StAnD Asteroid Search Campaign

Quick guide for Citizen Science

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StAnD Asteroid Search campaign

Asteroid Search Campaign

Welcome to the StAnD asteroid search campaign, organized by project StAnD in partnership with the **IASC Program (International Astronomical Search Collaboration).**

Over the course of approximately four weeks, images sets of the same sky region will be available for the participating schools. Each set consists of 4 images taken approximately 15 minutes from each other. In these images, we will try to discover and identify objects that are moving in relation to the background stars and galaxies. To validate the findings, some assumptions need to be verified: the trajectory of the object must be linear, with constant velocity (positions of the object in different images are equally spaced between each other, given the time interval between the images, and which is the same), and the object has similar magnitude (brightness) in all frames.

This initiative has the following main objectives:

- Contribute to planetary defence, by identifying asteroids that may pose a risk of collision with the Earth.
- Offer students the possibility of discovering new asteroids, which will become part of the database of known objects in our Solar System.
- Provide a hands-on experience of scientific practice and methods, involving concepts of different school subjects, and developing scientific and interpersonal skills.

The software **Astrometrica** will be used in the analysis. You can download at: http://iasc.cosmosearch.org/Content/Distributables/astrometrica-setup-v1.4.exe and install on your computer.

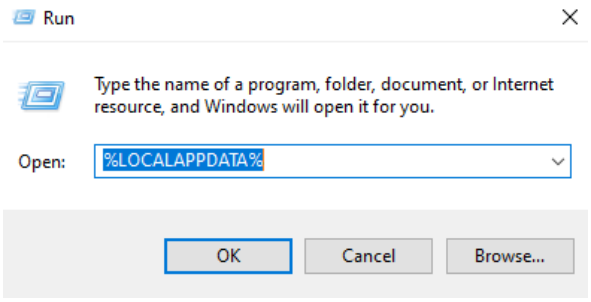
Installation is simple. You'll see a window with a dark background, where the Operating System command environment runs, and the installation window will follow, similar in every way to other software package installations in Windows environment.

Note : Astrometrica runs exclusively on Windows. There is no version for Linux or Mac.

Installation and RunTime Error 217

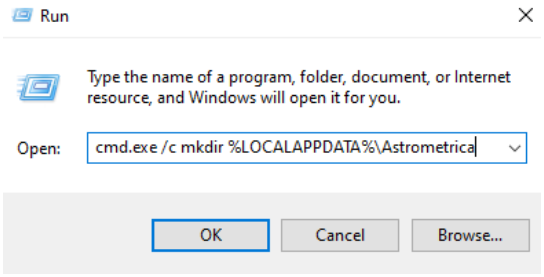
Sometimes difficulties will arise when installing Astrometrica. One of the most common is RunTime Error 217, caused by missing Windows system files. If you experience this error, please try this solution:

1) In Windows, go **to Start > Run** or, use the **Win+R** key combination, and type (or copy/paste) **%LOCALAPPDATA%** (including the %) signs and then press **Enter.**



2) This should open the user's AppData \Local folder. Astrometrica requires the "Astrometrica" folder to be present here. Otherwise, just create a new folder called "Astrometrica". Alternatively, the following command can be used in the **Start > Run** dialog box:

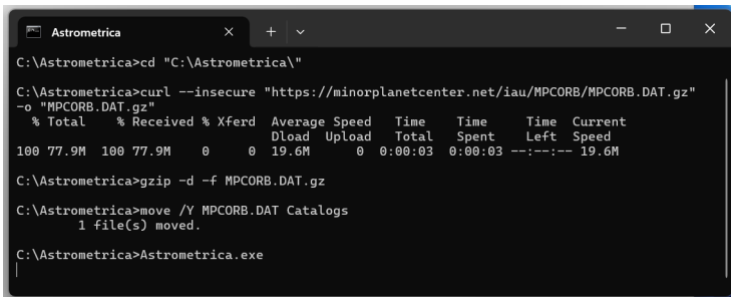
cmd.exe /c mkdir %LOCALAPPDATA%\ Astrometrica

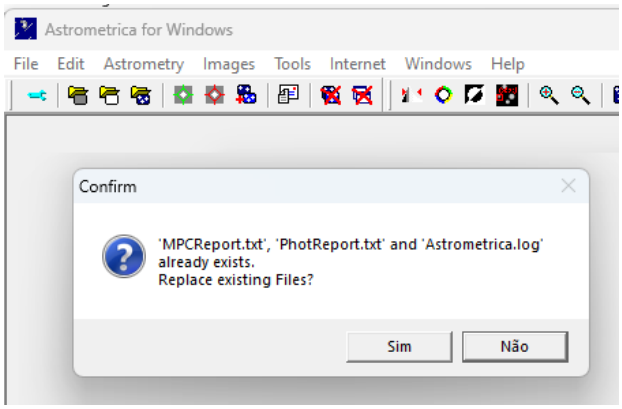


Using Astrometrica

Before using Astrometrica to detect asteroids and comets, check out this video that will introduce its main features: https://youtu.be/py68Hi137W4 .

