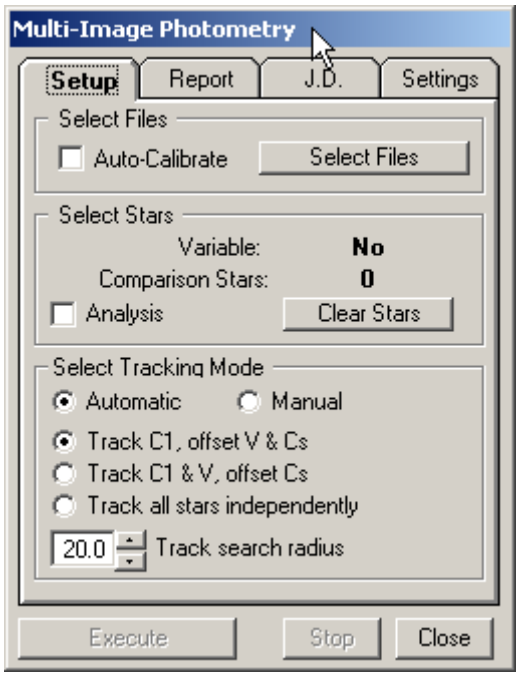
Multiple Image Photometry

Performs photometry on a sequence of images.

The Multiple Image Photometry Tool measures a sequence of images so that you can derive a light curve for a variable star as it varies in brightness. This tool loads a set of raw images, optionally calibrates them, performs photometry, and records the results in a ASCII text file.



The controls for this tool are distributed on four tabs:

Setup Tab

Select Files

Select Files – Opens the file selection dialog. Select the files that you want to do photometry on.

Calibrate Images – Calibrate the files as they are loaded, as specified in Calibration Setup.

Select Stars

Variable – Indicates with "Yes" or "No" whether the variable has been chosen yet.

Comp Stars – Indicates the number of comparison stars that have been selected.

Clear Stars – Clears the variable and all comparison stars.

Select Tracking Mode

Automatic – Tracks automatically and identifies stars from one image to the next. Use when the images are well tracked and the stars are well separated.

Manual – Requires the user to identify and verify that the correct stars are been found. Use for images that are badly tracked, and when the stars in the image are crowded close together.

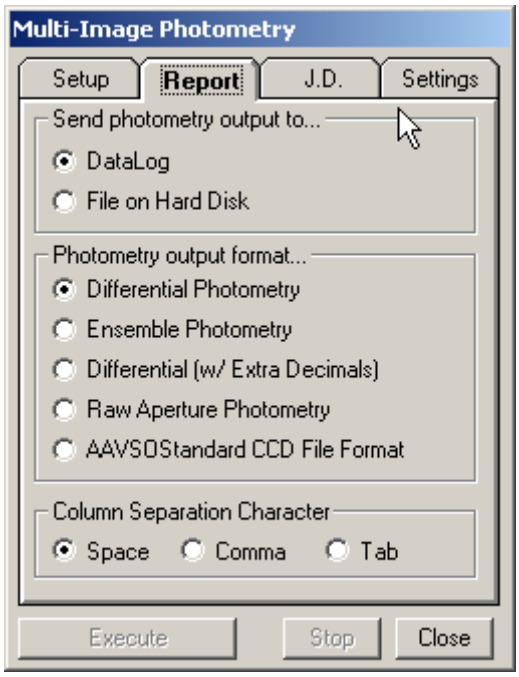
Track C1, offset V & Cs Track – Tracks C1 (the first comp star) and offsets from C1 to the variable star and all other comparison stars. Use for

Track C1 & V, offset Cs – Tracks V and C1 independently, and offsets from C1 to all of the other comparison stars. Use for asteroid and comet photometry, where the variable moves

relative to the stars.

Track all stars independently – Tracks V, C1, and all other comparison stars separately.

Track search radius – The radius used to find stars from one image to the next.



Report Tab

Send photometry output to...

DataLog – Saves output to the AIP4Win Data Log

File on Hard Disk – Saves output in a text file on your computer's hard disk. File formats for the data are described in Photometric Output File Formats.

Photometry output format...

