



(Modified and updated from the OSIRIS-REx Target Asteroids! website at <https://www.asteroidmission.org>) May 2021

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.
- Appropriate observing equipment or access to equipment.
- Membership in the Astronomical League through a member club or as an individual Member-at-Large.

Request a registration form from the coordinators.

- Complete the Target NEOs! registration form.
- Periodically you will receive updated information about the program.

Obtain instrumentation.

The minimum instrumentation recommended to participate in this project is:

- Telescope 8" or larger;
- CCD/CMOS Camera, computer with internet connection; and
- Data reduction software (available via Target NEOs!)

If you have an appropriate telescope and camera, you will be able to observe asteroids on the Target NEOs! list. The asteroids that can be observed depend on the telescope's aperture (diameter of the mirror or lens), light pollution, geographic location, and asteroid's location in the sky on a given night.

If you do not have a telescope, you can still participate in the program by obtaining access to observing equipment:

- Team up and use a telescope owned by a friend, astronomy club, local college or planetarium observatory.
- Use a commercial telescope service.
- Are you a member of a local astronomy club? If not, we recommend it! Local astronomy clubs provide connections and opportunities for observations. You will meet friendly members who will be happy to help you. Check out the Astronomical League and NASA Night Sky Network to locate a club near you.

Review the Target NEOs! master list.

Check the Target NEOs! List for new additions. The coordinators update the list as needed. When updates occur, we send an email to registered observers.



Plan your observing session(s) for a particular object or objects accessible from your location with your telescope.

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.

- Lowell Observatory, IAU Minor Planet Center, and NASA-JPL have helpful aids for planning observing sessions:
 - <ftp://ftp.lowell.edu/pub/elgb/astorb.html>
 - <http://www.minorplanetcenter.net/iau/MPEph/MPEph.html>
 - JPL Center for NEO Studies' Horizons website: <https://ssd.jpl.nasa.gov/horizons.cgi>

Observe an asteroid and collect data.

An observation consists of at least 3 images of the asteroid acquired over a sufficient length of time to observe motion and corresponding electronic files processed for the following:

- photometry (brightness) with or without broadband filters (Clear/Luminance, UBVRI, RBG, Sloan ugriz)
- astrometry (precise, accurate positions against a star field)
- spectroscopy while difficult for these faint objects, is welcome.

The minimum observation consists of three images corrected for flat field and dark subtraction, along with corresponding photometry and astrometry in standard IAU Minor Planet Center format (used by the most popular astrometry programs). More images are always appreciated. Some observers take as many as 80-100 sequential images in one night's set allowing for the determination of a rotation period. 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);
- Use low enough magnification to include reference stars in the field of view for astrometry and/or photometry (12 or more is best but not always possible);
- You use the proper order fit correction (if in doubt start with the lowest order first); and
- You place the asteroid of interest near the center of the field if your image quality (i.e., bad focus, coma or vignetting) is poor near the edges.



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.

Collect the following information:

Basic information (usually part of the original software setup and FIT file header for the image):

- Date (universal time or local time)
- Time (accurate to the nearest second; universal time or local time)
- Target NEOs! object observed
- Latitude of telescope location to nearest 10th of a second
- Longitude of telescope location to nearest 10th of a second

Observer Information

- Name
- Email
- Minor Planet Center Code for your telescope (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
- Focal Length
- Type or brand/model of CCD
- Pixel size
- Filters used (V or R?)
- For photometric observations, standard star catalogue used
- Anti-blooming (ABG) correction OFF

Submit observations as you make them (images and MPC-type report).

Email or provide access to images via Box or other similar platform to the Target NEOs! coordinators at meteorite@cox.net and carlhergenrother@gmail.com. Contact us if you have any questions.

