The Astronomical League s Asteroid Club Observing Guide

A Special Reprint Edition from the American Association of Amateur Astronomers

by Paul G. Comba,
As revised by Larry Robinson
10 Sept. 2000

Introduction

The Asteroid Club is one of the Astronomical League's observing award programs. Its purpose is to encourage amateurs to learn to observe and identify asteroids.

While the deep sky objects observed by amateurs remain the same year after year, the asteroids (like other planets) are constantly moving against the background of the constellations. By learning to identify asteroids you can greatly enhance your observing skills.

This booklet contains some general information about asteroids and some specific instructions and hints on how to find them, observe them, and record your observations. It also lists some resources for advanced observing projects.

The Asteroid Club offers two levels of awards.

- Regular members (25 asteroids) receive a certificate. A 4-inch telescope is recommended.
- Gold members (100 asteroids) receive a certificate and pin. A 6-inch telescope is recommended.

Since asteroids appear as points of light rather than extended objects, they do not suffer from light pollution as much as deep sky objects. Hence an asteroid observing program can be carried out successfully from urban and suburban locations.

To find an asteroid, you will need to determine the predicted position of the asteroid for the time you will be observing it and perhaps make a finder chart showing the position of the asteroid among the stars. This can best be done by using the internet to access the *Minor Planet Center* at http://cfa-www.harvard.edu/cfa/ps/mpc.html. This web page contains many resources to assist you in finding asteroid positions and to help you develop a list of targets to observe. Another resource is Lowell Observatory's *Asteroid Resource Page* at http://asteroid.lowell.edu/

There are numerous computerized planetarium programs that have asteroid features. Some of those are:

- SkyMap (SkyMap Software)
- Guide (Project Pluto)
- xephem (E. Downey)
- Home Planet (J. Walker)
- MyStars! (Relative Data Products)
- TheSky (Software Bisque)
- Starry Night (Sienna Software)
- Deep Space (D. S. Chandler)
- PC-TCS (D. Harvey)
- Earth Centered Universe (Nova Astronomics)
- Dance of the Planets (ARC)
- MegaStar V4.x (E.L.B. Software)
- SkyChart 2000.0 (Southern Stars Software)
- Voyager II (Carina Software)
- SkyTools (CapellaSoft)
- Autostar (Meade Instruments)

You can even go to the Minor Planet Center's Minor Planet Ephemeris Service on the internet at http://cfa-www.harvard.edu/iau/MPEph/MPEph.html and download a file for any asteroid you may may wish to display on any of these programs and get a file back that allows to you to track the asteroid real time and print your own finder charts.

How to Qualify

To qualify for an Asteroid Club award, you must be a member of the Astronomical League, either through an affiliated club or as a Member-at-Large, and you must observe and confirm the required number of asteroids. *To become a member of the Astronomical League as a Member-at-Large, contact Janet Stevens, Executive Secretary, Astronomical League, 5675 Real del Norte, Las Cruces, NM 88012-7289; phone (505) 382-9131.*

You may also join **The American Association of Amateur Astronomers, The Internet Astronomy Club**, which is a member society of the Astronomical League. Join on-line at our web page: http://WWW.CORVUS.COM. Or send a check for $20 ($25 family) for each membership to: **AAAA, P.O. Box 7981, Dallas, TX 75209-0981.** E-Mail: aaaa@corvus.com

To receive your certificate, send a copy (retain your originals) of your observations to the Asteroid Coordinator, Larry Robinson, 14680 W. 144th Street, Olathe, KS 66062-9765, Phone (913) 780-4239, E-mail: lrobinsn@ix.netcom.com. For the regular certificate (25 asteroids), submit copies of your sketches. If you wish to have your copies returned, include a self-addressed stamped envelope. After verification of your observations, your certificate (and pin) will be sent to you or your society's Awards Coordinator, whomever you specify. Be sure to specify which you prefer and provide the necessary address.

Larry Robinson, AL Asteroid Coordinator
14680 W. 144th Street
Olathe, KS 66062-9765
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Asteroids

Asteroids are also known as minor planets. Like planets, they revolve around the Sun. Most asteroid orbits lie between those of Mars and Jupiter and are called main-belt asteroids. Most main-belt asteroids have orbits with semi-major axes between 2.1 and 3.3 astronomical units and periods between 3 and 6 years.

