Ogden Astronomical Society • Ogden Utah

THE STAR DIAGONAL

THE JOURNAL OF THE OGDEN ASTRONOMICAL SOCIETY

OAS Executive Committee
President- Mike Klein
(801) 775-0341
Vice Pres- Dustin Klein
(801) 309-1233
Secretary- David Dunn
(801) 544-7705
Treasurer- Doug Say
(801) 731-7324

Vol. 38 Number 1 September 2008 http://ogdenastronomy.com/

Meeting Announcement

This month's meeting will be September 11, 2008. We will be having elections so please try to attend. Dues are now due.

The nominations for this year's officers are as follows:

Dustin Klein – President
Pam Smith – Vice President
David Dunn – Secretary
Doug Say – Treasurer

Nominations can be made at the meeting. The person that is to be nominated must have previously agreed to run.

The remainder of the meeting will be a business meeting.

Looking at the Star Party Schedule below, is anyone planning to attend either the Dead Horse Point or Curlew star parties? I know that my best bet would be Curlew. Let us know your plans on OAS_News.

Star Party Schedule

The proposed dates for the public star parties are as follows.

Sep. 6	Antelope Island
Sep. 13	Snowbasin
Sep. 25-27	Dead Horse Point
Sep. 26-27	Curlew Campground
Oct. 4	Antelope Island

Our Private Star Parties are as follows.

Aug. 27-30	Monte Cristo
Oct. 24-25	Messier Marathon - Curlew Campground

Shirt Orders

We are planning to put in an order for shirts, hoodies and sweatshirts with the OAS logo on them. We will take orders and money at our September and October meetings. The shirts will be delivered in our November meeting. Lee Priest will have the current prices and a catalog at the meetings.

Some Astronomical Diversions
Part II
Observing Satellites

By Jim McCormick

More often than not, on a typical night of observing, we can expect to witness one or more artificial satellites streak across the field of view (FOV). If we are using a Dob or other manually operated scope, there is an urge to give chase and catch up with it. Such a maneuver is one way, if not the only way, to visually track the ISS with a telescope. Having done so on a couple of occasions, I can report that some detail of the space station can be seen, at least through a 16" telescope. This was four or five years ago and it looked to me like a copper-colored letter "T" with an additional, shorter, crossbar across its middle. The yellow-orange color was surprising; it always looks white to me when viewed without the telescope.

The next time you see any satellite cross your FOV, try tracking it across the sky. Often the satellite will look like a bright star of near constant magnitude during short tracking intervals. Occasionally, though, you will notice it fade and then brighten again in a regular pattern. If so, you may be seeing a tumbling rocket booster or a rotating satellite. As a satellite passes, the angle at which you view it will change and consequently its profile may increase or decrease resulting in a gradual change of magnitude, or as its distance from you increase it can be expected to fade, or even disappear as it passes into Earth's shadow.

Iridium satellites are also quite interesting, but not as easy to track. We have all seen Iridium flashes or flares, although we may not have known what we were seeing the first time we witnessed one. These flashes are quite bright and are usually are seen as a series of flares separated by several seconds. Some of the better planetarium software (e.g., TheSky, Starry Night, SkyMap and Guide) allow one to determine future paths for Iridium satellites allowing us to predict the times and locations of Iridium passes. TLE's (two-line elements) for Iridium and many other types of satellites can be downloaded from http://celestrak.com/NORAD/elements. Iridium flares are the result of the sunlight reflecting off the satellite's highly reflective surfaces. Even when you have determined the path a given Iridium satellite will take, don't be surprised if a flare is not seen. Much depends on the satellite's orientation with respect to the line of sight. Sometimes a brilliant and long lasting (a couple seconds) flash can be seen and at other times a series of moderately bright, closely spaced flashes will be noted. At other times, you will not see any kind of flare at all.

The speed with which a satellite passes across your FOV depends on how far it orbits above the surface of the Earth. The ISS follows a low Earth orbit (357 km) and orbits in about 91 minutes. GPS satellites have higher orbit (20,000 km) and circle Earth in just a tiny bit short of 12 hours. Further out, are the geostationary communications satellites (35,785 km) with orbital periods equal to Earth's sidereal rotation time of 23 hours, 56 minutes and 4 seconds. Because geostats orbit in Earth's equatorial plane and match Earth rotation, from points on the surface, they remain very close to the same altitude and azimuth. Pretty close, but not precisely. The orbit will usually be slightly eccentric and slightly inclined to the equator. As a result, they speed up and slow down a bit and also move north and south of the equator a tad as they orbit. This cause them to trace small figure 8's against the starry background over their daily orbit.

So what do geostats look like through a telescope? How bright are they? Well, they look like stars of about 11th magnitude (give or take). If you are tracking a star near the declination of the satellites, the satellite will appear to move across the FOV at the rate of 15 arcminutes per minute. Or, if your telescope is stationary, with the satellite centered in the FOV, the background stars will move east to west across the field (right to left with or without a star diagonal) at the same rate.