The suggested image file name is in the format: Observer_Object_YYYYMMDD_HHMMSS.FITS

For example: Hergenrother_1999RQ36_20120318_041510.FITS



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
```

Submit Observation Summary to Coordinators

When you have completed observations and reports for 10 or 25 asteroids on the TNEO! List:

- Submit a summary of asteroids and dates to the coordinators.
- Request your award certificate and/or pin.

Obtain additional Information as needed.

Refer to the Target NEOs! Frequently Asked Questions (FAQs) page for more detailed assistance and helpful links to additional information about observing asteroids.

Contact the Target NEOs! Co-coordinators: Dolores Hill and Carl Hergenrother at meteorite@cox.net and carlhergenrother@gmail.com respectively and we will reply as soon as we are able.



Target NEOs! Asteroid List

Cumulative List as of January 2021

142 objects

Format for easy import into
observation planning programs:

Official name

(1) Ceres
 (12) Victoria
 (19) Fortuna
 (47) Aglaja
 (55) Pandora
 (62) Erato
 (94) Aurora
 (112) Iphigenia
 (142) Polana
 (163) Erigone
 (223) Rosa
 (268) Adorea
 (335) Roberta
 (379) Huenna
 (442) Eichsfeldia
 (447) Valentine
 (495) Eulalia
 (535) Montague
 (532) Herculina
 (578) Happelia
 (635) Vundtia
 (972) Cohnia
 (1197) Rhodesia
 (1241) Dysona
 (1257) Mora
 (1439) Vogtia
 (1566) Icarus
 (1580) Betulia
 (2026) Cottrell
 (2340) Hathor
 (3064) Zimmer
 (3122) Florence
 (3200) Phaethon
 (3361) Orpheus
 (3691) Bede

# desig	Name
1	Ceres
12	Victoria
19	Fortuna
47	Aglaja
55	Pandora
62	Erato
94	Aurora
112	Iphigenia
142	Polana
163	Erigone
223	Rosa
268	Adorea
335	Roberta
379	Huenna
442	Eichsfeldia
447	Valentine
495	Eulalia
535	Montague
532	Herculina
578	Happelia
635	Vundtia
972	Cohnia
1197	Rhodesia
1241	Dysona
1257	Mora
1439	Vogtia
1566	Icarus
1580	Betulia
2026	Cottrell
2340	Hathor
3064	Zimmer
3122	Florence
3200	Phaethon
3361	Orpheus
3691	Bede



(4055) Magellan
(4179) Toutatis
(4219) Nakamura
(5604) 1992 FE
(7350) 1993 VA
(7753) 1988 XB
(7888) 1993 UC
(8014) 1990 MF
(25143) Itokawa
(25308) 1998 XW82
(33342) 1998 WT24
(52760) 1998 ML14
(52381) 1993 HA
(65717) 1993 BX3
(68267) 2001 EA16
(68278) 2001 FC7
(69346) 1993 TV32
(85275) 1994 LY
(85989) 1999 JD6
(89136) 2001 US16
(99799) 2002 LJ3
(101955) Benu
(136635) 1994 VA1
(137032) 1998 UO1
(137126) 1999 CF9
(137799) 1999 YB
(138911) 2001 AE2
(141018) 2001 WC47
(141527) 2002 FG7
(143404) 2003 BD44
(144411) 2004 EW9
(154275) 2002 SR41
(159402) 1999 AP10
(163000) 2001 SW169
(163249) 2002 GT
(163364) 2002 OD20
(164221) 2004 QE20
(173664) 2001 JU2
(175114) 2004 QQ
(187040) 2005 JS108
(190491) 2000FJ
(204131) 2004 YL

was OSIRIS-REx finalist

OSIRIS-REx Target

4055 Magellan
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5604 1992 FE
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25308 1998 XW82
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68278 2001 FC7
69346 1993 TV32
85275 1994 LY
85989 1999 JD6
89136 2001 US16
99799 2002 LJ3
101955 Benu
136635 1994 VA1
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175114 2004 QQ
187040 2005 JS108
190491 2000FJ
204131 2004 YL