When launched, Astrometrica starts by updating the Minor Planet Center database (MPCOrb) in a OS environment. If you use your school network please ensure this type of connection is allowed.

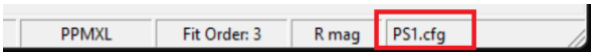




After the update, Astrometrica will ask if you want to delete the previous report that appears in the program logs. By clicking "Yes, the program will reset all information related to the last usage. Otherwise, all information stored in the previous usage will be added to the information that was produced, compromising the analysis.

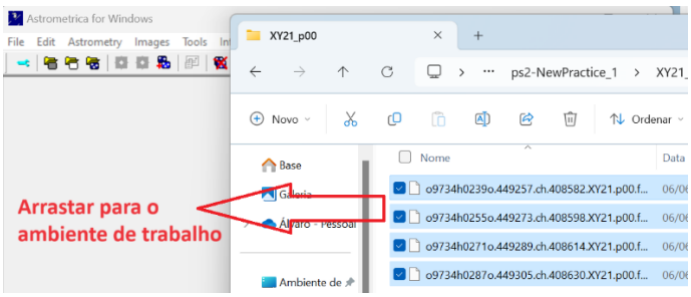
Astrometrica toolbar is shown in the image below. Here's a list of steps needed to make the manual asteroid detection process as effective as possible.

1. On the bottom right of the screen, check if the name of the .cfg file starts with **ps1** or **ps2** (code for the **P**an-**S** TARRS telescopes used).



If the file designation is different from that it will be necessary to reconfigure Astrometrica as follows: click on the icon **1** or select **File --> Settings ...--> Open** and then select the appropriate .cfg file.

2. To drag and drop the 4 images to Astrometrica workspace, click icon **2** or select **--> File images** or even **Ctrl+L**



3. Identification of the celestial region (**Object Data Reduction**): icon **3** or **Astrometry** --> **Data Reduction** or **Ctrl** + **A.** This will allow the program to know exactly their coordinates when marking the asteroids later.

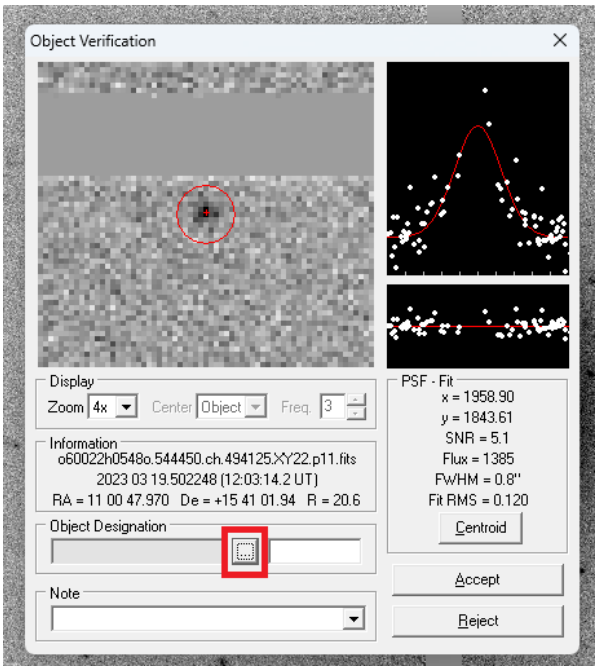
4. Identification of known asteroids (**Known Object Overlay**): icon **4** or **Tools --> Known Object Overlay** . Once the celestial region has been identified, and the date and time information contained in the image files, the program will consult the database to check whether asteroids are supposed to be found there, and which ones.

5. Animate the image sequence: icon **7** or Tools --> **Blink Image** s or **Ctrl+ B** . This will visually allow us to see if there are objects in straight and uniform movement.

