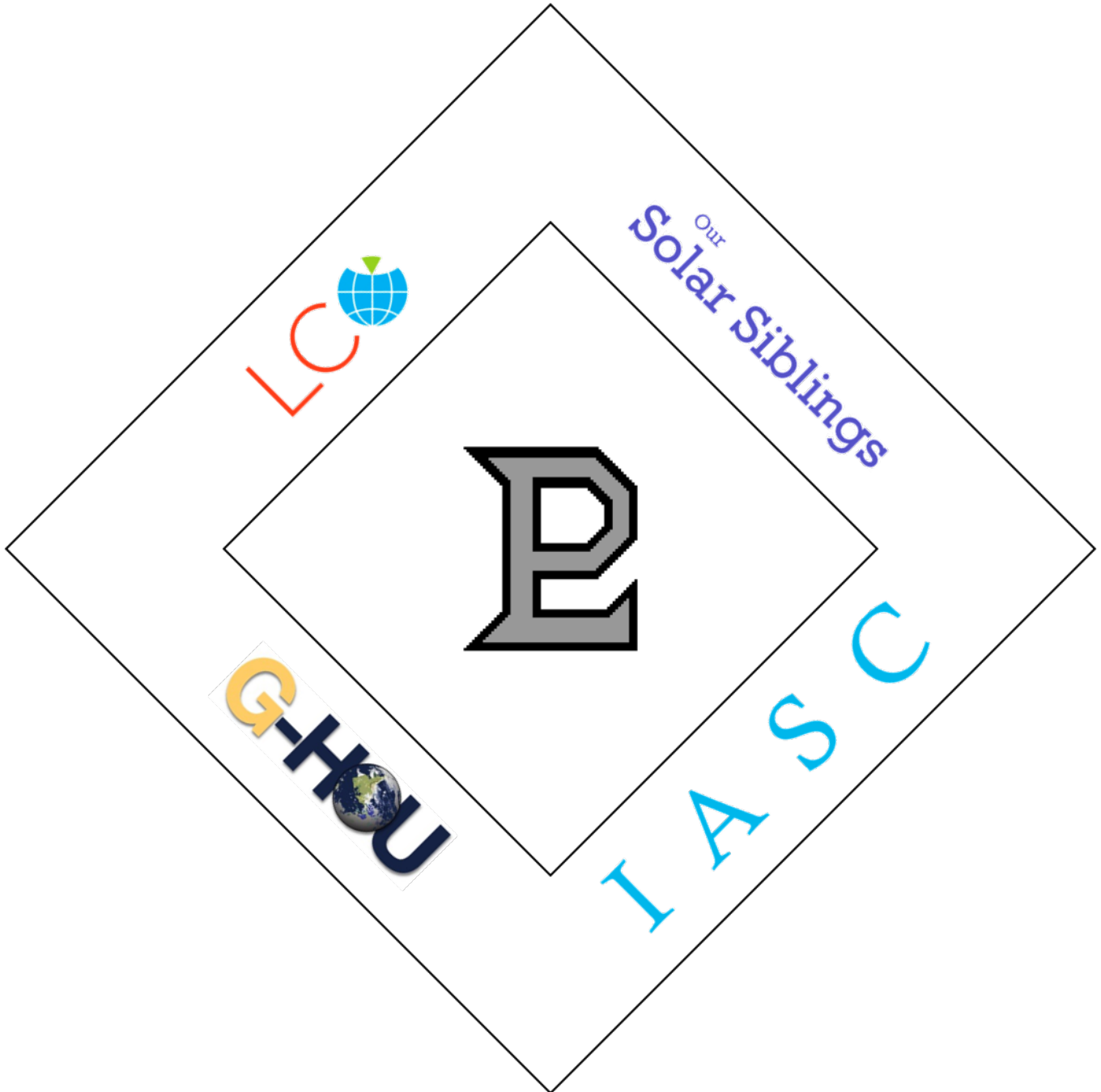


How to use the Orbit Calculator for Asteroid Observations



Orbit Calculator Instructions

Project Pluto supplies astronomical software, both commercial and freeware, to amateur and professional astronomers. The Find Orb orbit determination software can take a set of positional measurements of an asteroid, comet, or natural or artificial satellite, and determine its orbit.