Their orbits are usually elongated, with eccentricities between 0.05 and 0.35. Their orbital planes are usually close to the orbital plane of Earth, but a few have inclinations of 20 degrees or more. A few unusual asteroids have orbits that cross the orbit of Mars or the orbit of Earth. Because the Earth revolves around the Sun with a period of one year, it catches up with any particular asteroid approximately every 15 to 18 months. When the Earth catches up, the Sun, Earth, and asteroid are approximately in a straight line, and the asteroid is said to be at opposition. An asteroid is at its brightest at opposition, so this is the best time to observe it. An asteroid at opposition reaches the highest point of its trajectory and crosses the local meridian about midnight.

For about 45 day's before and after opposition an asteroid appears to move in retrograde motion (East to West) against the background of the stars. The retrograde motion slows gradually, and after approximately 45 days, the asteroid reaches a stationary point, after which it resumes its direct (West to East) motion.

Because of eccentricity, not all oppositions are equally good, If an opposition occurs when the asteroid is at aphelion (farthest from the Sun), the asteroid may be 2 or 3 magnitudes fainter than at perihelion (closest to the Sun). The near-perihelion oppositions are called favorable. If you miss a faint asteroid at a favorable opposition, you may have to wait 4 or 5 years before you have another chance. From mid-Northern latitudes, the asteroids (like the other planets and the Moon) are much higher above the horizon in the winter than in the summer. In any given year there will be about 50 asteroids that become brighter than magnitude 11 at opposition, and 120 that become brighter than 11. A few of them, however, may be too low in the sky to be conveniently observed.

How to Find And Observe Asteroids

To find an asteroid you will need to find out exactly where it is at the particular time you wish to observe it. To find an asteroid you will need to determine the position of the asteroid for the time you will be observing and perhaps make a finder chart showing the position of the asteroid among the stars. This can best be done by using the internet to access the Minor Planet Center at http://cfa-www.harvard.edu/cfa/ps/mpc.html This web page contains many resources to assist you in finding asteroid positions and help you develop a list of targets to observe. Another resource is Lowell Observatory's Asteroid Resource Page at http://asteroid.lowell.edu/

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If you know the position for the asteroid (Right Ascension and Declination), you can make your own finder chart and show the positions for the different nights you are observing. You should locate the asteroids position on the chart and note that position for a particular time in Universal Time.

NOTE: *Universal Time (UT) was formerly known as Greenwich Mean Time. It is based on a 24-hour clock; for example 14:00 is 2:00 p.m. Universal Time is 5 hours ahead of Eastern Standard Time (4 hours during daylight saving time), UT is 6 hours ahead of CST, 7 hours ahead of MST, and 8 hours ahead of PST. For example, 6:30 UT March 6 is 1:30 a.m. March 6 EST, and 10:30 p.m, March 5 PST.*

Another approach is to look for a distinctive grouping of stars in the eyepiece and then finding the matching pattern on the chart. Matching is best done using a low power (wide field) eyepiece. With a telescope of 6 inches or less, the chart will show more stars than you can see in the eyepiece, so you must ignore the fainter stars on the chart.

The next task is to point the telescope in the general vicinity of the asteroid. If your telescope has setting circles and has been polar aligned, you simply point your telescope using the setting circles. If your telescope does not have setting circles, use the "starhopping" method. To starhop you need a large scale sky atlas such as Tirion's Sky Atlas 2000.0. Using the asteroid coordinates that you have previously determined, choose the appropriate atlas chart and mark the position of the asteroid with a soft sharp pencil, Find a bright star that you can identify both in the sky and on the atlas and point the telescope at it. Using a finder and/or a low power eyepiece, move the telescope from star to star toward the asteroid, always making sure that what you see in the sky agrees with what you see on atlas.

NOTE: *The image through a telescope may have a different orientation from what you see on a chart. A refractor or a Schmidt-Cassegrain (SCT) telescope with a star diagonal*

gives an image that is rotated 180 degrees, i.e. inverted. Through a reflector, the image is rotated by an amount that depends on the position of the focuser. In both cases you can reconcile the sky and the chart by rotating chart.

