

Photometry Working Group Guidelines

International Asteroid Warning Network

Campaign for Asteroid 2025 FA22

(2025 September 15th – 2025 October 30th)

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INTRODUCTION

Thank you for your interest in participating in the Photometry Working Group (PWG) for the International Asteroid Warning Network (IAWN) exercise of 2025 focused on asteroid 2025 FA22!

Due to the number of participants for the PWG, we will establish some guidelines and minimum requirements for observers planning to submit photometry for IAWN. An example submission will be included with this document on the IAWN website to aid observers in formalizing their submissions (<https://iawn.net/obscamp/2025FA22/>). We also kindly ask that all participants sign up with the working group lead and provide some basic background information about the participant's observatory. Although the working group leads will do their best to include everyone's data, submissions not adhering to the minimum requirements may not be included in the campaign if time does not permit troubleshooting.

We ask that all photometric data submission adhere to a standard data format (outlined below) to ensure data from several observatories can be successfully combined and interpreted. The data should be sent in a timely manner after each set of observations to ensure critical, new information is added to the campaign as quickly as possible.

PARTICIPATION REQUIREMENTS

1. Sign-up

Email the working group lead, Adam Battle (adambattle@arizona.edu), to mention that you are interested in participating in the photometry portion of the IAWN campaign. Provide your name and an email that can be used for the campaign. If possible, sign up with the working group lead prior to the start of the campaign (16 Sept. 2025).

You may also include your observatory information at this time (see next step), but it is not necessary to indicate intent to participate. You must, however, provide observatory information by the time of your first data submission.

2. Provide Observatory Information

This information must be provided to the working group lead by the time of your first data submission. Please provide the following information:

- The observatory name (if one exists)
- The observatory latitude, longitude, and elevation **OR** the Minor Planet Center (MPC) observatory code. Please be sure that your MPC code is populated on the MPC website: <https://www.minorplanetcenter.net/iau/lists/ObsCodesF.html>
- Telescope aperture size (mm preferred)
- System field of view (arcmins preferred)
- Camera model
- Filters you will use in the campaign (e.g., Sloan Digital Sky Survey g' and r' filters)
- What software you will use to calibrate your photometry (e.g., Canopus, custom Python pipeline (is there a citation?), Astrometrica, Tycho Tracker, etc.)
- Confirmation that you will be able to correct your data for light flight time

3. Data Format

If possible, please submit files adhering to the Astronomical Data Exchange Standard (ADES) “.psv” format set forth by the MPC (see Preferred Data Format section). We however recognize that this is not easy or accessible to all observers and we establish a simpler, minimum format at the end of this section.

For both data formats, please send results with the following file name convention that uses underscores (_) instead of spaces. Capital letters or hyphens (-) can be used to include multiple words within each field (e.g., ObservatoryName or Observatory-Name). The extension of the file will be either “.psv” for ADES submissions or “.txt” for the minimum format:

“YYYYMMDDUTC_ObservatoryName/Code_2025FA22_NumOfExposures_FilterName”

Both format styles should use the light flight corrected time at mid-exposure for the image. The time should be presented with the ISO 8601 extended format (YYYY-MM-DDThh:mm:ss.sssZ). The trailing “Z” indicates UTC and is required.

Both formats should use a period (.) for decimal points (e.g., 23.1 for twenty-three and a tenth). No value should be used to indicate thousands (e.g., 1000 for one thousand).

Preferred Data Format (ADES.psv file)

When possible, submission with the Astronomical Data Exchange Standard (ADES) pipe separated value (.psv) format set forth by the MPC is preferred. This format is standardized and has been used by observers for several years.

If you submit ADES files, use the Pipe Separated Value (.psv) format and not the xml format. The .psv format uses pipes (|) to separate columns and will be similar to ingest as the minimum data format. Many astronomical software such as Astrometrica (version 4.12 and later) are capable of outputting this style of ADES report.

An example of this file can be found on the IAWN website: <https://iawn.net/obscamp/2025FA22/>

For more information on the ADES data format, you can visit:

<https://www.minorplanetcenter.net/mpcops/documentation/ades/> and

https://github.com/IAU-ADES/ADES-Master/blob/master/ADES_Description.pdf

Minimum Data Format (3-column .txt file)

The alternate, minimum data format option is to submit a “.txt” file with three columns and a simple header, as described below. Values should be single-space delimited (i.e., a single space between each value in a given row). The columns provided should be:

UTC light flight time corrected at mid-exposure, magnitude, magnitude uncertainty.

For the first line, please include a “#” or “/” to indicate a comment and include the following header titles: “obsTime”, “mag”, and “magUnc”.

The *UTC should be the light flight corrected time at mid-exposure* for the image. The time is presented with the ISO 8601 extended format (YYYY-MM-DDThh:mm:ss.sssZ). The trailing “Z” indicates UTC and is required.

