613\A154244_UKN_00067.FIT
Image Date/Time: 2023-06-13 09:15:27
Cross-checking objects on Image 2
Apertures 13x13/5/13/0° 75%
Style Slate Classico
Profile Tutorials

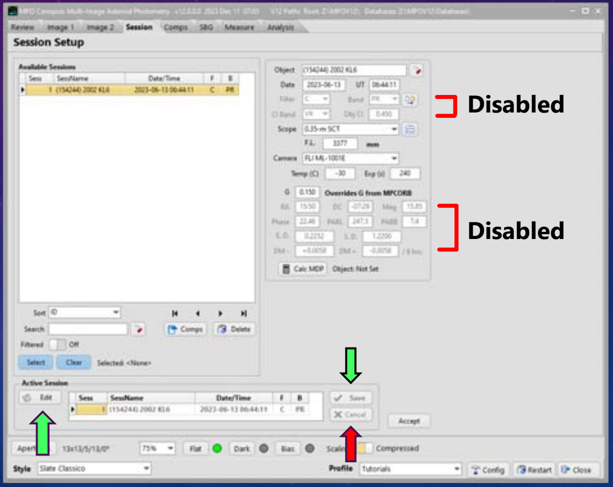
Confirming the Session

V12 Tutorial: Multi-image Asteroid Photometry

Confirming the Session

Review Session

- Confirm telescope, camera, and *G*.
- To Change a Setting: ***Use caution.***
  - Click <Edit>.
  - Change Scope, Camera, F.L., Camera, and *G*.
  - If *G* is changed, click <Calc MDP>
  - Do not change any value ***unless you are certain that it is significantly wrong.***
  - Click <Save> (save changes) or <Cancel> (keep original values).



Session Setup

Available Sessions

Sess	SessName	Date/Time	F	B
1	(154244) 2002 KL6	2023-06-13 06:44:11	C	PR

Object (154244) 2002 KL6

Date 2023-06-13 UT 06:44:11

Scope 0.35-m SCT

F.L. 3377 mm

Camera FLI ML-1001E

Temp (C) -30 Exp (s) 240

G 0.150 Overrides G from MPCORB

Object: Not Set

Selected: <None>

Active Session

Sess	SessName	Date/Time	F	B
1	(154244) 2002 KL6	2023-06-13 06:44:11	C	PR

Style Slate Classico

Profile Tutorials

Review
Image 1
Image 2
Session
Comps
SBG
Measure
Analysis
Sort
Search
Filtered
Off
Comps
Delete
Select
Clear
Calc MDP
Edit
Save
Cancel
Accept
Flat
Dark
Bias
Compressed
Config
Restart
Close
Disabled
Disabled

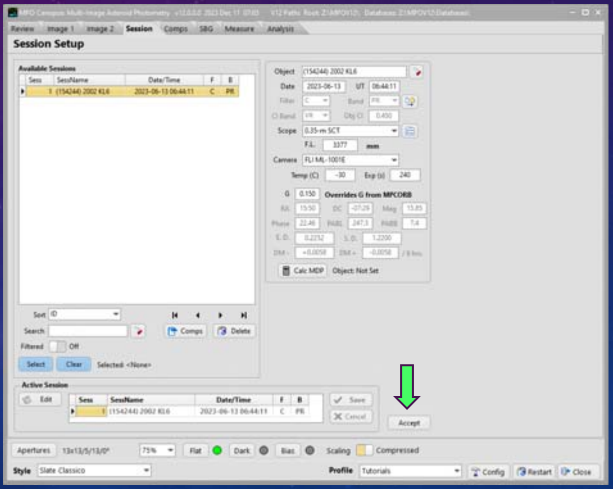
V12 Tutorial: Multi-image Asteroid Photometry

Confirming the Session

Accept Session

- Click <Accept> to accept session.

  Program goes to Comps page.


Review
Image 1
Image 2
Session
Comps
SBG
Measure
Analysis
Session Setup
Available Sessions
Comps
Delete
Select
Clear
Active Session
Edit
Save
Cancel
Accept
Calc MDP
Flat
Dark
Bias
Config
Restart
Close

Sess	SessName	Date/Time	F	B
1	(154244) 2002 KL6	2023-06-13 06:44:11	C	PR

Object (154244) 2002 KL6
Date 2023-06-13 UT 06:44:11
Filter C Band PR
CI Band VR Obj CI 0.450
Scope 0.35-m SCT
F.L. 3377 mm
Camera FLI ML-1001E
Temp (C) -30 Exp (s) 240
G 0.150 Overrides G from MPCORB
RA 15:50 DC -07:29 Mag 13.85
Phase 22.46 PABL 247.3 PABB 7.4
E.D. 0.2252 S.D. 1.2200
DM - +0.0058 DM + -0.0058 / 8 hrs
Object: Not Set
Sort ID
Search
Filtered Off
Selected: <None>

Active Session

Sess	SessName	Date/Time	F	B
1	(154244) 2002 KL6	2023-06-13 06:44:11	C	PR

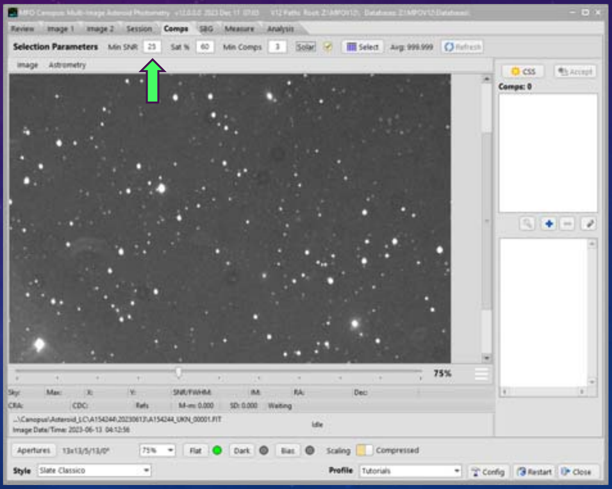
Apertures 13x13/5/13/0° 75% Scaling Compressed
Style Slate Classico
Profile Tutorials

Selecting Comp Stars

V12 Tutorial: Multi-image Asteroid Photometry

Selecting Comp Stars

- **Min SNR: 25**
  - Minimum SNR for a star to be considered acceptable comp star candidate.
  - Must also be from Priority = 1 star catalog (ATLAS in this case), unless too few stars, and then Priority = 2 stars are used.


Review
Image 1
Image 2
Session
Comps
SBG
Measure
Analysis
Image
Astrometry
Solar
Select
Refresh
CSS
Accept
75%
Apertures
Flat
Dark
Bias
Scaling
Compressed
Config
Restart
Close

Selection Parameters Min SNR 25 Sat % 60 Min Comps 3 Avg: 999.999

Comps: 0

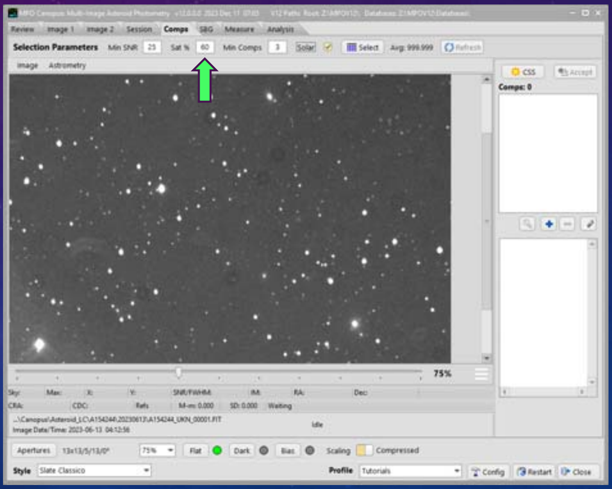
Style Slate Classico

Profile Tutorials

V12 Tutorial: Multi-image Asteroid Photometry

Selecting Comp Stars

- **Sat %: 60**
  - Percent of maximum pixel value.
  - 16-bit max: 65,535 x 0.6 = 39,231
    Config Sat % = 90, i.e., saturation value >= 58,982. 60% limit is well below saturation.
  - Helps avoid comp star saturation as air mass (and extinction) decreases.
  - Helps avoid always using first brightest 15 stars.


Review
Image 1
Image 2
Session
Comps
SBG
Measure
Analysis
Image
Astrometry
Solar
Select
Refresh
CSS
Accept
75%
Apertures
Flat
Dark
Bias
Scaling
Compressed
Config
Restart
Close

Selection Parameters Min SNR 25 Sat % 60 Min Comps 3 Avg: 999.999

Comps: 0

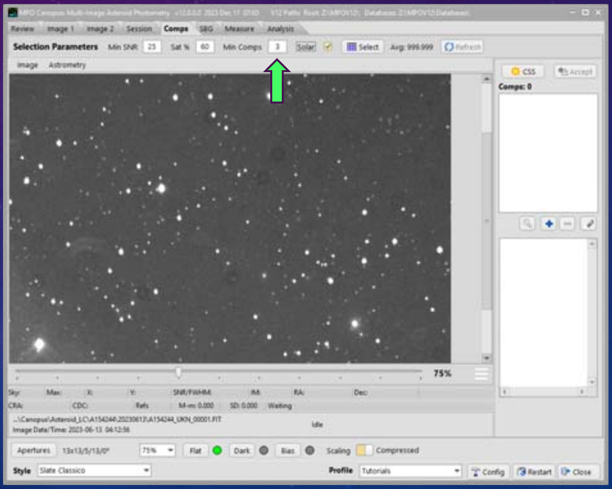
Style Slate Classico

Profile Tutorials

V12 Tutorial: Multi-image Asteroid Photometry

Selecting Comp Stars

- Min Comps: 3
  - The more the better.
  - Maximum allowed is 15.
  - Consider the number of stars in the field; don’t set the value *too* high.