A refractor or an SCT with an ordinary star diagonal reverses the image as mirror, left for right. Some people have learned to cope with this situation remember that "right on the chart means left in the sky", Others purchase an Amici prism (erecting prism) to show the field in the correct orientation. Amici diagonal, however, reduces the field of view of low-power eyepieces.

Your telescope should now be pointing to the correct field. To verify this, that the stars in the eyepiece agree with the stars on the chart. This can be sometimes by matching the brightest star in the eyepiece with a bright star on thechart, then verifying that the other nearby stars are in the same relationships.

Identifying The Asteroid

Once your telescope points to the correct field, look where the asteroid is supposed to be (according to the chart) and look for an "extra star". If the asteroid is brighter than about l0th magnitude, it can often be identified immediately. Usually, however, you will have to do more work.

In every case,

- YOU MUST OBSERVE THE ASTEROID IN TWO DISTINCT PLACES AT TWO DIFFERENT TIMES and
- AT THE TIME OF THE SECOND OBSERVATION, YOU MUST VERIFY THAT THE ASTEROID IS NO LONGER WHERE YOU SAW IT THE FIRST TIME.

For this reason, you must make a drawing showing all the stars near the (presumed) asteroid. At a later time you must observe the same area and the object must have moved.

How long does it take for the motion of an asteroid to be detectable? It depends on:

- how many stars there are in the field
- the position of the asteroid in relation to those stars
- the speed of the asteroid (most asteroids near opposition move between 30 an 40 arcsec/hr.)
- the size of the telescope.

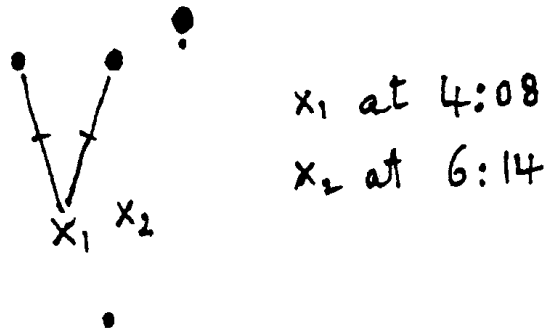
The most favorable situation is when the asteroid is crossing the line joining two nearby stars at a right angle. The least favorable situation is when there are only two or three stars in the field, and the asteroid has no obvious geometric relationship with them (e,g., in a line, isosceles triangle, right-angle triangle). With an 8-inch telescope it should usually be possible to detect the motion within two hours. With a smaller telescope the confirming observation will probably have to be made the next night.

When the two observations are made on different nights, it is essential to re-observe the field from the first night and verify that the object has moved and was not a star. It is also fun from time to time to observe the same asteroid three or more times.

How to Record and Report Observations

There are no specific rules regarding the drawings made at the telescope, except that brighter stars should be drawn as bigger dots. You can draw straight lines to show that three objects are aligned; tick marks to show that two distances appear to be equal; numbers to indicate the estimated size of an angle; etc,

The different positions of the asteroid may be marked with small crosses (see the figure):



If the drawing made at the telescope is too rough, you can redraw it, as long as the later sketch is a faithful representation of what you observed. If you re-observe a field after 2 or 3 hours, remember that it may have a different orientation.

How to Record Your Observations

Record your observations in a notebook. If some items remain the same throughout, note that in your logbook.

For each observation record:

- location;
- date and time to the nearest minute in Universal Time;
- number and name of asteroid;
- instrument used and power;
- any additional remarks.

For the regular certificate (25 asteroids), copies of your sketches or images should also be submitted if working visually. If a CCD is used and observations are reduced to astrometric positions, then copies of the astrometric positions in MPC format are acceptable . Please send copies and retain the originals. If you wish to have the copies returned to you, include a self-addressed stamped envelope. Upon verification of your observations, your certificate (and pin) will be forwarded to you or your society's "Awards Coordinator", whomever you choose. Be sure to specify which you prefer and provide the necessary address.