1. In order to determine an orbit, you will need an MPC Report. These reports are generated by *Astrometrica*.

```
COD F51
OBS J. Bulger, T. Lowe, A. Schultz, M. Willman
MEA J.P. Miller, C. Davis, R. Valadez (HSU, USA)
TEL 1.8-m f/4.4 Ritchey-Chretien + CCD
ACK MPCReport file updated 2019.12.12 20:39:45
NET PPMXL
Image set: ps1-20191124_6_XY32_p00
  HSU5001 C2019 11 24.60059104 58 20.844+19 30 04.58          19.4 R    F51
  HSU5001 C2019 11 24.61341104 58 20.156+19 30 00.29          19.6 R    F51
  HSU5001 C2019 11 24.62620804 58 19.451+19 29 56.29          19.3 R    F51
  HSU5001 C2019 11 24.63905404 58 18.849+19 29 51.80          19.7 R    F51
----- end -----
```

2. Navigate to the Project Pluto Find Orb website at <https://www.projectpluto.com/fo.htm>
3. In the MPC Report, copy a minimum of two or a maximum of four measurement lines for the same object.

NOTE: Using four lines will give you a more accurate orbit.

```
COD F51
OBS J. Bulger, T. Lowe, A. Schultz, M. Willman
MEA J.P. Miller, C. Davis, R. Valadez (HSU, USA)
TEL 1.8-m f/4.4 Ritchey-Chretien + CCD
ACK MPCReport file updated 2019.12.12 20:39:45
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Image set: ps1-20191124_6_XY32_p00
  HSU5001 C2019 11 24.60059104 58 20.844+19 30 04.58          19.4 R    F51
  HSU5001 C2019 11 24.61341104 58 20.156+19 30 00.29          19.6 R    F51
  HSU5001 C2019 11 24.62620804 58 19.451+19 29 56.29          19.3 R    F51
  HSU5001 C2019 11 24.63905404 58 18.849+19 29 51.80          19.7 R    F51
----- end -----
```

4. In the website, look for the window box that says, "Paste astrometry here, and/or upload it using the 'browse' button below".

On-line Find_Orb

Updated 2020 May 06

Special note about interstellar objects such as C/2019 Q4 = 2I/Borisov and A/2017 U1 = 1I = 'Oumuamua

Use the form below to get orbital elements and ephemerides from astrometric observations.

Suggested quick start: **Don't panic!** Copy/paste your observations in the large text window below, and/or click on "Browse" to pick a file containing the astrometry, and/or enter an object name.

[Click here if you're wondering how to get your observations into the correct format.](#)

Feed it *all* of your observations. There is almost never any benefit in giving the program a subset.

Then click the "compute orbit and ephemerides" button. Usually, that'll be all you need to do. If it isn't, hit the back arrow and look a little more closely at your options ([options documented here.](#)) If you're still not getting things to work, [contact me.](#)

[Click here if you just want orbital elements and/or ephemerides for an object, and don't have astrometry for it.](#)

Here are a [few hints that may be useful.](#)

Note that the orbit will be computed from all observations, from all three possible sources (cut/pasted, uploaded, or from MPC data), whether their designations match or not. So you can mix-and-match the three input sources, if you have (for example) some new observations of an object already known to MPC.

This is a modified, simplified, non-interactive version of the [Find_Orb](#) program.

There are [several other tools for asteroid observers](#) on this site.

Cut/paste observations in the [80-column MPC format](#), [PSV or XML ADES](#), or the [AstDyS/NEODys_csv format](#) below. Don't worry about it if some other text is copied in as well; extra text will simply be disregarded.

Paste astrometry here, and/or upload it using the "browse" button below.



And/or, you can upload a file containing the astrometry (to be combined with anything in the above text box.) No file chosen

And/or, you can [enter an object name](#), and Find_Orb will get the astrometry for it from the MPC (and combine it with anything from the file or text box) : (examples: 1997 XF11, 141P, Icarus, NEOCP designations)

Ephemeris starting date:

Number of steps :

5. Paste the copied lines from the MPC Report.

On-line Find_Orb

Updated 2020 May 06

Special note about interstellar objects such as C/2019 Q4 = 2I/Borisov and A/2017 U1 = 1I = 'Oumuamua

Use the form below to get orbital elements and ephemerides from astrometric observations.

