



### 1. Prerequisites for participation.

- An interest in astronomy;
- An interest in observing and providing data to the scientific community;
- An interest in learning more about asteroids and near-Earth objects; and
- Appropriate observing equipment or access to equipment.

### 2. Register on the website, [www.asteroidmission.org/target\\_asteroids/register](http://www.asteroidmission.org/target_asteroids/register)

- Complete the *Target Asteroids!* Registration Form.
- Press the submit button to register your interest in the project.
- You will receive autoreply confirmation of your registration;
- After confirmation you will have access to communication with other observers via the *Target Asteroids!* email list known as *ta\_observers@lpl.arizona.edu*; and
- Periodically you will receive updated information about the program.
- You are invited to direct questions or comments to the program co-leads anytime at: *target\_asteroids@lpl.arizona.edu*.

### 3. Obtain instrumentation.

- The minimum instrumentation recommended to participate in this project is:
- Telescope 8" or larger;
- CCD Camera, Computer with internet connection; and astrometry software.

If you have an appropriate telescope and CCD camera, you will be able to observe asteroids on the *Target Asteroids!* list. The particular asteroids that can be observed depend on the telescope's aperture (diameter of the mirror or lens), light pollution, and geographic location.

- If you do not have a telescope, you can still participate in the program by obtaining access to observing equipment:
  - You may team up and use a telescope owned by a friend, astronomy club, local college or planetarium/observatory.
  - Several private telescope services from which you may purchase telescope time provide good observing locations all over the world. Examples are Sierra Stars Observatory Network, iTelescope.net or LightBuckets. (Note: The *Target Asteroids!* program does not endorse any specific vendor).
  - There are organizations that partner with large private and public observatories, which provide images for schools and students.
    - They measure the computer images for astrometry (position with respect to background stars) and submit the data to designated organizations such as OSIRIS-REx's *Target Asteroids!*, Astronomical League, Association of Lunar & Planetary



Observers, Collaborative Asteroid Lightcurve Link, and the Minor Planet Center. Registrants using this option will need to make their own connections and arrangements for these submittals.

- Local astronomy clubs provide connections and opportunities for observations. Are you a member of a local astronomy club? If not, we recommend it! You will meet friendly members who will be happy to help you. Check out our partners, NASA Night Sky Network and The Astronomical League, to locate a club near you.

Join one of the International Astronomical Search Collaboration-*Target Asteroids!* (IASC-TA!) annual campaigns! The campaign provides telescope images of asteroids and you learn how to make position and brightness measurements. Contact [target\\_asteroids@lpl.arizona.edu](mailto:target_asteroids@lpl.arizona.edu) for more information.

#### 4. Review the *Target Asteroids!* list on the website for objects for which we need data.

Check the list for new additions. The program will update the list as needed but at least annually. When updates occur, we will send out a notification to the *Target Asteroids!* listserv (members include those participating in the Astronomical League's Target NEOs!).

#### 5. Plan your observing session(s) for a particular object or objects accessible from your location with your telescope. OSIRIS-REx science team member and *Target Asteroids!* co-lead, Carl Hergenrother sends recommendations for upcoming objects and special opportunities such as close flybys by near-Earth Asteroids.

Because not all asteroids are visible at the same time or in the same part of the sky, observers determine their own observing schedules. Many sky calendar software programs download the latest asteroid ephemerides (astronomical positions) from the IAU Minor Planet Center (MPC). These allow the observer to plan each evening's observing session. The objects on the *Target Asteroids!* list web page may be copied into these ephemeris programs. Click the links for interesting information about a specific asteroid on the *Target Asteroids!* list.

- The MPC and Lowell Observatory have helpful aids for planning observing sessions:
  - <ftp://ftp.lowell.edu/pub/elgb/astorb.html>
  - <http://www.minorplanetcenter.net/iau/MPEph/MPEph.html>
- Sergio Foglia and Tomas Vorobjov, who work with *Target Asteroids!* partner, International Astronomical Search Collaboration, designed an on-line tool specifically for planning *Target Asteroids!* observing sessions:
  - <http://iasc.scibuff.com/osiris-rex.php>

### 6. Observe an asteroid and collect data.

An observation consists of at least 3 digital or photographic images of the asteroid (centered) acquired over a ½ hour or more and corresponding report for one or more of the following:

- astrometry (precise, accurate positions against a star field);
- photometry to 0.1 magnitude accuracy; V or R is best; and
- spectroscopy while difficult for these faint objects is welcome.

Some observers prefer to obtain a large set of images only of an asteroid in a single night and let *Target Asteroids!* do the data reduction. They typically submit 30-80 images.

(Contact Carl Hergenrother if you would like instructions on how to produce these observations, including the use of digital SLR cameras).

The ideal observation documentation consists of at least three images corrected for flat field and dark subtraction, along with corresponding astrometry in standard IAU Minor Planet Center format (used by the most popular astrometry programs). Refer to the excellent NASA Amateur Observing Program here:

<http://aop.astro.umd.edu/> and Brian Warner's Guide to Photometry:  
<http://www.minorplanet.info/ObsGuides/Misc/photometryguide.htm>

Make sure:

- You are observing the correct asteroid and that it is a real object (not an image defect);
- There are 12 or more reference stars in the field of view for astrometry and/or photometry;
- You use the proper order fit correction; and
- You place the asteroid of interest near the center of the field.