Larry Robinson, AL Asteroid Coordinator
14680 W. 144th Street
Olathe, KS 66062-9765
(913) 780-4239
E-mail: lrobinsn@ix.netcom.com

For Advanced Observers

Ephemerides of Minor Planets is published yearly by the Institute of Applied Astronomy; Zhdanovskaya 8; St. Petersburg; 197110 Russia. The 2000 volume cost $41, including air shipment. They accept major credit cards. This book contains ephemerides for all numbered minor planets (except the most recently numbered ones) that reach opposition during the current year. It also contains opposition dates, orbital elements, light parameters, oppositions, etc. These data are also available in computer form with the computer program CERES, which can extract and manipulate the data.

The Minor Planet Center in Cambridge, MA, sponsored by the International Astronomical Union, is the clearinghouse and repository of all precise (astrometric) observations of minor planets, and new discoveries. It publishes *Minor Planet Circulars* and supports an on-line computer service. The MPC's webpage contains information about these services, and current and archival information on asteroids and comets and observing procedures. http://cfa-www.harvard.edu/iau/mpc.html. Another resource is Lowell Observatory's Asteroid Resource Page at http://asteroid.lowell.edu/

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- SkyChart 2000.0 (Southern Stars Software)
- Voyager II (Carina Software)
- SkyTools (CapellaSoft)
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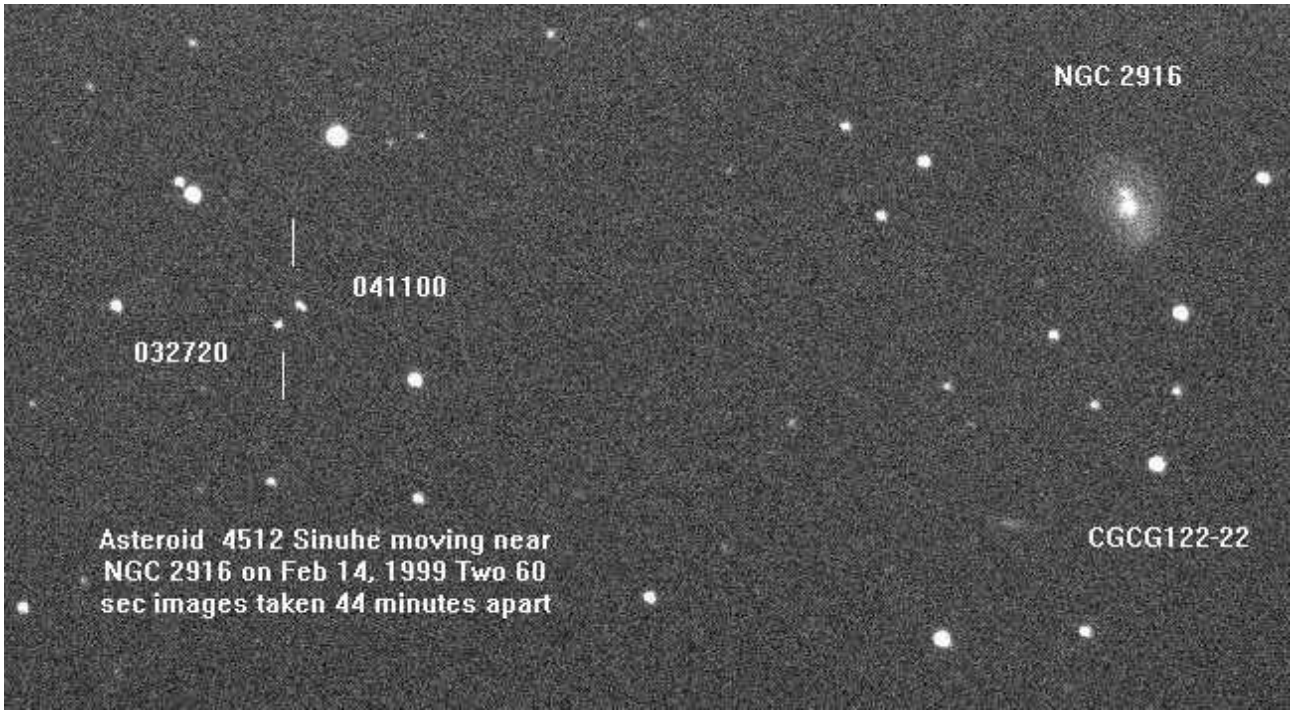
The following computer programs can produce star charts and plot asteroid positions. They are usually advertised in Sky & Telescope and Astronomy magazines.