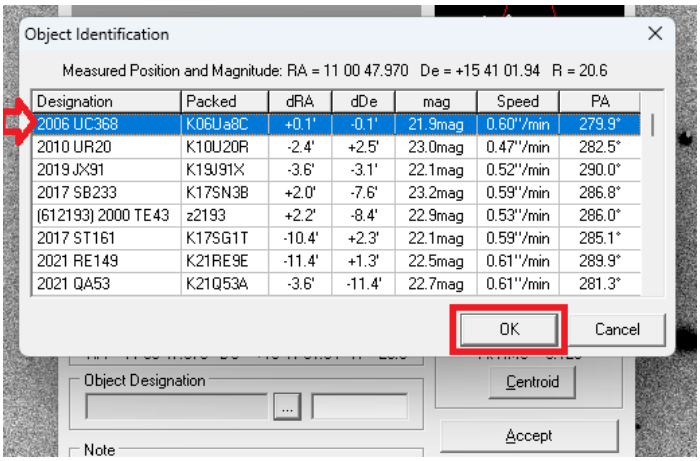
6. Zoom in to better view the animation: icon **5** or **Images -->Zoom** in **(2x**) By default, the view is at 25%. Zoom in twice to 100% allowing better visual acuity.

7. Search for objects by stopping the animated sequence with icon **8**, moving forward or backward in the sequence with icons **9** and **10**, and resuming the animation with icon **11**.

8. Once an object with a rectilinear and uniform movement has been identified, its position must be marked in the 4 images, whether objects are already referenced with a code, or if they are new objects. **Mark the position of the object when and where it is visible.** If the object is not visible in the frame, don't mark it.

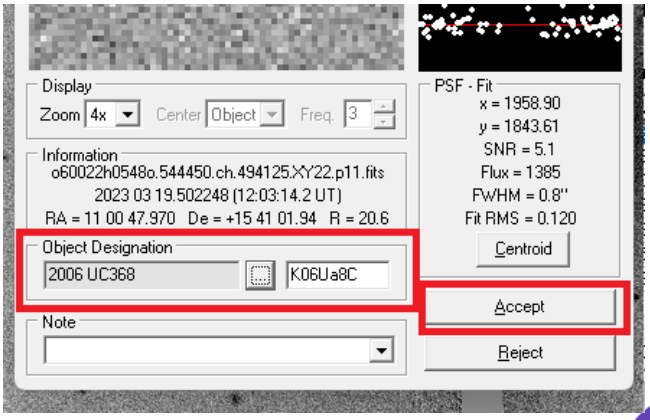


In the case of **previously known objects,** the known object overlay probably presents a deviation in relation to the object's real position. This needs to be corrected (this is what science is all about and is equally important to new discoveries). To do this, we mark the center of the asteroid's position and repeat its name by clicking on the button with **[...]**



An asteroid data table will appear. The **first indicates the closest to the asteroid in question**. We can see the respective data as **dRA** and **dDe** (deviations in relation to right ascension and declination and which must be less than 0.3' of a degree to be considered. Otherwise **Cancel** the association and mark as a new object), the magnitude that represents the brightness (the lower the value, the brighter the object) and the apparent angular velocity in arc seconds per minute.

This data can be explored in various ways, such as the concept of deviation for secondary school students, and/or this new presentation for speed, in seconds of arc per minute which, combined with other known parameters of the object, present in the Minor database Planet Center



(MPC), offer great teaching potential. We select the object and press **ok**. The asteroid identification is then transported to the "**Object Designation" field. Accept** later.