An example of this file can be found on the IAWN website: <https://iawn.net/obscamp/2025FA22/>

More details on the file name

In the file name, YYYY is the year; MM is the number of the month with 01 being January and 12 being December; DD is the day of the month (typically from 1 – 31) for the UTC day at the start of observations. The observatory name or MPC observatory code is next, followed by the target name (2025FA22 for this campaign). Next, include a zero-padded, four-digit number of exposures in your file (e.g., 0060 for sixty images; 0150 for one hundred and fifty images). Finally, include the ADES-approved name of the filter used for this set of observations (note: this will require submitting separate files for multi-band photometry with each filter in a separate file).

For filter names, please use the MPC ADES filter name format which denotes both the catalog and the band. For example, use “Sr” for Sloan r’ filters, but “Rc” for Johnson-Cousin’s R-band filter. More information can be found here:

<https://minorplanetcenter.net/mpcops/documentation/valid-ades-values/#band>

OBSERVING GOOD PRACTICES

Calibrations and Filters

Please ensure that you are calibrating your data to the correct star catalog that matches the filter you used for observations. This may be as simple as selecting the right catalog from the drop down in your data processing software. For example, if you use a Sloan filter, the data should be calibrated to Sloan brightness values in the same filter. Open/clear filters can be calibrated to Gaia G star values and should use solar-like stars if possible. If you are unsure what catalog to calibrate to, you can contact the working group lead.

Please do not submit Sloan u band or Johnson-Cousins U band data.

Exposure Times and Source Streaking

Most observatories will not be able to perform accurate photometry on streaked sources. As such, we recommend that observers use an exposure time that removes any streaking from both the asteroid and the in-frame stars. This exposure time will vary as the Earth-asteroid distance changes with time, but it can be calculated by dividing your site’s typical seeing in arcseconds (2” is a good average if you are unsure) by the sky motion rate of the asteroid during observations (in arcsecond per second). This will give you the longest exposure time you can take without streaking. Combine this information with the asteroid’s brightness and your telescope size to help determine your ability to get 0.1 mag uncertainties with no streaking from the asteroid or stars.

Data Processing Aperture and Annulus Sizes

The general rule of thumb is to use an aperture radius on the asteroid that is three times (3x) the full width at half maximum (FWHM) of point sources in the frame. The FWHM of all point sources in the frame should be approximately the same (assuming no target or star streaking). Apertures smaller than 3x FWHM will not collect all light from the measured source. Apertures larger than 3x FWHM will collect all light from the source, but add unnecessary background noise that reduces the signal-to-noise ratio (SNR) of the measurement.

An annulus (doughnut shape) is often used to estimate the median background count around the source being measured. Ideally, the area/number of pixels contained within this annulus is larger than the area/number of pixels in the aperture.

Airmass Constraints

The amount of atmosphere you are looking through (normalized to zenith – directly overhead) is called the airmass. Higher airmasses (more atmosphere) occur closer to the horizon and absorb more light from the sources. At elevations of 30 degrees or higher above the horizon, you will observe through an airmass of 2.0 or less, which is preferred. Higher airmasses (closer to the horizon) can significantly negatively impact your photometry and we recommend avoiding observations at airmasses of 2.0 or higher (lower than 30 deg elevation).

Frequently Asked Questions and Tips

- **Canopus can't find the asteroid**
 - Try updating the “MPCORB.dat” orbit file from this link:
<https://minorplanetcenter.net/iau/MPCORB.html>
- **What is light-flight time correction?**
 - Light takes a finite amount of time to travel from the asteroid to the Earth, at which point the observer collects that light. Because this project involves several observers around the world and the asteroid's distance will change drastically across the campaign, the time reported needs to be the time at which the light left the asteroid's surface so that data from many observatories can be combined.
- **Should I name my data after the filter on my telescope or the star catalog used for calibrations?**
 - Ideally, these two things should match! Use a catalog that most closely matches the filter on your telescope and report that common value (i.e., if you use Sr filter, calibrate to Sloan Digital Sky Survey r' stellar magnitudes).
- **I'm not sure what to name my filter for the data submission**
 - Use the ADES standard for filter naming conventions:
<https://minorplanetcenter.net/mpcops/documentation/valid-ades-values/#band>
 - Note that deprecated filters are named in single quotes. If your filter/calibration catalog is not listed here, email Adam Battle (adambattle@arizona.edu) to inquire.
- **What SNR or magnitude uncertainty should I aim for in my observations?**
 - We would like to keep individual measurements relatively clean to make the combination process as easy as possible. Aim for magnitude uncertainties of 0.1 mag or less. This can be achieved with a single frame object SNR of ~40 for most.
- **I have a lot of data, should I send all of it to you?**
 - We expect to receive no more than one image per minute from observers. If you have data more frequently than this, consider binning the data or down selecting data points so that you send us only approximately one image per minute.
 - You may also be interested in sending some data to us and keeping some separate for your own publication and that is okay with us!