Selection Parameters Min SNR 25 Sat % 60 Min Comps 3 Solar ☑ Avg: 999.999

Comps: 0

..\Canopus\Asteroid_LC\A154244\20230613\A154244_UKN_00001.FIT

Image Date/Time: 2023-06-13 04:12:56

Apertures 13x13/5/13/0* 75%

Style Slate Classico

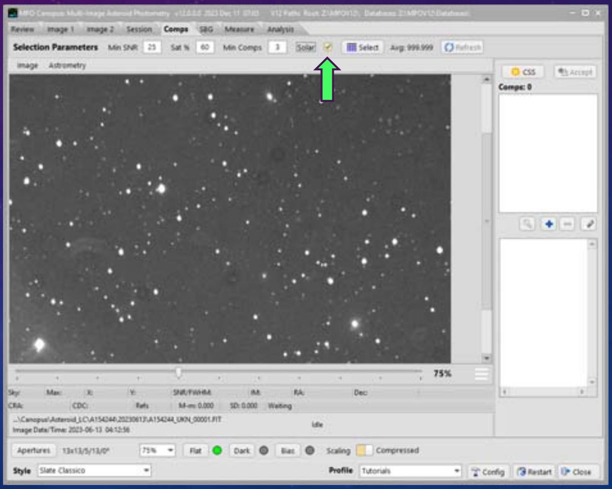
Profile Tutorials

Review
Image 1
Image 2
Session
Comps
SBG
Measure
Analysis
Select
Refresh
Image
Astrometry
CSS
Accept
75%
Sky:
Max:
X:
Y:
SNR/FWHM:
IM:
RA:
Dec:
CRA:
CDC:
Refs
M-m: 0.000
SD: 0.000
Waiting
Idle
Flat
Dark
Bias
Scaling
Compressed
Config
Restart
Close

V12 Tutorial: Multi-image Asteroid Photometry

Selecting Comp Stars

- Solar: Checked
  - Solar = 0.45 ≤ B-V ≤ 0.95
  - For asteroids, use solar-color stars even if applying transforms now or latter.
  - Helps minimize errors due to color differences.



Selection Parameters Min SNR 25 Sat % 60 Min Comps 3 Solar ☑ Avg: 999.999

Comps: 0

..\Canopus\Asteroid_LC\A154244\20230613\A154244_UKN_00001.FIT

Image Date/Time: 2023-06-13 04:12:56

Apertures 13x13/5/13/0* 75%

Style Slate Classico

Profile Tutorials

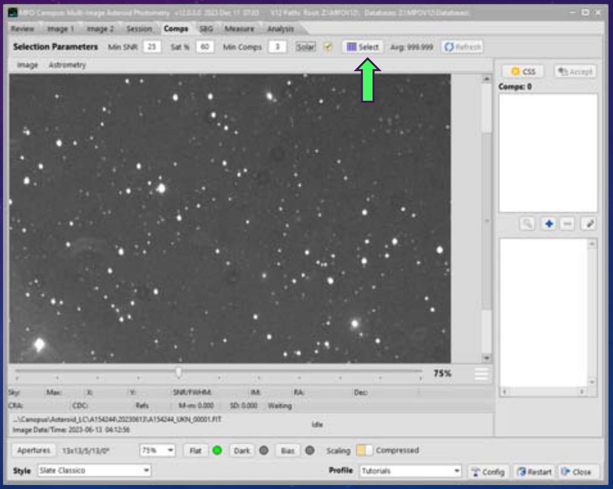
Review
Image 1
Image 2
Session
Comps
SBG
Measure
Analysis
Select
Refresh
Image
Astrometry
CSS
Accept
75%
Sky:
Max:
X:
Y:
SNR/FWHM:
IM:
RA:
Dec:
CRA:
CDC:
Refs
M-m: 0.000
SD: 0.000
Waiting
Idle
Flat
Dark
Bias
Scaling
Compressed
Config
Restart
Close

V12 Tutorial: Multi-image Asteroid Photometry

Selecting Comp Stars

- Click <Select> to start auto-select process.
  - Comps selection will appear after very short time.

Have Patience!

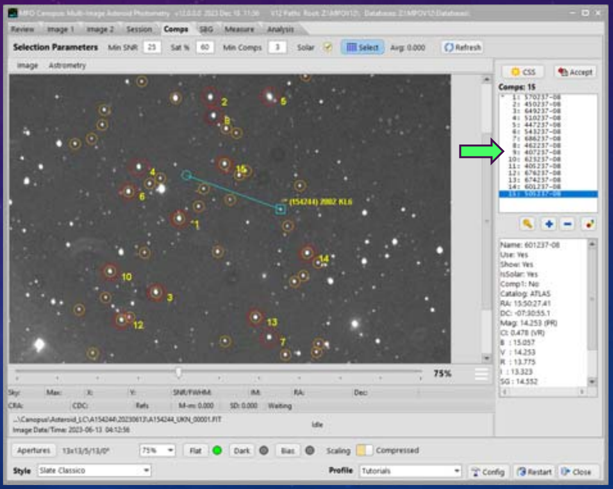

Selection Parameters
Min SNR 25
Sat % 60
Min Comps 3
Select
Avg: 999.999
Refresh
CSS
Accept
Comps: 0
75%
Config
Restart
Close

V12 Tutorial: Multi-image Asteroid Photometry

Selecting Comp Stars

Reviewing & Editing Comps List

- Selected comps are enclosed in orange circles and numbered.
- Comps appear in list at upper right.


Selection Parameters
Min SNR 25
Sat % 60
Min Comps 3
Select
Avg: 0.000
Refresh
(154244) 2002 KL6
CSS
Accept
75%
Config
Restart
Close

Comps: 15
1: 570237-08
2: 450237-08
3: 649237-08
4: 510237-08
5: 447237-08
6: 543237-08
7: 686237-08
8: 462237-08
9: 407237-08
10: 623237-08
11: 405237-08
12: 676237-08
13: 674237-08
14: 601237-08
15: [illegible]

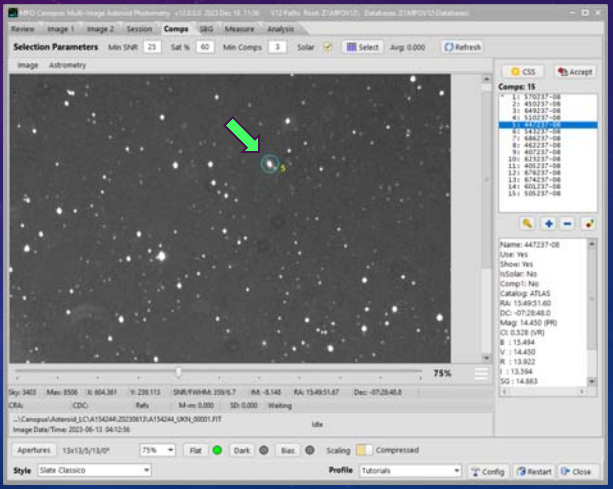
Name: 601237-08
Use: Yes
Show: Yes
IsSolar: Yes
Comp1: No
Catalog: ATLAS
RA: 15:50:27.41
DC: -07:30:55.1
Mag: 14.253 (PR)
CI: 0.478 (VR)
B : 15.057
V : 14.253
R : 13.775
I : 13.323
SG : 14.552

V12 Tutorial: Multi-image Asteroid Photometry

Selecting Comp Stars

Reviewing & Editing Comps List

- If all comps are good, click <Accept> to go to the StarBGone page.
- Comp 5 is a galaxy and has a close companion.
  - Click on it in the list. It is enclosed in an aqua-color circle.
  - Click <minus>under the list to remove it.

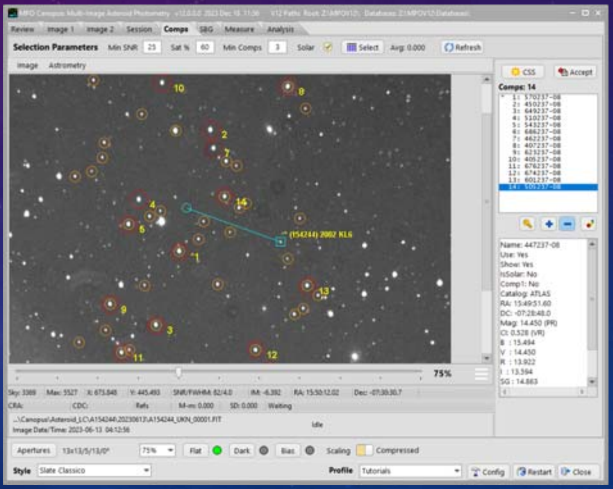

Review
Image 1
Image 2
Session
Comps
SBG
Measure
Analysis
Selection Parameters
Accept
Comps: 15
75%

V12 Tutorial: Multi-image Asteroid Photometry

Selecting Comp Stars

Reviewing & Editing Comps List

- Galaxy is gone from list.
- Items below galaxy have been moved up one place.
- Number on image updated to match new places in list.