Target NEOs! Instructions and Helpful Info.



(206378) 2003 RB	206378	2003 RB
(214088) 2004 JN13	214088	2004 JN13
(242450) 2004 QY2	242450	2004 QY2
(242708) 2005 UK1	242708	2005 UK1
(243566) 1995 SA	243566	1995 SA
(246566) 2008 SQ194	246566	2008 SQ194
(251346) 2007 SJ	251346	2007 SJ
(275677) 2000 RS11	275677	2000 RS11
(275976) 2001 XV10	275976	2001 XV10
(276049) 2002 CE26	276049	2002 CE26
(277475) 2005 WK4	277475	2005 WK4
(277570) 2005 YP180	277570	2005 YP180
(285263) 1998 QE2	285263	1998 QE2
(285944) 2001 RZ11	285944	2001 RZ11
(292220) 2006 SU49	292220	2006 SU49
(294739) 2008 CM	294739	2008 CM
(303450) 2005 BY2	303450	2005 BY2
(307564) 2003 FQ6	307564	2003 FQ6
(311925) 2007 BF72	311925	2007 BF72
(341050) 2007 HZ	341050	2007 HZ
(348306) 2005 AY28	348306	2005 AY28
(350713) 2001 XP88	350713	2001 XP88
(357024) 1999 YR14	357024	1999 YR14
(357439) 2004 BL86	357439	2004 BL86
(360191) 1988 TA	360191	1988 TA
(363305) 2002 NV16	363305	2002 NV16
(367943) Duende (2012 DA14)	367943	Duende
(371660) 2007 CN26	371660	2007 CN26
(380128) 1997 WB21	380128	1997 WB21
(381806) 2010 CL19	381806	2010 CL19
(382745) 2003 CC	382745	2003 CC
(382758) 2003 GY	382758	2003 GY
(387733) 2003 GS	387733	2003 GS
(410649) 2008 SO	410649	2008 SO
(412983) 1996 FO3	412983	1996 FO3
(416186) 2002 TD60	416186	2002 TD60
(424482) 2008 DG5	424482	2008 DG5
(426407) 2013 PL69	426407	2013 PL69
(433953) 1997 XR2	433953	1997 XR2
(436724) 2011 UW158	436724	2011 UW158
(451157) 2009 SQ104	451157	2009 SQ104
(452807) 2006 KV89	452807	2006 KV89

Target NEOs! Instructions and Helpful Info.



(455148) 1994 UG		455148	1994 UG
(455415) 2003 GA		455415	2003 GA
(457663) 2009 DN1		457663	2009 DN1
(458375) 2010 WY8		458375	2010 WY8
(468005) 2012 XD112		468005	2012 XD112
(482566) 2012 WK4		482566	2012 WK4
1994 CJ1		1994 CJ1	1994 CJ1
2001 QC34		2001 QC34	2001 QC34
2006 YF		2006 YF	2006 YF
2007 TK8		2007 TK8	2007 TK8
2008 WN2		2008 WN2	2008 WN2
2010 AF30		2010 AF30	2010 AF30
2011 JR13		2011 JR13	2011 JR13
2012 QG42		2012 QG42	2012 QG42
2012 TF53		2012 TF53	2012 TF53
2012 XM55		2012 XM55	2012 XM55
2012 XS93		2012 XS93	2012 XS93
2013 NJ		2013 NJ	2013 NJ
2013 WF108		2013 WF108	2013 WF108
2014 MK55		2014 MK55	2014 MK55
2014 SC324		2014 SC324	2014 SC324
2015 JF11		2015 JF11	2015 JF11
C/2013 UQ4 Catalina	comet	C/2013 UQ4 Catalina	C/2013 UQ4 Catalina

- Asteroid designations may contain one to three labels based on the number of oppositions observed:
- Provisional designations include the year of discovery, a letter signifying the half-month period, and a letter in order of discovery during that period (example: 2008 WN2).
- Permanent designation is a number assigned after the object has been observed for at least four oppositions (example: (163249) 2002 GT).
- Name may be submitted by the discoverer up to 10 years after a number has been assigned or the person may give permission to someone else to submit a name to the IAU Committee for Small-Body Nomenclature (example: (3361) Orpheus).
- Family Definitions: Apollo semi-major axis > 1.0 AU perihelion distance < 1.017 AU; Aten semi-major axis > 1.0 AU aphelion distance > 0.983 AU; Amor semi-major axis > 1.017 AU and < 1.3 AU.
- PHA = Potentially Hazardous Asteroid