Ok. So where do you point your telescope? If all the geostationary satellites were visible to the naked eye, we would see a string of beads stretching from the eastern horizon at azimuth 96 degrees to western horizon at azimuth 264 degrees. On the meridian, this band would be about 42.5 degrees above the horizon. On the celestial sphere, the declination of the center of this band of satellites is -6° 23' on the meridian and a bit further north near the east and west horizon (-5° 44') as seen from my observatory site in West Point. It is interesting to note that there is a significant parallax shift when viewing the same satellite from different latitudes along the Wasatch Front. For example, I view

Echostar 6 at declination -6° 23' 9". From Brigham City this satellite has a declination of -6° 25' 46" and from Salt Lake City, -6° 20' 32". For the sake of precision, if you use a computer to predict satellite paths, be sure to enter your exact latitude and longitude (obtained from a GPS device or map overlay).

If you have planetarium software capable of importing current satellite data, you can preview your observing sessions and determine when the various geostats will pass close to a give star or deep sky object. It would be wise to use same day data for accuracy; some satellites experience orbital corrections from time to time because of a drag factor. For instance, the ISS is boosted to a slightly higher orbit periodically. If you do not have such software, don't despair. At this time of the years you can use the star Epsilon Ophiuchus (ε Oph). Approximately a degree and a half south of Eps Oph you will find a loose grouping of a half dozen stars of about 10th magnitude. Once this group is located, begin to track it. Over a period of twenty minutes, you should be able to see four to eight geostationaries. Keep in mind that they may appear about a magnitude fainter that the stars in the above-mentioned group. With moderate magnification (a FOV the size of the Moon), these satellites will take about two minutes to cross the field. Once located, the telescope drive can be turned off so that the satellite(s) can be "frozen" while the stars pass by in the background.

If ε Oph proves hard to find (shouldn't though; it has a magnitude of 3.3), try first finding M11, the Wild Duck Cluster. M11 is just about 7 arcminutes north of the geostat "belt" when M11 in near the meridian. There is both good news and bad news associated with using M11 as a waypoint. The good news—it's easy to find M11. The bad news—you'll be searching in a dense part of the Milky Way with lots of 11th mag stars. Still, the geostats are conspicuous due to their apparent motion and you should be able to find them with a little perseverance.

There is another class of satellite I would like to mention at this point. Actually, I know little about them, but became interested in them while researching this article. The class is known by the fanciful name, "tundra ellipticals." The Russian "Molniya" satellites are of this class. I have never intentionally observed a Molniya, but suspect I have seen one or more of them through a telescope. Once in a great while, I have seen very slow moving objects plod across the FOV and suspect they may have been Molniyas.

The interesting thing about Molniya orbits is their eccentricity. A Typical Molniya satellite has a perigee of 450-600 km and an apogee of about 39,000 -40,000 km, with its perigee deep in the southern hemisphere and its apogee high in the northern latitudes. The satellite will make two orbits of Earth each day. Because satellites move most rapidly at perigee and moves slowly at apogee, Molniya satellites spend most of their time over the northern hemisphere. During a 12 hour orbit, they spend eight hours or more north of the equator with considerable "hang time" over high northern latitudes (thereby the term "tundra elliptical").

At any given time, there are 16 active satellites in the system. Curious to see what pattern these satellites track across the sky, I ran several simulations with GUIDE8 software and discovered four sets of tracks. One of these was of particular interest as the satellites remained in view (from northern Utah) longer than those in the other groups. The other groups also do not track as far above the horizon. Tracking one of these in the favorable group (Molniya 1-93), I found the following: 00:17–rises above southern horizon. 00:36–reaches altitude of 50 degrees. 01:02–altitude 74 degrees. 2:11–near zenith. 3:40–still moving slowly northward about 25 degrees south (above) Polaris. 4:24–near apogee. 6:31–still near the "sweet spot", but beginning to move south again. 11:02– closer to horizon now and moving faster. 11:31– back at the horizon in the southeast. Total time above the horizon, 11:14. 14:09– returns above the northwestern horizon (azimuth 335). 17:14–reaches maximum distance above northwestern horizon. 20:19–sets at azimuth 351. 0:13–reappears above southern horizon, completing the cycle.

The "sweet spot" mentioned above is the area of the northern sky where this group of Molniyas spend a lot of time and are moving the slowest. This spot is located about 20 degrees above (south of) Polaris. At this time the satellites are moving from west to east.

I suspect these Molniyas can be seen at all times during during this phase of their orbits, but will be difficult to find. Physically, Molniya satellites are similar to other communications satellites. They are 1.4 meters in diameters and 4.3 meters tall and have six solar panels in a windmill configuration. At apogee, they are a few thousand kilometer farther from Earth than are geostationary satellites, but for most of their orbits they are closer than geostats. Over the next few weeks, attempts will be made to view a Molniya and perhaps image one as well. I will report the results of my efforts next month and invite others to try to get a glimpse one too. Good hunting.