Review
Image 1
Image 2
Session
Comps
SBG
Measure
Analysis
Selection Parameters
Accept
Comps: 14
(154244) 2002 KL6
75%

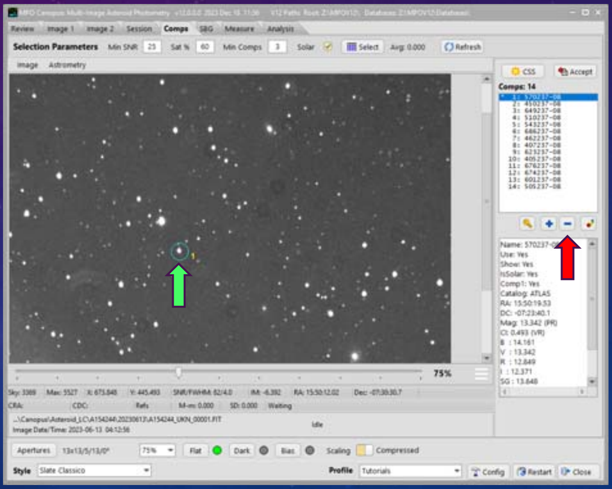
V12 Tutorial: Multi-image Asteroid Photometry

Selecting Comp Stars

A Good Comp 1

Comp 1 may be too bright and has a close companion.

- Click on #1 in the list.
- Click <minus>.
- If one appears, dismiss a message about no Comp 1.


Selection Parameters
Image
Astrometry
CSS
Accept
Config
Restart
Close

Comps: 14

```
* 1: 570237-08
  2: 450237-08
  3: 649237-08
  4: 510237-08
  5: 543237-08
  6: 686237-08
  7: 462237-08
  8: 407237-08
  9: 623237-08
 10: 405237-08
 11: 676237-08
 12: 674237-08
 13: 601237-08
 14: 505237-08
```

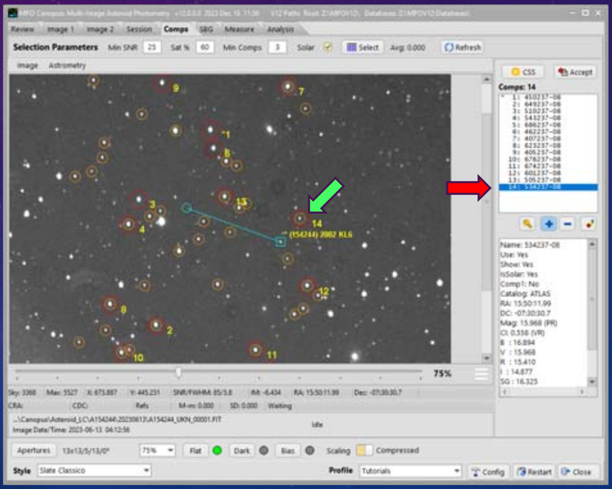
```
Name: 570237-08
Use: Yes
Show: Yes
IsSolar: Yes
Comp1: Yes
Catalog: ATLAS
RA: 15:50:19.53
DC: -07:23:40.1
Mag: 13.342 (PR)
CI: 0.493 (VR)
B  : 14.161
V  : 13.342
R  : 12.849
I  : 12.371
SG : 13.648
```

V12 Tutorial: Multi-image Asteroid Photometry

Selecting Comp Stars

Adding a New Comp 1

- Click on unnumbered star in the image.
- Click <plus>.
- Star added to end of list and is numbered on the image.


Selection Parameters
Image
Astrometry
CSS
Accept
(154244) 2002 KL6
Config
Restart
Close

Comps: 14

```
* 1: 450237-08
  2: 649237-08
  3: 510237-08
  4: 543237-08
  5: 686237-08
  6: 462237-08
  7: 407237-08
  8: 623237-08
  9: 405237-08
 10: 676237-08
 11: 674237-08
 12: 601237-08
 13: 505237-08
 14: 534237-08
```

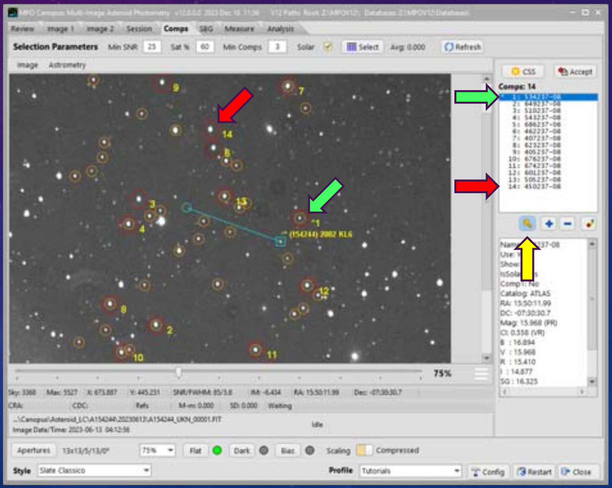
```
Name: 534237-08
Use: Yes
Show: Yes
IsSolar: Yes
Comp1: No
Catalog: ATLAS
RA: 15:50:11.99
DC: -07:30:30.7
Mag: 15.968 (PR)
CI: 0.558 (VR)
B  : 16.894
V  : 15.968
R  : 15.410
I  : 14.877
SG : 16.325
```

V12 Tutorial: Multi-image Asteroid Photometry

Selecting Comp Stars

Adding a New Comp 1

- Click <key>.
- Star swaps places with old Comp 1 (red arrows) and is made Comp 1 (green arrows).

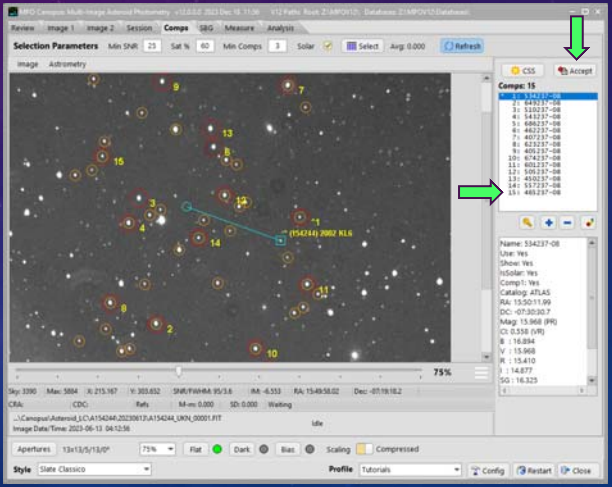


V12 Tutorial: Multi-image Asteroid Photometry

Selecting Comp Stars

Accept Comps List

- Continue review process until all stars in list are “good.”
- Have as many stars as possible, up to limit of 15.
- Click <Accept> when ready to move to StarBGone page.



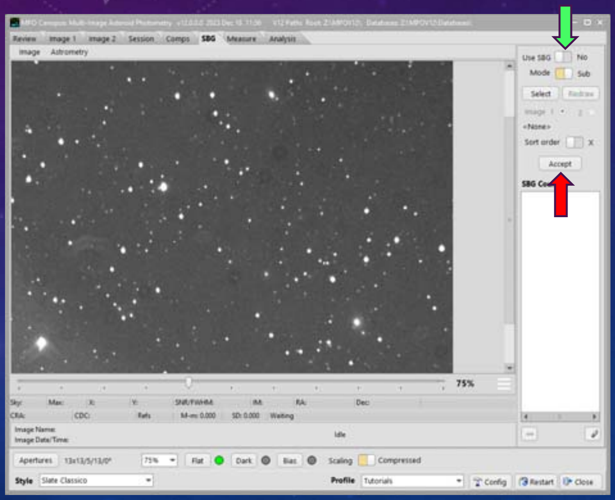
Selecting SBG Stars

V12 Tutorial: Multi-image Asteroid Photometry

Selecting StarBGone (SBG) Stars

Bypass SBG Stars: Use SBG: No

- Click <Accept>


Review
Image 1
Image 2
Session
Comps
SBG
Measure
Analysis
Image
Astrometry
Select
Redraw
Image 1
2
<None>
Accept
SBG Co
75%
Sky:
Max:
X:
Y:
SNR/FWHM:
IM:
RA:
Dec:
CRA:
CDC:
Refs
Image Name:
Image Date/Time:
Idle
Apertures
Flat
Dark
Bias
Config
Restart
Close

Use SBG ☐ No

Mode ☐ Sub

Sort order ☐ X

M-m: 0.000

SD: 0.000

Waiting

Apertures 13x13/5/13/0°

75%

Scaling ☐ Compressed

Style Slate Classico

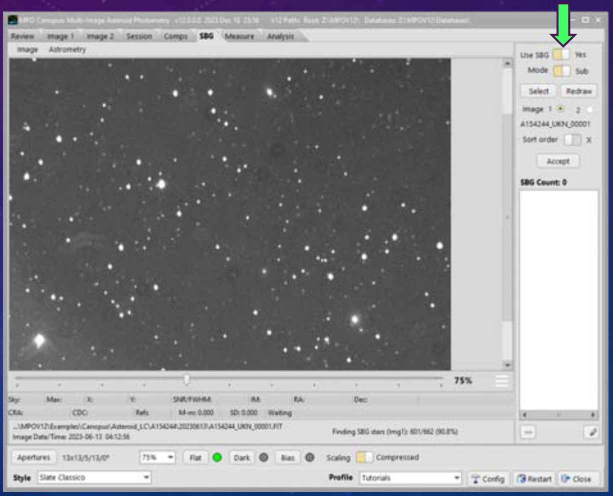
Profile Tutorials

V12 Tutorial: Multi-image Asteroid Photometry

Selecting StarBGone (SBG) Stars

Use SBG: Yes

- **No**
  Measure images “as-is”, i.e., without regard to stars intruding into the measuring apertures.
- **Yes**
  If a star intrudes into the target dead zone or measurement aperture, either ignore the image or subtract the star’s contribution to the value within the measuring aperture.