Differential Photometry – Outputs photometry as magnitude differences.

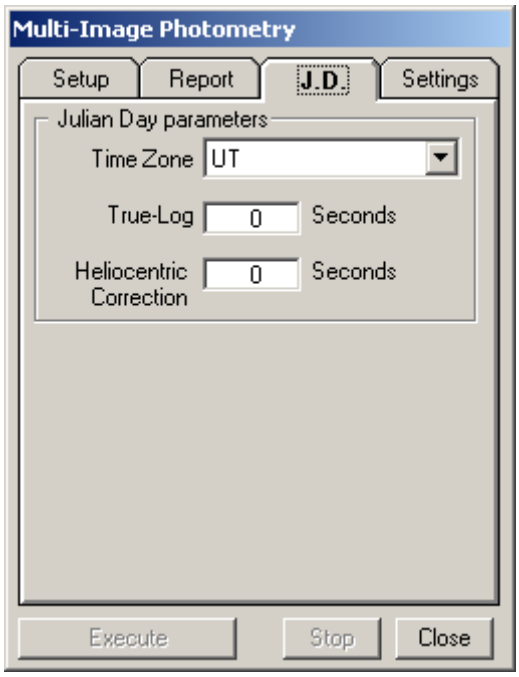
Ensemble Photometry – Outputs photometry as raw instrumental magnitudes.

Differential (w/ Extra Decimals) – Outputs photometry as magnitude differences.

Raw Aperture Photometry – Outputs the raw information gathered by aperture photometry.

AAVSO Format Outputs a report in a format compatible with the AAVSO's WebObs data submission software. Selecting this option causes the AAVSO Report Format form to become active.

File formats for the data are described in Photometric Output File Formats.



JD Tab

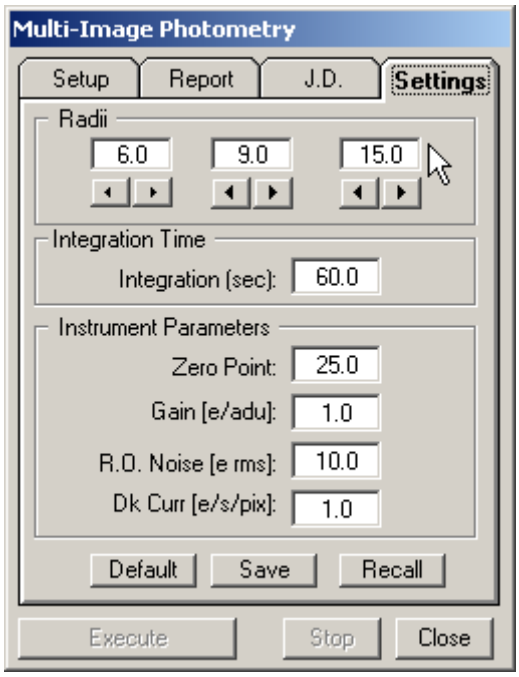
Julian Day

TZ – Select the time zone used to record the image times.

True-Log – The difference between the recorded time of image acquisition and the true time. Used to incorporate a correction for a slow PC clock, for example.

Heliocentric Correction – Used to account for the time difference due to light travel time due to

the Earth's location in its orbit around the Sun.



Settings Tab

Radii

Aperture – The radius of the aperture containing the star's light.

Inner Annulus – The inner boundary of the surrounding sky background.

Outer Annulus – The outer boundary of the surrounding sky background.

Instrument Parameters

Zero Point – An arbitrary constant in the equation for calculating the raw instrumental magnitude used to make the magnitude value seem reasonable.

Gain – The gain of the CCD camera used to acquire the images. Expressed in electrons per ADU.

Integration – The integration time for each exposure in seconds.

R.O.Noise – The readout noise for the camera in electrons.

Dk Current – The rate of dark current accumulation in electrons per pixel per second.

Default – Restores the photometry parameters to AIP4Win's default settings.

Save – Saves the current set of photometry parameters to the Registry.

Recall – Loads the photometry parameters from the Registry.

OK – Star the multiple image photometry operation.

Stop – Abort the operation.

Close – Quit the tool without performing any processing.