There are many excellent software packages available that allow the observer to locate asteroids, capture images, and "track-and-stack" many images to capture faint asteroids. Even if you can't see the asteroid in your images because it is faint, submit them anyway. We can stack many images to improve the signal to noise ratio and achieve up to one magnitude increase.

Collect the following information:

(It isn't as complicated as it looks – some information is entered once and doesn't change if you use the same equipment each time). Also programs such as Astrometrica (kindly provided by Herbert Raab) access reference star catalogs, read information from image headers, place your measurements in the desired report format, ready for email at the press of a button.



## Basic information

- Date (universal time or local time)
- Time (accurate to the nearest second; universal time or local time)
- *Target Asteroids!* object observed
- Latitude of observer or telescope, if remote (nearest 10th of a second)
- Longitude of observer or telescope, if remote (nearest 10th of a second)

## Observer Information

- Name
- Email
- Minor Planet Center Code (if any)
- Names of additional observers or measurers
- Submitter's contact information if different from observer

## Special requirements for each observation

- CCD flat field
- Dark or bias subtraction
- Accurate computer time +/- second
- Type of telescope (reflector, Schmidt-Cassegrain, etc.)
- Aperture
- Type or brand/model of CCD
- Filters used (V or R?)
- For photometric observations, standard star catalogue used
- Minor Planet Center (MPC) code for the observer (if the observer has one)
- Anti-blooming (ABG) correction OFF

## 7. Submit observations (images and astrometry, and/or photometry or spectroscopy).

- Upload images to the *Target Asteroids!* ftp site at <ftp://orexftp.lpl.arizona.edu/pub>

Connecting to the ftp site for the first time:

- Click Start
- My Network Places
- In Network task pane click "Add network place" (Add network place wizard will begin)
- Click next to continue
- Chose "another network location"
- Next



## Target Asteroids! Instructions



- Type or copy ftp://orexftp.lpl.arizona.edu/pub in the network address box
- Next
- Chose “log on anonymously”
- Next
- Type a name of your choice for this ftp site
- Next
- Finish

This will set up an icon in “My network places” from which you may connect directly to the public ftp site in the future and take you to the ftp site.

Copy image files from your local computer and paste into the ftp site window. Click “X” to exit. After this, you will only have to click on the icon in “My Network Places” to connect.

The suggested image file name is in the format:

- Observer\_Object\_YYYYMMDD\_HHMMSS\_Flag(TA or TNEOs).FITS  
(In file names use “\_” instead of spaces).  
For example:
- Hergenrother\_1999RQ36\_20120318\_041510\_TA.FITS
- TA or TNEOs flag lets us know if you are a general or Astronomical League Target NEOs! observer.  
Astrometry data should be submitted also to the MPC in the appropriate format.

Images are transferred to folders for *Target Asteroids!* Co-leads. So don’t worry if they seem to “disappear” after uploading. Email a quick note to let us know you have uploaded your images so we can make sure they were transferred successfully. Then send your astrometry or photometry data to:  
Target\_Asteroids@lpl.arizona.edu.

Use the Minor Planet Center format for your reports. Some astronomical software packages automatically output in this format. For example:

```
COD H06
CON M. Nissinen, Kauppakatu 70 A 10
CON 78200 Varkaus, Finland [markku.nissinen@pp.inet.fi]
OBS M. Nissinen
MEA M. Nissinen
TEL 0.43-m f/4.5 astrograph + CCD
NET GSC 1.1 (corrected)
ACK measurements of E1018 141018 2001 WC47.
NUM 3
E1018   C2012 04 21.16863 11 48 12.72 +32 20 12.0      H06
E1018   C2012 04 21.17934 11 48 15.36 +32 19 42.3      H06
E1018   C2012 04 21.20296 11 48 21.18 +32 18 35.5      H06
```

### 8. Obtain additional Information as needed.



## *Target Asteroids!* Instructions



Refer to the *Target Asteroids!* Frequently Asked Questions (FAQs) page for more detailed assistance and helpful links to additional information about observing asteroids. The *Target Asteroids!* list webpage has links to interesting information about each asteroid. To contact the *Target Asteroids!* Co-leads: Dolores Hill or Carl Hergenrother, email [Target\\_Asteroids@lpl.arizona.edu](mailto:Target_Asteroids@lpl.arizona.edu).

For more information about the mission, visit the OSIRIS-REx mission website:

<http://www.asteroidmission.org/>

### *Target Asteroids!* Partners

- Association of Lunar & Planetary Observers
- Astronomical League
- Catalina Sky Survey
- iTelescope.net
- International Astronomical Search Collaboration
- Mt. Lemmon SkyCenter
- NASA Night Sky Network
- Oceanside Photo & Telescope
- Sierra Stars Observatory Network