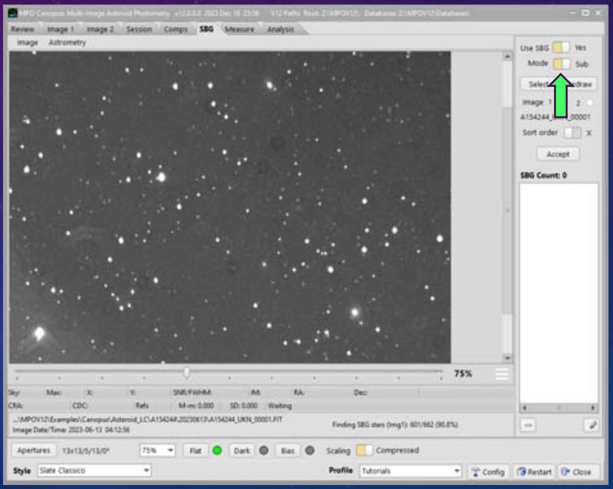

Review
Image 1
Image 2
Session
Comps
SBG
Measure
Analysis
Image
Astrometry
Use SBG
Yes
Mode
Sub
Select
Redraw
Accept
SBG Count: 0
75%
Apertures
Flat
Dark
Bias
Scaling
Compressed
Style
Slate Classico
Profile
Tutorials
Config
Restart
Close

V12 Tutorial: Multi-image Asteroid Photometry

Selecting StarBGone (SBG) Stars

Mode: Sub

- Determines how selected SBG stars are handled.

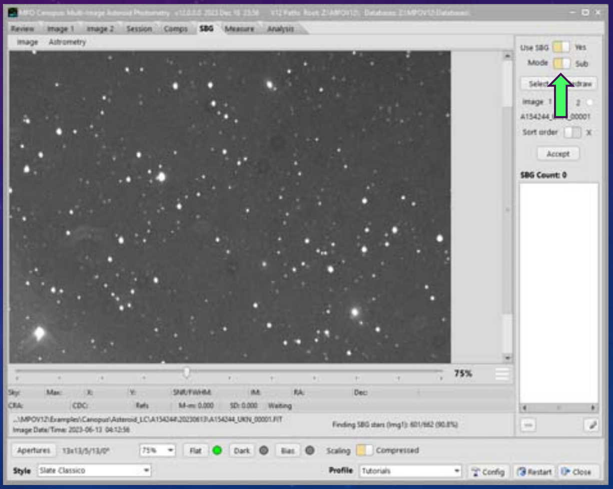

Review
Image 1
Image 2
Session
Comps
SBG
Measure
Analysis
Image
Astrometry
Use SBG
Yes
Mode
Sub
Accept
SBG Count: 0
75%
Apertures
Flat
Dark
Bias
Scaling
Compressed
Style
Slate Classico
Profile
Tutorials
Config
Restart
Close

V12 Tutorial: Multi-image Asteroid Photometry

Selecting StarBGone (SBG) Stars

Mode: Sub

- **Skip**
  If a star intrudes into the target dead zone or measurement aperture, skip the image.
- **Sub**
  If a star intrudes into the target dead zone or measurement aperture, subtract the star's contribution to the value within the measuring aperture.



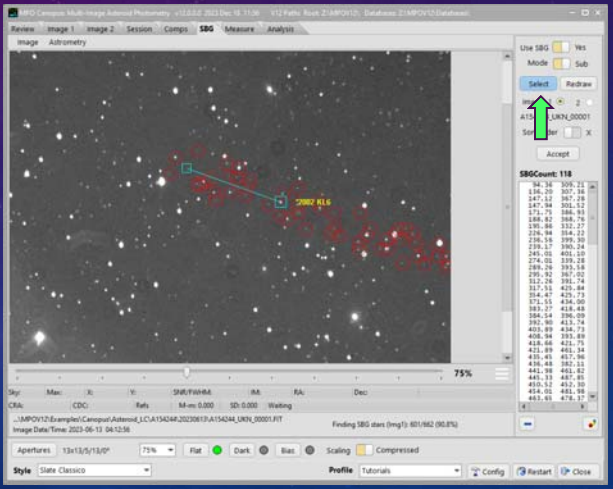
Use SBG
Yes
Mode
Sub
Accept
SBG Count: 0
75%

V12 Tutorial: Multi-image Asteroid Photometry

Selecting StarBGone (SBG) Stars

Selecting SBG Stars

- Click <Select>.
- After a few seconds, the asteroid path on Image 1 is shown as aqua-colored line.
- All stars within two Dead Zone diameters of the path are enclosed by red circles.



Use SBG
Yes
Mode
Sub
Select
Redraw
Accept
SBGCount: 118
75%

V12 Tutorial: Multi-image Asteroid Photometry

Selecting StarBGone (SBG) Stars

Checking Image 1 and 2

If field shifts significantly, SBG stars on Image 2 may not be on Image 1.

- **Click <2> radio button.**
- **Click <1> radio button.**

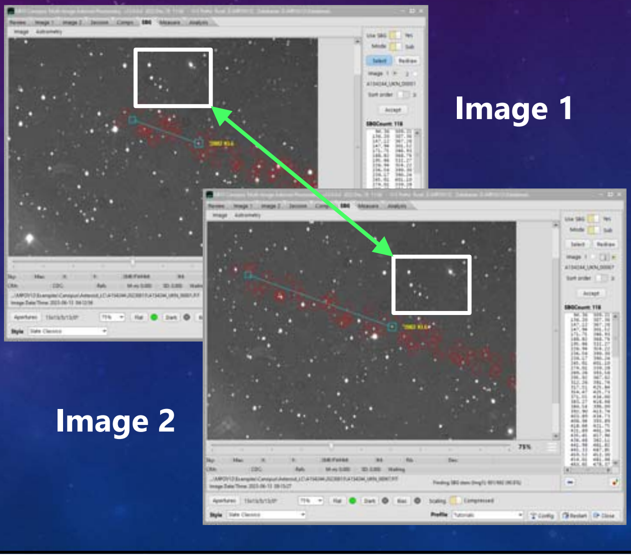


Image 1

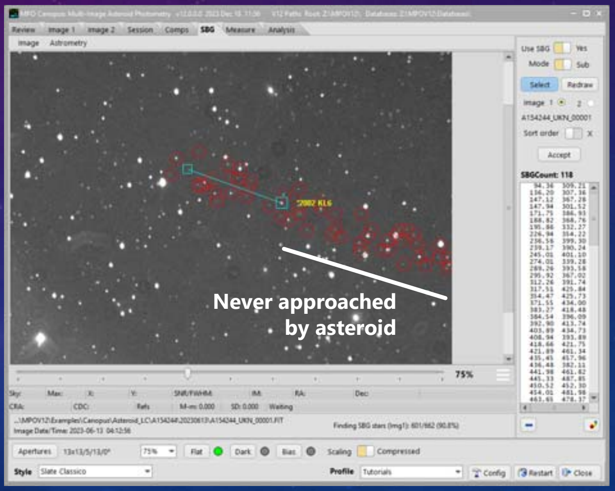
Image 2

V12 Tutorial: Multi-image Asteroid Photometry

Selecting StarBGone (SBG) Stars

Dropping Uninvolved Stars

- **Not required but can same some processing time if there is a large number of SBG stars.**
- **Stars to right of asteroid start on Image 1 never involved.**



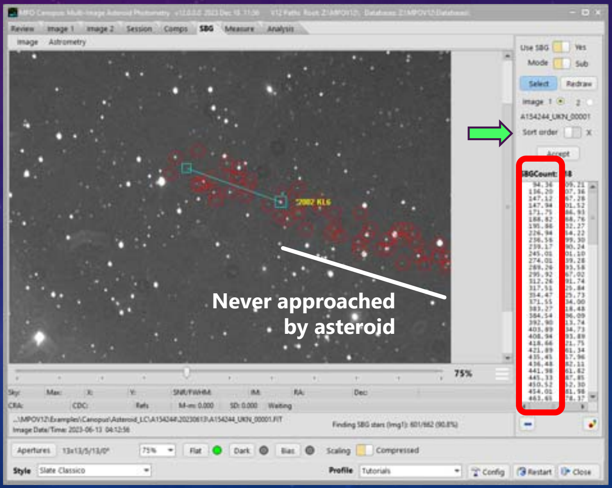
Never approached by asteroid

V12 Tutorial: Multi-image Asteroid Photometry

Selecting StarBGone (SBG) Stars

Sort Order: X

- **X**
  Merged list of Image 1 and 2 stars sorted by X-value. Good if motion is mostly left-right.
- **Y**
  Merged list of Image 1 and 2 stars sorted by Y-value. Good if motion is mostly up-down.