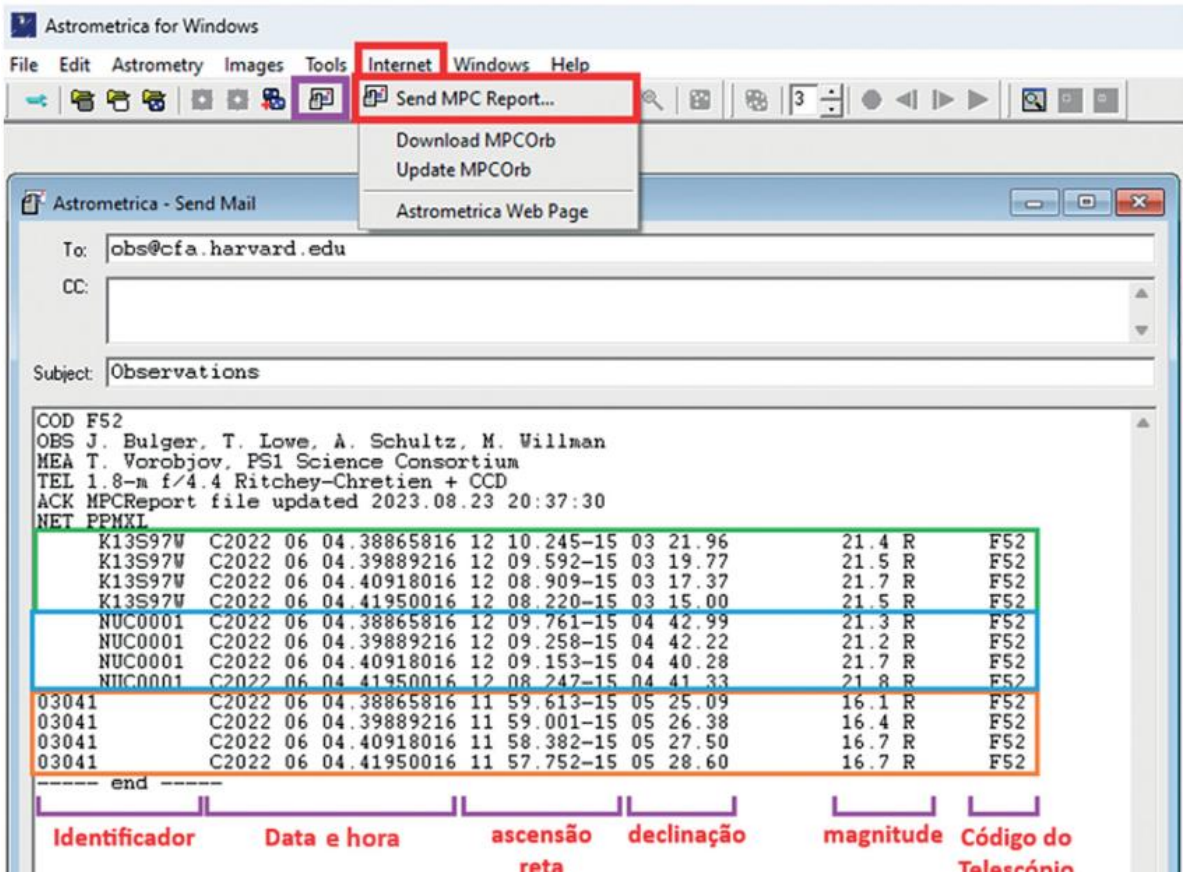
We can now copy and paste the designation to mark this same object in the next 3 images in the sequence, remembering that we must mark the object in all the images where it is visible. If your asteroid position, whether new or known, in one or two images, coincides with the grid lines, or falls outside the available region, it will not be marked. We are thus correcting the data on the asteroid's trajectory, and it is important to highlight to students the importance of this process as they often feel frustrated if they do not find **new asteroid**s.

8.1. When finding a **new asteroid** not identified with **Known Object Overlay ,** we will have to create an identifier made up of **three capital letters and 4 digits** that will be used as a counter, to increment **throughout the campaign** . The suggestion for the three letters is to use the initials of the school name (e.g., Escola **S**ecundária **M**arques **C**astilho- for the first discovery I would use the identifier **SMC**0001, and in the following cases SMC0002, SMC0003, ...).

8.2. If it **is only possible to register** just one of the images, it should not be marked because a single point does not define an orientation (a little more Mathematics and Physics).

Report

To access the report at the end of the analysis, simply select the icon  (**Send MPC Report**) and a window will appear with that report. This begins by presenting information relating to the telescope and operators in the header, as well as the date and time of analysis of these images. Using the example of Figure, below the NET PPMXL line (catalog used) we have information relating to the discoveries made, namely the identifiers of the objects found, the date and time of the images, the Right Ascension and Declination coordinates of the object in each image of the sequence, and magnitude.