- MPO98, MPO99, etc, by Bdw Publishing;
- HyperSky by Willmann-Bell
- Computer Aided Astrometry by John Rogers



From his own Sunflower Observatory near Kansas City, AL Asteroid Coordinator Larry Robinson imaged Asteroid 4512, Sinuhe, near spiral galaxy NGC 2916 in Leo. It was images such as this one, recording the change in position of an asteroid over a period of time, that enabled Larry to earn the AL's Asteroid Certificate Number One.

The American Association of Amateur Astronomers

www.AstroMax.com

Observation Log

and SketchTemplate

Object: _____

Constellation: _____

R.A. _____**h** _____**m** **Dec.** _____**d** _____**m**

Observer: _____ **Listed Magnitude:** _____ **Listed Size:** _____

Date: _____ **Source:** _____

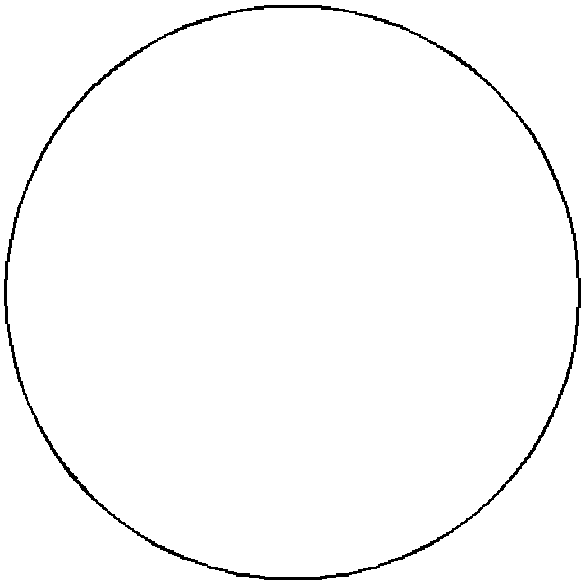
Time: _____ **Telescope:** _____

Site: _____ **Eyepiece(s):** _____

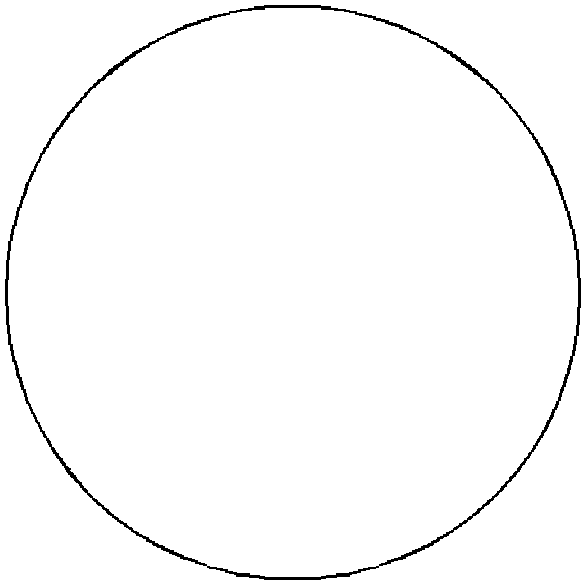
Seeing (1-10)_____ **Transparency (1-5)** _____ **Filter(s):** _____

Field Drawing

Low Power Ocular



High Power Ocular



Description and Notes

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The American Association of Amateur Astronomers

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A Special Service of

The American Association of Amateur Astronomers

You MUST be a member of the Astronomical League, either through membership in an affiliated astronomical society or as a Member-at-Large, to receive certification for any of the AL observing programs.

As a member of the AAAA, not only are you eligible to earn any of the AL observing awards, but you will also get your own subscription to the Astronomical League's newsletter, the REFLECTOR, as well as our own quarterly newsletter, *The American Astronomer*.

Join the AAAA, the first nationwide astronomy club for all amateur astronomers.

Tell Your Friends the Benefits of Joining
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Full Membership in the Astronomical League.
Discounts on Astronomical Publications.

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E-mail: aaaa@astromax.com

To join the American Association of Amateur Astronomers, send your name and address along with your check for $20.00 ($25.00 family) made payable to AAAA, to:
AAAA, P.O. Box 7981, Dallas, TX. 75209