2002 KL6
Sort order
SBGCount: 118
75%

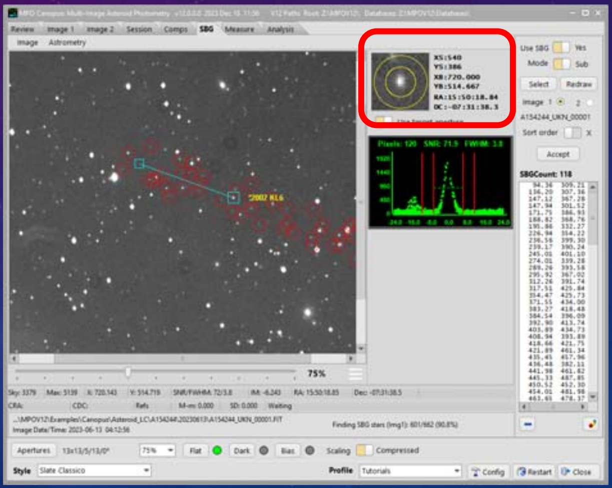
Never approached by asteroid

V12 Tutorial: Multi-image Asteroid Photometry

Selecting StarBGone (SBG) Stars

Finding First Uninvolved Star

- **List is merged, so X-value might be on Image 1 or 2.**


2002 KL6
Pixels: 120 SNR: 71.9 FWHM: 3.8
SBGCount: 118
75%

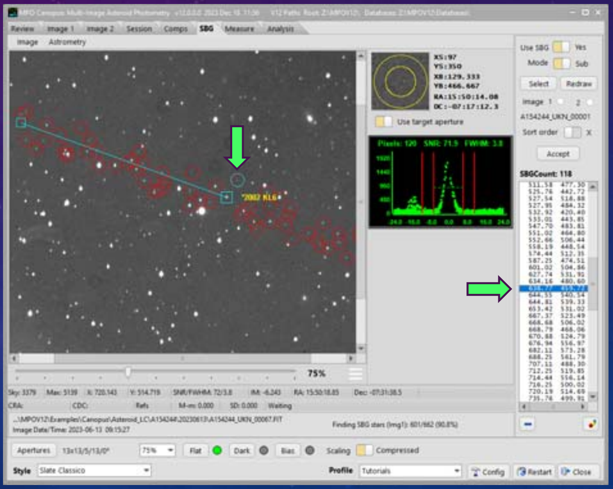
XS:540
YS:386
XB:720.000
YB:514.667
RA:15:50:18.84
DC:-07:31:38.3

V12 Tutorial: Multi-image Asteroid Photometry

Selecting StarBGone (SBG) Stars

Finding First Uninvolved Star

- Click on a star in list.
- Aqua circle surrounds it on image.
- Find star with X just beyond start of asteroid path.

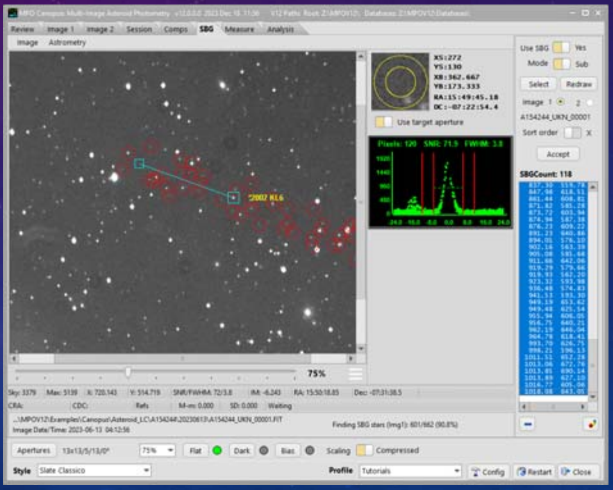


V12 Tutorial: Multi-image Asteroid Photometry

Selecting StarBGone (SBG) Stars

Finding First Uninvolved Star

- Do not click on list.
- Scroll to bottom of list.
- Shift+Click on last star in list.

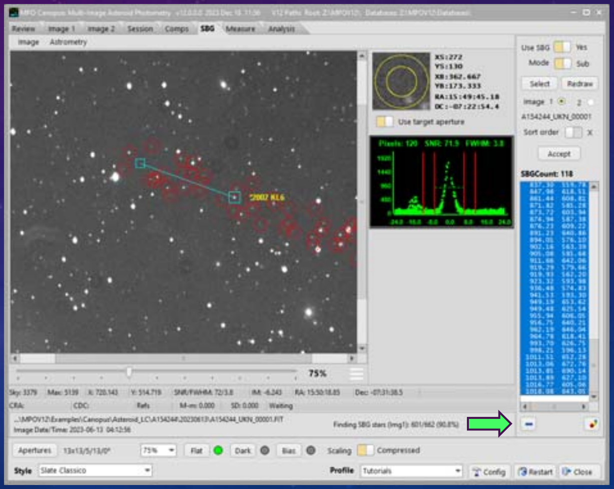


V12 Tutorial: Multi-image Asteroid Photometry

Selecting StarBGone (SBG) Stars

Finding First Uninvolved Star

- Click <minus>.
- Answer "Yes" to dialog question.

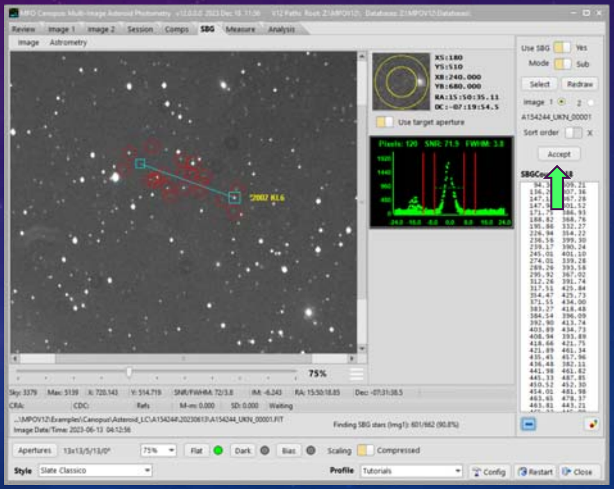


V12 Tutorial: Multi-image Asteroid Photometry

Selecting StarBGone (SBG) Stars

Accept List

- Deleted stars gone from Images 1 and 2.
- Click <Accept> when ready to go to Measurements page.



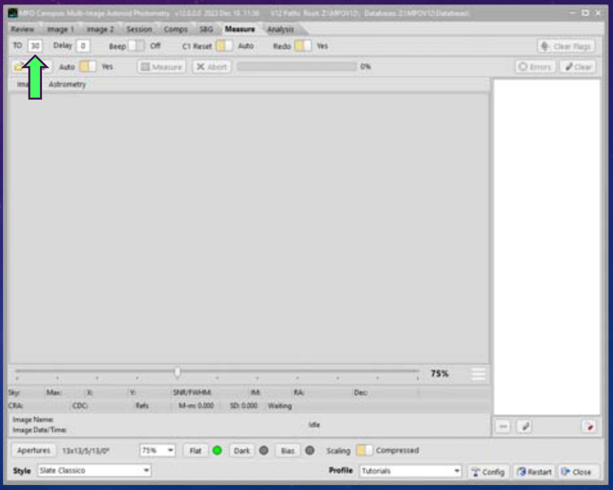
Measuring the Images

V12 Tutorial: Multi-image Asteroid Photometry

Measuring the Images – Getting Setup

TO (time-out): 30

- Maximum number of seconds to wait for an image to automatch.
- Should be 10 to 60 seconds.


Review
Image 1
Image 2
Session
Comps
SBG
Measure
Analysis
Clear Flags
Measure
Abort
0%
Errors
Clear
Astrometry
75%
Idle
Apertures
Flat
Dark
Bias
Scaling
Compressed
Style
Slate Classico
Profile
Tutorials
Config
Restart
Close

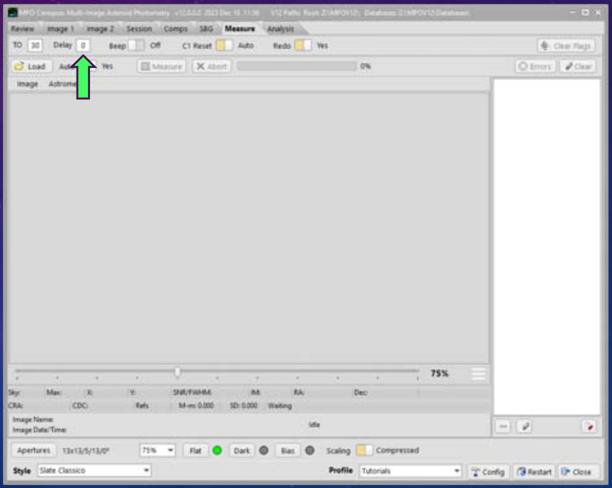
TO 30
Delay 0
Beep Off
C1 Reset Auto
Redo Yes
Auto Yes

V12 Tutorial: Multi-image Asteroid Photometry

Measuring the Images – Getting Setup

Delay: 0

- Seconds to pause between images when "C1 Reset" = Auto.
- 0 sec = 1/6 second; a small pause is required to allow Windows to process images.