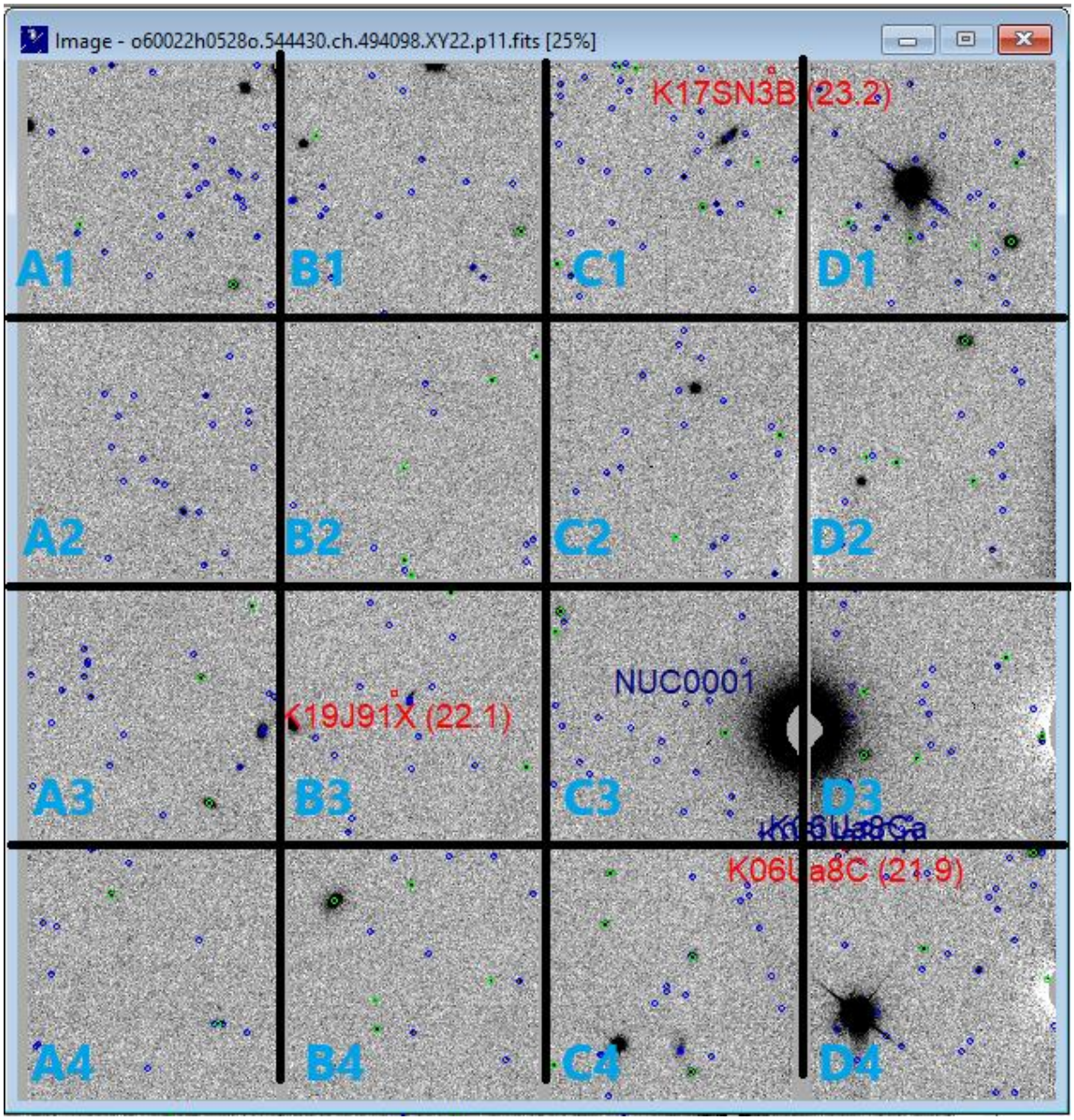


If no moving objects are detected, be they new discoveries or known objects, the content of the report between the *NET PPMXL line* and the line that ends it will only have the indication " ***No moving objects detected*** ".

The content of this report will then be selected and copied to be submitted on the platform. The school teams that independently manage the campaign (already very experienced) carry out this process directly on the platform, indicating the names of the participants involved in the analysis (https://iasc.cosmosearch.org). Newcomer schools should copy the contents to a simple text editor such as Notebook , adding at the end the name of the students involved in the analysis, saving it as the name of the analyzed image zip file (eg **ps2-NewPractice.txt**), and sending it by email to iasc@nuclio.org We will submit it on the platform indicating the authorship of the analysis.

Questions and Questions during the analysis

To better communicate, let's consider the images in a 4x4 matrix, whose rows are A,B ,C,D, and the columns 1,2,3,4. Each cell will be referenced by its position in this matrix (eg C2).



This approach will be easier to position ourselves in relation to observations or doubts about the objects under analysis.