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```
HSU5801 C2019 11 24.60859104 58 20.844419 30 04.58 19.4 R F53
HSU5801 C2019 11 24.61341104 58 20.156419 30 00.29 19.6 R F53
HSU5801 C2019 11 24.62620804 58 19.451419 29 56.29 19.3 R F53
HSU5801 C2019 11 24.63904604 58 19.049419 29 51.00 19.7 R F53
```



And/or, you can upload a file containing the astrometry (to be combined with anything in the above text box.) No file chosen

And/or, you can [enter an object name](#), and Find_Orb will get the astrometry for it from the MPC (and combine it with anything from the file or text box) : (examples: 1997 XF11, 141P, Icarus, NEOCP designations)

Ephemeris starting date:

Number of steps :

Next, click on the Compute orbit and ephemerides Button.

6. A new webpage will load showing information such as:

- Semimajor Axis (a)
- Eccentricity (e)
- Perihelion or Perigee Distance (q)
- Aphelion or Apogee Distance (Q)
- Absolute Magnitude (H)

"Pseudo-MPEC" for HSU5001
 Created 2020 Aug 31 21:32:54 UT using [Find_Orb](#)
[Click here for an explanation of pseudo-MPECs](#)

- [Astrometry](#)
- [Observing stations](#)
- [Orbital elements](#)
- [Residuals](#)
- [Ephemeris](#)
- [Click here to search NEAT images for this object using Skymorph](#)
- [Click here to search DSS2 images for this object using Skymorph](#)
- [Click here to search Spacewatch images for this object using Skymorph](#)

[Orbit Simulator View](#)

Astrometry:

Station	Obs. Date	RA	Dec	RA Error	Dec Error	Mag	Filter
HSU5001	C2019 11 24.60059104	58 20.844+19 30 04.58	19.4 R	FS1			
HSU5001	C2019 11 24.61341104	58 20.156+19 30 00.29	19.6 R	FS1			
HSU5001	C2019 11 24.62620804	58 19.451+19 29 56.29	19.3 R	FS1			
HSU5001	C2019 11 24.63905404	58 18.849+19 29 51.80	19.7 R	FS1			

Station data:
 (FS1) Pan-STARRS 1, Haleakala (N20.707235 W156.255910) US/Hawaii.
 Observers N. Primak, A. Schultz, S. Watters, J. Thiel, T. Goggia. Measurer
 PSI Science Consortium. 1.8-m Ritchey-Chrétien + CCD.

Orbital elements: HSU5001
 Perihelion 2020 May 23.72184 +/- 482 TT = 17:19:27 (JD 2458993.22184)