Review
Image 1
Image 2
Session
Comps
SBG
Measure
Analysis
Load
Measure
Abort
Clear Flags
Errors
Clear
Apertures
Flat
Dark
Bias
Scaling
Compressed
Config
Restart
Close

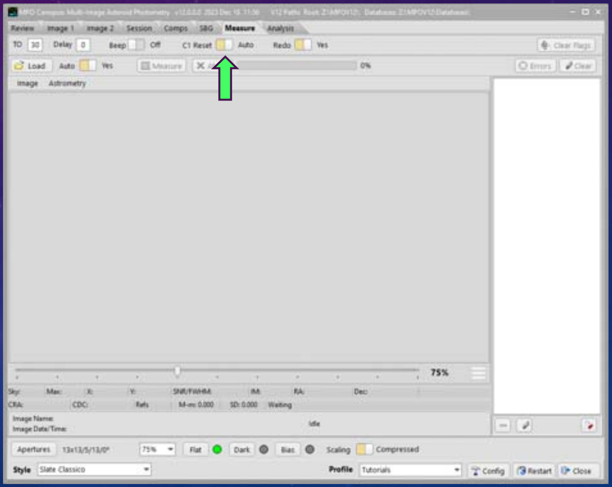
TD 30
Delay 0
Beep Off
C1 Reset Auto
Redo Yes
Style Slate Classico
Profile Tutorials

V12 Tutorial: Multi-image Asteroid Photometry

Measuring the Images – Getting Setup

C1 Reset: Auto

- Determines the action taken if Comp 1 cannot be found automatically, e.g., image shifted too far.


Review
Image 1
Image 2
Session
Comps
SBG
Measure
Analysis
Load
Measure
Clear Flags
Errors
Clear
Image
Astrometry
Apertures
Flat
Dark
Bias
Scaling
Compressed
Config
Restart
Close

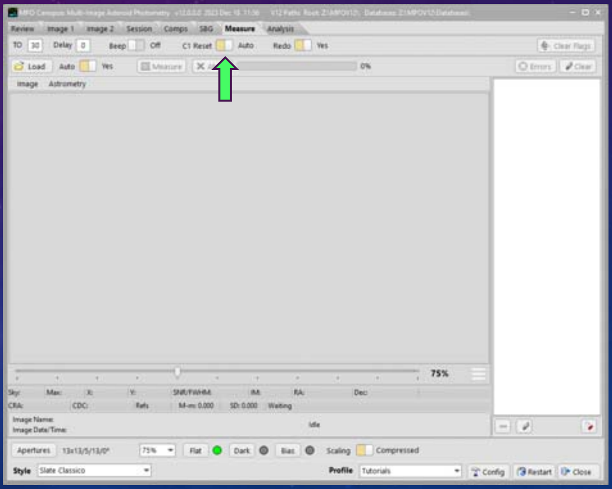
TD 30
Delay 0
Beep Off
C1 Reset Auto
Redo Yes
Auto Yes
Style Slate Classico
Profile Tutorials

V12 Tutorial: Multi-image Asteroid Photometry

Measuring the Images – Getting Setup

C1 Reset: Auto

- **Auto**
  If Comp 1 is not found, the program tries to find it after doing an automatch. If not found, a manual override can be done.
- **Manual**
  If Comp 1 is not found, the measuring pauses to allow ***Shift+Click*** on star in the image to reset the Comp 1 position. A message asking to verify the new position allows accepting or reselecting Comp 1.


Review
Image 1
Image 2
Session
Comps
SBG
Measure
Analysis
TO 30
Delay 0
Beep Off
C1 Reset Auto
Redo Yes
Clear Flags
Load
Auto Yes
Measure
0%
Errors
Clear
Image
Astrometry
75%
Sky:
Max:
X:
Y:
SNR/FWHM:
IM:
RA:
Dec:
CRA:
CDC:
Refs
M-m: 0.000
SD: 0.000
Waiting
Image Name:
Image Date/Time:
Idle
Apertures
13x13/5/13/0°
75%
Flat
Dark
Bias
Scaling
Compressed
Style
Slate Classico
Profile
Tutorials
Config
Restart
Close

V12 Tutorial: Multi-image Asteroid Photometry

Measuring the Images – Getting Setup

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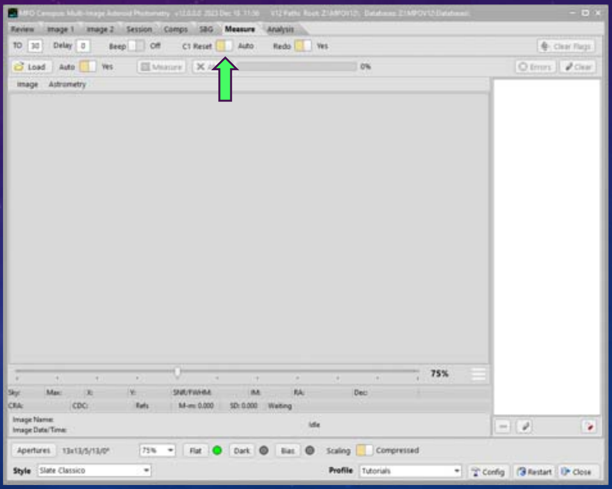
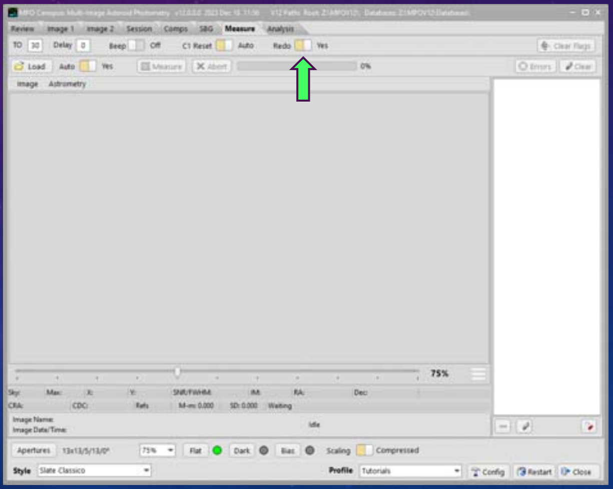


V12 Tutorial: Multi-image Asteroid Photometry

Measuring the Images – Getting Setup

Redo: Yes

- **Yes**
  If image with date/time within 1.5 seconds of existing record, the existing record is overwritten.
- **No**
  If image with date/time within 1.5 seconds of existing record, the image is bypassed, i.e., it is not measured.

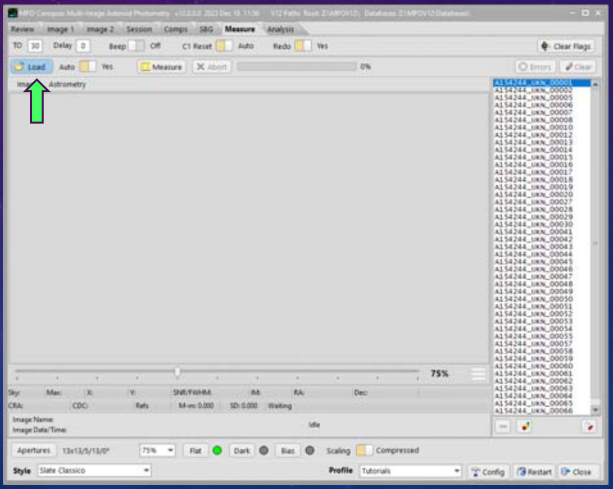

Review
Image 1
Image 2
Session
Comps
SBG
Measure
Analysis
TO 30
Delay 0
Beep Off
C1 Reset Auto
Redo Yes
Clear Flags
Load
Auto Yes
Measure
Abort
0%
Errors
Clear
Image
Astrometry
75%
Sky:
Max:
X:
Y:
SNR/FWHM:
IM:
RA:
Dec:
CRA:
CDC:
Refs
M-m: 0.000
SD: 0.000
Waiting
Image Name:
Image Date/Time:
Idle
Apertures
13x13/5/13/0°
75%
Flat
Dark
Bias
Scaling
Compressed
Style
Slate Classico
Profile
Tutorials
Config
Restart
Close

V12 Tutorial: Multi-image Asteroid Photometry

Measuring the Images – Getting Setup

Loading the Images

- Click <Load>.
- Images selected on Review page are loaded into list, sorted by ascending date/time.
- Only the paths are stored in the list and memory.
- Each image is loaded one-at-a-time on demand.