How to Measure Magnitudes in Multiple Images

1. To perform photometry on raw images, define their calibration using the Calibration Setup tool.
2. Open the Multiple Image Photometry Tool window.

3. To have images calibrated on the fly, check the **Calibrate Image** check box.
4. Click on **Select Files**. Navigate to the directory containing the files.
5. Select the images you wish to measure.
6. Click **Open** to confirm the selection.
7. The first image in the sequence will be loaded.
8. Now select the variable and comparison stars. To select a star, **click on its image**. You must select the variable star first, then C1, C2, and so forth.
9. You must select a variable star and at least one comparison star.
10. To remove a star that you have selected, **click on its image**. It will be removed.
11. To clear all stars, click on the selected variable star, or click on the **Clear Stars** button.
12. Select a tracking mode, either **Automatic** or **Manual**. For well-tracked image sequences, use **Automatic**.
13. Select the tracking method. For variable stars use the **Track C1** method.
14. Select the **Track Search Radius**. The defines the search distance used to track stars from one image to the next.
15. Select where to send the photometric output: either the **Data Log** or a text **file on your hard disk**.
16. Select the type of photometric output you want: either **Differential** or **Ensemble** photometry.
17. Select the **Aperture**, a circle to contain the image of the star. A good starting value is 6 pixels.
18. Select the **Inner Annulus** and **Outer Annulus** radii. This region measures the sky brightness. Good starting values are 9 and 15 pixels.
19. Verify that the **Instrument Parameters** are correct for your CCD camera.
20. To insure the correct Julian Day number, select your **time zone** from the dropdown list, and enter the clock and heliocentric correction factors.
21. Click **Execute**, AIP for Windows will load, optionally calibrate, track, and perform differential photometry the selected stars in each image. To terminate a run, click the **Stop** button.

Manual Tracking

In manual tracking mode, each new image is loaded, optionally calibrated, and displayed with photometry glyph superimposed on the image. Meanwhile, the bottom of the tool will expand to show two new buttons: **Accept** and **Skip**. Depending on the tracking mode, the user may decide to:

1. Accept the star identifications by clicking **Accept**;
2. Re-identify the stars by **clicking on them with the mouse**, and when they are correct, click on **Accept**; or **Skip** over the image by clicking **Skip**.

If the tracking mode is:

Track C1, offset V & Cs Track, then the user should **click on C1**. The remaining stars should then be properly identified.

Track C1 & V, offset Cs, then the user should **click on V** and then **click on C1**. This should correctly idetify the variable and the comparison stars.

Track all stars independently, the user should click on V, C1, C2, and so on, in that order,

to identify each of the stars.

When the star identifications are correct, click on **Accept**.

The Multiple Image Photometry Tool generates a report giving full details of the photometric measurements. You can load this file into a spreadsheet or other software for analysis of the data contained in the file.

Photometric Settings

Setting the **Star Aperture** and **Sky Annulus** is a lot easier than it sounds. You can estimate them by eye, or measure the star image with the Star Image Tool. The Star Image Tool tells you the Sigma (a measure of the star's radius) or FWHM (Full-Width Half-Max, a measure of the star's diameter). Good rules of thumb for the settings are:

Parameter	Sigma	FWHM
Star Aperture	5 x sigma	2 x FWHM
Inner Sky Annulus	7.5 x sigma	3 x FWHM
Outer Sky Annulus	12.5 x sigma	5 x FWHM

Example: To set the radii, measure several a typical star images. Say that sigma turns out to be 1.2 pixels, and FWHM is 2.8 pixels. You would set the inner radius to 6. The middle radius should be 1.5 times the inner radius, and the outer radius should be 2.5 times the inner radius, so you would set the inner radius to 9 and the outer radius to 15.

Loading and Saving Your Photometric Settings: Once you have determined optimum settings for your images, you can save them in the Registry by clicking the **Save** button. You can retrieve these saved setting by clicking on the **Recall** button.

Output Format

The file format for the data generated is described in Photometric Output File Formats.

Photometry is a fundamental tool for every working astronomer. Consult the ***Handbook of Astronomical Image Processing*** for more on photometric measurements.