 Epoch 2019 Nov 25.0 TT = JDT 2458812.5 Auto-Find
 M 324.12347807 +/- 60 (J2000 ecliptic)
 n 0.19851790 +/- 0.161 Peri. 233.64865 +/- 100
 a 2.51023991 +/- 1.57 Node 239.25096 +/- 39
 e 0.0850191 +/- 0.242 Incl. 10.31799 +/- 40
 P 4.96 H 16.2 G 0.15 U 11.5 SR
 q 2.66285950 +/- 1.28 Q 3.15772032 +/- 39.1
 From 4 observations 2019 Nov. 24 (55.4 min); mean residual 0".26

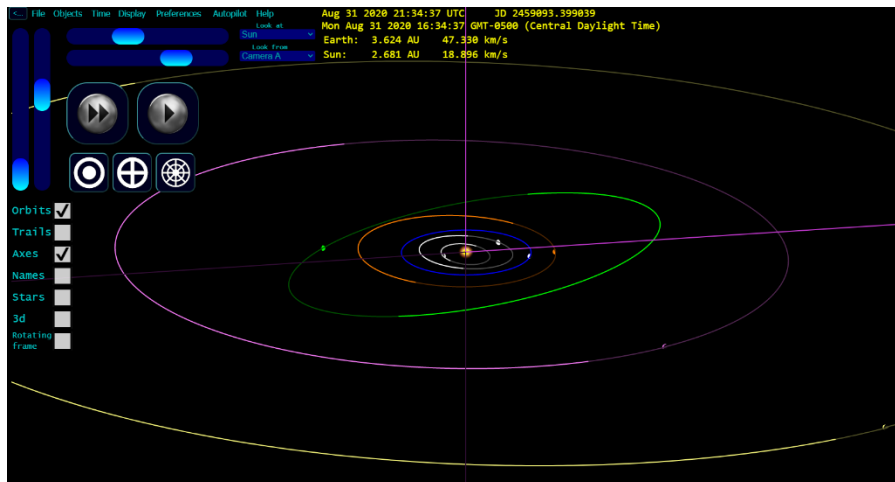
Residuals in arcseconds:
 191124 FS1 .22+ .00 191124 FS1 .56- .16+
 191124 FS1 .03- .07- 191124 FS1 .38+ .09-

Ephemerides (geocentric):

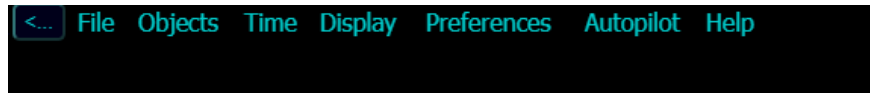
Date (UTC)	RA	Dec	delta	r	elong	mag	sig	PA
2020 09 01 09 29 29.197	+06 59 58.49	3.6229 2.6804	17.9	21.6	60d	7		
2020 09 02 09 31 06.181	+06 59 55.80	3.6194 2.6807	18.4	21.6	61d	7		
2020 09 03 09 32 42.067	+06 41 58.44	3.6157 2.6811	18.9	21.6	61d	7		
2020 09 04 09 34 19.555	+06 32 42.44	3.6120 2.6814	19.4	21.6	61d	7		
2020 09 05 09 35 55.942	+06 23 31.84	3.6081 2.6818	19.9	21.6	61d	7		
2020 09 06 09 37 32.128	+06 14 18.69	3.6041 2.6822	20.4	21.6	61d	7		
2020 09 07 09 39 08.109	+06 05 03.62	3.6000 2.6825	20.9	21.6	61d	7		
2020 09 08 09 40 43.686	+05 55 44.88	3.5958 2.6829	21.4	21.6	61d	7		
2020 09 09 09 42 19.454	+05 46 24.31	3.5914 2.6832	21.9	21.7	62d	7		

Next, click on Orbit Simulator View.

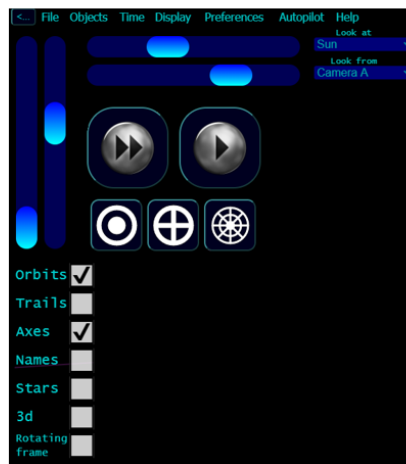
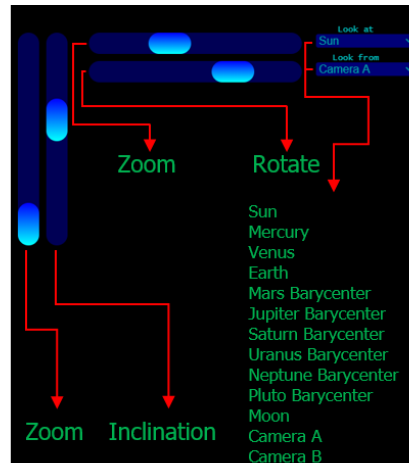
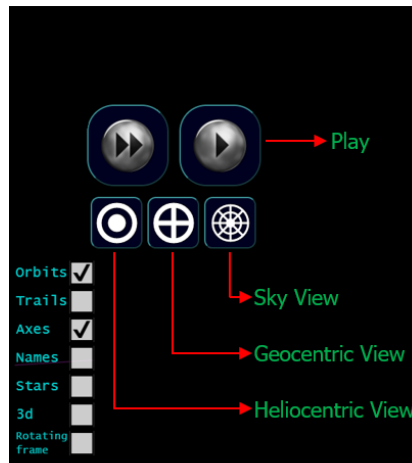
7. A new webpage will load showing an animation of the orbit.



You can familiarize yourself with some of the menu options, buttons and sliders.



File	Objects	Time	Displays	Autopilot	Help
Save as	Create objects	Calendar date (Local)	Screens	Now	Description
Screen shots	Create object with clones	Calendar date (UTC)	Frame A	Single events	Quick help
Collision log	Import object	Julian day	Frame B	Per iteration	Manual
	Edit objects (vectors)	Time step	Rotating frame	Per graphic update	About
	Edit objects (elements)	Set time & date	Stereo		
	Vectors		Cities A		
	Delete objects		Cities B		
	Orbits		Camera A		
			Blank		
			Large play button		



Go Discover