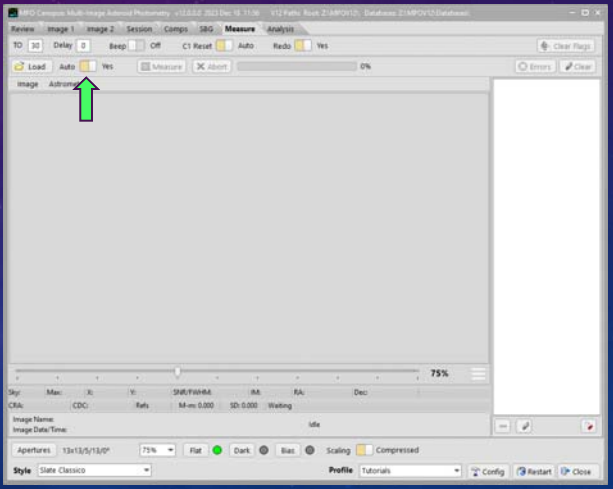

Review
Image 1
Image 2
Session
Comps
SBG
Measure
Analysis
TO 30
Delay 0
Beep Off
C1 Reset Auto
Redo Yes
Clear Flags
Load
Auto Yes
Measure
Abort
0%
Errors
Clear
Image
Astrometry
75%
Apertures
13x13/5/13/0°
Flat
Dark
Bias
Scaling
Compressed
Style
Slate Classico
Profile
Tutorials
Config
Restart
Close

V12 Tutorial: Multi-image Asteroid Photometry

Measuring the Images – Getting Setup

Auto: Yes

- **Yes**
  After an image is measured, the next image in the list is automatically loaded and measured.
- **No**
  After an image is measured, the program waits for an <Enter> on the keyboard before loading and measuring the next image.



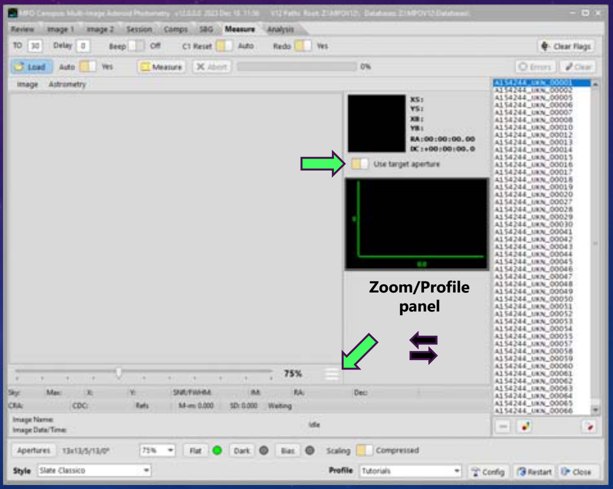
Review
Image 1
Image 2
Session
Comps
SBG
Measure
Analysis
TO 30
Delay 0
Beep Off
C1 Reset Auto
Redo Yes
Clear Flags
Load
Auto Yes
Measure
Abort
0%
Errors
Clear
Image
Astrometry
75%
Sky:
Max:
X:
Y:
SNR/FWHM:
IM:
RA:
Dec:
CRA:
CDC:
Refs
M-m 0.000
SD: 0.000
Waiting
Image Name:
Image Date/Time:
Idle
Apertures
13x13/5/13/0°
Flat
Dark
Bias
Scaling
Compressed
Style
Slate Classico
Profile
Tutorials
Config
Restart
Close

V12 Tutorial: Multi-image Asteroid Photometry

Measuring the Images – Getting Setup

Apertures: Use target apertures

- **Use Target Apertures**
  Aperture shown next to <Apertures> are used to measure the target.
- **Use Comps Apertures**
  The current comp star apertures are used to measure the target.
- Requires showing (temporarily at least) the zoom/profile panel.



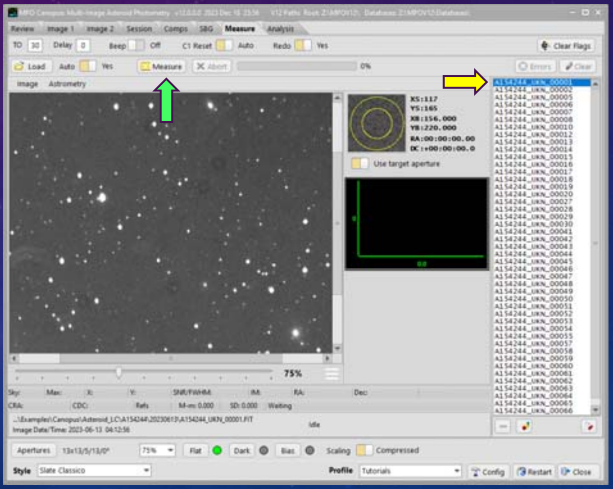
Review
Image 1
Image 2
Session
Comps
SBG
Measure
Analysis
Load
Auto Yes
Measure
Abort
0%
Clear Flags
Image
Astrometry
XS:
YS:
XB:
YB:
RA:00:00:00.00
DC:+00:00:00.0
Use target aperture
Zoom/Profile panel
75%
Apertures
13x13/5/13/0°
Style
Slate Classico
Profile
Tutorials
Config
Restart
Close

V12 Tutorial: Multi-image Asteroid Photometry

Measuring the Images

Measure the Images

- Double-click on the first image in the list to see it before starting.
- Click <Measure>.

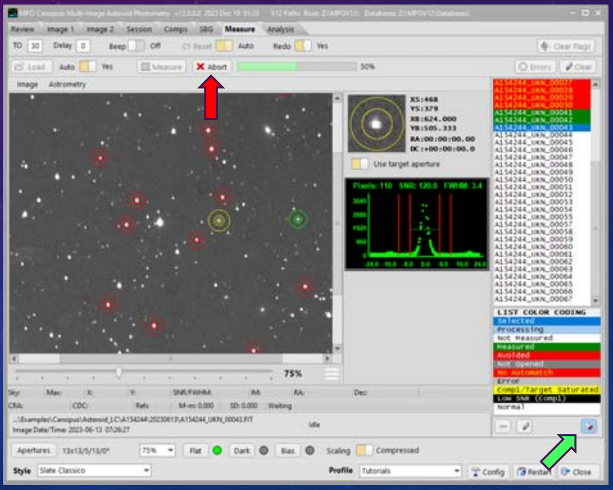

Review
Image 1
Image 2
Session
Comps
SBG
Measure
Analysis
Clear Flags
Load
Measure
Abort
Image
Astrometry
Use target aperture
75%
Apertures
Style
Profile
Config
Restart
Close

V12 Tutorial: Multi-image Asteroid Photometry

Measuring the Images

Measure the Images

- Click <Abort> to stop processing.
- Use <flashlight> to toggle color coding legend.
- Be kind to the program and your CPU! Avoid do other things in this or other programs when measuring.
- ***Don't click on the images list; at best, this can change which is the current and next image.***

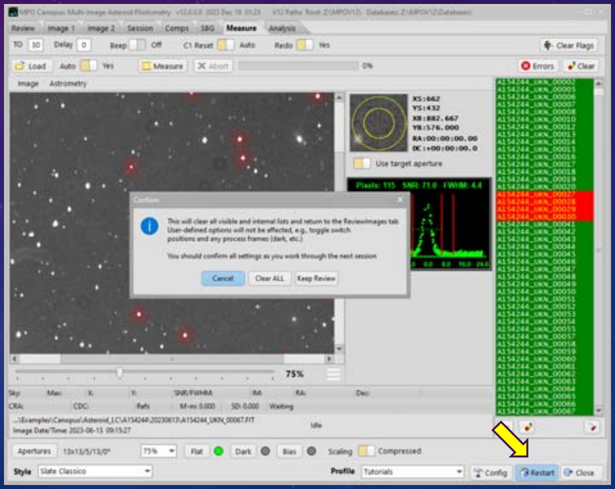

Review
Image 1
Image 2
Session
Comps
SBG
Measure
Analysis
Load
Measure
Abort
50%
Image
Astrometry
Use target aperture
LIST COLOR CODING
Selected
Processing
Not Measured
Measured
Avoided
Not Opened
No Automatch
Error
Comp1/Target Saturated
Low SNR (Comp1)
Normal
75%
Config
Restart
Close

V12 Tutorial: Multi-image Asteroid Photometry

Measuring the Images

To Measure More Images

- Click <Restart>. This is a *must*.
- Clear All
  Clears all internal lists and variables along with the selected images list from the Review page.
- Keep Review
  Clears all internal lists and variables but keeps the selected images list from the Review page. Good if measuring more than one target in same set of images.



This will clear all visible and internal lists and return to the ReviewImages tab
User-defined options will not be affected, e.g., toggle switch positions and any process frames (dark, etc.)

You should confirm all settings as you work through the next session

Confirm
Cancel
Clear ALL
Keep Review
Use target aperture
75%
Restart
Close
Config

V12 Tutorial: Multi-image Asteroid Photometry

Measuring the Images

To Measure More Images

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- Clear All
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- Keep Review
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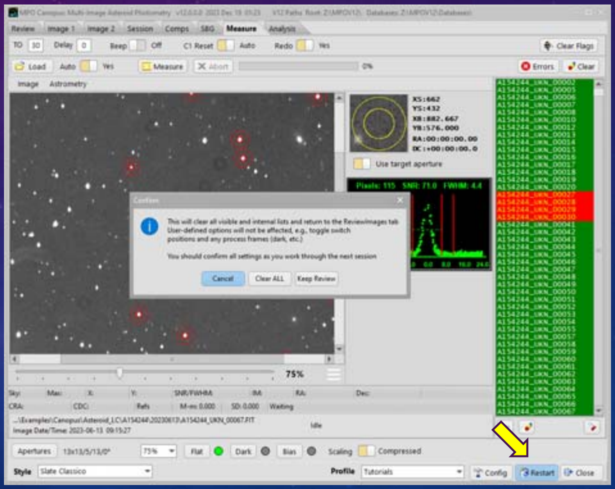

This will clear all visible and internal lists and return to the ReviewImages tab
User-defined options will not be affected, e.g., toggle switch positions and any process frames (dark, etc.)