Discoveries and Development

Challenge and discovery are, without a doubt, powerful levers for learning and developing skills. I believe that participating students internalize a set of concepts, learn work routines and methodologies and develop a set of skills during these activities.

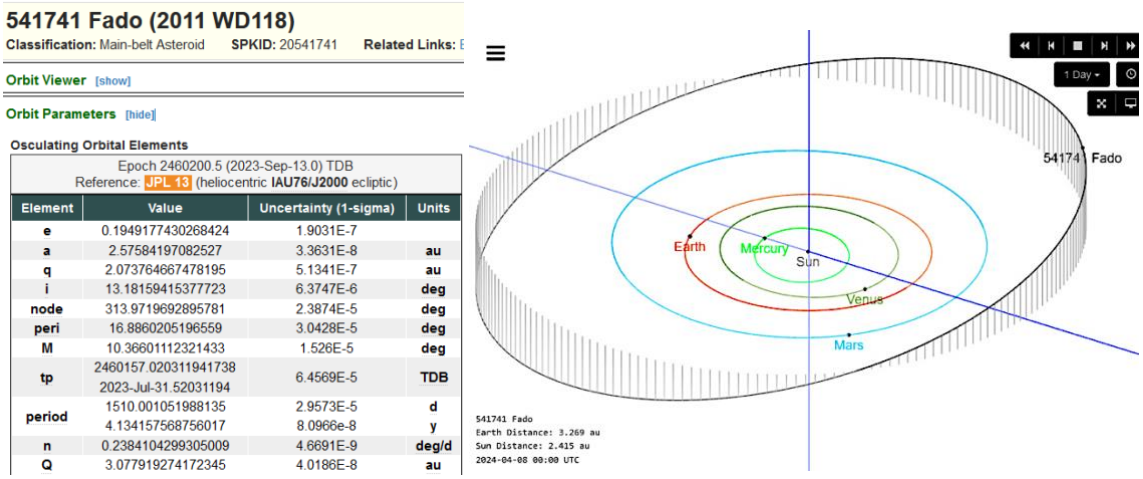
The immediacy that characterizes the new generation can sometimes lead some students to some frustration, particularly when they do not make new discoveries. It is up to us to make them realize that correcting the orbits of already cataloged asteroids is a very important scientific contribution, and even the very absence of asteroids in a group of images is a scientific discovery. It is, with each passing day, extremely important to work on determination and resilience to overcome any challenge that the future presents.

But talking about discoveries, we have three distinct levels of discoveries:

Preliminary findings : these are detections that have not been fully verified by Minor Planet Center (MPC) and may still be rejected for various reasons.

Provisional Findings: already verified by Minor Planet Center as asteroid discoveries. They must now undergo additional observations over a period of three to five years in order to verify the asteroid's orbit and consolidate any additional measurements of the object. Discovery credit may go to others depending on the circumstances of the discovery.

Definitive discoveries: became part of the list of known objects in the Solar System, with a well-described orbit in the Minor Planet Center (MPC) and on the NASA website. The authors of the discovery may be called upon to assign the asteroid's official name. In the example below we have the Fado Asteroid discovered by students at Escola Secundária Doutor Manuel Gomes De Almeida – Espinho.



541741 Fado (2011 WD118)

Classification: Main-belt Asteroid **SPKID:** 20541741 **Related Links:**

Orbit Viewer [show]

Orbit Parameters [hide]

Osculating Orbital Elements

Epoch 2460200.5 (2023-Sep-13.0) TDB
Reference: JPL 13 (heliocentric IAU76/J2000 ecliptic)

Element	Value	Uncertainty (1-sigma)	Units
e	0.194917743026842 4	1.9031E-7	
a	2.57584197082527	3.3631E-8	au
q	2.073764667478195	5.1341E-7	au
i	13.18159415377723	6.3747E-6	deg
node	313.9719692895781	2.3874E-5	deg
peri	16.8860205196559	3.0428E-5	deg
M	10.36601112321433	1.526E-5	deg
tp	2460157.020311941738 2023-Jul-31.52031194	6.4569E-5	TDB
period	1510.001051988135 4.134157568756017	2.9573E-5 8.0966e-8	d y
n	0.2384104299305009	4.6691E-9	deg/d
Q	3.077919274172345	4.0186E-8	au

Much could be advanced here, but without losing focus, this is just a small practical guide for this Citizen Science experience. In other texts, the scope of the activity will be explored in more depth in terms of its educational potential. We are counting on you! Happy hunting!