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Confirm
Cancel
Clear ALL
Keep Review
Use target aperture
75%
Restart
Close
Config

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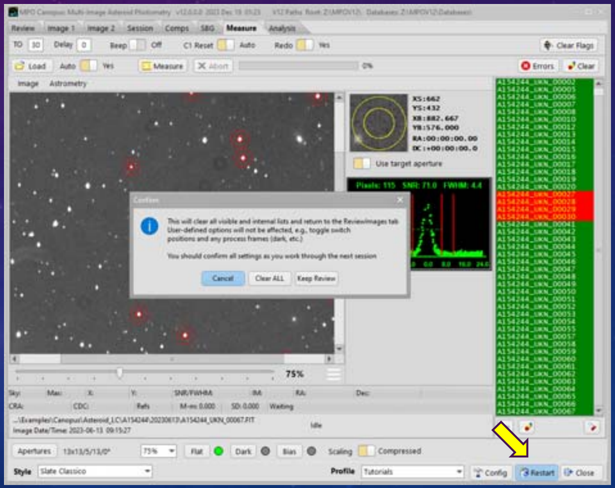


This will clear all visible and internal lists and return to the Review\Images tab
User-defined options will not be affected, e.g., toggle switch positions and any process frames (dark, etc.)

You should confirm all settings as you work through the next session

Confirm
Cancel
Clear ALL
Keep Review
Review
Image 1
Image 2
Session
Comps
SBG
Measure
Analysis
Load
Measure
Abort
Use target aperture
75%
Config
Restart
Close

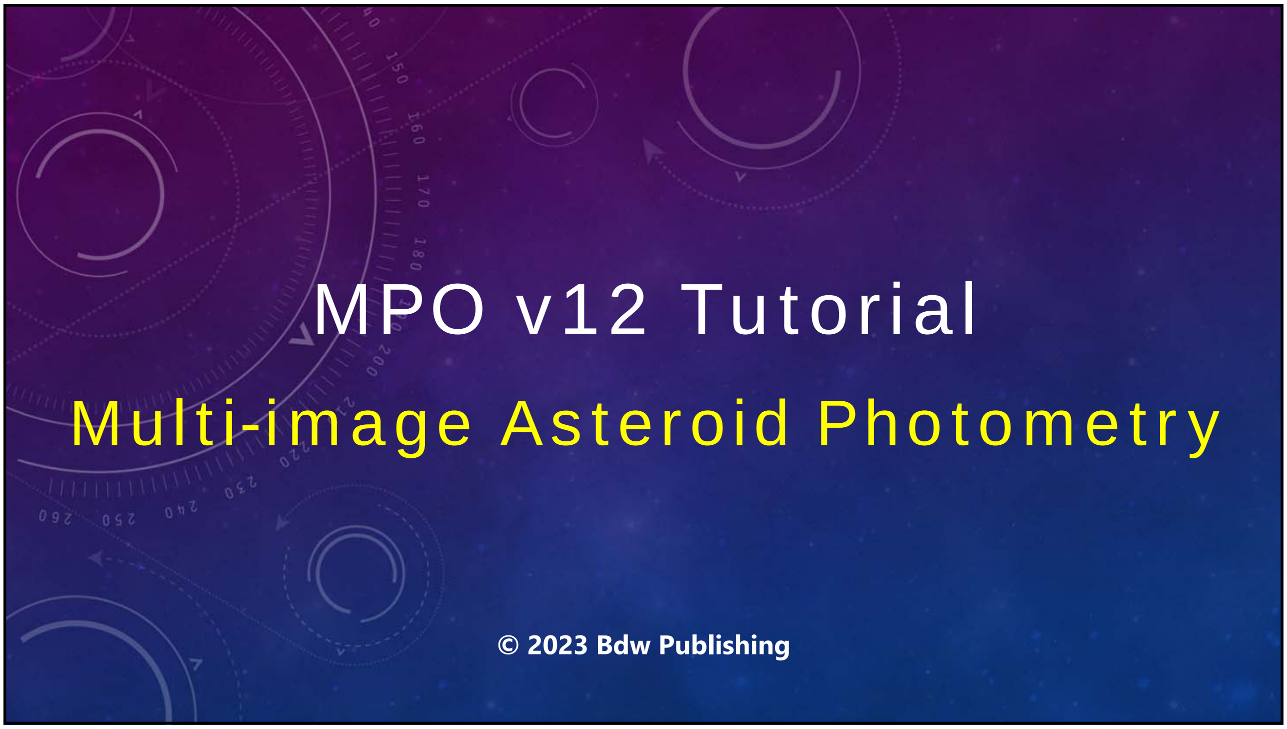
V12 Tutorial: Multi-image Asteroid Photometry

Avoid Information Overload

Before Period Analysis

- Measure the other two nights for the asteroid in the examples.

It’s Time to Take a Break!



MPO v12 Tutorial

Multi-image Asteroid Photometry

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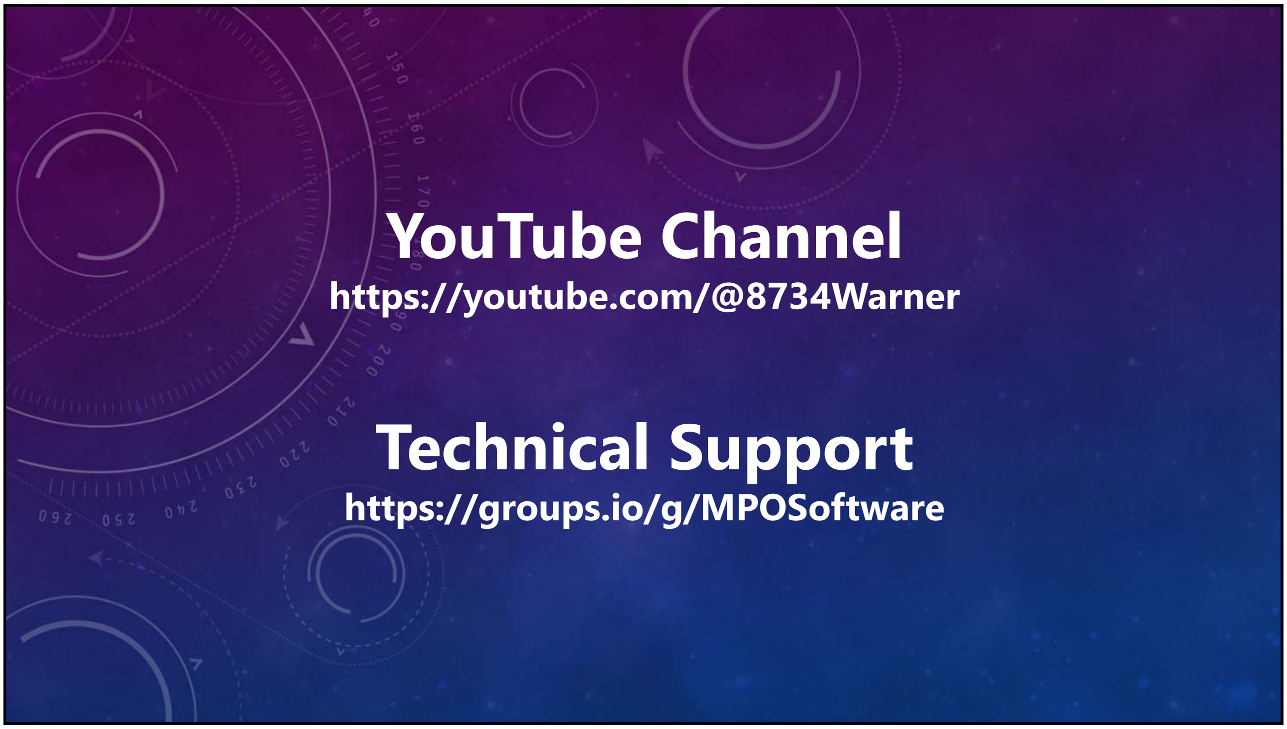

YouTube Channel

https://youtube.com/@8734Warner

Technical Support

https://groups.io/g/MPOSoftware

Producer/Director/Writer/Editor

Brian D. Warner

for MPO Software & Bdw Publishing

Brian D. Warner

Narration

Brian D. Warner

Addison (AI Voice)

Addison appears courtesy of Speechlo on-line voice generation

https://speechlo.com

Music

Music from Uppbeat (free for Creators!)

https://uppbeat.io/t/icosphere/glaze
https://uppbeat.io/t/pryces/aspire
https://uppbeat.io/t/soundroll/higher
https://uppbeat.io/t/hey-pluto/welcome-tropical
https://uppbeat.io/t/sensho/safari

Catering
Brian D. Warner

Caffeination
Brian D. Warner

Computers & Network Support
Brian D. Warner

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No humans were harmed during the making of this production

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